

THE EFFECT OF GENDER ON DIFFERENT CATEGORIES OF
STUDENTS' MISCONCEPTIONS ABOUT FORCE AND MOTION

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ABSTRACT

THE EFFECTS OF GENDER ON DIFFERENT CATEGORIES OF STUDENTS' MISCONCEPTIONS ABOUT FORCE AND MOTION

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The main purpose of this study was to investigate the effects of gender on different categories of tenth grade students' misconceptions about force and motion. The Force Concept Inventory Test (FCI), Mechanics Baseline Test (MBT), Physics Attitude Scale (PAS) and Experience Questionnaire About Force and Motion (EQFM) were developed by the researcher to assess students' misconceptions, achievement, attitudes, and experiences, respectively. There were nine dependent (students' total scores on the FCI and their scores on eight misconception categories (Kinematics, Impetus, Active Force, Action/Reaction Pairs, Concatenation of Influences, Other Influences on Motion, Resistance and Gravity)) and six independent (students' gender, MBT scores, attitude, experience, school type and age) variables involved in this study.

This study was conducted with 10 schools; 20 classes; total of 651 10th grade high school students in the academic year of 2002-2003. For each school, two classes were used in the study. MBT, PAS, FCI and EQFM were administered. Findings of the FCI and MBT indicated that general performances of the subjects were relatively low and many students have misconceptions in interpreting force and motion. The statistical results indicated that gender difference is effective on students' misconceptions in force and motion. When the data were analyzed using MANOVA, gender difference was observed on the collective dependent variables of scores on total FCI, and on misconception categories of Impetus, Active Force, Resistance and Gravity in favor of males although there were no significant difference on scores of both groups on the other categories of misconceptions. Moreover, when the same data were analysed using MANCOVA, while controlling students' age, attitude, experience, achievement scores, and school types, observed difference on the misconception categories of Active Force and Resistance were disappeared.

Keywords: Misconceptions, Gender, Preconceptions, Force and Motion, Physics Education, Attitude, Experience.

ÖZ

CİNSİYETİN ÖĞRENCİLERİN KUVVET VE HAREKET KONUSUNDA SAHİP
OLDUKLARI KAVRAM YANILGILARININ FARKLI KATEGORİLERİ
ÜZERİNDEKİ ETKİSİ

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Bu çalışmanın amacı, cinsiyet farkının onuncu sınıf öğrencilerinin kuvvet ve hareket konusuna ait kavram yanılgılarının farklı kategorileri üzerine olan etkilerini araştırmaktır. Öğrencilerin kuvvet ve hareket konusundaki kavram yanılgılarını, başarılarını, tutumlarını ve tecrübelerini ölçmek amacıyla sırasıyla Kuvvet ve Hareket Başarı Testi (KHBT), Temel Mekanik Başarı Testi (TMBT), Kuvvet ve Hareket Konularına Karşı Tutum Ölçeği (KHTÖ) ve Kuvvet ve Hareket Konularına Yönelik Tecrübe Anketi (KHTA) geliştirilmiştir. Bu çalışma dokuz bağımlı (öğrencilerin KHBT'deki toplam puanları ve sekiz kavram yanılgısı kategorisindeki puanları) ve dokuz bağımsız değişken içermektedir.

Bu çalışma 10 okul, 20 sınıf ve toplam 651 10. sınıf lise öğrencisinin katılımıyla 2002-2003 öğretim yılında yapıldı. Çalışmada her okuldan 2 sınıf kullanıldı. TMBT ve KHTÖ uygulamanın ilk haftasında verildi. KHBT ve KHTA ise bir hafta sonra verildi. KHBT ve TMBT'nin bulguları öğrencilerin genel performanslarının oldukça düşük olduğunu ve öğrencilerin büyük çoğunluğunun kuvvet ve hareketi yorumlamada kavram yanılgılarına sahip olduğunu göstermiştir. İstatistiksel sonuçlar cinsiyetin öğrencilerin kuvvet ve hareket konularında sahip oldukları kavram yanılgıları üzerinde etkili olduğunu gösterdi. Veriler MANOVA ile analiz edildiğinde, toplam KHBT ve İmpetus, Aktif Kuvvet, Direnç, ve Yerçekimi kavram yanılgıları kategorileri skorları üzerinde erkeklerin lehine anlamlı bir fark olmasına rağmen; diğer kavram yanılgıları kategorilerindeki skorlar üzerinde iki grup arasında anlamlı bir fark gözlemlenmemiştir. Öte yandan, aynı veriler yaş, tutum, tecrübe, başarı skorları ve okul türleri kontrol altına alınıp, MANCOVA kullanılarak analiz edildiğinde, Aktif Kuvvet ve Direnç kavram yanılgıları kategorilerinde gözlemlenen fark ortadan kalkmıştır.

Anahtar Kelimeler: Kavram Yanılgıları, Cinsiyet, Ön Kavramlar, Kuvvet ve Hareket, Fizik Eğitimi, Tutum, Tecrübe.

to my family
miss you much...

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LIST OF SYMBOLS

FCI:	Force Concept Inventory
MBT:	Mechanics Baseline Test
PAS:	Physics Attitude Scale
EQFM:	Experience Questionnaire about Force and Motion
H:	Hypothesis
df:	Degrees of Freedom
n:	Sample Size
μ :	Mean of the Population
M:	Mean of the Sample
S:	Standard Deviation of the Sample
α :	Significance Level
#:	Number

CHAPTER 1

INTRODUCTION

Education is the right of all and all-possible avenues must be explored to ensure that everyone obtains the best education possible for them. Individual differences between students will affect what they gain from the education they experience. In addition to class and race, gender is a major factor that leads students to have different educational experiences. Gender relations is one of the major social forces shaping education (Anonymous, 2002). Addressing the factors related to gender that are involved in school performance is important to ensure that all students will succeed to the best of their ability.

The relationship between student achievement in science and socioeducational factors, such as home background and school environment has been the subject of a great deal of interest in the school effectiveness debate (Young, 1991). Gender differences may exist in many different areas of education; from performance to attitudes, from classroom activities to perceptions about careers.

The content of science courses is closer to what can be faced in everyday life. It is known that the knowledge which pupils gain through experiences is more useful than the others. If this is not so, children begin to memorize the facts, and concepts. In this case nobody can expect a child to like, not to be afraid of and to be successful in science courses. They might fail from the course just because they have not remembered a figure or formula. This also causes science anxiety.

Researchers (Becker, 1989; Erickson & Erickson, 1984; Haggerty, 1987; Sudweeks, 1993) have reported that there is a difference between girls and boys in science achievement. In many countries issues of science achievement and gender have been explored through qualitative and quantitative studies. In these studies, sex differences were found to be the greatest for physics achievement, than for biology or chemistry achievement (Young, 1991), with boys appearing to outscore girls in physics subtests.

According to TIMSS results, males had significantly higher average science achievement than females in many countries and also the gender differences in physics reflected advantages for males (TIMSS, 2000).

Factors contributing to gender differences in education are numerous and might include: genetic differences, previous experiences, personality, child rearing practices, the image of certain school subjects, attitudes of teachers, parents and peers, cultural beliefs and social practices.

Biological explanations for the underrepresentation or underachievement of women in physical science date back more than one hundred years. These theories have evolved over time, but the underlying rationale remains the same. Brain-based sex difference models assert that male and females brains function differently and thus give rise to varying levels of success for males and females in a variety of pursuits (Baird, 1997). On the other hand, different treatments and expectations of teachers, parents and others can also cause gender differences (Anonymous, 2001; Baird, 1997; Erickson & Erickson, 1984).

Although many gender equity issues will only be resolved slowly, requiring major societal changes much can be achieved at the level of individual teachers and schools.

While social differences between the genders exist, the participation of both genders in various activities and the benefits they will gain from them will be enhanced by broadening the culture and nature of education and making it relevant to both genders rather than forcing one gender to adopt the attitudes and behavior of the other (Anonymous, 2001).

Studies have identified different causes for the gender differences in science achievement such as; attitudes toward science, different interaction of teachers with male and female students, teachers attitudes toward technology, parent expectations toward their daughters and sons, and their different ways of learning etc.

Some findings show that females' lack of physical science experiences puts them at a deficit for learning physics concepts (Jones, Howe & Rua, 2000). In addition, Lee and Burkam (1996) have argued that attitudes about the usefulness of science in the future and fear of asking questions in and looking forward to science class are socially constructed. Their studies have shown that differential treatment of males and females begins at an early age, starting with parents.

Researches of last decades demonstrate that many factors influence gender gaps in early grades, and these gender gaps grow and persist through high school. For instance, science-related experiences for boys and girls are not the same over childhood and adolescence. The out-of-school experiences available to them, and chosen by them, are expressions of the values and attitudes of the larger culture. As

long as the culture maintains the traditional views of what is appropriate for girls (bread-making, knitting, or sewing) and boys (mending bicycle tires, changing a fuse, or playing with motors) and conveys the ideas that science is more appropriate for boys than for girls, it is likely that adolescents will bring these values and attitudes to school (Jones, Howe & Rua, 2000).

The education system have to meet both girls' and boys' needs. It is important for policymakers, practitioners, and the public to be aware of gender differences in school performance. Schools can carry out this function by fostering teacher and student awareness of equity issues; creating a climate in which both females and males learn mathematical, scientific and technical skills effectively; allocating adequate teaching time to the skill areas in which each gender has the most difficulty; and by providing concrete examples of the usefulness of these skills in future career choices (Anonymous, 2001; Chandavarkar, Doran & Jacobson, 1991; Jones, Howe & Rua, 2000; Young, 1991).

Thus, designing curriculum and instruction that changes students' misconceptions and improves their ability to apply conceptual understanding into real situations is a necessity. Teachers and educators must be careful about the creativity of children and also cognitive development level. The learning environment and teaching methods must be organized accordingly (Becht, 1999; Clement, 1982; McDermott, 1984).

Researchers realized that there is a direct correlation between a child's early learning experiences and later achievement in mathematics, science and technology.

Thus, students' preconceived ideas should be taken into account while planning the teaching-learning process.

Students bring their own ideas about science with them when they study the subject and very often the students' ideas conflict with proper science. Resolving these conflicts can be very difficult. However, the resolution process cannot even begin until students become aware that they have some initial knowledge (Maloney, 1990).

One of the factors affecting students' learning in science is their existing knowledge prior to instruction. Bruner (1986) stated that effective learning takes place in meaningful experiences; finding or creating connections between new information and preexisting knowledge. Constructivists argue that learners must construct personal interpretation and meaning based on prior knowledge and experience (Bell, 2001).

A misconception is a preconception, an alternate conception, or an understanding that differs from the understandings held by experts in the field (Hestenes, Wells & Swackhamer, 1992). Much work has been done analyzing students' preconceptions and misconceptions about force and motion (Halloun & Hestenes, 1985; McDermott, 1984). As Thornton and Sokoloff (1998) studies made explicit, students do not commonly understand kinematics and dynamics concepts as a result of thorough traditional instruction. Many students have difficulty in understanding physics and often have misconceptions. Understanding how misconceptions are formed can make it easier for classroom teachers to help their students uncover and overcome their misconceptions.

Scholars have shown great interest in the relationship of gender to participation and performance in science. Several studies have suggested that physical and biological sciences and general sciences show the greatest discrepancies in achievement-test performance according to gender (Becker, 1989).

There are many reasons the gender gap might exist. Tolmie and Howe (1993) studied different gender groupings in physics classes and discovered that males and females exhibit different thinking styles. Recently, McCullough (2001) reported that, changing the context of a question can affect student response patterns, and this context dependency might have a gender component.

It appears that male and females may not be consistent with each other in their response to the contextual changes. It may be possible to create a test that decreases the gender gap (McCullough, 2000). Similarly, gender differences have been observed in the misconceptions concerning force and motion concepts in many studies (Eryılmaz, 2002; Eryılmaz & Tatlı, 2001; McCullough, 2001; Yılmaz & Eryılmaz, 1999). More work is needed to better understand how physics assessment instruments may depend on gender in their effect on performance.

The primary goal of this study is to identify tenth grade students' misconceptions concerning force and motion concepts and to investigate the effect of gender on different categories of misconceptions concerning force and motion concepts.

1.1 The Main Problem and Sub-problems

1.1.1 The Main Problem

The main problem of this study is:

What is the effect of gender on different categories of tenth grade students' misconceptions about force and motion in the district of Yenimahalle and Çankaya in Ankara?

1.1.2 The Sub-problems

The following sub-problems (SP) were investigated based on the main problem:

SP1: What is the effect of gender on students' total conceptual understanding of force and motion and their eight categories of misconceptions?

SP2: What is the effect of gender on the students' conceptual understanding of force and motion and their eight categories of misconceptions when the student' conceptual understanding of mechanics (MBT), attitudes towards physics (PAS), school type, age, and experiences (EQFM) related force and motion are controlled.

1.2 Hypotheses

The problems are tested with the following hypotheses. They are stated in null form, and tested for a significance level of $\alpha = .05$.

Null Hypothesis 1

$$H_{0[1,2,3,4,5,6,7,8,9]}: \mu_m - \mu_f = 0$$

1: total scores on FCI; 2,3,4,5,6,7,8,9: misconception scores on each misconception category

There is no significant main effect of gender on the population means of the collective dependent variables of: high school students' total FCI scores and their scores on eight misconception categories.

Null Hypothesis 2

$$H_{0[1,2,3,4,5,6,7,8,9]}: \mu_m - \mu_f = 0 \quad \text{when 10, 11, 12, 13, 14 are controlled.}$$

1: total scores on FCI; 2,3,4,5,6,7,8,9: misconception scores on each misconception category; 10: scores on MBT; 11: scores on PAS; 12: school type; 13: age; 14: scores on EQFM

There is no significant main effect of gender on the population means of the collective dependent variables of: high school students' total FCI scores and their scores on eight misconception categories when the effect of students' MBT scores, PAS scores, school types, students' age and EQFM scores are controlled.

1.3 Definition of Important Terms

Following terms are necessary in understanding this study.

Misconceptions related to force and motion: All ideas about force and motion that are contradictory to or inconsistent with the Newtonian idea. This term was measured by the Force Concept Inventory (FCI) test.

Total Scores on Force Concept Inventory (FCI): Correct responses of students' on each item were added to obtain this variable. It varies from 0 to 30. Higher scores on the test mean fewer misconceptions about force and motion.

Misconception categories: There are eight misconception categories. These are; kinematics, impetus, active force, action/reaction pairs, concatenation of influences on motion, resistance and gravity.

Misconception scores on each misconception category: Students' total scores, which they gain from wrong responses on each misconception category. Higher scores indicate more misconceptions on each misconception category.

Scores on Mechanics Baseline Test (MBT): Correct responses of students' on each item were added to obtain this variable. It varies from 0 to 26. Higher scores mean greater achievement about force and motion.

Scores on Physics Attitude Scale (PAS): 24 items, which were designed to be rated on 5 point likert type response format, were used to measure this variable. Higher scores indicate positive attitude towards force and motion.

School Type: The type of school, which the students go. This variable was formed of three different types, which were 'Normal high school', 'Super high school' and 'Anatolian high school'.

Students' age: The ages of students in months when the time of testing.

Experience About Force and Motion (EQFM): 13 items, which were designed to be rated on 3 point likert type response format and three items which were designed to be rated on 4 point likert type response format were used to measure this variable. Higher scores indicate more experiences related to force and motion.

1.4 Significance of the Study

Sex differences were found at every grade level and in every subject area in the written science achievement tests. Somewhat less attention has been paid to research on gender differences in science than in mathematics. Several years after the initial intervention programs in math, researchers began to examine the disparities in the science achievement of girls and boys.

The gender issue has been studied taking different approaches to the question of how the gender affects student performance in physics. It is known from related literature that there is a gender gap on the total FCI. However, no study investigating the interpretation of gender difference on different subcategories of misconceptions about force and motion have been found so far. This study aimed to cover this gap.

Although the issues of why women do not select science as a career or issues of boys perform better than girls are complex and very controversial, the factors underlying the differential participation and achievement of boys and girls in school science are needed to be examined. The results and conclusions provide information to help teachers take students' misconceptions into account in their teaching, thereby improving science instruction in Turkey. And also it is expected that the results of this study will give textbook authors information about high school students' misconceptions, thereby enhancing the quality of Turkish science textbooks.

Both educators and researchers need to be engaged in a new research for identifying parameters that control for quality and successful learning engagements. Therefore, documenting the difficulties students have in understanding force and motion concepts will be useful for developing meaningful conceptual knowledge

about physics and its real world applications. The results of this study will enable the teachers and the curriculum developers to identify factors, which may have influenced male and female students' negative attitudes towards physics. The study could have important implications for treating misconceptions and giving more attention to improve education equity for both girls and boys in further research studies.

This study has a discrepancy from other gender studies that it will investigate the gender difference on both total scores and different misconception categories. Therefore, this study will shed light on both the appearance and details. It is also expected from the results of this study that it will obtain comprehension about what the effect of experience, attitude, age, and school type can be on students' physics achievement.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Factors Affecting Students' Achievement in Physics

Many educational efforts dealing with science education have been exerted on determining the factors affecting the achievement in science and especially in physics from elementary through graduate schools.

Student achievement is not simply a matter of what happens in school. Although schools can and do make a significant difference, some researchers identified numerous factors that affect student success. In these studies four categories of variables that affect student achievement are discussed: (1) School, (2) the Family and the Individual, (3) Social Incentives, and (4) Socio-Economic Conditions (Anonymous, 2001).

In physics, there exist too many studies conducted on different type of factors believed to be effective on achievement. According to study of Yıldırım and Eryılmaz (1999) gender has a significant effect on students' physics achievement, in favor of boys. Another finding of the study was that students from high socioeconomic status background generally tend to get higher scores from physics than those from low socioeconomic background.

Results of Chandavarkar, Doran and Jacobson (1991) supports the belief that

teachers' efforts to make lessons interesting and relevant to student needs are effective. This suggests that to improve achievement in physics, schools should recruit and assign teachers who have the preparation needed or certification as a teacher of physics. Moreover, the international comparisons showed that students who study physics over several years have higher performance and that physics can be studied and learned at a younger age with no significant difficulties.

One of the factors affecting students' learning in physics is their existing knowledge prior to instruction. Hewson and Hewson (2003) pointed out that the students' prior knowledge provides an indication of the alternative conceptions as well as the scientific conceptions. The results show a significantly larger improvement in the acquisition of scientific conceptions as a result of the instructional strategy and materials, which explicitly dealt with student alternative conceptions.

Moreover, results of Eryılmaz and Tatlı (2001) showed that the correlation between students' misconceptions and achievement in physics is statistically significant. That is, the fewer the students' misconceptions are, the higher the students' achievements are. It was also found that the conceptual change discussion was significantly effective in improving students' physics achievement in force and motion (Eryılmaz, 2002).

Researchers pointed out that there appear a significant correlation between students' attitudes towards physics and physics achievement scores. Şifa and Sancar (1999) concluded that the physics achievement scores of the students who have higher attitude scores will also be high.

According to study of Hoffmann (2002), in explaining physics achievement, besides the educational setting and the teacher-class combination, the related self-concept and pre-achievement are the best predictors for boys and girls. For boys the general interest in physics matters has an additional weight, while the achievement of girls is significantly influenced by the behavior of the boys in their physics classes. The introductory physics instruction oriented to girls' and boys' interests instead of the traditional physics lessons leads to significantly better learning achievement for both. If boys in physics classes are accepted as being loud, uncontrolled and disturbing, the losers are the girls.

Moreover, science literacy depends on such factors as improving physics learning, increasing positive attitudes towards physics, teaching methods, classroom environment, homework and projects, choice of teachers and encouraging to bring gender equity and awareness to every aspect of schooling (AAUW, 1992; Mattern & Schau, 2002).

Research findings indicate that novice learners hold a wide range of beliefs on basic concepts in science, and beliefs learners hold of the natural world tend to be naive, unstudied, and intuitive (Aguirre, 1988; Halloun & Hestenes, 1985; Mildenhall & Williams, 2001; Pine, Messer, & John, 2001). Building models reflective of how students learn, what students learn, and what they need to learn next in order to grow useful knowledge structures could open doors to new worlds of learning.

Many studies indicate that there are differences between achievement of male and female students in science (Häussler & Hoffmann, 2002; Kahle & Lakes, 2003; Lee & Burkam, 1996; Young, 1991). Besides, National Center for Education Statistics' (NCES) results show similar science proficiency scores for males and females at age 9. The report also indicates that a gender gap in science achievement begins to appear at age 13 and be narrow at age 17.

In addition to this, much gender research in physics has focused on increasing female participation and promoting their success in physics (AUWW, 1992; Baird, 1997; Erickson & Erickson, 1984; Häussler & Hoffmann, 2002; Kahle & Lakes, 2003).

2.2 Existence of Gender Gaps in Education

In recent years scholars have shown great interest in the relationship of gender to participation and performance in education. Addressing the factors related to gender that are involved in school performance is important to ensure that all students will succeed to the best of their ability.

