

How Successful are Artificial Intelligence Chatbots on Higher Education Entrance Physics Exams in Turkey

Neşet Demirci

Balikesir University Necatibey Faculty of Education, 10100, Balikesir

demirci@balikesir.edu.tr

ORCID ID: 0009-0006-2990-0979

ABSTRACT

In this study, the performance of artificial intelligence chatbots—OpenAI's ChatGPT, Google Gemini, and Microsoft's Copilot—was evaluated and compared based on their responses to questions from the Turkish Higher Education Entrance Physics Examination over the past three years. Analysis of the chatbots' responses to TYT Physics questions showed that ChatGPT correctly answered 38.09% of the questions, while both Gemini and Copilot achieved a correct answer rate of 28.57%. For AYT Physics questions, ChatGPT demonstrated a higher success rate, correctly answering 45.23% of the questions, compared to 26.18% for Gemini and 14.28% for Copilot. While ChatGPT exhibited the best performance overall, Copilot performed the worst. Nonetheless, the overall performance of all three chatbots was insufficient for providing consistently accurate answers to both TYT and AYT questions.

Keywords: Chatbots; ChatGPT; Gemini; Copilot; Physics; Higher Education Entrance Exam; and Turkey

INTRODUCTION

Artificial Intelligence (AI) refers to the ability of computer systems to perform tasks that typically require human intelligence, such as learning, reasoning, problem-solving, and decision-making. It involves developing mathematical models and algorithms that enable machines to process data, identify patterns, and make predictions or decisions based on available information (Minkinen & Mäntymäki, 2023). Recent advancements in AI have significantly influenced various aspects of life, including education, where AI tools are increasingly integrated to enhance learning experiences and outcomes (Mustofa et al., 2024). However, keeping pace with the rapid evolution of AI tools can be challenging. For instance, Microsoft has embedded GPT-4 into Bing Chat and Windows 11 under the Copilot branding, OpenAI has introduced new features in ChatGPT and launched GPT-4o, and Google has integrated Bard into its ecosystem, rebranding it as Gemini to appeal to a wider audience (Siddharth, 2024). According to Actor-Network Theory (ANT), productive AI bots like OpenAI's ChatGPT, Microsoft's Copilot, and Google's Gemini function as active actors within networks of embedded cognition and action (Latour, 2007). These non-human agents interact with human users by processing inputs, generating outputs, and updating information. They contribute to learning and cognitive development by facilitating discussions, providing information, encouraging reflective thinking, and fostering problem-solving skills (Santos, 2023). Rudolph, Tan, and Tan (2023) highlight the competitive growth of these AI-driven tools, including Bard/Gemini, Bing Chat/Copilot, and ChatGPT, which are powerful writing aids with distinct features that are transforming educational practices, despite inherent limitations. Notably, copilot leverages GPT-4, while Gemini operates on the PaLM-2 model (Google AI PaLM 2 – Google AI, n.d.).

Initially designed to process and generate natural language, Large Language Models (LLMs) have also demonstrated utility in generating programming and symbolic languages, such as mathematics. OpenAI's ChatGPT exemplifies this capability. As a Generative Pre-trained Transformer (GPT), ChatGPT simulates human-like conversation by generating and responding to text using advanced LLMs. Its methodology and success in everyday interactions underscore the potential of AI-assisted physics education (Bitzenbauer, 2023; Kortemeyer, 2023; MacIsaac, 2023; Polverini & Gregorcic, 2024; Yeadon & Hardy, 2023).

Microsoft Copilot is a generative artificial intelligence (AI) chat engine developed by Microsoft, integrated into Edge, Office applications, and Bing. A dedicated Copilot app for Windows was announced in January 2024. Copilot utilizes the Microsoft Prometheus model, built on OpenAI's GPT-4 large language model, and is optimized through both supervised and reinforcement learning techniques. While most features are available to free preview users, paid subscribers gain access to additional functionalities, including the ability to create private chats through "Microsoft Copilot Pro." Similarly, Gemini, developed by Google AI, is a versatile family of large language models designed for tasks such as writing, productivity, and learning. Gemini models are tailored for different purposes and resource constraints, and its ongoing evolution is expected to enhance its utility across various applications (Google, 2024).

Artificial intelligence (AI) has made remarkable progress in emulating human cognitive functions; however, its ability to learn is still hindered by inherent limitations. These constraints can be better understood by examining established cognitive theories, such as Bloom's Taxonomy and Cognitive Load Theory (CLT). These frameworks offer valuable insights into the processes of knowledge acquisition and processing, applicable to both human learners and AI systems.

AI Learning and Bloom's Taxonomy

Bloom's Taxonomy classifies cognitive skills into six hierarchical levels: remembering, understanding, applying, analyzing, evaluating, and creating (Bloom et al., 1956; Anderson and Krathwohl, 2001). AI systems navigate these levels with varying degrees of proficiency, but they encounter inherent limitations.

1. Remembering and Understanding: AI excels in foundational cognitive skills such as memorization and pattern recognition. Large language models (LLMs) like ChatGPT can store and retrieve vast amounts of information, yet their grasp of understanding is often shallow, lacking genuine semantic comprehension (Bender and Koller, 2020).
2. Applying and Analyzing: AI can adeptly apply learned rules and analyze structured data, but its capacity to generalize to new, unstructured challenges remains constrained. In contrast to human learners, who rely on contextual reasoning and experiential knowledge, AI often struggles with transfer learning and integrating complex concepts (Marcus, 2018).
3. Evaluating and Creating: Higher-order thinking encompasses judgment, synthesis, and innovation, which AI approaches through probabilistic models rather than true critical reasoning. Despite the progress seen in generative AI, such systems do not possess intrinsic creativity or metacognitive awareness, setting them apart from human cognitive abilities (Boden, 2004).

AI Limitations and Cognitive Load Theory

Cognitive Load Theory, introduced by Sweller in 1988, suggests that the efficiency of learning is influenced by three types of cognitive loads: intrinsic, extraneous, and germane. Similarly, AI systems face comparable limitations in their processing abilities:

1. Intrinsic Load: The complexity of a task directly impacts the cognitive effort required for understanding it. AI models, while capable of learning intricate patterns from vast datasets, rely heavily on computational power. They lack the innate intuition that characterizes human learning, resulting in a rigid and data-dependent approach to knowledge acquisition (Lake et al., 2017).
2. Extraneous Load: Inefficient instruction can lead to unnecessary cognitive strain, which ultimately hampers the learning process. AI models, especially neural networks, are not immune to this issue; they often experience "catastrophic forgetting." This phenomenon occurs when new information disrupts previously learned knowledge, thereby diminishing overall efficiency (French, 1999).
3. Germane Load: Developing meaningful schemas is crucial for achieving deep learning. Unlike humans, AI systems cannot independently refine and restructure their knowledge without external guidance. Although reinforcement learning algorithms can enhance performance, they do not possess the kind of conceptual flexibility that humans naturally exhibit (Hassabis et al., 2017).

Enhancing AI Performance with Improved Training Methods

Recent advancements in AI training methodologies seek to overcome existing limitations and enhance the performance of chatbots. Two notable techniques, Few-Shot Prompting and Reinforcement Learning with Human Feedback (RLHF), show great promise in this regard:

1. Few-Shot Prompting: This approach allows AI to learn and generalize from a limited number of examples, minimizing its dependence on large pretraining datasets. By utilizing contextual cues from just a few instances, AI systems can significantly improve their application and analytical abilities, addressing issues commonly associated with transfer learning (Brown et al., 2020).
2. Reinforcement Learning with Human Feedback (RLHF): By incorporating human evaluators into the training process, RLHF fine-tunes AI responses based on qualitative human input. This iterative feedback loop enhances the AI's capability to assess and generate responses that resonate with human expectations, thereby bolstering its higher-order cognitive skills, such as judgment and contextual reasoning (Christiano et al., 2017).

These methodologies help alleviate unnecessary cognitive load by simplifying training processes and improving AI's ability for organized learning. Additionally, they tackle challenges in schema development by promoting adaptive learning mechanisms that allow AI to continually enhance its understanding in a dynamic way.