In 1992 the AAUW Report: *How Schools Shortchange Girls* (Wellesley College Center for Research on Women, 1992) pointed out how the current debate on education reform neglects gender bias, referring to sex-unspecified "students" or "youth" in their discourse. The report also presented compelling evidence that girls are not receiving the same quality, or even quantity, of education as their brothers.

Some papers indicate that although there have been slight declines in the gender gaps in areas such as high school course enrollment and math and science

proficiency, there are still clearly defined differences in educational experience by gender. While the sex role socialization perspective points to the origin of much of

this difference in early childhood socialization, research confirms that more distinct differences among girls and boys begin to be apparent at approximately the middle school age and are quite distinct by grade twelve. Gender differences that seem most critical based on the literature are not only proficiency in upper level math and science courses but also self-esteem and personal perceptions of ability to succeed in these disciplines. This could lead to gender difference in future educational attainment and career aspirations (Anonymous, 2001).

2.3 Causes of Gender Differences

Historically, the gender imbalance was thought to be the result of differing brain structures and functions between men and women. Indeed, some theorists still hold to that view. However, explanations based on gender-specific socialization have largely displaced the brain difference models. Socialization theories hold that girls are directed away from physical science by parents, teachers, and peers (male and female) because such studies are considered to be unfeminine. Such theories further suggest that girls themselves select out of physical science because the issues involved in those fields do not match the issues with which girls are encouraged to be concerned (Baird, 1997).

According to study of Baird (1997) the "lack of interest" is the primarily reason of the "lack of female participation" in physics. A majority of female physics teachers and a minority of male physics teachers feel there is something about the structure, content, or pedagogy of physics that discourages greater participation is disconcerting. Nevertheless, many teachers do nothing to encourage greater female participation.

Physical, biological and general sciences show the greatest discrepancies in achievement test performance according to gender. The results of Haggerty's (1987) study illustrate the importance of looking beyond statistical analyses, to examine the behavior and characteristics of individual students. It has been noted that although females do as well as males in science course achievement, on standardized tests males regularly outperform females. The teacher-made unit test emphasized knowledge, which could be rote learned, whereas the standardized tests required that students apply their knowledge to new situations.

Haggerty's study showed that boys participated in class discussions more than did girls and they demonstrated a more active and inquiring approach to laboratory activities. In addition to these results, girls appeared to be more concerned with meeting the teacher's expectations with respect to providing correct answers and completing assigned tasks.

The meta-analysis covering the literature between 1970 and 1991 examined gender differences in student attitudes toward science, and correlations between attitudes toward science and achievement in science (Weinburgh, 1995). The results

of this analysis of gender differences in attitude as a function of science type indicate that boys show a more positive attitude toward science than girls in all types of science. However, the correlation between attitude and achievement for boys and girls as a function of science type indicates that for biology and physics the correlation is positive for both, but stronger for girls than for boys.

There are some interesting and significant differences in the interests, experiences and performances of girls and boys in found that the early-established differences in the interests and activities of boys and girls result in the parallel differences in their science performances (Johnson, 1987). According to the author, the different out-of-school activities of boys and girls would provide them with opportunities to use, and hence to become familiar with, rather different measuring instruments. Results of Johnson showed that boys' activities afford greater opportunities than those of girls for acquiring experiences with which to consolidate later conceptual learning in physics. Moreover, boys do reinforce their practical learning more than girls by reading relevant information books and by watching appropriate television programmes.

The of literature support the belief that girls and boys come to school with vastly different science-related experiences and these deficiencies in experiential background appear to affect course selection and future achievement (Farenga & Joyce, 1999). The evidence indicate that the examination of science experiences reported by girls identified that they participated in more observational and life science activities. However, boys participated in activities that involved more

interactions with machines and the manipulation of objects as identified by physical science subscale scores.

The reanalysis of Becker (1989) from earlier reviews indicates that subject matter indeed relates to the magnitude of science-achievement gender differences. Besides, it is not justified to claim that males have blanket advantage in every area of science.

Results of Häussler and Hoffmann (2002) showed some implications for promising in enhancing girls' interest, self-concept, and achievement in physics.

These can be listed as:

- Adapting the curriculum in a way that comes to the interest of girls (and likewise of boys).
- Teaching girls and boys separately, which enhances the effect of an interest-guided curriculum.
- Recognizing that separating girls and boys in physics classes is probably ineffective when not supported by a girl-friendly curriculum and a gender-fair teacher.
- Ignoring girls' feelings towards monoeducation, which are, on average, ambivalent at first. Once they have experienced it, they like the separation and would like to continue it. Boys are indifferent in this respect.
- Measuring achievement several weeks after the instruction has ended, which may reveal interesting developments.

- Being patient when it comes to changing teacher behavior. This is much more difficult and takes more time.

Moreover, Sudweeks and Tolman (1993) reported another possible explanation for gender difference on science achievement tests. They pointed out that the test, which was used, might be contained questions that favored one gender or the other because of extraneous characteristics in the individual items. The authors observed eight of the nine flagged items were more difficult for females and concluded that the possible factors for these differences include; a) differences in the students' reading experiences and interests, b) differences in their academic experiences, and c) differences in the science-related, out-of-school experiences of the two groups.

2.4 Preconceptions on Learning Physics

Over the years, members of the physics teaching community have begun to conduct systematic observations and research on students' learning and understanding of physical concepts, models and lines of reasoning. Physics education research has revealed that students already have a number of ideas about how physical systems behave even before they start to study physics (Aguirre, 1988; Halloun & Hestenes, 1985; Maloney, 1990).

It is well established that, during their experiences in everyday life, children develop their own ideas that they use to make sense of the natural phenomena they experience in the world around them (Van Hise, 1988). But in many cases these ideas are either incorrect or differ from the scientific accepted ones. To the science

educator, these ideas, "preconceptions", or "alternative conceptions" are important because they significantly interfere with learning (McDermott, 1984; Palmer & Flanagan, 1997).

Many studies were carried out in many different subjects in physics, especially in mechanics. Since late 1970s' many investigators met at the same point of decision that, students' preconceptions about force and motion has a great influence on performance in introductory mechanics (Clement, 1982; Eryılmaz, 2002; Haşmetoğlu, 1994; Ridgeway, 1988; Sadanand & Kess, 1990; Van Hise, 1988). The studies

concerning physics students' reasoning about the concept of force and motion have indicated that students exhibit misconceptions which can interfere with learning and which are surprisingly resistant to be changed (Clement, 1982; Halloun & Hestenes, 1985; Palmer & Flanagan, 1997; Van Hise, 1988). In addition to these studies, many other research studies are being carried out for the investigation and remediation of these misconceptions regarding force and motion (Çataloğlu, 1996; Eryılmaz, 1992; 2002; Haşmetoğlu, 1994; Palmer & Flanagan, 1997; Yılmaz, 2001).

Eryılmaz (1992), Thornton and Sokoloff (1995), and Tao and Gunstone (1999) designed different studies about the process of conceptual change in force and motion during computer-supported physics instruction for improving student achievement. In these studies students are encouraged to interact with a physical problem in their environment much the way a scientist does using microcomputer based laboratory probeware.

Briefly most of the studies accomplished in this area is concerned with detecting and dispelling misconceptions of students related to introductory mechanics.

2.5 Gender and Physics Learning

The discipline of physics is structured around the learning of concepts, rules and laws. Knowledge of rules and laws are important for physics but it is not sufficient for a meaningful understanding of concepts. A student may for instance, remember that Newton's second law is mathematically formulated as $F = ma$, but remembering that rule will not help the student understand the concept of net forces in various situations. Students must be able to apply the concept of Newton's second law in sometimes novel situations. If students feel they do not really understand the concepts beyond memorization of rules and definitions, they cannot be confident in their ability to apply those concepts (Pearce, 1997).

For years physics education researchers have used surveys and other investigative tools to learn what physics students know and how they think. Students use various knowledge structures to make sense of situations. Students build these structures from information based on prior experience or through instruction.

Researchers have been probing students' mental models to better understand the origin of student difficulties (Itza-Ortiz & Rebello, 2002). In their study, they interviewed 16 students in a calculus-based physics class six times over two semesters. During each interview the students were asked the same questions about mechanics, but in different context. According to their findings; the students'

responses tended to be more Newtonian-like after instruction, but not all of them remain "Newtonian thinkers" through different contexts. In the second semester most students' responses are consistent with the Newtonian model even when the concepts of the study are more abstract than on the first semester. They concluded from the study that thinking while responding to physics questions is dependent both on the instruction as well as on the context of the question.

Another research, which was studied by McCullough (2001), found significant differences among responses of males and females to the contextual changes. McCullough (2000) designed a study to explore the issue of possible context dependence. A modified version of a diagnostic instrument (FCI) was created using female and daily-life contexts instead of the male and school-oriented contexts in the

original (e.g., instead of a cannon shooting a cannonball, a baby knocks a bowl off her high-chair tray). The physics is identical; only the context has changed. Both modified and original versions were administered in class. Significant discrepancies for four test items were found: two for males only and two for females only. She suggested that, in certain cases, slight changes in the context of a conceptual question might affect students' performance in mechanics.

Eryılmaz (2001) determined important findings concerning the effect of traditional lecturing on freshmen students' misconceptions in a mechanics course. His findings from 435 students indicated that male students show fewer misconceptions and higher achievement than female students and the correlation between students' misconceptions and achievement in physics is statistically

significant. This study also pointed out that although there has been a statistically significant effect of conventional lecturing on students' misconceptions, this effect has been far from being great enough to have a practical significance.

2.6 Misconceptions Concerning Force and Motion

Students come to the class with a well established system of common sense beliefs about how the physical world works. In this respect, the research into student misconceptions and their reasoning in mechanics has been the subject of many investigations and studies. Many physics education research has established that common sense beliefs about force and motion are incompatible with scientific concepts in most respects.

Clement (1982), and Halloun and Hestenes (1985) pointed out that student over a wide range of age and educational background have misconceptions about many concepts in mechanics. Besides, Eryılmaz (1992) has identified that not only ordinary students but also honor students and even physics teachers in fact highly misunderstand some concepts of mechanics.

Hestenes et al. (1992) designed a 29 item test (FCI) to probe students' beliefs about Newtonian mechanics. This test has been given to more than 1500 high-school students and more than 500 university students. The results indicated that students' initial knowledge had a large effect on their performance in physics, and conventional instruction produced comparatively small improvement in their basic knowledge, as well as the small gain was independent of the professor or the teacher.

As a result of these studies concerning misconceptions about force and motion in the literature, let us briefly explain these misconceptions that one could come across:

- i. Impetus: Impetus is conceived to be an inanimate "motive power" or "intrinsic force" that keeps things moving. Students are often used the term impetus is like "force", "energy", and "power" interchangeably, as the terms "velocity" and "acceleration". Students do not call it as impetus naturally but frequently they use the word "force" here, instead. This conception contradicts Newton's first law. Impetus can be gained, lost, or reconstructed in a variety of ways varying from student to student. In addition, some students believe in circular impetus that tends to move objects in circles (Hestenes et al., 1992).
- ii. Active Force: This misconception corresponds most closely to Newton's Second Law. Some students believe that active agents (usually living things) are causal agents which have the power to cause motion or to create impetus and transfer it to other (Halloun & Hestenes, 1985; Hestenes et al., 1992).
- iii. Velocity is proportional to Force: Students sometimes believe that there is a linear relation between force and velocity rather than force and acceleration. Therefore they expect a constant velocity from a constant force.
- iv. Motion implies force: From everyday experience students untutored in physics generally assume that a force is always necessary to sustain

motion, even at steady speed. Clement (1982) indicates that some students have an idea that continuing motion, even at constant velocity, enable an assumption of the presence of force in frictionless medium in the direction of motion.

- v. Passive forces: The idea that a table or chair (the things which are not alive) could exert a force upwards when there was no motion was generally not accepted by the students. These students also associated the ability to exert a force with something that was alive (McDermott, 1984).
- vi. Gravity: Many students confused the concepts of mass and weight and of velocity and acceleration. These students have misleading thought

that the body with a greater weight will cause a bigger acceleration in free fall (i.e., heavier objects fall faster) or that gravity varies significantly over a few meters, whereas the variation is actually about 1 part 10^{13} (Eryılmaz, 2002; Hestenes et al., 1992).

- vii. Action-Reaction Pairs: Students often the term "interaction" by a "conflict metaphor". They see an interaction as a "struggle between opposing forces". It follows from the metaphor that "victory belongs to the stronger". Hence, students find Newton's Third Law unreasonable, and they prefer some versions of dominance principle: In a conflict, the "more forceful" exerts the greater force. Here "more

forceful" can mean "bigger", "greater mass" or "more active".

Therefore, they believe that greater mass implies greater force or the most active one produces greatest force (Clement, 1982; Eryılmaz, 2002; Hestenes et al.,1992).

- viii. Ideal versus real systems: Some students have confusions concerning frictionless world. That could be why some students believed that the speed of an object decreases even though the net force acting upon it is zero (Halloun & Hestenes, 1985).
- ix. Position, Velocity and Acceleration Confusion: Students could not distinguish clearly between the concepts of velocity and position. When two objects have the same position, students think that they have the same velocity at that time. Also it is evident in the literature
- x. that some students confused the velocity and the acceleration of an object. For example; when two objects have the same speed, students think that they have the same acceleration at that time (Hestenes et al.,1992; McDermott, 1984).

2.7 Summary of Findings of the Reviewed Studies

1. The most important factors that affect students' achievement in physics are students' prior experiences, gender, misconceptions, socioeconomic status, instruction, conceptual, and contextual changes (Baird, 1997; Chandavarkar,

Doran & Jacobson, 1991; Eryılmaz, 1992; 2002; Eryılmaz & Tatlı, 2001; Häussler and Hoffmann, 2002; Hewson & Hewson, 2003; Itza-Ortiz & Rebello, 2002; McCullough, 2000; Tao & Gunstone, 1999; Thornton & Sokoloff, 1995; Yıldırım & Eryılmaz, 1999).

2. Male and female students are different in their attitudes, interests, and experiences (AAUW, 1992; Baird, 1997; Erickson & Erickson, 1984; Farenga & Joyce, 1999; Häussler and Hoffmann, 2002; Hoffmann 2002; Johnson, 1987; Şifa & Sancar 1999; Van Hise, 1988; Weinburgh, 1995).
3. Males more participate in class discussion and laboratory activities than females (Haggerty, 1997; Kahle & Lakes, 2003).
4. Males have more out-of-school activities than females that provide opportunities for acquiring physics experiences (Farenga & Joyce, 1999; Johnson, 1987).
5. Males and females have different science achievement in favor of males (Becker, 1989; Erickson & Erickson, 1984; Johnson, 1987; Lee & Burkam, 1996).
6. Students frequently have preconceptions about physics concepts that they have been obtained prior to instruction (Aguirre, 1988; Halloun & Hestenes, 1985; Maloney, 1990; McDermott, 1984; Palmer & Flanagan, 1997; Van Hise, 1988).
7. Most of the students have similar misconceptions related to force and motion (Clement, 1982; Çataloğlu, 1996; Eryılmaz, 1992; 2002; Haşmetoğlu, 1994; Palmer & Flanagan, 1997; Ridgeway, 1988; Sadanand & Kess, 1990; Van Hise, 1988; Yılmaz, 2001).

8. Females have more misconceptions than males on concepts related to force and motion (Crough, 2002; Eryılmaz, 2002; Eryılmaz & Tatlı, 2001; McCullough, 2002).
9. Gender differences was only investigated over total scores of students in related literature (Crough, 2002; Eryılmaz & Tatlı, 2001; McCullough, 2002).
Differences over different misconception categories were not investigated so far.

CHAPTER 3

METHOD

In the previous chapters, problems and hypotheses of the study were presented, related literature was reviewed accordingly. In this chapter, population and sampling, description of variables, development of measuring tools, procedure, methods used to analyze data and assumptions and limitations will be explained briefly.

3.1 Population and Sample

The target population of the study consists of all 10th grade students in Turkey. Since it is not feasible to select a representative sample from this population, it will be appropriate to define an accessible population. The accessible population is all 10th grade students of public high schools in the district of Yenimahalle and Çankaya in Ankara. This is the population for which the results of this study will be generalized. Desired sample size was determined as 1500 students, which is approximately 10 % of the whole population. Stratified random sampling integrated with convenience sampling was used to obtain representative sample. The schools in these districts were obtained from the catalogue of public high school. Averages of 60-65 students per school corresponding to two classes were participated in the study. Among the classes in each school, participated classes were selected by taking into consideration of the convenience of administration and teachers. Table 3.1

presents numbers of schools and students throughout the districts, numbers of selected schools throughout these districts and numbers of selected students from each of the district.

Table 3.1 Numbers of schools, students, selected schools and students through districts

District	# of schools	# of students	# of selected schools	# of selected students
Çankaya	23	8675	6	368
Yenimahalle	16	6496	4	283

Ten public high schools, their 20 classes and 651 high school students were involved in this study. As shown in Table 3.2, the sample of the study was composed of 329 Normal High School students, 270 Super High School students and 52 Anatolian High School students of 10th grade. Of the sample, 48% were female and 52% were male students. Table 3.2 presents number of schools, number of classes and number of students from each type of public high school.

Table 3.2 Numbers of selected schools, classes and students according to public high school type

Public High School Type	selected # of schools	selected # of classes	selected # of students
Normal High School	5	10	329
Super High School	4	8	270
Anatolian High School	1	2	52
Total	10	20	651

Some characteristics of the sample are presented in Table 3.3 and Table 3.4.

Normal High Schools were coded as 1, Super High Schools were coded as 2 and Anatolian High Schools were coded as 3 in this study.

Table 3.3 Characteristics of the sample according to public high school type

Public High School Type	Gender	
	Male	Female
1	114	115
2	132	155
3	26	26

Distribution of ages with respect to gender is given in Table 3.4 in which ages of the students' range from 14 to 18. This study was conducted during the second semester of the 2002-2003 academic year.

Table 3.4 Distribution of Ages of Students with respect to Gender

Age	Males	Females	Total
14	4	0	4
15	134	94	228
16	168	180	348
17	30	39	69
18	2	0	2
Total	338	313	651

3.2 Variables

There are fifteen variables involved in this study, which were categorised as dependent and independent.

3.2.1 Dependent variables

The dependent variables (DVs) of this study are students' total misconception scores and eight categories of students' misconceptions concerning force and motion as measured by the force concept inventory (FCI) test. They are both continuous and interval variables. Hence, we have totally nine dependent variables in this study.

3.2.2 Independent variables

The independent variables (IVs) of the present study are gender, total MBT scores, students' attitudes toward force and motion, type of high school, students' age and students' experiences about force and motion. Among these, gender was used as the group membership and the remainings were used as covariates to match two groups statistically.

3.3 Measuring Tools

In this study for the assessment of students' characteristics four instruments were used. These are Force Concept Inventory Test (FCI), Mechanics Baseline Test (MBT), Physics Attitude Scale (PAS), and Experience Questionnaire about Force and Motion (EQFM).

3.3.1 Force Concept Inventory Test

The FCI is a conceptual exam, designed to measure students' understanding some of the basic concepts of Newtonian mechanics and to identify which common misconceptions students exhibit. The first version of the FCI (Hestenes, Wells & Swackhamer, 1992) is revised by Ibrahim Halloun, Richard Hake, Eugene Mosca and David Hestenes and placed on the web in 1995. This revised version (Halloun et al., 1995) has 30 items whereas the original FCI had 29. Besides, the items 15 and 19 in the original version have been removed while the items 5, 18 and 26 have been added in 1995 version. The FCI is the most appropriate test for this study because of detecting students' misconceptions and being used as a diagnostic assessment tool at every level of introductory physics instruction, from high schools to universities.

The items of the revised version of the FCI which is used in this study were translated into Turkish by the researcher. A specialist from the Ministry of Education and an instructor from the department of Secondary School Science and Mathematics education helped in the translation process. During the translation of the items, related literature was examined and instruments developed by other researchers in earlier studies were collected first. Afterwards, the researcher translated the items by getting benefit from these instruments. Translated items of the inventory were checked and corrected by a specialist from the Ministry of Education. Then the test was applied to three randomly selected 10th grade students one by one. The researcher told all the students that they had to explain the reasons of their responses while answering. By interviewing the students about their responses to the questions and taking their opinions about the wording of the items,

required modifications have been done. Finally, the items were discussed and investigated with an instructor from the department of Secondary School Science and Mathematics before getting the last case. Hence, the researcher concluded that the last form of the items was understandable and there was also no evidence of common misunderstanding, which might be attributed to the formulation of grammatical mistakes of the questions. While calculating the achievement scores, 1 point was given for each correct answer and higher scores indicate lower number of misconceptions.

The FCI (Hestenes et al., 1992) has been designed to address six conceptual dimensions within the field of force and kinematics. According to these dimensions the authors of the FCI set out a classification of misconceptions which are included in the test items. The researcher revised this classification by using the students' explanations concerning their responses to the questions during the interviews. In this revision process, the new misconceptions were constructed and corresponding items were selected in coordination with an instructor from the Secondary School Mathematics and Science Education. Table 3.5 presents this new classification of commonsense misconceptions probed by the Inventory. It includes eight misconception categories, which are formed by 35 sub-categories. Two new categories (Resistance and Gravity) are constructed by separating 'Other Influences on Motion' category into three different categories. Five new sub-categories (AR3, Ac, G6, G7, and G8) are constructed according to students' misconceptions, which are detected through the students' interviews. Moreover, Table 3.5 shows the changes in the 1995 version of the FCI. The number of the items in the original

version of the inventory has been changed in 1995 version. For example in 1992 version of the FCI, item 20 that has been in the sub-category of K1, is numbered as 19 in 1995 version. All of the items in two versions of the inventory were checked one by one and a new list concerning the correct numbers of the items, and distracters was formed by the researcher. Another person was also formed a list of these items by following the same. These two lists were compared and appropriateness was examined. 31 new distracters were added to the sub-categories of the classification and the last form of the list has taken its last form with the guidance of an instructor in physics education. The Cronbach's alpha (α) reliability coefficient of the FCI was found .74 (see Appendix A for the FCI in Turkish form).

Table 3.5 Classification of commonsense misconceptions probed by the Inventory and the distracters measuring related misconceptions concerning force and motion

MISCONCEPTIONS	FCI - 92	Inventory Item FCI - 95	Added in 2003
1) KINEMATICS			
K1. Position-velocity undiscriminated	20B,C,D	19B,C,D	
K2. Velocity-acceleration undiscriminated	20A; 21B,C	19A; 20B,C	
K3. Nonvectorial velocity composition	7C	9C	
2) IMPETUS			
I1. Impetus supplied by "hit"	9B,C; 22B,C,E; 29D	11B,C; 30B,D,E; 27D	
I2. Loss/Recovery of original impetus	4D; 6C,E; 24A; 26A,D,E	7D; 8C,E; 21A; 23A,D,E	
I3. Impetus dissipation	5A,B,C; 8C; 16C,D; 23E; 27C,E; 29B	13A,B,C; 10C; 12C,E; 14E; 24C,E; 7B	10E; 12D
I4. Gradual/delayed impetus build-up	6D; 8B,D; 24D; 29E	8D; 10B,D; 21D; 27E	26C,D
I5. Circular impetus	4A,D; 10A	7A,D; 6A	
3) ACTIVE FORCE			
AF1. Only active agents exert forces	11B; 12B; 13D; 14D; 15A,B; 18D; 22A	28B; 15D; 16D; 17E ; 30A	5A; 18A,C,E
AF2. Motion implies active force	29A	27A	5A,C,D,E; 18C,D,E
AF3. No motion implies no force	12E	29E	
AF4. Velocity proportional to applied force	25A; 28A	22A; 26A	26B
AF5. Acceleration implies increasing force	17B	3B	
AF6. Force causes acceleration to terminal velocity	17A; 25D	3A; 22D	
AF7. Active force wears out	25C,E	22C,E	
4) ACTION/REACTION PAIRS			
AR1. Greater mass implies greater force	2A,D; 11D; 13B; 14B	4A,D; 28D; 15B; 16B	
AR2. Most active agent produces greatest force	13C; 11D; 14C	15C; 28D; 16C	
AR3. Passive(lighter)mass implies greater force*			4B; 18A ; 28C

The continuation of Table 3.5

5) CONCATENATION OF INFLUENCES			
CI1. Largest force determines motion	18A,E; 19A	17A,D	
CI2. Force compromise determines motion	4C; 10D; 16A; 19C,D; 23C; 24C	7C; 6D; 12A; 14C; 21C	
CI3. Last force to act determines motion	6A; 7B; 24B; 26C	8A; 9B; 21B; 23C	
6) OTHER INFLUENCES ON MOTION			
CF. Centrifugal force	4C,D,E; 10C,D,E	7C,D,E; 6C,D,E	5E; 18E
Ob. Obstacles exert no force	2C; 9A,B; 12A; 13E; 14E	4C; 11A,B; 29A; 15E; 16E	
Ac. Getting more way implies increasing acceleration*			20A
7) RESISTANCE			
R1. Mass makes things stop	29A,B; 23A,B	27A,B; 14A,B	
R2. Motion when force overcomes resistance	28B,D	25B,D	
R3. Resistance opposes force/impetus	28E		
8) GRAVITY			
G1. Air pressure-assisted gravity	9A; 12C; 17E; 18E	11A; 29D; 3E; 17D	
G2. Gravity intrinsic to mass	5E; 9E; 17D	13E; 3D	
G3. Heavier objects fall faster	1A; 3B,D	1A; 2B,D	1D
G4. Gravity increases as objects fall	5B; 17B	13B; 3B	
G5. Gravity acts after impetus wears down	5B; 16D; 23E	13B; 12E; 14E	
G6. Lighter objects fall faster*			1B,E; 2C,E
G7. Gravity equals to friction force*			25A,E
G8. Ignoring gravity*			29C

Note: Sub-categories marked with asterisk are the new ones constructed in this study.

3.3.2. Mechanics Baseline Test (MBT)

This test has been designed to assess student understanding of the most basic concepts in mechanics (Hestenes & Wells, 1992). It is the next step above the Inventory in mechanics understanding. The MBT emphasizes concepts that cannot be grasped without formal knowledge about mechanics. Its main intent is to assess quantitative understanding. The multiple-choice distracters in the Baseline are not commonsense alternatives as they are in the Inventory, though they include typical student mistakes, which are more often due to deficient understanding than to carelessness. Thus, student difficulties with the test appear to stem from real deficiencies in understanding the basic concepts (Hestenes & Wells, 1992).

The test consists of 26 multiple-choice questions. All of the questions were directly taken from the original MBT and translated into Turkish by following the same translation procedure of the FCI test. While calculating the achievement scores, 1 point was given for each correct answer and higher scores indicate greater achievement about mechanics. The Cronbach's alpha (α) reliability coefficient of the MBT was found .74 (see Appendix B for the MBT in Turkish form).

3.3.3 Physics Attitude Scale (PAS)

The PAS was adapted from the scale used by Taşlıdere (2002). It consisted of 24 items. Initially, the scale had been designed to collect data about students' attitudes toward simple electricity. Because of the test's being content based, it was revised to collect data about students' attitudes toward force and motion by the

researcher due to the appropriateness of the study. The content of simple electricity in the original scale was changed with the content of force and motion concepts. The content of force and motion covers; kinematics, Newtonian Principles of Motion, Motion on Earth. The items of the new scale are identical; only the content has changed as force and motion. This instrument was referred to as Physics Attitude Scale. The questions were designed to be rated on a 5-point likert type response format (absolutely disagree, disagree, neutral, agree, and absolutely agree). PAS requested only the information of students' name and surname. Considerable care was taken for being understandable and clear of the items'. Required modifications about the wording of the items have been done by taking the opinions of two physics professor from the department of Physics at METU, one instructor from the department of Secondary School Science and Mathematics Education at METU. While calculating the PAS scores, 1 point for absolutely disagree, 2 point for disagree, 3 point for neutral, 4 point for agree and 5 point for absolutely agree were given. The Cronbach's alpha (α) reliability coefficient of the PAS was found .92 (see Appendix C for the PAS).

3.3.4 Experience Questionnaire about Force and Motion (EQFM)

The EQFM was adapted from the questionnaire used by Sencar (2002). It consisted of 18 items. It was designed to collect data about students' experiences about force and motion. This instrument was referred to as Experience Questionnaire about Force and Motion. Two items requested information on the students' gender

and age. Eight items were taken directly; only the content of electricity was changed with the content of force and motion concepts. In addition to these items, the researcher developed eight items by making literature review and taking the opinions of one instructor from Secondary School Science and Mathematics Education and two physics professor from the department of Physics at METU.

Three items were designed to be rated on a 4-point likert type response format (very interested, interested, uninterested, very uninterested) and 13 items were designed to be rated on a 3-point likert type response format (never, sometimes, frequently). Totally there were 16 items addressing students' experiences about force and motion. The Cronbach's alpha (α) reliability coefficient of the FCI was found .75 (see Appendix D for the EQFM).

3.3.5 Validity and Reliability of Measuring Tools

To establish the face and content validity, a specialist from the Ministry of Education and an instructor from the department of Secondary School Science and Mathematics Education checked the Turkish version of the FCI and MBT. Necessary changes have been done before the study. Reliability was established by interviewing a sample of students who had taken the test and by a statistical analysis of the test results. The researcher interviewed nine students who took the highest scores and seven students who took the lowest scores in the FCI. During the interviews most of the students repeated the answers they had given on the written test.

The PAS and EQFM were checked by two physics professor from the department of Physics at METU, one instructor from the department of Science and Mathematics Education at METU and four 10th grade students from different schools according to content and format of the instruments. All these people were explained about the main purpose of test and then they evaluate measuring tool according to given criteria of appropriateness of items to the grade level, verbally understandable and clear. Suggestions were taken into consideration in the revision of the instruments. Reliability analyses were performed for the FCI, MBT, PAS and EQFM separately.

3.4 Procedure

Design used in the study was both cross-cultural survey and causal comparative since both the students' misconceptions on force and motion and effect of gender on the same concept were investigated, respectively. The study started with a detailed examination of the literature. After determining the keyword list, the researcher searched Dissertation Abstracts International (DAI), Social Science Citation Index, Educational Resources Information Center (ERIC), Ebscohost, science direct and Internet. Previous studies made in Turkey were also searched from YOK, Hacettepe Eđitim Dergisi, Eđitim ve Bilim, and ađdađ Eđitim Dergisi. Photocopies of the documents were taken from METU library, library of Bilkent University and TUBİTAK Ulakbim. All of the papers were read; results of the

studies were compared with each other. In case of new recent articles on this topic the researcher continuously checked and followed the literature.

After that, the measuring instruments were developed by the help of the findings from the literature as mentioned in section 3.3. These measuring tools were checked by a specialist from the Ministry of Education and an instructor from the department of secondary school science and mathematics education, two physics professor from the department of Physics at METU. Necessary changes were done before the study. Following the selection of subjects required permissions have been granted from all schools' administrations for the application of the tests by talking over the study one by one. The physics teachers were explained the application of instruments. Then, the appropriate administration days were decided according to the schools' lecture programs.

Since there were four different measuring tools used in this study, two class hours required for the administration. While the MBT and PAS were given in the first week, the FCI and EQFM were given in the previous week.

The researcher and the class teacher administered the instruments to the participants together during the spring 2002-2003 semester. In order to have students relaxed and comfortable, the researcher read directions and told that they would learn the results but the grades of these tests would not affect their physics grades. One class hour and extra 5 minutes was given to students to complete the tests. The time was adequate to complete the instruments. They were warned not to forget to complete the PAS and the EQFM. In addition to this, the researcher controlled these

instruments while collecting the tests and gave back if there was any blank on them. In one of the classes there were eight students who didn't take the EQFM because of the photocopies were lacking. These students were given this questionnaire later by the researcher. No problems were encountered during the administration of the instruments.

Finally, all data were entered to the computer. The variables were formed. The statistical analyses were done by using SPSS and the process of writing the thesis started.

Data list, consisting of sex, birth-date, type of schools and answers of each subject to each question were prepared by using Excel in which columns show variables and rows show students participating in the study. The statistical analyses were done by using both Excel and SPSS. The data obtained in the study were analyzed in two parts, which were presented as descriptive statistics and inferential statistics.

In order to test the null hypotheses, all statistical computations were done by using statistical package program (SPSS). Statistical technique named MANCOVA was used since it can both equate groups on one or more independent variables.

This study conducted with 651, 10th grade high school. Table 3.6 shows all variables and the variable set entry order that were used in the statistical analyses.

Table 3.6 MANCOVA variable set composition and statistical model entry order

Variable set	Entry order	Variable name
A	1 st	X1 = PAS
		X2 = MBT
(Covariates)		X3 = experience
		X4 = age
		X5 = school type variable 1
		X6 = school type variable 2
B		
(Group Membership)	2 nd	X7 = males vs females
A*B		X8 = X1*X7
	3 rd	X9 = X2*X7
(Covariates * Group		X10 = X3*X7
interactions)		X11 = X4*X7
		X12 = X5*X7
		X13 = X6*X7

The statistical analyses of this study were performed by using statistical package program for social sciences (SPSS). The significance level was set to the .05 since it is the mostly used value in education studies. In other words, the probability of rejecting null hypothesis (probability of making Type I-error) was set to .05 as a priori to hypothesis testing.

3.5 Power Analysis

This study conducted with 651 high school students and the number of variables was 15. Effect size of this study was set to large (0.8) because of the significant gender difference results obtained from previous studies. The power of this study was calculated as 0.97; therefore, the probability of failing to reject a false null hypothesis (probability of making Type 2-error) was found as .03 (i.e., $1 - .97$).

3.6 Assumptions

1. The administrations of the FCI, MBT, PAS and EQFM were under standard conditions.
2. The subjects of the study answered the items of the FCI, MBT, PAS and EQFM sincerely.

CHAPTER 4

RESULTS

The results of this study are explained in four different sections. First section presents the descriptive statistics in which dependent variables of this study are explored. The second section is the inferential statistics. In the third section, the descriptive comparison of male and female students' misconceptions are presented. The findings of the study will be summarized in the last section.

4.1 Descriptive Statistics

Descriptive statistics related to total scores on the FCI were categorized according to students' gender and presented in Table 4.1. Students' achievement scores range from 0 to 30 in which higher scores mean greater achievement. As Table 4.1 indicated, the scores favor male students more than female students. For instance, male students had a mean of 9.73 from the achievement scores while female students had a mean of 7.53, which means that female students had more misconceptions than male students. Table 4.1 also presents some other basic descriptive statistics of participants like minimum, maximum, S.D, skewness, kurtosis, possible minimum and possible maximum. Minimum score was 2 for male students whereas it was 1 for female students. For male students, the maximum score was 27 whereas it was 24 for female students. The value for skewness was 1.06 for male students, which could be accepted as approximately normal. In a similar manner, for the female students skewness was 1.26, which could also be accepted as

normal. When the kurtosis values taken into account, value for male students' achievement score was 1.42. Likely, kurtosis for female students' achievement scores was 2.01. According to the values of both skewness and kurtosis, the distributions of male and female students' scores on the FCI again could be accepted as approximately normal.

Table 4.1 Descriptive Statistics for the FCI Scores According to Students' Gender

Gender	N	Mean	Min	Max	S.D	Skewness	Kurtosis	Pos.min	Pos.max
FCI Scores									
Male	338	9.73	2	27	4.63	1.06	1.42	0	30
Female	313	7.53	1	24	3.98	1.26	2.01	0	30
Total	651	8.67	1	27	4.46	1.14	1.63	0	30
KINEMATICS									
Male	338	1.27	0	3	0.81	0.16	-0.49	0	4
Female	313	1.34	0	3	0.82	0.06	-0.57	0	4
Total	651	1.30	0	3	0.82	0.11	-0.54	0	4
IMPETUS									
Male	338	6.22	0	11	2.15	-0.36	-0.10	0	20
Female	313	6.93	0	12	1.99	-0.40	0.49	0	20
Total	651	6.56	0	12	2.11	-0.40	0.16	0	20
ACTIVE FORCE									
Male	338	4.55	0	9	1.51	0.00	0.13	0	17
Female	313	4.94	0	10	1.63	-0.01	-0.03	0	17
Total	651	4.74	0	10	1.58	0.02	0.03	0	17
ACTION/REACTION PAIRS									
Male	338	2.55	0	6	1.41	-0.03	-0.91	0	10
Female	313	2.71	0	5	1.45	-0.21	-0.83	0	10
Total	651	2.63	0	6	1.43	-0.12	-0.89	0	10

The continuation of Table 4.1

CONCATENATION of INFLUENCES									
Male	338	1.88	0	5	1.15	0.27	-0.64	0	10
Female	313	2.02	0	5	1.11	0.18	-0.64	0	10
Total	651	1.95	0	5	1.13	0.22	-0.65	0	10
OTHER INFLUENCES on MOTION									
Male	338	1.98	0	6	1.29	0.31	-0.40	0	10
Female	313	2.04	0	6	1.35	0.47	-0.14	0	10
Total	651	2.01	0	6	1.32	0.39	-0.25	0	10
RESISTANCE									
Male	338	1.56	0	3	0.94	-0.04	-0.87	0	3
Female	313	1.74	0	3	0.93	-0.30	-0.76	0	3
Total	651	1.65	0	3	0.94	-0.16	-0.86	0	3
GRAVITY									
Male	338	3.02	0	7	1.71	-0.19	-0.75	0	17
Female	313	3.53	0	8	1.74	-0.03	-0.54	0	17
Total	651	3.27	0	8	1.74	0.09	-0.69	0	17

Descriptive statistics of experience scores measured by the EQFM were also categorized according to students' gender and presented in Table 4.2. Students' experience scores range from 16 to 51 in which higher scores mean greater experience about force and motion. As Table 4.2 indicated, male students means are higher than female students means which mean that male students had much more experience about force and motion than female students. While male students had a mean of 39.90 and female students had a mean of 37.85 on the EQFM. Table 4.2 also presents some other basic descriptive statistics related to experience scores. Minimum score was 26 for male students whereas it was 27 for female students. For male students, the maximum score was 51 whereas it was 49 for female students. While the value of skewness for male students was -0.39; -0.02 for female students.

When the kurtosis values taken into account, value for male students was 0.04 and for female students was -0.59. According to the values of both skewness and kurtosis, the distributions of male and female students' scores on the EQFM again could be accepted as approximately normal.

Table 4.2 Descriptive Statistics for the EQFM Scores According to Students' Gender

Experience Scores									
Gender	N	Mean	Min	Max	S.D	Skewness	Kurtosis	Pos.min	Pos.max
Male	338	39.90	26	51	4.49	-0.39	0.04	16	51
Female	313	37.85	27	49	4.43	-0.02	-0.59	16	51
Total	651	38.91	26	51	4.58	-0.19	-0.40	16	51

Descriptive statistics related to scores on the MBT were also categorized according to students' gender and presented in Table 4.3. Students' achievement scores range from 0 to 26 in which higher scores mean greater achievement. As Table 4.3 indicated, male students mean is higher than female students mean which means that male students had much more achievement about force and motion than female students. While male students had a mean of 9.26 and female students had a mean of 8.13 from the achievement scores. Table 4.3 also presents some other basic

descriptive statistics related to the achievement scores. Minimum score was 2 for male students whereas it was 1 for female students. The maximum score was 25 for both male and female students. While the value of skewness for male students was 1.51; 1.64 for female students. When the kurtosis values taken into account, value for male students was 2.26 and for female students was 4.29. According to the values of both skewness and kurtosis, the distributions of male and female students' scores on the MBT again could be accepted as approximately normal.

Table 4.3 Descriptive Statistics for the MBT Scores According to Students' Gender

MBT Scores									
Gender	N	Mean	Min	Max	S.D	Skewness	Kurtosis	Pos.min	Pos.max
Male	338	9.26	2	25	4.35	1.51	2.26	0	26
Female	313	8.13	1	25	3.96	1.64	4.29	0	26
Total	651	8.72	1	25	4.20	1.56	3.04	0	26

Descriptive statistics of the PAS scores were also categorized according to students' gender and presented in Table 4.4. Students' attitude scores range from 24 to 120 in which higher scores mean greater attitude about force and motion. As Table 4.4 indicated, male students mean is higher than female students mean which

means that male students had much more attitude about force and motion than female students. While male students had a mean of 84.58 and female students had a mean of 80.30 on the attitude scale. Table 4.4 also presents some other basic descriptive statistics related to the attitude scores. Minimum score was 35 for male students whereas it was 31 for female students. For male students, the maximum score was 120 whereas it was 112 for female students. While the value of skewness for male students was -0.34; -0.43 for female students. When the kurtosis values taken into account, value for male students was 0.14 and for female students was 0.28. According to the values of both skewness and kurtosis, the distributions of male and female students' scores on the PAS again could be accepted as approximately normal.

Table 4.4 Descriptive Statistics for the PAS Scores According to Students' Gender

PAS Scores									
Gender	N	Mean	Min	Max	S.D	Skewness	Kurtosis	Pos.min	Pos.max
Male	338	84.58	35	120	14.81	-0.34	0.14	24	120
Female	313	80.30	31	112	14.68	-0.43	0.28	24	120
Total	651	82.52	31	120	14.89	-0.37	0.21	24	120

Three histograms with normal curves related to male students' FCI scores, female students' FCI scores, all of the students' FCI scores on the FCI were given in Figure 4.1.