AI Accuracy in STEM Assessments

Recent empirical studies have explored the effectiveness of AI-driven assessments in STEM education, providing valuable insights into their accuracy and applicability. A systematic review conducted by Xu and Ouyang (2022) analyzed 63 empirical studies on AI in STEM from 2011 to 2021. The review highlighted that AI applications in this field serve various functions, including evaluating academic performance, assessing learning progress, and analyzing instructional quality. These AI-driven assessments have shown promise in improving both the efficiency and quality of STEM education by delivering timely and objective feedback. Further, Zhai, Nyaaba and Ma (2024) investigated the performance of generative AI models, specifically ChatGPT and GPT-4, on the 2019 National Assessment of Educational Progress (NAEP) science assessments. The findings revealed that both AI models consistently exceeded the performance of most students across different grade levels. Remarkably, the AI models maintained a stable level of performance, even as the cognitive demands of the tasks increased, indicating their capability to effectively manage complex problem-solving challenges. In addition, Zhai (2024) explored the revolutionary impact of AI and machine learning on science assessments, underscoring a transition towards performance-based evaluations. These new methods encourage students to actively participate in scientific practices, including modeling, explanation, and argumentation. The findings of the study revealed that AI-driven assessments can deliver timely and objective feedback, thereby easing the workload for educators and improving the overall assessment process. These studies collectively highlight significant advancements in AI-driven assessments, particularly in their ability to accurately evaluate complex cognitive tasks within STEM education. The incorporation of AI into educational assessments not only boosts efficiency but also aligns with modern educational goals that prioritize higher-order cognitive skills.

Using AI tools in Physics Education

In physics education research, the capabilities and impacts of AI tools like ChatGPT, Gemini, and Copilot have been increasingly studied. Bitzenbauer (2023) conducted a pilot study in secondary education, where students posed physics questions to ChatGPT and evaluated its responses. The study found that interacting with ChatGPT positively influenced students' perceptions of AI tools. Yeadon and Halliday (2023) analyzed the performance of GPT-4 and GPT-3.5 on 593 questions from 42 exams spanning 10 courses at Durham University (2018–2022). Their results showed that GPT-4 consistently scored around 50%, indicating some progress but highlighting challenges with university-level physics questions.

Dahlkemper et al. (2023) demonstrated that ChatGPT can evaluate answers to complex physics questions at a level comparable to that of researchers. However, Gregorcic and Pendrill (2023) published a case study showing that ChatGPT-3.5's responses to simple mechanics problems often included contradictions and inaccuracies. Similarly, dos Santos (2023) compared the performance of ChatGPT-4, Bing, and Bard, concluding that ChatGPT-4 outperformed the others by providing more accurate and detailed answers.

Kortemeyer (2023) assessed ChatGPT-3.5's performance on Force Concept Inventory (FCI) questions, finding that it scored between 50% and 60%, comparable to novice students. West (2023) corroborated these findings, reporting that upgrading from ChatGPT-3.5 to ChatGPT-4 significantly improved performance on FCI questions. Specifically, ChatGPT-4 scored between 90% and 100%, comparable to expert physicists. West also noted that while ChatGPT-3.5 often produced inconsistent results across tests, ChatGPT-4 displayed greater reliability with minimal variation. Yeadon and Hardy (2023) further evaluated ChatGPT-3.5's ability to solve physics test questions across three educational levels—from high school to university entrance—and found that at the university entrance level, it provided correct solutions 30% to 40% of the time.

Although Artificial Intelligence (AI) offers numerous benefits to physics and physics education, it also presents significant limitations and drawbacks that need to be addressed. A primary concern is the accuracy and reliability of AI-generated content. For example, studies have shown that while GPT-3.5-turbo achieves an accuracy of 83.4% on GCSE-level physics questions, its performance drops significantly to 37.4% on more complex problems, such as those encountered at A-level or university levels (Yeadon & Hardy, 2024). Furthermore, as a developmental tool, AI has demonstrated significant inaccuracies, particularly when addressing straightforward questions like multiple-choice items. These inconsistencies pose challenges for educators relying on AI for accurate assessment and feedback (Yeadon & Hardy, 2024).