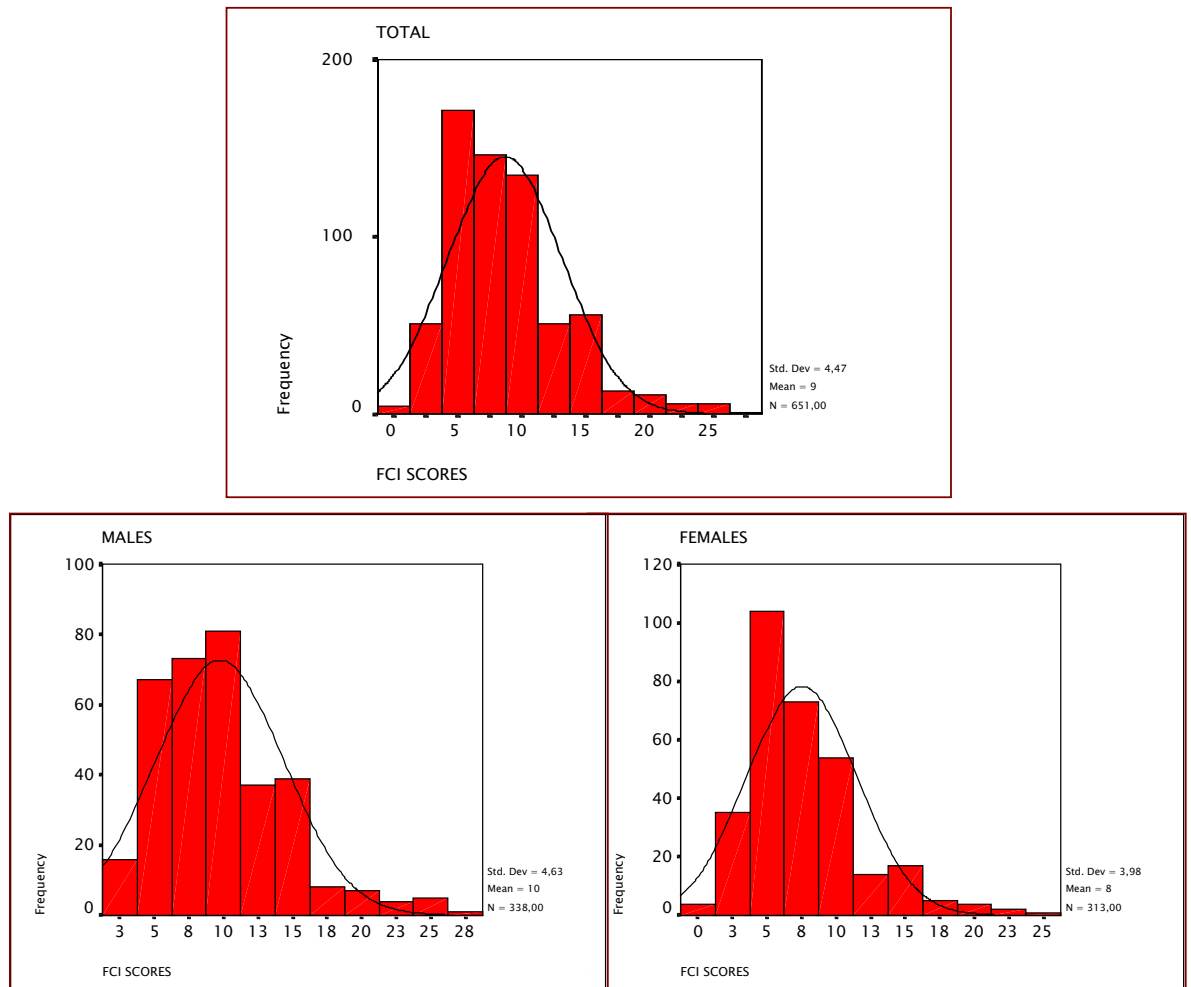


Figure 4.1 Histograms of students' scores for the FCI.

4.2 Inferential Statistics

This section has four different sub sections. The first sub section deals with the missing data. Then the second sub section deals with determination of the covariates. Verification of MANOVA and MANCOVA assumptions are given in the next sub section. Finally, the analyses of the null hypotheses are given.

4.2.1 Missing Data Analysis

651 high school students were given concept tests and questionnaires. 7 students who had been tested did not fill the experience questionnaire. These students' missing questionnaires were completed by applying them again. There wasn't any missing data in variables. So missing data analysis wasn't done.

4.2.2 Determination of the Covariates

Five independent variables (students' age, experience towards force and motion, PAS scores, MBT scores and type of schools) were pre-determined as potential confounding factors of the study. To statistically equalize the differences among male and female students, these variables were included in Set 1 as covariates. All pre-determined independent variables in Set 1 have been correlated with total FCI scores. Table 4.5 presents the results of these correlations and their level of significance. All independent variables in Set 1 have significant correlations with the dependent variable (FCI). Table 4.5 also presents the results of correlations among independent variables. As seen from this table, none of the independent

variables in Set 1 have high correlations with each other. Therefore, there is no multicollinearity among the independent variables.

Table 4.5 Significance Test of Correlation Among Variables

Variables	Correlation Coefficients					FCI
	Agemonth	Experience	PAS	MBT	Type1&Type2	
Agemonth						.89*
Experience	-.08*					.15*
PAS	-.13*	.22*				.24*
MBT	.16*	.07	.09*			.55*
Type1&Type2	.53*	.13*	.16*	.66*		.42*

*Correlation is significant at the .05 level (2-tailed).

4.2.3 Assumptions of MANCOVA

Multiple Analysis of Covariance (MANCOVA) has four assumptions: homogeneity of regression, equality of variances, normality, multicollinearity. All the variables were tested for all the assumptions and results were given.

Homogeneity of regression assumption means that the slope of the regression of a dependent variable on covariates (Set 1) must be constant over different values of gender (Set 2). Table 4.6 indicates the results. As seen from the table, Set 1*2 did not result in significant F-change ($F(6, 637)=1.37, p>.05$). In other words, the assumption is viable. Thus, the interaction set (Set 1*2) could be dropped from further inferential statistical analysis.

Table 4.6 Analysis of the homogeneity of Regression Assumption for students' scores on the FCI

IV Set	R ² Change	F Change	df1	df2	Sig. F Change
Set 1	.36	59.20	6	644	.00
Set 2	.02	23.48	1	643	.00
Set 3	.01	1.37	6	637	.23

For normality assumption, skewness and kurtosis values given in descriptive statistics section were used. The skewness and kurtosis of scores on the FCI were in acceptable range for approximately normal distribution.

Levene's Test of Equality was used for determination of the equality of variance assumption. As Table 4.7 indicated, accept one of the nine dependent variable, all the error variances across groups were equal.

Table 4.7 Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
FCI	7.12	1	649	.01
KINEMATICS	0.61	1	649	.43
IMPETUS	3.54	1	649	.06
ACTIVE FORCE	1.12	1	649	.29
ACTION/REACTION PAIRS	0.00	1	649	.97
CONCATENATION of INFLUENCES	1.36	1	649	.25
OTHER INFLUENCES on MOTION	1.50	1	649	.22
RESISTANCE	0.85	1	649	.36
GRAVITY	0.06	1	649	.81

For the testing of multicollinearity assumption correlation among covariates were examined. Since in the correlation matrix, there were no higher correlations, there is no problem with this assumption.

As a last assumption independency of observation was examined. This assumption was met with the observations of the researcher and the class teacher together. It is observed that all participants did their test by themselves.

4.2.4 Null Hypothesis 1

The first null hypothesis was; 'There is no significant main effect of gender on the population means of the collective dependent variables of: high school students' total FCI scores and their scores on eight misconception categories.

Multivariate analysis of variance was conducted to determine the effect of gender on the nine dependent variables; total scores on the FCI and eight misconception categories as shown in Table 4.8.

The Wilks' λ of .94 is significant, $F(9,641) = 4.98$, $p=.00$, indicating that we can reject the first null hypothesis. That is; gender was generally effective on the students' total conceptual understanding of force and motion and their eight categories of misconceptions. Hence, analyses of variances (ANOVA) on each dependent variable were conducted as follow-up tests to the MANOVA.

Table 4.8 MANOVA results for null hypothesis 1

Effect		Value	F	Hypothesis df	Error df	Sig.
Gender	Wilks' Lambda	.94	4.98	9	641	.00

The gender difference on the total FCI and misconception categories of Impetus, Active Force, Resistance and Gravity were significant while misconception categories of Kinematics, Action/Reaction Pairs, Concatenation of Influences and Other Influences on Motion were nonsignificant as indicated in Table 4.9. Female students had more misconceptions than male students on the total FCI and misconception categories of Impetus, Active Force, Resistance and Gravity.

Table 4.9 Follow up ANOVA results for null hypothesis 1

Source	Dependent variables	df	Error df	F	Sig.
	FCI	1	649	41.93	.00
	KINEMATICS	1	649	1.07	.30
	IMPETUS	1	649	18.84	.00
	ACTIVE FORCE	1	649	9.82	.00
Gender	ACTION/REACTION PAIRS	1	649	2.10	.15
	CONCATENATION of INFLUENCES	1	649	2.41	.12
	OTHER INFLUENCES On MOTION	1	649	.36	.55
	RESISTANCE	1	649	5.96	.02
	GRAVITY	1	649	14.56	.00

4.2.5 Null Hypothesis 2

The second null hypothesis was, ' There is no significant main effect of gender on the population means of the collective dependent variables of: high school students' total FCI scores and their scores on eight misconception categories when the effect of MBT scores, PAS scores, students' age, type of schools and EQFM scores are controlled.'

Multivariate analysis of covariance was conducted to determine the effect of gender on the dependent variable of total FCI scores when MBT scores, PAS scores, age, type of schools and EQFM scores are controlled.

As seen from Table 4.10, the second null hypothesis was rejected ($F(9, 635) = 2.75, p=.00$). That is; gender was generally effective on the students' total conceptual understanding of force and motion and their eight categories of misconceptions when the students' conceptual understanding of mechanics, attitudes towards physics, age, type of schools and experiences related force and motion are controlled. Hence, analyses of covariance (ANCOVA) on each dependent variable were conducted as follow-up tests to the MANCOVA.

Table 4.10 MANCOVA results for null hypothesis 2

Effect		Value	F	Hypothesis df	Error df	Sig.
Gender	Wilks' Lambda	.96	2.75	9	635	.00

The ANCOVAs on the three dependent variables (total FCI, misconception categories of Impetus and Gravity) were significant while the ANCOVAs on the remaining six dependents were nonsignificant as shown in Table 4.11.

Female students had more misconceptions than male students on the total FCI and misconception categories of Impetus and Gravity. Although significant differences were found among male and female students on the collective dependent measures of dependent variables Active Force and Resistance, significant differences were not found from ANCOVA results. Reason of this can be the high correlation among the dependent variables.

Table 4.11 Follow up ANCOVA results for null hypothesis 2

Source	Dependent variables	df	Error df	F	Sig.
	FCI	1	643	23.48	.00
	KINEMATICS	1	643	.53	.47
	IMPETUS	1	643	6.94	.01
	ACTIVE FORCE	1	643	3.65	.06
Gender	ACTION/REACTION PAIRS	1	643	1.84	.18
	CONCATENATION of INFLUENCES	1	643	1.41	.24
	OTHER INFLUENCES on MOTION	1	643	.01	.92
	RESISTANCE	1	643	2.41	.12
	GRAVITY	1	643	6.78	.01

As seen from Table 4.12 female students had higher scores than male students on misconception categories of Impetus and Gravity while they had lower scores from the total FCI. In other words, male students had fewer misconceptions on misconception categories of Impetus and Gravity.

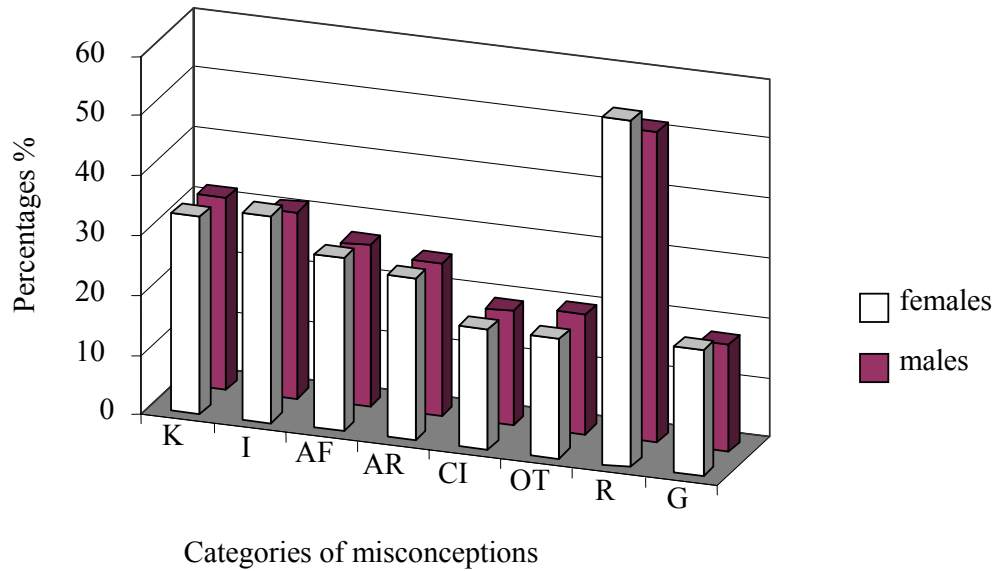
Table 4.12 Estimated means for the significant dependent variables in the ANCOVA

Dependent Variable	Gender	Mean
FCI	Male	9.36
	Female	7.93
IMPETUS	Male	6.35
	Female	6.78
GRAVITY	Male	3.09
	Female	3.45

4.3 Students' Misconceptions Concerning Force and Motion

Force Concept Inventory is designed to monitor students' understanding of the conceptual field of force and related kinematics. Types of misconceptions studied in this study and their descriptions were given in Chapter 2 and Chapter 3. The descriptive statistics of the percentages of each misconception category were calculated over the total scores that students' had on each misconception category. While this calculation process one point was given for every wrong distracter on each misconception sub-category. Then, the scores on each misconception category were found by the addition of the total scores on each misconception sub-category.

The total of these scores on each misconception category was divided by the product of the number of the different questions on each misconception category and the number of students. The result was multiplied by 100 for getting the percentages of each misconception category. This calculation was done for males and females separately. Figure 4.2 gives us these percentages of the FCI misconception categories scores for male and female students. In that figure, K indicates the 1st misconception category mentioned in Chapter 3 and likewise I, AF, AR, CI, OT, R and G indicate the corresponding misconception categories mentioned in the same chapter. Look back and see instruments section of Chapter 3 to understand and cope with coming figures. When Figure 4.2 was examined, percentages of all misconception categories for females and males are approximately the same. On the other hand, the percentages of misconception category 'Resistance' for males and females were quite higher than the other misconception categories' percentages. That is to say, the students had too many misconceptions in Resistance category.

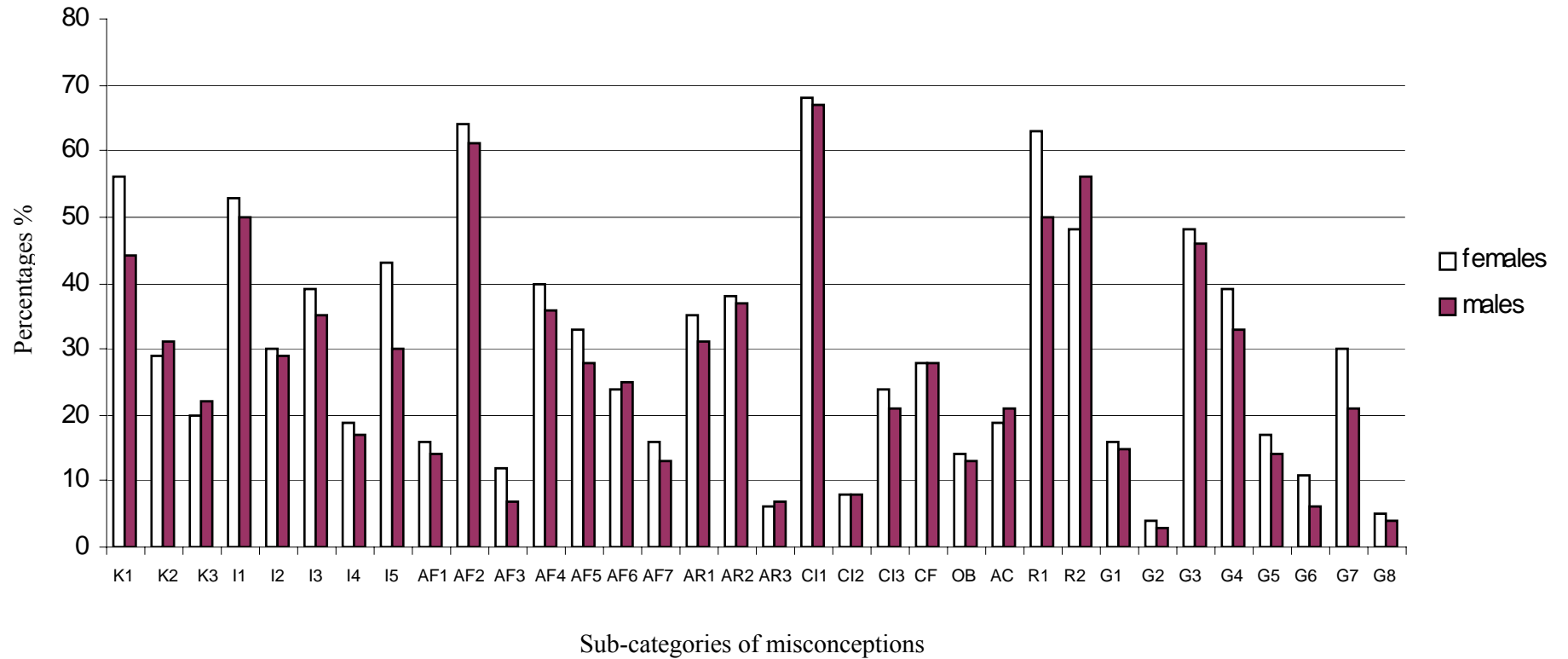


	K	I	AF	AR	CI	OTH	R	G
Males	32	31	27	26	19	20	52	18
Females	33	35	29	27	20	20	58	21

Figure 4.2 Percentages of students for eight categories of misconceptions

Figure 4.3 presents the percentages of 34 different sub-categories of misconceptions for male and female students. When Figure 4.3 examined, percentages of all misconception categories for females and males are approximately the same. On the other hand, there were differences in some misconception percentages across male and female students on the sub-categories. For example, when we look at the misconception sub-categories K1, I5, R1 and G7, there were observable differences in favor of males. In other words; females have more

misconceptions than males in these misconception sub-categories. However, for the misconception sub-category R2, there is a significant difference in favor of female students which means that males have more misconceptions than females in this misconception sub-category.



	K1	K2	K3	I1	I2	I3	I4	I5	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AR1	AR2	AR3	CI1	CI2	CI3	CF	OB	AC	R1	R2	G1	G2	G3	G4	G5	G6	G7	G8
Females	56	29	20	53	30	39	19	43	16	64	12	40	33	24	16	35	38	6	68	8	24	28	14	19	63	48	16	4	48	39	17	11	30	5
Males	44	31	22	50	29	35	17	30	14	61	7	36	28	25	13	31	37	7	67	8	21	28	13	21	50	56	15	3	46	33	14	6	21	4

Figure 4.3 Percentages of students for 34 different sub-categories of misconceptions including FCI questions

4.4 Summary of the Results

- It is easily understood from the average FCI scores that most of the students have misconceptions related to force and motion.
- There is a significant positive correlation between students' attitudes and their misconceptions. For students having positive attitudes toward force and motion, number of misconceptions held in force and motion were lower.
- There is a significant positive correlation between students' experience scores and their misconceptions. For students having more experience about force and motion, number of misconceptions held in force and motion were lower.
- Students' experience related to force and motion did not have a significant effect on students' MBT scores.
- There is a significant positive correlation between students' age and their misconceptions. Most of the older students who had been observed to have less number of misconceptions related to force and motion were in Super High School.
- There is a significant negative correlation between students' age and PAS scores. That is to say, older students have low attitudes about force and motion than younger students.
- Students' experiences about force and motion have a significant effect on PAS scores and positively correlated with.
- There is a significant positive correlation between the type of students' schools and their MBT scores. Students who are going to Normal High Schools have

- lower achievement on force and motion concepts than the students going to Super High Schools and Anatolian High School.
- Students who have higher MBT scores also have less number of misconceptions related to force and motion.
- A gender difference was observed in the PAS, MBT and experience scores. Again the male students have an advantage over female students.
- Significant gender difference on the collective dependent variables of high school students' total FCI scores and their scores on eight misconception categories were observed.
- When the follow up ANOVA results were examined, it was seen that males were better on the total FCI scores and misconception categories of Impetus, Active Force, Resistance and Gravity than females.
- There was no significant difference on the misconception categories of Kinematics, Action/Reaction Pairs, Concatenation of Influences and other Influences on Motion according to the results of ANOVA.
- Significant gender difference on the collective dependent variables of high school students' total FCI scores and their scores on eight misconception categories were observed when students' age, MBT scores, PAS scores, EQFM scores and type of schools were controlled.
- Significant gender difference were observed on the three dependent variables of scores on the total FCI and misconception categories of Impetus and Gravity for the advantages of males while there was no significant difference on the remaining six dependents.