While existing research has extensively explored the performance of AI chatbots on physics exams at high school and university levels, studies focusing on non-English contexts, such as Turkish, remain limited. Addressing this gap, the present study seeks to answer the following research question: How successful are Artificial Intelligence Chatbots (Microsoft Copilot, Google Gemini, and OpenAI ChatGPT) in Higher Education Entrance Physics Exams in Turkey?

METHODOLOGY

To address the research question, this study employed a qualitative case study approach (Yin, 2009), which is particularly suited for understanding phenomena within specific contexts (Stake, 1995). In this case, the study evaluated the effectiveness of AI language models—ChatGPT, Gemini, and MS Copilot—in solving Higher Education Entrance Physics Exam questions. In Turkey, students must pass two distinct exams to gain admission to universities: the TYT (Basic Competency Test) and the AYT (Field Competency Test). The TYT, the first stage of the university entrance exams, assesses students' basic knowledge and skills, while the AYT, the second stage, evaluates subject-specific knowledge and competencies. The TYT includes four main sections: Turkish, Social Sciences, Science, and Mathematics, comprising a total of 120 multiple-choice questions. In contrast, the AYT covers three fields: Social Sciences, Science, and Literature-Humanities, with 80 multiple-choice questions. The combined results from these exams are used for university placement. These exams are conducted annually in June, and students are encouraged to consult official sources for the latest information on the format, syllabus, and application dates. In the TYT, 7 of the 20 science questions are physics-based, while in the AYT, 14 of the 30 science questions focus on physics. The Student Selection and Placement Center (ÖSYM) administers these exams, and detailed information is accessible on their official website (ÖSYM, 2024).

The physics questions used in this study to assess the three chatbots (ChatGPT, MS Copilot, and Gemini) were sourced from past TYT and AYT exams available on the ÖSYM website (ÖSYM, 2024). All chatbot responses are compared and validated against official answer keys given by ÖSYM. Currently, all three AI tools can process image-based questions. However, the free trial version of ChatGPT 4.0o imposes a daily limit on the number of image-based questions that can be analyzed. TYT and AYT physics questions are a mix of text-only questions and questions containing both figures and text. For the latter, the illustrated questions were photographed and input into the chatbots, while text-only questions were directly presented with the simple prompt: "What is the answer to this question?"

In line with Brown et al. (2020), rapid prompting techniques such as Zero-Shot and Few-Shot prompting significantly influence the quality of AI-generated responses. Zero-Shot method is particularly useful when extensive training data is unavailable. By giving the model a handful of examples, it can generalize from these examples to perform similar tasks more accurately. Zero-Shot prompting involves asking a question without providing any prior context or examples, while Few-Shot prompting includes presenting examples to the model beforehand. This study utilized Zero-Shot prompting for all interactions. However, when chatbots provided irrelevant answers to illustrated questions, the illustrations were described textually in rephrased questions to maintain the integrity of the original content.

The chatbots were asked a total of 21 multiple-choice physics questions from the TYT and 42 from the AYT, all sourced from the exams administered between 2022 and 2024. Their responses were recorded, compared, and evaluated (sample answers are provided in the Appendix). Answers unrelated to the questions or not among the provided options were coded as "N" and deemed incorrect (see Tables 1 and 2).

FINDINGS AND INTERPRETATION

This section is divided into two main parts. The first part analyzes and presents the answers provided by chatbots to TYT physics questions, while the second part focuses on the answers given to AYT physics questions.

Findings Related to Chatbots' Answers to TYT Physics Questions

An analysis of the answers provided by chatbots to TYT Physics questions over the past three years reveals the following performance: ChatGPT answered 38.09% of the questions correctly, while both Gemini and Copilot each answered 28.57% of the questions correctly. These results suggest that the current performance of chatbots in correctly answering TYT Physics questions is relatively low. A summary of the answers provided to the TYT questions is presented in Table 1. The data is compared across different years and chatbots.