- Comparing ANCOVA results with ANOVA results, significant gender difference were observed on the collective dependent variables of scores on Active Force and Resistance in the ANOVA however, this difference was disappeared when students' age, MBT scores, PAS scores, EQFM scores and type of schools were controlled in the ANCOVA.

4.4.1 Interviews of Students

In order to establish the content validity of the FCI, interviews were carried out with 16 students by the researcher (the selection of these students and interviews were explained in section 3.3.5). These interviews have been able to estimate the probability of misconceptions held by the students, false negatives and false positives.

The answer to a given question is said to be a "false negative" if a Newtonian thinker has chosen a non-Newtonian response. An answer is a "false positive" if a Newtonian response has been chosen for non-Newtonian reasons. The Newtonian response to most questions is so obvious and unproblematic to Newtonian thinkers that false negatives can only be attributed to carelessness or inattention (Halloun & Hestenes, 1995). The researcher confirmed this with the students interviews in this study. The students' remarks were recorded and transcribed. The excerpt below is taken from a student interview who has got low score from the FCI concerning "heavier objects fall faster" misconception. The students who choose distracter D in Item 2 is fall on this misconception.

Researcher: " Why did you chose "D" in this item?"

Student: "I think the same as the previous item. Because, as for me heavier objects fall faster. There is not any definiteness but I think it will fall faster because of its' weight".

The other misconceptions about force and motion were determined like this misconception mentioned above.

CHAPTER 5

CONCLUSIONS, DISCUSSION AND IMPLICATIONS

This chapter is divided into six subsections. Conclusions are given in the first subsection. The second subsection presents the discussion of the results. In the third and fourth subsection internal and external validities of the study are given; respectively. Next, implications are presented. Finally, the last section presents recommendations for further research studies.

5.1 Conclusions

As previously mentioned the sample of the study chosen from the accessible population which was a large randomized and stratified one. Hence, there is no limitation about the generalizability of this study to the target population.

It is expected that male students had fewer misconceptions than female students. The results of this study generally supported the findings of the literature as female students have significantly more misconceptions than male students in mechanics. However, the statistical analyses done also indicated something different. Gender difference were observed only on total misconception scores in the related literature. On the other hand, in this study categories of misconceptions were additionally observed but significant gender differences among male and female

students were observed only on the misconception categories of Impetus, Gravity, Active Force and Resistance in the ANOVA. Furthermore, the gender difference on the misconception categories of Active force and Resistance were disappeared when the covariates were controlled in the ANCOVA.

Besides, the findings of this research supported the findings of the literature that more experienced students have lower misconceptions in mechanics than lower experienced students. Student experiences about force and motion created an effect on students' mechanics achievement.

Moreover, results of this study showed that actually significant gender difference on scores concerning force and motion partially seemed to be appear because of the effects of age, attitude, mechanics achievement, experience and school type.

5.2 Discussion of Results

In comparing the results of this research with those of the previous studies, this research supports most of the findings of the previous studies. For instance, as can be seen from the basic descriptive statistics of achievement scores, most of the students have misconceptions related to force and motion. Moreover, the percentages of students' misconceptions are relatively similar to the results of previous studies (Hestenes et al., 1992; Eryılmaz, 1992; 2002).

The findings of this research is in agreement with that of Eryılmaz's (1992 ; 2002) studies, that male students have fewer misconceptions than female students in mechanics. Moreover, in this study when the categories of misconceptions identified

in detailed the gender difference couldn't have been found on all of the categories of misconceptions in force and motion. The gender difference was observed on the total FCI scores and misconception categories of Impetus, Active Force, Resistance and Gravity. The difference on Active Force and Resistance was disappeared when the covariates were controlled.

Hestenes et al. (1992) reports that the students' mechanics achievement scores were lower than their misconception scores. Different from Hestenes et al., we found that the students' misconception scores are lower than their mechanics achievement scores. The reason for this result should be that the students were better on formula based knowledge than the conceptual based knowledge.

From the articles reviewed the most appropriate to our study is the study of (Sencar, 2001). Sencar (2001) aimed to identify possible gender differences among different categories of misconceptions concerning simple electric circuits. In our study we aimed to identify the effect of gender on different categories of misconceptions concerning force and motion. Sencar performed her study by using 1678 high school students. She had six independent variables as gender, interest, experience, age, occupation of mother and father. At the end she found that observed gender differences on the collective dependent variables of scores on some items in favor of males were disappeared while controlling students' age and interest-experience scores. Similar results were obtained from this study. She concluded that experience create gender difference on students' scores. The findings of this study support her findings. Moreover, we have found that students' attitudes and mechanics achievements create gender difference on their misconception scores.

Data also were analyzed by using MANOVA and MANCOVA as did by Sencar in her work. In addition to these analyses, Mann Whitney U test was also used to investigate the effect of gender on different categories of misconceptions. Both parametric and nonparametric analyses gave the same results.

5.2.1 Internal Validity of the Study

Internal validity of the study is the degree to which extraneous variables may influence the results of research. Possible threats to internal validity and the methods used to cope with them are discussed in this section.

There are two weaknesses in causal comparative research: lack of randomization and inability to manipulate independent variable. Since the groups are already formed, random assignment of subjects to groups is not possible in that kind of research. Therefore, the major threat to the internal validity of a causal comparative study is subject characteristics threat. In this study not the individuals but the groups were randomly selected, therefore many subject characteristics (prior knowledge, age, attitude, gender) might affect results of the study. To be able to cope with this threat, students' ages, experiences, attitudes were all considered as possible subject characteristics and assessed with the questionnaire.

The tests were administered to all groups in similar conditions by the researcher. Due to this, location and instrumentation threat can not be a threat to the study. Maturation could not be a threat to the study since students' ages were included as a covariate in the analysis.

Finally, confidentiality was not a problem in this study since characteristics and names of students were not used anywhere. Their names were taken for the sake of statistical analysis.

5.2.2 External Validity

Subjects of the study were randomly selected from the accessible population consist of 651 tenth grade students. Therefore, generalization of this study's findings has not any limitation. So the results and conclusions found in this study can easily be applied to target population.

Since all testing procedure took place in ordinary classrooms during regular class time there were possibly no remarkable differences among the environmental conditions. Therefore, the researcher believes that external effects were sufficiently controlled by the settings used in the study.

5.3 Implications

According to the findings of this study and the previous studies done following implications can be offered:

1. For aiding students' conceptual understanding through instruction every educator should be aware of students' background, daily life experiences and differences in type of activities that has an important role on their preconceptions.
2. For promoting females performance and positive attitudes in physics, teachers should encourage girls to set meaningful learning goals and help students

understand their attributions by creating both female and male oriented teaching instruction.

3. As can be seen from the interviews of the students, teacher-student interactions and also use of laboratory materials should be improved, in order to get students acquire usefull knowledge related to real life by effective and permanent methods.
4. Teachers should spend more time to produce more conceptual talk about conceptually challenging topics that students describe their own views and ideas about a variety of phenomena.
5. As can be seen from the results of the study, overall scores does not reveal the facts every time. Although males were seen as advantageous over females on total scores, this advantageous couldn't be seen on all of the misconception categories.
6. The physics lessons should be organized to enable students' conceptual learning instead of rote learning and supplied with experiments and activities that student can perform and learn concepts by doing themselves.
7. Different instructional technics are needed to apply by taking into consideration of students' misconceptions for gaining comprehension learning in physics.

5.4 Recommendations for Further Research

This study suggested different issues for future studies. These are briefly as follows:

1. Not only age, experiences, attitudes and school types but also many other variables (text context, mathematics background, learning styles, etc) may affect

gender difference on students' misconceptions and achievement in force and motion.

Future research could investigate the effect of gender on students' misconceptions by controlling different variables.

2. Future research could perform a replication of this study using different physics topics.
3. For different grade levels, students' misconceptions can be investigated and detected using similar design of this study.
4. Future research could not only be interested in the effects of gender but also effects of other variables such as; contextual change, learning style, quality of teacher and instruction on students' misconceptions and achievement in force and motion.
5. According to the suggestions of McCullough (2001; 2002), gender stereotyping pictures concerning force and motion concepts could be improved for both boys and girls.

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APPENDIX A

KUVVET VE HAREKET BAŞARI TESTİ

Bu test 30 çoktan seçmeli sorudan oluşmaktadır ve öğrencilerin kuvvet ve hareket konularındaki kavramsal başarılarını ölçmek için hazırlanmıştır. Bu test yurtdışında hazırlanmış olup birçok lise ve üniversite öğrencilerinin başarılarını ölçmede kullanılmıştır. Lütfen verdiğiniz cevapların sizin yalnızca kişisel görüşlerinizi yansıtmasına dikkat ediniz ve aşağıdaki kurallara uyunuz.

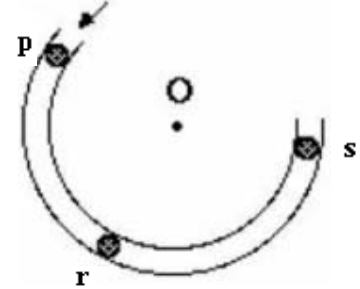
- ◆ Bu testin üzerine kesinlikle hiçbir şey **yazmayınız** veya **işaretlemeyiniz**.
- ◆ Bütün cevaplarınızı **cevap kağıdı** üzerine işaretleyiniz ve isminizi üzerine yazmayı unutmayınız.
- ◆ Her soruda yalnızca bir şık işaretleyiniz.
- ◆ Yanlışlar doğru cevapları götürmeyecektir. Lütfen, bütün sorulara cevap veriniz.
- ◆ Testi 40 dakikada bitirmeyi planlayınız.

Teşekkürler.

- 1) Aynı büyüklükte, birinin ağırlığı diğerinin iki katı olan iki metal top, bir evin çatı katından aynı anda ve aynı yükseklikten serbest bırakılıyor. Topların yere düşme süresi için ne söylenilebilir?
- (A) Ağır top, hafif topun yarı süresinde yere ulaşır.
 (B) Hafif top, ağır topun yarı süresinde yere ulaşır.
 (C) Yaklaşık aynı zamanda yere ulaşırlar.
 (D) Ağır top, hafif topun kesin yarı süresinde değil ama daha önce yere ulaşır.
 (E) Hafif top, ağır topun kesin yarı süresinde değil ama daha önce yere ulaşır.
- 2) Bir önceki problemdeki iki metal top yatay masa üzerinde aynı hızla hareket ederken masadan düşüyor. Bu durumda :
- (A) Her iki top da masanın ayaklarından itibaren yaklaşık aynı yatay uzakta yere çarpar.
 (B) Hafif top, ağır topa oranla, masadan iki kat daha uzakta yere çarpar.
 (C) Ağır top, hafif topa oranla, masadan iki kat daha uzakta yere çarpar.
 (D) Ağır top, hafif topa oranla kesinlikle masaya daha yakın yere çarpar.
 (E) Hafif top, ağır topa oranla kesinlikle masaya daha yakın yere çarpar.
- 3) Tek katlı bir yapının çatısından düşen bir tuğla için, aşağıda söylenenlerin hangisi doğrudur?
- (A) Düşüşünden kısa bir süre sonra en yüksek hızına ulaşır ve yere çarpıncaya kadar bu sabit hızla devam eder.
 (B) Hızını sürekli artırır çünkü yere yaklaştıkça yerçekimi artar.
 (C) Hızını sürekli artırır çünkü ona etkiyen yerçekimi kuvveti sabittir.
 (D) Bütün nesnelere yeryüzünde durma doğal eğiliminden dolayı düşer.
 (E) Yerçekimi ve hava kuvvetlerinin aşağı doğru itmelerinin birleşik etkisinden dolayı düşer.
- 4) Büyük bir kamyon ile ufak bir araba merkezi çarpışma yapıyor. Çarpışma sırasında,
- (A) Kamyon arabaya, arabanın kamyonu uyguladığı kuvvetten daha fazla kuvvet uygular.
 (B) Araba kamyonu, kamyonun arabaya uyguladığı kuvvetten daha fazla kuvvet uygular.
 (C) Birbirlerine herhangi bir kuvvet uygulamazlar, araba kamyonun önüne çıktığından dolayı parçalanır.
 (D) Kamyon arabaya kuvvet uygular, araba kamyonu kuvvet uygulamaz.
 (E) Araba kamyonu, kamyon arabaya aynı büyüklükte kuvvet uygular.

SONRAKİ İKİ SORUYU (5 ve 6) CEVAPLANDIRIRKEN AŞAĞIDAKİ AÇIKLAMAYI VE ŞEKLİ KULLANINIZ.

Yandaki şekil "O" merkezli çemberin bir parçası biçimindeki sürtünmesiz bir tüpü göstermektedir. Tüp, sürtünmesiz yatay bir masa üzerine sabitlenmiştir. Masaya yukarıdan bakılmaktadır. Hava tarafından uygulanan kuvvetler önemsizdir. Bir top yüksek hızla "p" ucundan tüpüne fırlatılır ve "s" ucundan dışarı çıkar.



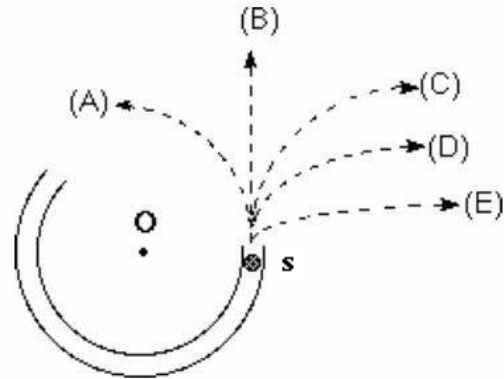
5) Top "r" noktasındayken, aşağıdaki sabit kuvvetleri dikkate alınız.

- 1) Aşağı doğru yerçekimi kuvveti
- 2) "r" den "O" ya doğru tüpün uyguladığı kuvvet
- 3) Topun hareketi doğrultusunda bir kuvvet
- 4) "O" dan "r" ye doğru bir kuvvet

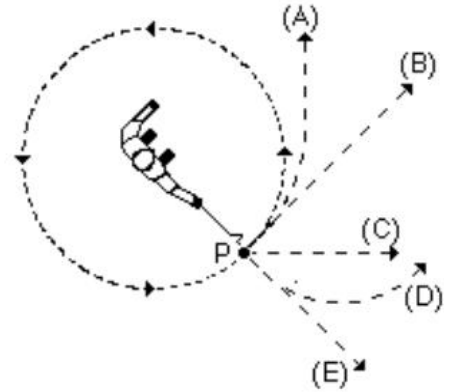
Yukarıdaki kuvvetlerden hangisi(hangileri) top "r" noktasındayken sürtünmesiz tüp içindeki topa etmektedir?

- (A) Yalnız 1 (B) 1 ve 2 (C) 1 ve 3 (D) 1, 2 ve 3
(E) 1, 3 ve 4

6) Sağdaki şekilde top "s" ucunda tüpten çıkıp sürtünmesiz masa üzerinde hareket ederken, hangi yolu izler?



- 7) Çelik bir top ipe bağlanır ve yandaki şekilde görüldüğü gibi yere paralel düzlemde dairesel bir yörüngede döndürülür. Şekilde gösterilen P noktasında ip topun yanından aniden kopmaktadır. Eğer bu olaylar doğrudan doğruya yukarıdan şekildeki gibi gözlenirse, ip koptuktan sonra topun izleyeceği en yakın yol hangisidir?

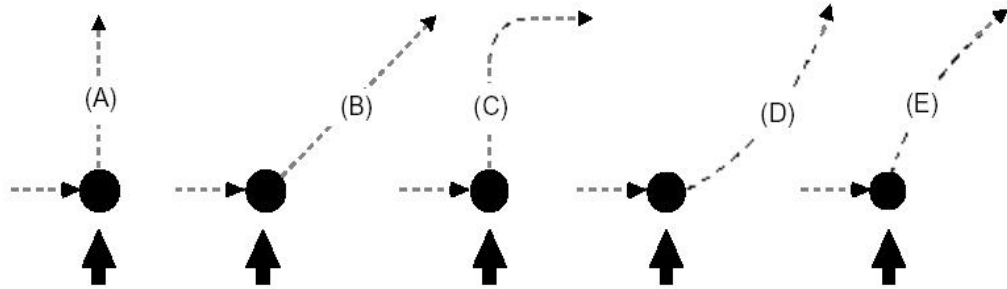


SONRAKİ DÖRT SORUYU (8'DEN 11'E KADAR) CEVAPLANDIRIRKEN AŞAĞIDAKİ AÇIKLAMAYI VE ŞEKLİ KULLANINIZ.

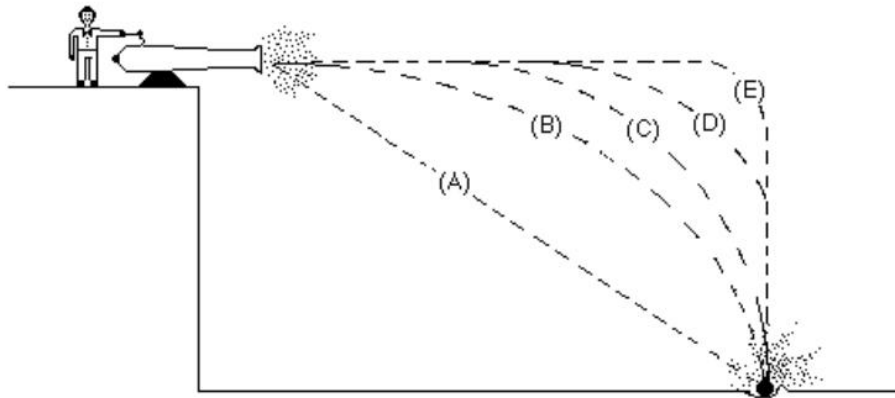
Aşağıdaki şekilde, sürtünmesiz yatay bir düzlemde sabit V_0 hızıyla düz bir çizgi üzerinde "a" noktasından "b" noktasına doğru kaymakta olan bir Hokey diski görülmektedir. Hava tarafından uygulanan kuvvetler önemsizdir. Diske kuşbakışı bakılmaktadır. Disk "b" noktasına ulaştığı anda kalın ok yönünde hızlı bir vuruşa maruz kalır. Eğer disk "b" noktasında hareketsiz olsaydı, vuruş diski vuruş yönünde V_k hızıyla harekete başlatırdı.



- 8) Vuruştan sonra disk, aşağıdaki yollardan hangisini en yakın izleyecektir?



- 9) Vurulduktan hemen sonra diskin hızı:
- (A) Vuruşdan önceki " V_0 " hızına eşittir.
 - (B) Vuruşdan dolayı kazandığı hız " V_k " ya eşittir ve ilk hız " V_0 " dan bağımsızdır.
 - (C) " V_0 " ve " V_k " hızlarının aritmetik toplamına eşittir.
 - (D) Ya " V_0 " yada " V_k " hızından daha küçüktür.
 - (E) Ya " V_0 " yada " V_k " hızından daha büyüktür, ama bu iki hızın aritmetik toplamından daha küçüktür.
- 10) Sekizinci soruda seçmiş olduğunuz sürtünmesiz yolda, diskin vurulduktan sonraki hızı:
- (A) Sabittir.
 - (B) Sürekli artar.
 - (C) Sürekli azalır.
 - (D) Bir süre için artar ve sonra azalır.
 - (E) Bir süre için sabit kalır ve sonra azalır.
- 11) Sekizinci soruda seçmiş olduğunuz sürtünmesiz yolda, vuruşdan sonra diske etkiyen başlıca kuvvet(ler):
- (A) Aşağı doğru yer çekimi kuvvetidir.
 - (B) Aşağı doğru yer çekimi kuvveti ve hareket yönünde yatay bir kuvvettir.
 - (C) Aşağı doğru yer çekimi kuvveti, yukarıya doğru yüzey tarafından etkiyen bir kuvvet ve hareket yönünde yatay bir kuvvettir.
 - (D) Aşağı doğru yer çekimi kuvveti ve yukarıya doğru yüzey tarafından bir kuvvettir.
 - (E) Hiçbiridir. (Cisme hiçbir kuvvet etkimez).
- 12) Aşağıdaki şekilde gösterildiği gibi bir gülle, top tarafından bir uçurumun tepesinden fırlatılıyor. Gülle aşağıdaki yollardan hangisini en yakın izler?

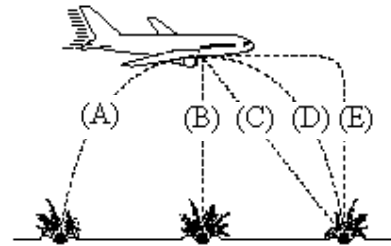


13) Bir çocuk, çelik bir topu, dikey olarak yukarıya doğru fırlatıyor. Topun çocuğun elinden ayrıldıktan sonraki fakat yere değmeden önceki hareketini göz önünde bulundurun ve havanın uyguladığı kuvvetleri ihmal edin. Bu koşullarda, topun üzerine etkiyen kuvvet(ler):

- (A) Aşağıya doğru bir yerçekim kuvveti ile beraber, yukarıya doğru sürekli azalan bir kuvvettir.
- (B) Top, çocuğun elinden çıktıktan sonra tepe noktasına ulaşmaya kadar yukarıya doğru sürekli azalan bir kuvvet; düşerken cisim yere yaklaştıkça sürekli artan yerçekimi kuvvetidir.
- (C) Top, tepe noktasına ulaşana kadar aşağı doğru hemen hemen sabit yer çekimi kuvveti ile beraber yukarıya doğru sürekli azalan bir kuvvet ve düşerken sadece aşağı doğru sabit yerçekimi kuvvetidir.
- (D) Sadece dikey, aşağı doğru, neredeyse sabit yerçekimi kuvvetidir.
- (E) Yukarıdakilerin hiçbiridir. Top, yeryüzü üzerinde, hareketsiz kalma doğal eğilimden dolayı yere düşer.