Table 1: Summary Table of Answers Given by Chatbots to TYT Physics Questions

Ques tions	2024				2023				2022			
	Ans wer	Chat GPT	Copil ot	Gemi ni	Ans wer	Chat GPT	Copil ot	Gemi ni	Ans wer	Chat GPT	Copil ot	Gemi ni
1	E	N	D	C	A	D	E	A	B	D	C	E
2	A	D	E	C	D	E	C	C	E	E	E	E
3	D	D	E	D	B	B	B	D	E	C	A	N
4	B	B	B	A	B	B	B	B	A	A	A	D
5	E	A	N	A	A	E	C	C	E	N	D	N
6	A	B	C	N	C	N	N	N	D	A	D	C

7	D	D	C	D	C	C	N	C	A	D	C	B
Correct (%)		42,86	14,28	28,57		42,86	28,57	42,86		28,57	42,86	14,28

Note: N indicates that given answer not acceptable/irrelevant or not related to question. The web link of exam questions and related answers is given in reference section.

Comparison of answers to TYT 2024 physics questions

ChatGPT correctly answered 42.86% of the 2024 TYT Physics questions, while Copilot and Gemini answered 14.28% and 28.57%, respectively. A detailed comparison of the responses provided for each question is outlined below (Note: Sample chatbot responses to some questions are given in the appendix).

In the first question from the TYT 2024 Physics exam, a mass-volume graph depicting two different water samples and two different powder paints with varying densities was presented. The question required identifying which water or water mixture could be used to create a tulip with a red flower and a green stem on water, according to the art of marbling. Based on the graph, water A had the highest density, followed in decreasing order by red dye, green dye, and water B. ChatGPT analyzed the question step by step according to the graph and concluded that all the given statements were correct, selecting option E ("all of the above") as the answer. However, option E only correctly included Statements I and III, and there was no option that accurately represented all the Statements as correct. Consequently, ChatGPT's answer was marked as incorrect and categorized as "N" (irrelevant). Copilot provided entirely unrelated explanations and selected option D. Similarly, Gemini offered explanations unrelated to the question and chose option C. For instance, Gemini provided information about the process of marbling and erroneously claimed that no brush is used in marbling and that it is a traditional Turkish art. It is crucial to understand that the density of the paint must be smaller than the density of the liquid used, a detail not explicitly stated in the question. Thus, the densities of the dyes should be smaller than that of the least dense liquid or mixture. Therefore, water A, being denser than the dyes, as well as a mixture of water A and B, could be used, which is correctly indicated by option E. All three chatbot tools overlooked this detail.

In the second question, it was stated that three blocks of different masses, composed of distinct materials, remained stationary on a horizontal plane when the same horizontal force F was applied separately to each block. Each block had a unique coefficient of static friction with the horizontal surface. The question asked for a comparison of the magnitudes of the friction forces acting on the blocks. ChatGPT and Copilot applied the relation $f_s = kN$ to each block individually and provided answers based on this formula, without considering whether the masses would move. ChatGPT identified the correct answer as option D, whereas Copilot, despite using the same reasoning, incorrectly selected option E. Gemini compared the forces using the friction coefficients alone and selected option C. However, according to Newton's third law, since the applied force does not move the objects, the frictional force acting on each block must equal the applied force F . Therefore, the correct answer was option A, where all frictional forces are equal.

In the third question, which focused on the buoyancy of liquids, iron, aluminum, and wooden balls of equal volumes were slowly released into a large container of water. Among these, two sank, and one floated. The question provided three Statements regarding this scenario and asked which were true. ChatGPT and Gemini correctly explained and inferred the right answer, while Copilot provided a completely incorrect response. Copilot mistakenly claimed that iron is denser than aluminum and, therefore, experiences more buoyancy because it sinks more. Additionally, it incorrectly stated that the wooden ball displaces more water than the others. In reality, the iron and aluminum balls sink, while the wooden ball floats. Since all the balls have equal volumes, the buoyant forces acting on them are equal. However, the wooden ball does not displace more water than the other two. Thus, with the first two Statements being true, the correct answer is option D.