14) Yere göre yatay olarak uçuşunu sürdüren bir uçağın kargo bölümünden kazara bir cisim düşüyor.

Sağdaki şekilde görüldüğü gibi, yerden bu olayı izleyen bir adam, cisim uçaktan düştükten sonra hangi yolu izlediğini gözler ?



SONRAKİ İKİ SORUYU (15 ve 16) CEVAPLANDIRIRKEN AŞAĞIDAKİ AÇIKLAMAYI VE ŞEKLİ KULLANINIZ.

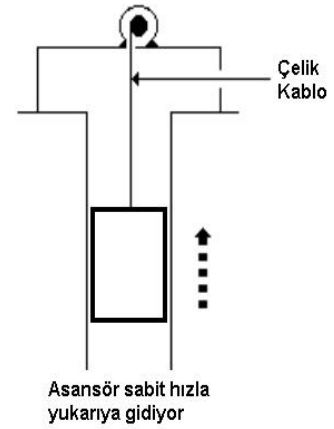
Büyük bir kamyon yolda bozuluyor ve aşağıdaki şekilde görüldüğü gibi bir araba kamyonu arkadan iterek tamirciye ulaştırmaya çalışıyor.



- 15) Kamyonu iten araba sabit hıza ulaşmak için hızlanırken:
- (A) Arabanın kamyonu uyguladığı kuvvet ile kamyonun arabaya karşı uyguladığı kuvvet eşittir.
 - (B) Arabanın kamyonu uyguladığı kuvvet, kamyonun arabaya karşı uyguladığı kuvvetten daha küçüktür.
 - (C) Arabanın kamyonu uyguladığı kuvvet, kamyonun arabaya karşı uyguladığı kuvvetten daha büyüktür.
 - (D) Arabanın motoru çalıştığından dolayı, araba kamyonu iter, ancak kamyonun motoru çalışmadığından dolayı kamyon arabaya karşı bir kuvvet uygulayamaz. Kamyon, arabanın yolunda olduğundan dolayı sadece itilir.
 - (E) Ne araba ne de kamyon birbirlerine kuvvet uygular. Kamyon, arabanın yolunda olduğundan dolayı sadece itilir.

- 16) Araba sürücüsünün kamyonu itmek istediği sabit hıza ulaşıldıktan sonra:
- (A) Arabanın kamyonu uyguladığı kuvvet ile kamyonun arabaya uyguladığı kuvvet eşittir.
- (B) Arabanın kamyonu uyguladığı kuvvet, kamyonun arabaya uyguladığı kuvvetten daha küçüktür.
- (C) Arabanın kamyonu uyguladığı kuvvet, kamyonun arabaya uyguladığı kuvvetten daha büyüktür.
- (D) Arabanın motoru çalıştığından dolayı araba kamyonu iter, ancak kamyonun motoru çalışmadığından dolayı kamyon arabaya karşı bir kuvvet uygulayamaz. Kamyon, arabanın yolunda olduğundan dolayı sadece itilir.
- (E) Ne araba ne de kamyon birbirlerine kuvvet uygular. Kamyon, arabanın yolunda olduğundan dolayı sadece itilir.

- 17) Yandaki şekilde görüldüğü gibi bir asansör, çelik halatlarla sabit bir hızla yukarıya doğru çekiliyor. Tüm sürtünme etkileri önemsizdir. Bu durumda asansöre etkiyen kuvvetler için aşağıdakilerden hangisi söylenebilir?



- (A) Halat tarafından yukarı doğru etkiyen kuvvet, aşağıya doğru olan yer çekimi kuvvetinden daha büyüktür.
- (B) Halat tarafından yukarı doğru etkiyen kuvvet, aşağı doğru etkiyen yer çekimi kuvvetine eşittir.
- (C) Halat tarafından yukarı doğru etkiyen kuvvet, aşağı doğru etkiyen yerçekimi kuvvetinden daha küçüktür.
- (D) Halat tarafından yukarı doğru etkiyen kuvvet, aşağı doğru etkiyen yerçekimi kuvvetiyle, aşağı doğru etkiyen hava basınç kuvvetinin toplamından daha büyüktür.
- (E) Yukarıdakilerin hiçbiri. (Asansör çelik halatlar tarafından üzerine yukarı doğru etkiyen bir kuvvetten değil, halatın kısılmasından dolayı yukarı çıkar).

- 18) Aşağıdaki şekil, A'dan daha yüksek bir noktadan ip üzerinde sallanmaya başlayan bir çocuğu göstermektedir.

Aşağıdaki farklı kuvvetleri dikkate alınız:

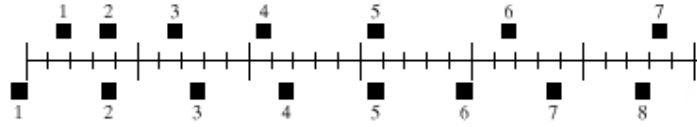
1. Aşağı doğru bir yerçekimi kuvveti.
2. A'dan O'ya doğru ip tarafından uygulanan bir kuvvet.
3. Çocuğun hareketi yönünde bir kuvvet.
4. O'dan A'ya doğru bir kuvvet.

Çocuk A noktasında iken yukarıdaki kuvvetlerden hangisi(hangileri) çocuğa etki eder?



- (A) Yalnız 1 (B) 1 ve 2 (C) 1 ve 3 (D) 1, 2 ve 3 (E) 1, 3 ve 4

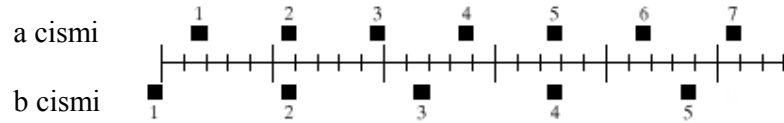
- 19) İki farklı cismin 0,20 saniye aralıklarla konumları aşağıdaki şekilde numaralandırılmış karelerle gösterilmektedir. Cisimler sağa doğru hareket etmektedirler.



Cisimlerin aynı hızda oldukları an var mıdır?

- (A) Hayır (B) Evet, 2. anda (C) Evet, 5. anda (D) Evet, 2.ve 5. anda
(E) Evet, 3. ve 4. anlar arasında

- 20) İki farklı cismin 0,20 saniye aralıklarla konumları aşağıdaki şekilde numaralandırılmış karelerle gösterilmektedir. Cisimler sağa doğru hareket etmektedirler.

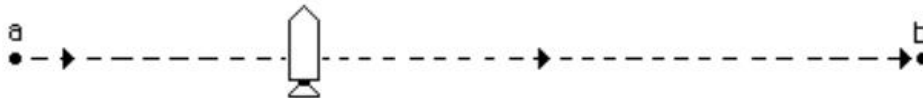


"a" ve "b" cisimlerinin ivmeleri için ne söylenilebilir?

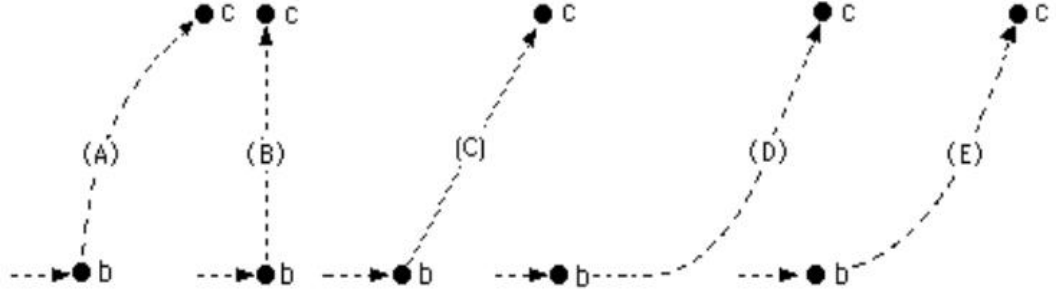
- (A) "a" cisminin ivmesi, "b" cisminin ivmesinden daha büyüktür.
(B) "a" cisminin ivmesi, "b" cisminin ivmesine eşittir ve sıfırdan büyüktür.
(C) "b" cisminin ivmesi, "a" cisminin ivmesinden daha büyüktür.
(D) "a" cisminin ivmesi, "b" cisminin ivmesine eşittir ve sıfırdır.
(E) Bu soruyu cevaplamak için verilenler yetersizdir.

SONRAKİ DÖRT SORUYU (21'DEN 24'E KADAR) CEVAPLANDIRIRKEN AŞAĞIDAKİ AÇIKLAMAYI VE ŞEKLİ KULLANINIZ.

Uzayda "a" noktasından "b" noktasına doğru hareket eden bir roket, aşağıdaki şekilde görülmektedir. Bu hareketi sırasında rokete etkileyen herhangi bir dış kuvvet bulunmamaktadır. "b" noktasından itibaren, roketin motorları çalıştırılıyor ve "ab" çizgisine dik, sabit bir itme (roket üzerindeki kuvvet) oluşuyor. Roket uzaydaki "c" noktasına varana kadar sabit itme sürdürülüyor.



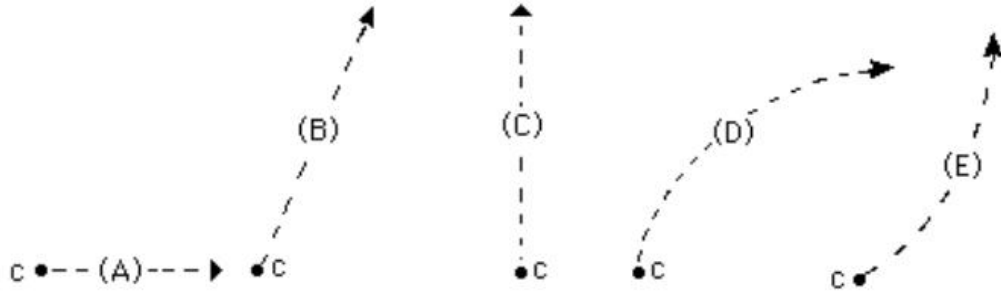
21) Aşağıdaki yollardan hangisi roketin "b" ve "c" noktaları arasındaki izleyeceği yolu en iyi göstermektedir?



22) Roketin "b" noktasından "c" noktasına hareketi boyunca hızı:

- (A) Sabittir.
- (B) Sürekli artar.
- (C) Sürekli azalır.
- (D) Bir süre artar ve sonra sabit kalır.
- (E) Bir süre sabit kalır ve sonra azalır.

23) "c" noktasında roketin motoru durduruluyor ve itme, aniden sıfıra düşüyor. "c" noktasından sonra roketin izleyeceği yolu aşağıdaki yollardan hangisi göstermektedir?



24) "c" noktasından sonra roketin hızı:

- (A) Sabittir.
- (B) Sürekli artar.
- (C) Sürekli azalır.
- (D) Bir süre artar ve sonra sabit kalır.
- (E) Bir süre sabit kalır ve sonra azalır.

- 25) Bir kadın, büyük bir kutu üzerine sabit yatay bir kuvvet uygulamaktadır. Sonuçta, kutu yatay bir zemin boyunca sabit " V_0 " hızı ile hareket ediyor. Kadın tarafından uygulanan sabit yatay kuvvet:
- (A) Kutunun ağırlığıyla aynı büyüklüktedir.
 - (B) Kutunun ağırlığından daha büyüktür.
 - (C) Kutunun hareketine karşı olan toplam kuvvetle aynı büyüklüktedir.
 - (D) Kutunun hareketine karşı koyan toplam kuvvetten daha büyüktür.
 - (E) Ya kutunun ağırlığından ya da kutunun hareketine karşı koyan toplam kuvvetten daha büyüktür.
- 26) Eğer bir önceki sorudaki kadın aynı yatay zemin boyunca kutuyu itmek için uyguladığı sabit yatay kuvveti iki katına çıkartırsa, o zaman kutu:
- (A) Önceki sorudaki " V_0 " hızının iki katı olan sabit bir hızla hareket eder.
 - (B) Önceki sorudaki " V_0 " hızından daha büyük sabit bir hızla hareket eder ancak hız tam iki katı büyüklükte değildir.
 - (C) Belli bir süre, önceki sorudaki " V_0 " hızından daha büyük ve sabit bir hızla hareket eder, sonra gittikçe artan bir hızla hareket eder.
 - (D) Belli bir süre gittikçe artan bir hızla, sonra sabit bir hızla hareket eder.
 - (E) Sürekli olarak artan bir hızla hareket eder.
- 27) 25. sorudaki kadın kutuya yatay kuvvet uygulamayı aniden durdurursa, o zaman kutu :
- (A) Hemen duracaktır.
 - (B) Belli bir süre sabit hızla hareket etmeye devam edip, sonra yavaşlayarak duracaktır.
 - (C) Hemen yavaşlayarak duracaktır.
 - (D) Sabit bir hızla hareket etmeye devam edecektir.
 - (E) Bir süre hızını arttırıp, sonra yavaşlayıp duracaktır.

28) Sağdaki şekilde, "a" öğrencisi 95 kg ve "b" öğrencisi 77 kg'dır. Benzer özdeş ofis sandalyeleri üzerinde karşılıklı oturmaktadırlar.

"a" öğrencisi, çıplak ayaklarını "b" öğrencisinin dizlerine görüldüğü gibi koyar. Sonra "a" öğrencisi, birden ayaklarını ileriye iterek, her iki sandalyenin de hareket etmesini sağlar.

İtme sırasında ve öğrenciler hâlâ birbirlerine değerken:



- (A) Öğrencilerden hiçbiri diğerine kuvvet uygulamaz.
 (B) "a" öğrencisi "b" öğrencisine kuvvet uygular, fakat "b", "a" üzerine hiç kuvvet uygulamaz.
 (C) Her iki öğrenci de birbirine kuvvet uygular, fakat "b" daha fazla kuvvet uygular.
 (D) Her iki öğrenci de birbirine kuvvet uygular, fakat "a" daha fazla kuvvet uygular.
 (E) Her iki öğrenci de birbirine eşit büyüklükte kuvvet uygular.
- 29) Boş bir ofis sandalyesi, bir zeminde hareketsiz durmaktadır. Aşağıdaki kuvvetleri dikkate alınız:
1. Aşağı doğru yer çekimi kuvveti.
 2. Zemin tarafından uygulanan yukarı doğru bir kuvvet.
 3. Hava basıncı tarafından uygulanan aşağı doğru net kuvvet.

Ofis sandalyesine hangi kuvvet(ler) etkimektedir?

- (A) Yalnız 1 (B) 1 ve 2 (C) 2 ve 3 (D) 1, 2 ve 3
 (E) Hiçbiri (Sandalye hareketsiz olduğundan üzerine hiçbir kuvvet etki etmemektedir).
- 30) Çok kuvvetli esen rüzgara rağmen, bir tenis oyuncusu raketiyle tenis topuna vuruyor ve top ağın üzerinden geçerek rakibin sahasına düşüyor. Aşağıdaki kuvvetleri dikkate alınız:

1. Aşağı doğru yer çekimi kuvveti.
2. "Vurmayla" oluşan kuvvet.
3. Hava tarafından uygulanan kuvvet.

Yukarıdaki kuvvetlerden hangisi(hangileri) tenis topunun raketle temasını kaybettikten sonra ve yere değmeden önce tenis topu üzerine etki etmektedir?

- (A) Yalnız 1 (B) 1 ve 2 (C) 1 ve 3 (D) 2 ve 3 (E) 1, 2 ve 3

APPENDIX C

Kuvvet ve Hareket Konularına Karşı Tutum Ölçeği

Sevgili Öğrenci,

Bu anket sizin kuvvet ve hareket konularına karşı tutumlarınızı ölçmek için geliştirilmiştir. Cevaplarınız önümüzdeki yıllarda fizik derslerinin sizin görüşleriniz ve beklentileriniz doğrultusunda şekillenmesine katkıda bulunabileceğinden önem taşımaktadır. Lütfen bütün soruları yanıtlayınız. Bu araştırmada toplanılan tüm bilgiler kesinlikle gizli tutulacaktır.

Her bir cümleyi dikkatle okuduktan sonra, cümleye ne derecede katıldığınızı veya katılmadığınızı belirtmek için yanındaki seçeneklerden birini (X) şeklinde işaretleyiniz.

Adı Soyadı:

DİKKAT!	Kesinlikle Katılıyorum	Katılıyorum	Tarasızım (ortadayım)	Katılmıyorum	Kesinlikle Katılmıyorum
Burada Kuvvet ve Hareket ünitesi içinde yer alan ✓ Kinematik ✓ Newton'un Hareket Kanunları ✓ Yeryüzünde Hareket özellikleri ile ilgili tutum soruları "Kuvvet ve Hareket" adı altında sorulmaktadır.					
1. "Kuvvet ve Hareket" konularını severim.					
2. <i>u</i> konularına karşı olumlu hislerim vardır.					
3. <i>u</i> konularında öğrendiklerimin, hayatımı kolaylaştıracağı düşünüyorum.					
4. <i>u</i> konularının, gelecekte öneminin gittikçe artacağına inanıyorum.					
5. <i>u</i> konularının, ilerideki çalışmalarında bana yararlı olacağını düşünüyorum.					
6. <i>u</i> konularında başarılı olmak için elimden geleni yaparım.					
7. <i>u</i> konularında elimden gelenin en iyisini yapmaya çalışırım.					
8. <i>u</i> konularında başarısız olduğumda daha çok çabalarım.					
9. <i>u</i> konularını öğrenebileceğimden eminim.					
10. <i>u</i> konularında başarılı olabileceğimden eminim.					
11. <i>u</i> konularında zor işleri yapabileceğimden eminim.					
12. <i>u</i> konularında yapılacak iş ne kadar zor olursa olsun, elimden geleni yaparım.					
13. <i>u</i> konularının, ilerideki meslek hayatımda önemli bir yeri olacağını düşünüyorum.					
14. <i>u</i> konularında öğrendiklerimin, gündelik hayatta işime yarayacağını düşünüyorum.					
15. <i>u</i> konuları veya teknolojideki uygulamaları ile ilgili kitaplar okumaktan hoşlanırım.					
16. Fizik topluluğuna üye olmak isterim.					
17. Benim için "kuvvet ve hareket" konuları eğlencelidir.					
18. Okulda "kuvvet ve hareket" konularını çalışmaktan hoşlanırım.					
19. Diğer konulara göre "kuvvet ve hareket" konuları daha ilgi çekicidir.					
20. "Kuvvet ve Hareket" ile ilgili daha zor problemler ile başa çıkabileceğimden eminim.					
21. Okuldan sonra arkadaşlarla "kuvvet ve hareket" konuları hakkında konuşmak zevklidir.					
22. Bana hediye olarak "kuvvet ve hareket" ile ilgili bir kitap veya konu ile ilgili aletler verilmesinden hoşlanırım.					
23. Yeterince vaktim olursa en zor "kuvvet ve hareket" ile ilgili problemleri bile çözebileceğimden eminim.					
24. Arkadaşlarla "kuvvet ve hareket" konuları veya teknolojideki uygulamaları ile ilgili meseleleri konuşmaktan hoşlanırım.					

APPENDIX D

Kuvvet ve Hareket Konuları İle İlgili Tecrübe Anketi

Bu anket kuvvet ve hareket konularındaki tecrübenizi ortaya çıkarmak üzere hazırlanmıştır. Lütfen her soruyu dikkatle okuyup size en uygun seçeneği çarpı (X) işareti ile belirtiniz.

1. Cinsiyetiniz:

Kız

Erkek

2. Doğum tarihiniz: ____ / ____ (ay / yıl)

3. Çocukken hareketli oyuncak ve aletlerle ne kadar ilgilidiniz?.....

Çok İlgiliyim	İlgiliyim	İlgisizim	Çok İlgisizim
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. Şu anda hareketli oyuncak ve aletlerle ne kadar ilgilisiniz?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------	--------------------------

5. Hareketli araç (yada taşıt) kullanmaya ne kadar ilgilisiniz?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Hiç	Ara sıra	Sık Sık
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6. Daha önce ilkokul, ortaokul ya da lisede kuvvet ve hareket ile ilgili deney yaptınız mı ?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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7. Çeşitli araç gereçler kullanarak kuvvet ve hareket konularıyla ilgili bir deney Düzeneği hazırladınız mı?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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8. Daha önce hiç bir araba hareket halindeyken aniden durduğunda sizin ve içindeki insanların hareketini gözlemlediniz mi?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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9. Daha önce hiç buz üzerinde patenle veya kızakla kaydınız mı?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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10. Daha önce hiç yüksek bir yere elinizdeki birşeyi fırlattınız mı?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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11. Her hafta düzenli olarak spor (basketbol,futbol,voleybol,tenis,vb) yapar mısınız?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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12. Daha önce hiç yap-boz ya da logo oynadınız mı?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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13. Kullanma kılavuzunu kullanarak mekanik araçların tamirini yapabilir misiniz?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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14. Daha önce hiç bir araba durgun haldeyken aniden harekete geçtiğinde içindeki insanların ve kendinizin hareketini gözlemlediniz mi?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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15. Daha önce hiç bir ağacın üst dallarına taş veya herhangi birşey fırlattınız mı?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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16. Eve yeni alınan mekanik bir aleti kullanma kılavuzundan yararlanarak kurmayı veya kullanmayı hiç denediniz mi?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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17. Daha önce hiç yokuş yukarı veya yokuş aşağı bisiklet kullandınız mı?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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18. Daha önce hiç ağır bir cismi yerde sürüklemeye çalıştınız mı?.....

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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APPENDIX E

ANSWER KEY

ANSWER KEY FOR KHBT

- 1) C
- 2) A
- 3) C
- 4) E
- 5) B
- 6) B
- 7) B
- 8) B
- 9) E
- 10) A
- 11) D
- 12) B
- 13) D
- 14) D
- 15) A
- 16) A
- 17) B
- 18) B
- 19) E
- 20) D
- 21) E
- 22) B
- 23) B
- 24) A
- 25) C
- 26) E
- 27) C
- 28) E
- 29) B
- 30) C

ANSWER KEY FOR TMBT

- 1) B
- 2) D
- 3) E
- 4) C
- 5) A
- 6) C
- 7) C
- 8) D
- 9) A
- 10) E
- 11) E
- 12) C
- 13) B
- 14) B
- 15) E
- 16) A
- 17) D
- 18) B
- 19) C
- 20) C
- 21) A
- 22) B
- 23) D
- 24) A
- 25) A
- 26) E

APPENDIX F															
RAW DATA															
Std	Gender	Age	Sch.T.	FCI	MBT	EQFM	PAS	K	I	AF	AR	CI	OT	R	G
1	1	195	1	10	10	40	96	1	4	5	3	3	3	1	5
2	1	195	1	5	7	36	73	1	6	5	5	4	2	2	1
3	1	189	1	12	7	44	96	1	6	5	4	1	2	1	4
4	1	195	1	8	5	44	110	2	7	4	2	2	3	3	1
5	1	203	1	7	5	35	107	2	6	5	2	3	2	2	2
6	1	193	1	7	7	42	66	1	7	6	1	3	5	2	3
7	0	195	1	3	5	42	94	2	9	7	3	2	2	3	4
8	1	192	1	9	6	46	95	1	7	4	2	1	2	2	4
9	0	189	1	4	7	41	89	1	9	5	3	3	4	3	3
10	1	191	1	10	7	40	78	2	8	5	0	1	3	1	4
11	0	194	1	5	6	35	86	1	6	5	0	1	1	1	2
12	0	190	1	6	6	38	89	2	6	5	3	2	1	3	3
13	0	190	1	3	7	30	89	2	7	5	4	1	3	2	6
14	0	195	1	6	9	41	101	2	8	5	1	1	6	1	5
15	0	191	1	9	6	39	94	2	7	4	1	3	1	2	2
16	0	194	1	8	10	42	103	2	5	4	2	5	0	2	4
17	0	192	1	7	12	43	89	2	5	5	4	3	1	3	5
18	0	195	1	5	4	32	96	0	7	4	4	4	0	3	4
19	1	196	1	5	7	43	102	2	6	8	3	3	3	3	5
20	0	183	1	4	6	29	74	2	6	5	2	4	3	2	6
21	0	189	1	4	6	34	94	1	7	6	0	4	4	3	5
22	0	188	1	6	7	33	84	2	6	6	0	1	3	1	4
23	0	188	1	5	7	39	84	1	9	5	0	1	4	3	6
24	1	187	1	12	9	29	95	2	3	3	2	4	0	1	2
25	0	195	1	3	7	33	56	2	6	7	3	3	1	3	5
26	1	193	1	6	5	36	84	1	9	4	4	2	2	2	5
27	1	186	1	11	7	41	108	3	7	4	3	1	0	3	0
28	0	189	1	5	1	42	87	1	7	6	4	4	1	2	6
29	1	190	1	7	9	45	111	1	7	5	1	3	4	3	2
30	1	196	1	5	11	36	91	1	9	5	5	2	1	0	4
31	0	195	1	1	5	36	91	1	11	5	3	2	4	3	4
32	0	194	1	7	5	38	83	1	7	6	1	2	2	3	5
33	1	190	1	14	13	36	103	3	3	5	2	3	1	0	1
34	1	199	1	9	8	42	106	2	6	4	2	2	3	3	1
35	1	189	1	4	6	41	87	1	10	5	4	3	2	2	4
36	0	186	1	5	5	39	91	1	6	5	4	1	1	3	4
37	1	204	1	6	10	45	80	3	6	5	4	1	1	1	5
38	0	185	1	3	14	35	96	2	10	5	3	0	2	1	6
39	1	187	1	6	9	41	101	2	8	5	3	1	2	2	5
40	0	192	1	3	7	38	87	1	12	3	4	1	1	2	6
41	0	195	1	6	3	32	88	1	8	6	3	1	0	3	6
42	1	194	1	8	8	46	90	1	6	6	5	3	2	2	3

43	0	183	1	9	3	36	80	2	6	3	2	2	2	2	3
44	0	195	1	6	7	35	69	2	5	5	5	3	0	3	5
45	0	185	1	11	13	37	82	0	7	5	3	2	1	0	4
46	0	193	1	2	4	31	92	2	7	5	3	4	4	2	6
47	0	193	1	4	6	36	90	3	4	6	4	2	2	3	6
48	0	187	1	5	3	39	100	1	8	3	4	4	3	2	5
49	1	184	1	7	8	35	85	1	6	6	4	3	3	2	3
50	1	189	1	8	3	41	80	2	5	4	4	2	3	3	4
51	1	188	1	3	6	43	95	1	9	6	4	2	1	3	5
52	1	185	1	3	5	46	85	2	9	4	3	2	2	1	7
53	0	186	1	3	2	36	72	1	6	9	0	2	5	2	6
54	0	198	1	5	6	42	79	1	7	7	3	1	2	2	2
55	0	190	1	3	7	38	90	2	8	7	4	2	1	3	5
56	1	186	1	10	6	43	74	1	3	6	2	4	1	2	5
57	1	191	1	10	9	41	97	2	5	4	3	1	1	2	2
58	1	192	1	3	9	36	88	1	7	8	1	4	0	1	4
59	1	192	1	8	5	42	85	3	10	3	4	1	1	1	6
60	1	197	1	10	7	39	86	1	5	4	3	2	1	0	3
61	1	190	1	4	2	34	88	1	8	7	3	3	5	1	3
62	1	186	1	9	7	40	85	2	7	5	0	3	2	2	5
63	1	199	1	8	6	36	71	0	3	8	5	2	1	2	4
64	0	195	1	8	5	43	96	1	7	4	4	3	2	2	2
65	1	189	1	5	8	48	84	1	7	4	5	4	1	3	2
66	1	192	1	5	6	32	88	1	9	6	2	3	2	1	4
67	1	192	1	10	12	38	92	1	5	3	4	3	2	2	5
68	1	199	1	5	6	37	76	2	8	6	1	2	1	2	4
69	1	193	1	16	12	48	79	0	5	3	4	2	3	1	2
70	1	191	1	10	8	36	60	0	5	4	3	4	1	1	3
71	1	207	1	9	6	33	97	1	3	5	2	3	2	2	3
72	1	186	1	8	6	44	78	1	7	5	2	3	1	2	4
73	1	192	1	10	7	42	77	3	5	3	2	3	3	1	4
74	1	191	1	3	5	40	84	1	6	8	1	2	4	1	6
75	1	195	1	8	6	37	92	1	8	3	4	2	3	1	2
76	1	203	1	14	6	42	46	1	5	5	3	1	3	1	2
77	1	191	1	3	4	45	84	3	9	5	3	2	0	2	5
78	0	197	1	2	8	38	84	1	10	3	5	3	1	3	2
79	1	197	1	9	6	26	73	2	8	5	2	0	2	0	3
80	1	198	1	8	5	41	71	1	5	4	4	3	2	2	4
81	1	189	1	8	9	45	72	3	9	5	1	0	0	1	4
82	1	206	1	6	5	41	57	1	5	5	2	3	1	2	2
83	1	185	1	5	7	38	73	1	6	5	3	4	1	2	4
84	1	197	1	9	4	38	99	2	7	6	1	1	1	2	2
85	1	197	1	2	7	33	99	2	10	5	2	0	4	3	6
86	1	188	1	4	7	36	97	2	10	3	2	0	2	3	6
87	1	190	1	8	7	41	99	1	7	6	0	1	3	3	3
88	0	186	1	8	8	34	93	2	9	7	0	1	2	3	2
89	1	195	1	3	6	30	73	2	8	5	4	1	2	2	3
90	1	190	1	4	7	38	87	1	7	8	2	4	3	2	2
91	1	188	1	8	7	31	106	1	7	5	2	2	1	1	2
92	0	194	1	7	9	41	88	2	6	4	3	3	2	1	3

93	1	188	1	7	6	36	60	1	9	6	4	1	0	3	2
94	1	192	1	4	6	44	75	2	8	5	2	1	1	3	5
95	1	185	1	4	7	30	68	2	7	6	4	2	0	2	5
96	1	194	1	7	9	35	88	2	3	6	3	1	2	2	2
97	1	202	1	12	6	43	102	1	5	3	5	2	1	1	1
98	1	190	1	10	7	37	70	1	5	5	3	1	3	1	3
99	1	190	1	5	5	41	69	1	6	7	3	3	4	2	2
100	1	187	1	14	10	38	97	1	8	4	1	0	0	0	2
101	1	219	1	13	9	38	98	1	8	3	1	1	0	1	2
102	0	181	1	6	9	39	103	1	9	8	1	1	0	2	4
103	1	194	1	13	9	38	88	2	3	5	0	3	2	2	5
104	1	188	1	8	7	41	81	1	10	5	2	0	3	2	2
105	1	196	1	12	6	41	71	1	5	3	1	2	0	0	3
106	0	186	1	5	8	41	80	0	10	5	5	1	2	2	3
107	0	203	1	1	4	38	85	2	9	5	4	3	1	3	5
108	0	191	1	6	6	37	88	1	3	6	2	3	4	1	4
109	1	189	1	8	4	46	98	1	6	4	4	1	2	0	1
110	0	191	1	6	9	33	87	2	9	3	5	2	0	2	5
111	1	195	1	4	8	41	81	1	7	5	3	3	0	1	5
112	1	198	1	3	6	36	82	1	8	4	4	3	4	3	3
113	1	195	1	6	8	38	83	2	6	7	2	3	4	2	2
114	0	189	1	5	5	34	71	1	6	7	2	3	5	2	6
115	0	187	1	8	2	37	72	3	6	5	2	4	1	2	1
116	1	184	1	12	6	42	94	0	4	5	4	4	3	0	2
117	1	194	1	7	8	49	111	1	6	4	3	2	0	2	3
118	1	194	1	8	9	42	100	1	9	2	2	1	1	0	4
119	0	187	1	9	9	32	76	0	3	7	3	1	4	2	4
120	1	191	1	18	13	46	104	2	2	3	1	1	5	0	1
121	0	183	1	3	9	35	87	3	9	5	3	2	1	2	4
122	0	186	1	17	9	40	110	2	4	2	1	1	0	0	2
123	0	201	1	11	8	43	103	1	6	4	1	1	6	1	4
124	1	202	1	16	13	42	87	1	4	3	2	2	4	0	3
125	0	204	1	11	12	39	68	0	7	3	4	2	3	1	1
126	0	204	1	17	11	35	60	0	6	3	3	2	2	0	0
127	1	200	1	21	18	35	64	0	4	3	2	0	0	0	1
128	1	197	1	14	14	37	76	0	4	5	0	3	4	1	4
129	0	206	1	9	13	45	104	2	5	4	5	2	0	0	3
130	1	209	1	16	20	39	104	0	3	3	4	3	1	2	1
131	1	206	1	14	20	34	73	1	5	4	1	1	3	0	3
132	1	197	1	11	13	45	86	3	4	6	4	1	1	1	3
133	1	207	1	14	13	35	68	0	6	2	4	2	2	1	1
134	1	196	1	17	16	41	88	0	3	2	4	2	2	2	1
135	1	204	1	19	10	37	46	0	3	4	3	0	3	1	0
136	1	201	1	12	18	41	100	1	9	3	2	0	0	2	2
137	1	205	1	23	17	46	106	0	3	3	1	0	1	0	3
138	1	200	1	17	10	42	99	0	0	4	2	2	1	1	1
139	1	195	1	13	19	48	86	1	7	5	4	1	2	0	1
140	1	207	1	14	15	36	83	0	4	5	3	1	2	1	2
141	0	197	1	12	12	46	94	0	9	5	5	0	3	2	0
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143	0	201	1	12	17	39	99	1	6	4	4	1	3	0	1
144	0	200	1	15	11	46	62	2	4	5	0	1	2	1	3
145	1	198	1	17	12	41	89	0	6	3	3	2	2	0	0
146	0	209	1	11	12	39	78	2	7	4	1	1	2	3	3
147	0	202	1	13	14	39	79	2	5	5	1	3	3	1	2
148	1	190	1	17	21	43	109	0	6	4	1	2	2	0	2
149	0	204	1	13	10	36	95	2	7	3	2	2	1	1	3
150	0	207	1	9	9	45	86	1	8	4	5	2	3	2	0
151	0	203	1	12	13	41	94	0	7	4	3	1	0	3	1
152	1	202	1	13	11	49	35	1	6	3	4	0	1	2	4
153	1	203	1	14	15	46	96	0	4	5	3	3	4	2	1
154	1	211	1	8	6	43	92	1	6	7	3	2	4	2	2
155	1	207	1	20	15	43	88	0	3	3	0	1	0	2	0
156	1	203	1	9	9	46	83	1	5	4	1	3	4	2	2
157	1	204	1	10	11	35	67	1	6	6	1	2	2	0	3
158	1	188	1	18	12	46	84	0	5	4	1	1	2	1	2
159	1	207	1	7	6	45	101	0	6	4	3	1	1	1	1
160	0	206	1	10	11	29	78	1	10	6	2	2	4	1	4
161	1	201	1	11	7	32	73	1	6	2	4	1	2	3	1
162	1	214	1	14	10	40	102	2	2	4	3	2	1	0	6
163	0	207	1	9	5	36	68	1	6	6	4	1	3	1	5
164	1	210	1	15	8	47	80	2	6	4	2	2	1	1	0
165	1	207	1	9	10	37	51	0	8	7	3	2	0	3	2
166	0	201	1	6	9	35	64	1	6	6	5	3	3	3	4
167	1	199	1	20	12	39	91	1	4	1	1	1	0	0	4
168	1	201	1	7	8	39	84	1	9	7	2	2	0	3	0
169	1	197	1	10	9	43	106	1	7	6	3	2	3	2	3
170	0	184	1	14	15	45	77	1	4	6	1	1	3	2	3
171	1	206	1	14	12	40	112	2	5	4	0	1	2	2	1
172	1	192	1	6	11	28	77	2	7	4	4	4	3	1	4
173	1	206	1	10	7	38	82	3	4	5	2	4	1	1	2
174	0	201	1	7	10	42	67	3	6	6	3	1	5	1	6
175	0	204	1	14	16	41	85	1	8	3	1	2	0	1	1
176	0	200	1	6	6	46	88	2	9	5	5	1	0	3	4
177	0	207	1	7	11	36	76	2	7	6	2	3	1	0	4
178	0	202	1	9	8	27	75	2	10	4	3	0	0	0	4
179	1	213	1	15	9	43	82	0	7	2	1	1	4	2	1
180	0	213	1	6	7	45	87	2	9	6	5	0	0	3	4
181	1	207	1	26	18	46	120	0	1	0	1	1	0	0	1
182	1	203	1	15	10	39	80	1	5	5	1	1	2	1	1
183	1	201	2	11	8	46	80	0	6	4	6	2	2	2	1
184	1	199	2	14	12	45	98	1	6	6	0	1	3	2	1
185	1	200	2	10	12	40	99	1	6	6	2	2	5	2	1
186	1	191	2	13	11	41	86	0	5	5	3	1	4	2	6
187	1	195	2	12	11	36	91	1	7	5	1	2	4	2	1
188	0	204	2	9	7	43	94	1	5	5	2	1	5	3	5
189	1	205	2	10	6	34	67	1	7	5	3	2	2	2	2
190	0	202	2	15	7	35	84	2	4	3	1	4	2	2	0
191	0	202	2	11	7	35	84	2	5	4	1	3	2	2	2
192	0	185	2	7	9	44	76	2	7	4	4	2	1	1	7

193	0	205	2	6	8	34	44	1	6	4	5	3	1	2	4
194	1	197	2	8	10	36	100	1	8	5	4	1	2	2	4
195	0	200	2	6	8	36	64	2	7	6	1	3	2	2	6
196	1	207	2	15	11	40	98	1	7	6	0	1	2	1	1
197	0	197	2	4	5	40	62	2	8	5	4	3	2	1	4
198	1	200	2	3	8	37	74	2	11	3	3	0	3	3	5
199	0	204	2	12	6	43	106	1	6	4	0	1	4	2	4
200	1	207	2	6	8	34	73	1	9	6	4	1	2	2	5
201	0	201	2	4	5	34	55	1	8	4	4	1	3	1	6
202	1	202	2	10	11	34	88	3	9	5	1	1	3	1	4
203	1	207	2	16	14	42	82	2	3	3	2	1	0	1	2
204	1	207	2	16	12	43	88	1	4	1	3	2	0	2	1
205	1	207	2	10	7	46	82	2	4	3	2	1	2	2	4
206	0	196	2	4	5	44	65	1	7	6	4	3	2	2	4
207	0	201	2	8	8	38	85	2	6	2	4	3	3	1	6
208	0	207	2	5	4	39	59	1	8	5	4	2	2	2	7
209	0	201	2	3	8	36	59	3	7	7	4	3	1	2	6
210	0	200	2	6	9	34	73	2	7	6	3	3	1	1	3
211	0	200	2	4	7	41	47	2	9	6	3	2	2	2	4
212	0	201	2	8	10	41	68	1	2	7	2	3	1	2	4
213	1	197	2	12	11	40	87	2	4	5	3	2	2	0	1
214	1	201	2	5	9	34	66	1	9	6	5	1	2	1	7
215	1	200	2	8	10	42	73	2	3	7	1	2	4	3	5
216	1	204	2	10	5	33	60	2	10	3	0	1	3	2	4
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218	0	205	2	5	3	33	86	1	6	6	4	3	2	1	6
219	0	205	2	3	7	30	31	3	7	5	5	2	3	1	6
220	0	200	2	7	4	36	68	0	7	6	4	3	2	1	5
221	0	190	2	5	4	32	72	0	8	8	3	2	2	1	8
222	0	200	2	5	5	38	45	0	7	7	4	3	2	1	6
223	0	204	2	14	9	36	80	2	4	4	1	4	1	1	2
224	1	196	2	7	7	40	77	1	10	3	4	2	3	0	6
225	1	202	2	12	13	37	98	0	6	3	5	1	1	2	2
226	0	204	2	7	8	35	32	1	8	6	0	2	2	2	3
227	1	203	2	8	7	39	67	1	8	4	3	2	3	2	4
228	0	213	2	4	3	41	78	2	9	5	3	2	1	2	6
229	1	197	2	12	11	30	109	1	6	5	2	2	4	1	1
230	1	202	2	14	8	40	89	1	5	6	2	0	2	3	2
231	1	198	2	8	10	40	99	1	8	6	4	1	2	1	2
232	0	203	2	5	11	37	42	0	7	7	4	3	3	1	8
233	1	205	2	9	11	45	109	0	8	4	4	1	2	3	2
234	0	201	2	4	9	33	55	0	11	7	2	2	1	3	3
235	0	191	2	8	8	39	67	2	7	8	3	1	3	1	3
236	1	201	2	5	10	42	79	2	10	4	3	3	2	3	1
237	1	200	2	9	6	38	63	1	6	3	3	2	0	2	4
238	0	203	2	3	8	29	48	2	7	6	2	2	3	2	7
239	0	203	2	6	9	39	89	2	9	6	3	0	3	2	4
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241	1	190	2	6	11	40	76	2	8	5	3	1	4	1	2
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245	0	201	2	5	6	31	58	1	7	5	2	2	4	1	5
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253	1	202	2	11	5	36	66	1	9	5	0	1	2	2	1
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257	1	200	2	7	6	41	73	2	7	4	0	0	3	1	5
258	1	207	2	9	11	43	71	2	6	5	2	2	1	2	6
259	0	205	2	4	7	42	90	1	9	4	4	3	2	3	4
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263	0	207	2	12	6	32	77	2	6	3	0	1	1	1	1
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265	0	199	2	5	7	35	73	0	9	6	4	1	4	3	4
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272	1	208	2	12	9	43	45	1	3	7	2	1	2	3	3
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279	0	200	2	8	4	33	88	1	5	6	3	2	3	1	3
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281	0	200	2	3	9	32	82	2	8	8	1	3	5	2	4
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283	0	199	2	12	7	45	111	0	6	5	5	3	2	2	3
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285	0	198	2	9	6	36	78	0	9	4	4	1	1	1	4
286	1	201	2	8	11	41	102	2	8	4	4	0	1	1	3
287	0	197	2	4	3	37	100	1	8	6	4	2	3	2	3
288	1	196	2	16	3	27	106	1	4	4	4	0	0	2	0
289	1	205	2	11	6	35	84	1	8	6	0	2	3	1	0
290	0	200	2	10	4	39	110	0	10	3	2	1	2	2	1
291	1	199	2	5	8	41	70	1	5	6	4	4	3	3	2
292	0	198	2	7	3	44	45	1	9	3	3	2	0	1	1