In the fourth question, heat exchange, heat, and temperature conditions were analyzed. A box of milk, cheese, and olives, initially at room temperature, was placed in a refrigerator at $+4^{\circ}\text{C}$. Afterward, the refrigerator's electricity was cut off, and the items were kept in the refrigerator until thermal equilibrium was reached. Three Statements were provided about the final state, asking which were true. ChatGPT and Copilot answered correctly, while Gemini incorrectly stated that statement-II was false and Statement-I was true. The correct answer is option B, which states that the final temperatures of the milk, cheese, and olives are equal, while the other two Statements are false.

In the fifth question, three identical lamps were connected in parallel to a generator, and their potential-current (V - I) graph was provided. The question asked to compare the potential differences between the lamps and the energy they consume per unit of time. ChatGPT and Gemini ignored the fact that the lamps were connected in parallel,

solving the question solely based on the resistance values derived from the V-I graph. Both determined the answer to be option A. Copilot, on the other hand, failed to perform any calculations, instead posing unrelated questions in its reasoning, ultimately providing irrelevant answers and selecting option A. As a result, Copilot's response was marked as "N" (irrelevant). According to the V-I graph, lamp A has the largest resistance, while lamp C has the smallest resistance. Since the lamps are connected in parallel, their potential differences are equal. The lamp with the smallest resistance (lamp C) will consume the most power, while the lamp with the largest resistance (lamp A) will consume the least power ($P=V^2/R$). This relationship is correctly stated in option E.

In the sixth question, a snapshot of a wave traveling in the x-direction along an ideal arc was provided. The question asked for the vibration direction of three distinct points on the wave. ChatGPT correctly determined the wave's propagation direction from the graph but incorrectly identified the vibration directions of the three points, selecting option B while describing the vibration directions consistent with option D. Gemini incorrectly answered option A with an unrelated solution, stating that the wave moves to the left instead of the right and analyzing the vibration directions of four unrelated points (A, B, C, D instead of K, L, M). Copilot also provided incorrect vibration directions without a detailed explanation. According to the wave's propagation direction, points K and M vibrate in the +y-direction, while point L vibrates in the -y-direction, correctly stated in option A.

In the seventh question, a scenario involving a concave mirror with coincident axes, a converging lens, and a light source was presented. It was stated that red light emitted from the light source, positioned at the mirror's focal point, first reflects off the mirror, then refracts through the lens, and passes through point K. The question asked through which point blue light would pass after being reflected and refracted in the same manner if emitted instead of red light. Since blue light refracts more than red light, it will not pass through point K or any point beyond K along the axis. Instead, it will pass through a point between points T and K. The correct answer, therefore, is option D. ChatGPT and Gemini correctly identified this answer, while Copilot incorrectly selected option C without providing a solution.

Comparison of Answers to TYT 2023 Physics Questions

In the first question, it was planned to perform atmospheric measurements at different altitudes using a balloon on a newly discovered planet. A mass-volume graph of four gases (at constant temperature and pressure) was provided. Assuming the planet's atmosphere has a constant temperature, the question asked about the composition of the planet's atmosphere and the gases that could be used to fill the balloon. For the balloon to ascend, the gas filling it must have a lower density than the planet's atmosphere. Based on the graph, this condition is met if gas A constitutes the atmosphere, and a mixture of gases B and D is used to fill the balloon. This scenario corresponds to option A. ChatGPT and Copilot incorrectly answered the question by only interpreting the graph values, while Gemini correctly evaluated the provided information and selected the correct option.

In the second question, it was stated that the total displacement of a car moving on a highway for 30 seconds was equal to the total distance it traveled during this period. The question asked which of the three Statements related to this scenario were true. Despite providing detailed solutions, ChatGPT and Gemini reached incorrect conclusions. Copilot, however, directly stated the correct answer as option C without offering a detailed explanation. For the car's displacement to equal its total distance, it must move along a straight path in a single direction. However, it is not certain whether the car travels at a constant speed. Therefore, Statements II and III are correct, and the correct answer is option D. ChatGPT and Gemini exhibited a general misunderstanding of speed in their solutions.