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295	1	203	2	5	12	47	85	1	10	5	3	2	1	3	3
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297	0	203	2	8	5	33	71	0	6	4	4	2	3	3	3
298	0	191	2	9	11	40	80	2	9	3	1	2	1	3	3
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300	1	199	2	12	11	33	74	1	6	2	5	1	1	2	0
301	0	202	2	3	4	43	63	1	8	6	3	3	1	2	4
302	1	201	2	9	7	34	58	3	7	5	3	3	2	1	0
303	0	207	2	7	13	41	80	1	8	6	3	3	2	2	4
304	1	207	2	7	5	39	91	0	8	3	4	4	3	2	5
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307	0	201	2	7	9	44	59	1	7	5	4	3	3	3	3
308	0	201	2	2	8	34	72	2	8	7	3	2	3	2	6
309	0	201	2	4	10	39	68	1	8	7	0	2	3	3	4
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313	1	205	2	9	14	40	86	1	8	4	3	2	0	2	2
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315	0	196	2	6	11	30	71	1	7	7	1	2	1	2	2
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317	1	201	2	22	9	44	88	1	3	2	1	0	0	0	0
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319	1	195	2	10	5	36	72	1	6	3	1	2	1	2	1
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321	1	202	2	10	11	36	79	3	5	4	4	3	4	1	1
322	1	197	2	5	4	39	54	1	10	5	2	3	1	2	4
323	1	207	3	13	22	33	83	0	7	2	1	2	0	2	2
324	0	195	3	7	15	43	110	1	6	4	4	3	0	2	6
325	1	204	3	10	23	39	69	0	6	6	2	3	2	3	4
326	1	207	3	9	23	44	96	1	7	5	4	1	2	2	4
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329	1	202	3	21	25	40	100	0	2	4	0	1	4	0	2
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331	1	198	3	14	16	48	102	0	5	6	3	1	2	0	5
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334	0	215	3	21	25	37	98	0	2	4	3	1	3	0	1
335	1	207	3	14	22	42	68	0	8	3	1	0	2	1	2
336	1	184	3	13	22	39	67	1	5	4	5	1	1	1	2
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338	1	203	3	8	22	43	74	1	7	5	4	1	3	2	5
339	0	207	3	10	22	39	68	0	6	7	1	3	2	3	5
340	1	199	3	12	23	38	97	0	5	6	0	1	4	2	5
341	1	214	3	24	25	42	73	0	0	2	4	1	1	0	0
342	0	209	3	18	25	35	66	0	4	5	1	1	4	1	1

343	1	205	3	18	22	43	82	1	3	3	1	3	2	0	4
344	1	200	3	7	20	35	57	1	7	4	3	1	3	2	6
345	1	205	3	8	20	41	82	1	7	7	1	2	2	1	3
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347	0	183	3	22	15	38	93	0	4	1	1	1	1	0	1
348	1	186	3	24	21	42	108	1	3	1	1	0	1	0	0
349	0	198	3	15	14	29	78	1	6	2	0	0	0	0	3
350	0	191	3	12	11	36	88	0	4	5	3	4	0	0	4
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353	0	186	3	14	15	39	83	2	6	3	1	1	1	2	0
354	1	189	3	14	14	41	88	0	5	4	5	1	4	0	2
355	0	174	3	19	16	41	112	0	6	3	1	1	1	1	0
356	0	192	3	16	15	30	88	1	4	2	1	1	1	0	4
357	0	207	3	13	11	43	63	2	3	6	1	2	3	1	3
358	0	195	3	12	14	41	83	0	9	2	4	1	2	0	2
359	0	199	3	17	14	38	90	1	7	3	0	0	0	0	1
360	1	190	3	16	8	46	87	2	3	6	0	1	2	0	5
361	1	193	3	17	15	31	94	0	6	4	0	2	1	0	1
362	0	205	3	10	8	37	82	1	6	4	4	4	1	2	1
363	0	207	3	16	10	38	85	0	4	5	0	3	3	0	1
364	0	198	3	24	23	37	82	1	0	0	1	3	0	0	0
365	0	184	3	19	12	45	81	0	3	3	3	1	2	1	1
366	1	191	3	27	21	36	87	0	0	1	1	0	0	0	1
367	1	194	3	26	14	51	80	0	1	2	0	0	1	1	1
368	0	199	3	19	16	35	97	1	4	1	0	2	0	1	3
369	1	189	3	23	19	43	115	2	1	1	1	2	0	1	0
370	0	195	3	6	11	34	98	2	7	5	4	3	3	3	2
371	0	193	3	15	17	47	112	1	6	6	1	0	1	1	1
372	1	205	3	21	18	41	98	0	3	3	1	2	0	0	0
373	1	191	3	13	14	41	100	0	7	6	2	1	2	1	1
374	1	189	3	22	18	47	109	0	2	1	3	2	1	0	2
375	1	191	1	14	13	43	112	2	3	4	2	1	2	2	3
376	1	187	1	6	7	44	69	3	7	3	3	3	1	1	7
377	1	190	1	9	5	39	90	2	5	4	3	1	3	1	4
378	1	186	1	13	8	42	100	2	4	4	3	2	3	1	2
379	0	187	1	6	7	46	86	2	7	6	3	1	3	1	6
380	1	199	1	6	7	36	73	2	9	4	2	1	2	3	4
381	0	186	1	11	8	38	81	2	8	4	2	2	2	1	1
382	0	193	1	7	7	37	86	1	8	4	3	3	1	1	3
383	1	189	1	10	5	45	88	3	8	4	1	1	2	1	0
384	0	186	1	4	2	37	68	0	5	4	4	2	0	3	1
385	0	195	1	5	8	34	76	1	11	8	2	1	5	3	3
386	0	201	1	7	8	35	76	1	9	7	2	1	3	0	4
387	0	192	1	3	8	45	98	2	8	5	2	4	2	1	4
388	1	186	1	10	8	45	75	1	8	5	1	2	3	1	2
389	1	190	1	12	10	42	84	3	7	3	1	2	2	1	0
390	0	193	1	9	10	40	91	2	6	3	4	4	4	3	0
391	0	198	1	3	10	38	79	1	9	5	3	2	3	2	4
392	0	185	1	12	10	32	69	0	7	3	5	4	0	1	1

393	0	188	1	7	8	40	105	1	6	5	0	4	2	3	4
394	0	194	1	3	8	31	76	1	9	6	3	1	4	3	5
395	1	184	1	4	7	38	101	2	7	4	4	2	1	3	5
396	1	191	1	7	9	37	84	2	8	5	4	3	3	2	3
397	1	186	1	7	7	34	77	1	4	7	3	3	4	1	2
398	1	187	1	6	10	39	71	0	6	4	2	1	4	1	6
399	1	193	1	11	10	39	66	1	7	3	3	3	1	0	5
400	1	180	1	7	8	45	107	1	10	4	1	3	1	1	5
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402	0	187	1	4	4	42	78	1	10	5	3	2	3	0	6
403	1	192	1	3	9	39	67	2	9	5	5	0	6	2	3
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405	1	191	1	11	6	47	58	2	4	7	4	3	2	2	1
406	1	194	1	15	8	48	94	1	4	2	1	2	4	1	3
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408	1	192	1	11	8	45	109	2	3	5	3	0	3	0	5
409	0	185	1	9	11	41	65	2	6	3	3	3	3	0	5
410	1	184	1	16	10	33	74	1	6	4	2	1	0	1	4
411	1	188	1	6	8	37	70	1	6	6	5	3	2	2	7
412	1	193	2	16	15	43	98	1	2	3	4	4	2	0	2
413	1	199	2	9	10	41	83	1	4	6	2	3	3	2	3
414	0	196	2	14	8	37	93	1	6	4	2	1	1	1	2
415	0	198	2	7	5	40	91	1	7	8	3	2	2	3	3
416	1	209	2	14	16	44	100	2	5	3	1	1	1	1	2
417	0	208	2	6	12	49	84	1	9	7	3	0	3	1	5
418	0	199	2	5	3	37	110	1	9	5	4	2	0	3	2
419	1	205	2	5	10	49	104	2	5	5	5	4	4	1	3
420	0	198	2	4	7	39	87	1	9	6	4	1	5	2	5
421	0	207	2	2	9	35	59	1	10	7	3	1	4	2	5
422	0	199	2	5	3	41	86	1	8	6	2	3	0	2	2
423	0	210	2	5	6	44	91	2	8	1	5	0	0	2	4
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425	1	207	2	6	9	37	86	1	7	7	1	3	3	3	3
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430	0	209	2	10	6	42	71	1	2	5	5	1	1	3	4
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433	0	203	2	9	9	37	79	0	6	6	2	2	4	3	2
434	1	200	2	8	14	33	84	2	8	4	4	2	2	1	3
435	0	197	2	5	3	32	68	2	10	7	3	1	0	2	3
436	1	198	2	10	12	37	76	1	8	2	3	2	1	1	4
437	1	205	2	7	7	43	85	2	7	5	2	3	4	1	4
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439	1	199	2	12	7	41	82	2	4	3	3	2	1	2	1
440	0	219	2	3	11	38	86	1	7	8	2	3	1	3	5
441	1	195	2	6	7	46	63	1	7	4	5	2	3	3	1
442	0	200	2	4	7	40	84	1	10	5	4	2	4	1	4

443	1	199	2	8	9	37	77	1	5	6	4	3	3	3	2
444	0	195	2	10	9	41	79	2	4	6	1	2	3	1	4
445	0	197	2	4	7	37	68	1	8	4	5	2	2	1	5
446	0	199	2	4	6	39	99	2	8	3	5	1	1	2	4
447	1	205	2	7	8	38	61	1	6	6	2	3	2	1	3
448	1	198	2	11	10	45	72	2	4	3	3	3	0	1	4
449	1	203	2	7	8	41	70	1	5	5	0	1	1	1	4
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452	0	203	2	10	7	38	57	2	5	5	2	1	2	0	0
453	0	210	2	3	7	41	96	2	7	4	5	2	1	2	5
454	0	204	2	7	7	40	80	1	4	4	2	1	3	0	1
455	0	207	2	6	10	31	63	1	9	5	4	1	2	2	5
456	1	198	2	14	7	35	120	2	5	3	0	2	1	2	4
457	1	216	2	13	8	43	92	1	5	4	0	1	3	1	2
458	0	200	2	10	11	36	76	1	5	4	2	2	2	2	1
459	1	213	2	5	8	37	77	1	6	5	5	2	2	3	3
460	1	201	2	7	9	41	98	0	6	4	4	3	4	2	2
461	1	202	2	10	11	38	76	0	6	4	2	2	2	0	3
462	0	204	2	13	7	32	73	0	5	4	0	3	0	1	1
463	0	207	2	6	9	41	70	1	9	3	3	2	1	1	6
464	1	201	2	7	7	41	81	1	9	6	4	1	2	3	2
465	0	197	2	5	10	37	51	2	4	10	1	3	1	2	5
466	0	204	2	6	13	33	55	2	11	5	2	1	0	0	7
467	1	199	2	10	11	40	81	1	8	4	1	2	4	3	1
468	1	199	2	8	7	44	115	0	6	4	5	2	3	2	0
469	0	200	2	7	11	32	71	0	10	4	3	3	0	1	4
470	0	197	2	6	8	38	67	1	1	4	1	0	2	1	4
471	0	196	1	7	7	32	63	1	4	5	4	3	4	3	2
472	1	196	1	16	9	45	61	1	2	3	2	4	0	1	1
473	1	189	1	14	7	41	90	1	7	4	0	4	3	1	2
474	0	183	1	5	8	46	67	0	8	5	3	1	3	2	2
475	1	188	1	4	4	37	83	2	10	4	2	1	2	1	6
476	0	194	1	8	5	40	98	0	7	4	2	0	4	2	4
477	1	195	1	7	6	42	78	2	8	6	2	1	3	1	7
478	0	189	1	5	3	31	96	2	9	5	2	3	2	1	4
479	1	193	1	8	11	37	70	2	8	4	1	2	0	1	6
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487	1	192	1	9	7	40	94	1	4	7	4	4	2	1	2
488	1	190	1	6	8	37	94	1	7	4	1	2	2	2	5
489	1	190	1	4	5	45	62	1	9	5	5	1	2	3	4
490	1	201	1	5	7	40	83	1	7	6	3	4	3	2	3
491	0	193	1	6	8	34	73	3	7	3	3	2	2	2	4
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495	1	190	1	5	5	39	71	1	8	4	2	1	1	1	5
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500	0	191	1	2	8	41	85	1	9	8	3	4	4	2	2
501	1	186	1	12	7	41	93	1	6	3	1	2	0	3	6
502	1	188	1	13	7	41	87	2	4	1	3	1	1	0	4
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504	1	195	1	9	3	34	74	1	8	5	1	4	1	1	6
505	0	199	1	6	8	44	80	3	6	5	1	2	3	1	4
506	1	194	1	6	4	37	96	1	9	7	1	1	0	3	5
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509	0	189	2	15	11	43	101	2	5	2	4	1	1	0	1
510	0	214	2	9	5	34	57	2	6	1	4	2	2	2	3
511	1	211	2	19	11	43	110	0	5	4	0	0	2	1	2
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515	0	198	2	6	8	42	75	2	8	4	3	2	1	1	1
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517	0	206	2	7	12	44	75	0	5	5	4	1	1	2	5
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519	0	197	2	11	3	38	83	0	7	7	0	0	2	1	5
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521	0	200	2	6	7	34	65	1	8	3	2	0	3	1	6
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523	1	216	2	3	8	42	77	2	8	8	4	1	3	3	6
524	1	201	2	7	14	32	73	2	8	4	4	1	3	2	1
525	0	208	2	4	6	43	79	2	8	4	3	1	3	2	4
526	0	207	2	3	5	42	84	2	8	4	3	2	4	2	4
527	1	199	2	3	7	43	81	3	9	7	4	1	3	3	5
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529	1	198	2	4	7	39	77	1	11	4	4	3	2	3	1
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531	0	197	2	11	9	40	68	1	6	6	3	1	2	3	2
532	0	198	2	10	5	40	86	2	4	2	5	3	1	2	3
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537	0	201	2	6	8	44	65	2	6	6	1	3	6	2	2
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539	0	196	2	11	8	37	85	0	9	4	3	2	1	2	0
540	0	187	1	9	9	40	86	2	6	3	4	1	1	2	4
541	0	192	1	7	9	32	63	1	7	3	1	3	1	1	5
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545	1	190	1	11	7	43	77	2	5	5	4	2	1	1	3
546	1	186	1	5	8	43	86	3	7	6	3	1	3	2	4
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556	0	190	1	6	5	34	71	1	8	7	0	1	1	2	2
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559	1	186	1	5	5	45	78	1	7	7	5	1	5	3	1
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563	1	186	1	6	5	45	65	1	10	6	4	0	1	2	1
564	0	190	1	6	6	42	47	1	7	3	1	2	3	2	3
565	0	192	1	10	4	34	56	0	7	5	3	3	1	2	2
566	0	191	1	3	2	41	59	1	9	3	0	4	1	3	3
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568	1	188	1	6	5	44	69	2	8	2	2	3	0	3	3
569	1	191	1	5	6	39	68	1	6	5	2	1	5	3	3
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574	1	188	1	9	6	40	94	2	2	6	4	4	1	1	6
575	1	195	1	10	4	43	86	1	4	6	4	4	1	2	3
576	0	193	1	9	6	40	98	1	5	5	3	4	3	2	3
577	1	188	1	11	6	44	104	2	6	3	1	1	1	1	5
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583	1	193	1	6	10	41	105	0	9	5	3	3	0	1	5
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586	1	194	1	5	9	41	59	2	7	4	2	4	1	2	5
587	1	186	1	7	3	36	98	1	8	5	4	3	2	0	6
588	0	185	1	2	7	46	96	1	9	7	3	1	2	2	5
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590	0	188	1	1	5	41	80	1	9	6	5	4	1	2	5
591	1	187	1	11	9	44	87	2	4	7	2	1	3	2	5
592	0	195	1	4	3	34	103	2	7	6	4	4	2	2	7

593	0	190	1	9	2	46	96	3	6	4	2	2	1	1	6
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595	1	196	1	11	8	26	96	1	5	2	1	4	0	3	3
596	0	191	1	6	3	44	103	1	5	5	3	5	0	2	4
597	0	186	1	9	11	48	74	1	7	2	3	3	1	2	0
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603	1	191	1	14	9	40	102	2	4	6	3	1	1	2	1
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605	1	192	1	7	8	38	75	1	9	5	2	1	0	1	5
606	1	206	1	5	8	42	85	0	8	8	2	2	2	3	6
607	0	190	1	8	5	34	74	1	7	5	2	2	1	1	2
608	1	189	1	9	11	48	105	1	7	3	1	2	2	2	4
609	0	190	1	7	7	32	85	1	8	4	2	3	3	1	4
610	0	188	1	8	6	42	87	1	6	7	1	4	3	2	3
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613	0	199	2	9	11	37	80	2	0	6	3	3	3	2	3
614	1	207	2	14	3	36	85	2	5	4	4	1	1	0	1
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616	0	205	2	5	10	33	85	3	7	5	5	2	1	2	5
617	0	196	2	5	4	42	72	2	8	5	3	2	3	3	1
618	1	199	2	12	9	39	93	2	5	3	3	1	2	1	2
619	1	200	2	13	11	35	105	1	6	3	3	0	0	2	2
620	0	203	2	3	5	39	72	1	10	5	1	3	3	3	3
621	0	201	2	8	6	38	96	3	4	4	5	3	2	2	5
622	0	201	2	3	9	38	103	1	10	6	3	3	4	2	3
623	0	201	2	10	9	38	103	1	6	5	0	1	1	1	4
624	0	200	2	18	11	41	101	2	2	4	1	2	1	1	2
625	1	203	2	15	6	37	97	1	5	5	1	2	3	1	1
626	0	204	2	8	6	43	94	2	7	4	4	3	2	2	2
627	0	201	2	7	8	32	94	1	8	7	2	1	4	2	6
628	0	202	2	7	8	39	91	2	9	6	3	1	1	2	5
629	0	204	2	3	6	39	85	3	8	9	3	2	2	2	3
630	1	210	2	13	6	39	87	0	8	3	1	1	1	1	1
631	1	205	2	12	6	44	87	1	5	3	4	1	1	2	4
632	0	195	2	7	7	41	80	2	7	3	5	3	1	1	1
633	0	207	2	8	8	39	81	0	8	4	2	3	3	1	5
634	0	209	2	6	8	38	90	2	5	7	2	4	2	2	3
635	0	199	2	9	9	38	88	2	10	4	4	1	1	1	1
636	0	199	2	8	6	29	82	1	5	7	1	4	4	1	3
637	1	195	2	7	7	44	94	2	7	4	2	2	2	3	4
638	0	202	2	7	5	40	75	2	7	7	1	3	3	2	2
639	1	200	2	5	6	36	82	2	7	6	4	0	2	2	3
640	0	207	2	10	10	32	72	1	7	4	3	1	1	0	6
641	0	205	2	6	6	37	69	1	7	6	5	3	3	3	3
642	1	196	2	14	13	37	97	1	3	5	4	1	2	0	2

643	1	207	2	8	6	37	89	2	8	5	2	1	2	1	5
644	0	199	2	15	4	37	99	1	4	3	2	1	2	0	2
645	1	209	2	12	11	29	91	2	7	4	1	1	2	1	3
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647	1	205	2	11	10	28	77	2	4	6	1	2	2	2	3
648	1	201	2	10	8	42	84	1	6	4	1	3	1	2	5
649	0	200	2	9	8	32	79	1	8	4	2	1	2	3	1
650	1	201	2	11	10	42	83	0	6	5	2	3	1	3	3
651	1	206	2	10	6	32	93	0	5	5	1	3	3	2	3