In the third question, the energy consumption of three different lamps with equal illumination intensity, operating for an equal amount of time, was compared. The lamps were a 75-watt incandescent lamp, a 13-watt LED lamp, and a 40-watt fluorescent lamp. The incandescent lamp, with the highest power rating, consumed the most energy, while the LED lamp, with the lowest power rating, consumed the least energy. This outcome is correctly provided in option B. ChatGPT and Copilot accurately calculated the energy consumption for each lamp and selected the correct answer, while Gemini provided an incorrect answer without performing any calculations.

In the fourth question, the modes of heat transfer—radiation, conduction, and convection—were examined. The question specifically asked how heat from the Sun reaches Earth. The correct answer is option B, as the Sun's heat reaches Earth through radiation. All three bots answered this question correctly.

In the fifth question, six identical lamps were connected to an electrical circuit. The question asked which lamps retained the same brightness when the switch was moved from position 1 to position 2. Only lamp K maintained the same brightness, making option A the correct answer. All three bots answered this question incorrectly, indicating that the circuit's schematic and its implications were not fully understood.

In the sixth question, a point K and a light source were placed at the center of a lampshade suspended at a certain height from the ground. The question described three scenarios: (1) replacing the lampshade with a transparent one of smaller radius, (2) painting the entire lampshade with a translucent material, and (3) shortening the chain suspending the lampshade. The question asked which of the options correctly described the changes in light intensity, illuminance, and luminous flux. At the end of the second scenario, the illuminance at point K decreased, but the descriptions of the other scenarios were incorrect. This outcome corresponds to option C. Both ChatGPT and Gemini provided detailed explanations but incorrectly concluded that there was more than one correct answer. Copilot failed to solve the problem, stating that additional information about light intensity was needed.

In the seventh question, an astronaut was tasked with placing three systems on the Moon: (1) two plane mirrors, (2) a plane mirror and a concave mirror, and (3) a plane mirror and a convex mirror. A diagram showed a laser beam from Earth entering each system, and the question asked which systems would reflect the light beam back to Earth. By analyzing the reflections, systems I and II reflect the light beam back to Earth, while system III does not. The correct answer is option C. ChatGPT and Gemini correctly answered this question, while Copilot provided a completely irrelevant explanation unrelated to the question.

In summary, ChatGPT and Gemini performed equally, each answering 42.86% of the questions correctly. Copilot, on the other hand, achieved a lower accuracy rate, correctly answering only 28.57% of the questions.

Comparison of Answers to TYT 2022 Physics Questions

ChatGPT correctly answered 28.57% of the 2022 TYT Physics questions, Gemini answered 14.28%, and Copilot answered 42.86%. Below is a detailed comparison of the answers provided by each chatbot to the respective questions (Note: The answers provided by the chatbots to some questions are given in the appendix).

In the first question, three different scenarios involving variations in gravity were presented, and it was asked which of these scenarios required the construction of an item with a larger mass. In Scenario 1, a dining table for four people is replaced with a larger table for six people; in Scenario 2, a vase of flowers is replaced with a heavier vase of the same size and shape to prevent it from being blown away by the wind; and in Scenario 3, a light dessert spoon is replaced with a heavier spoon. Among these scenarios, only the heavier vase in Scenario 2 definitively requires the use of a larger mass, while no certainty exists for the other scenarios. Therefore, the correct answer is B. All three chatbots answered this question incorrectly due to misinterpretations. Notably, Copilot provided different answers when asked the same question on multiple occasions.

In the second question, a teacher placed a 1 kg book on a horizontal table and asked students to discuss the forces acting on the book. Since no additional forces are acting on the book or the table, the students cannot draw the given inference. According to the principle of action-reaction, the force exerted by the book on the Earth, the Earth on the book, the book on the table, and the table on the book is 10 N. However, it cannot be concluded that the force exerted by the Earth on the table is also 10 N. Therefore, the incorrect inference is given in Option E. All three chatbots answered this question correctly.

In the third question, water was flowing through pipes of varying diameters, and certain sections of the pipes were damaged, causing water to gush out. In the first pipe, water gushed from the section with a larger diameter, while in the second case, water gushed from the narrower section. The question required comparing the height of the gushing water at these points and the velocities of the flowing water in the respective sections of the pipes. According to Bernoulli's principle, as the cross-sectional area of the flowing water decreases, pressure decreases while velocity increases. Consequently, water gushing from a larger diameter pipe should rise higher, while the velocity of water flowing through the narrower pipe should be greater. This comparison is accurately represented in Option E. Although all three chatbots provided partially correct explanations, they ultimately answered the question incorrectly. Gemini mentioned Bernoulli's principle but incorrectly compared the velocities between the two points and chose Option E as the correct answer, explaining that Statements I, II, and III were correct under this option. However, since the question did not include Statements and only required a single answer option, this response was categorized as unrelated (N).

The fourth question focused on heat conduction. Ayşe held two metal plates that had been in the room for a long time and observed that Plate K felt colder than Plate L. A piece of ice was placed on each plate, and the question asked which plate would melt the ice first and why. Since Plate K, which feels colder, has a higher thermal conductivity, the ice on this plate will melt first. This explanation corresponds to Option A. Both ChatGPT and Copilot answered this question correctly, while Gemini provided an incorrect response.

In the fifth question, a positively charged comb touched a neutral piece of paper, causing the paper to touch the comb and hang in the air. The section of the paper in contact with the comb was labeled A, while the other section was labeled B. The forces acting on these sections, denoted as F_a and F_b , respectively, and the gravitational force acting on the paper, denoted as G , were analyzed. Three statements were provided about these forces, and the question asked which of them were correct. The correct explanations are that F_b acts vertically downward and F_a is greater than G . Thus, the correct option is E. Statement I, which claims that F_a acts vertically downward, is incorrect since A will be pulled while B is pushed. All three chatbots answered this question incorrectly. ChatGPT claimed that none of the statements were correct, while Gemini asserted that Statements I and II were correct, although this was not among the answer options. Copilot incorrectly stated that the correct answer was D.

The sixth question asked about the behavior of wavefronts as they move from the open sea toward the shore, where they become denser. The question required determining which of the quantities—wavelength, frequency, and speed—would decrease as the waves approached the shore. While the speed and wavelength decrease, the frequency remains constant because the source's frequency does not change. The correct answer is D. All three chatbots incorrectly stated that the frequency decreases alongside the wavelength as the waves approach the shore. This question involved a diagram, and the incorrect responses from all three chatbots suggest potential challenges in interpreting diagrams or figures.

In the seventh question, parallel stairs were depicted, one leading from the ground floor to the first floor and another from the first to the second floor. Ali and another person behind him were ascending the lower staircase. The lower part of the upper staircase acted as a plane mirror. The question asked which directions Ali should look in to first see the person behind him and then see his own reflection in the mirror. Ali should look in Direction I to see the person behind him and in Direction II to see himself. Directions II and IV can also be used to observe an area ahead. The correct answer is A.

Findings Related to Chatbots' Answers to AYT Physics Questions

When analyzing the responses provided by chatbots to the AYT Physics questions over the past three years, their performance in terms of correct answers is as follows: ChatGPT correctly answered 45.23%, Gemini correctly answered 26.18%, and Copilot correctly answered 14.28%. These percentages indicate that the accuracy of the chatbots in answering AYT questions remains relatively low, like their performance on TYT questions. A detailed comparison of the answers given to the AYT questions by year and chatbot is presented in Table 2 below.

Table 2: Summary Table of Answers Given by Chatbots to AYT Physics Questions

Questions	2024				2023				2022			
	Answer	Chat GPT	Copilot	Gemini	Answer	Chat GPT	Copilot	Gemini	Answer	Chat GPT	Copilot	Gemini
1	D	E	A	N	D	C	N	C	D	C	B	E
2	E	E	A	E	C	C	C	C	D	E	C	C
3	B	E	D	A	A	E	N	N	A	D	E	D
4	B	D	D	E	D	D	B	D	A	C	N	D
5	E	E	B	N	C	C	B	N	A	A	N	N
6	B	C	C	E	D	D	D	D	B	C	C	D
7	A	A	C	A	E	E	C	N	E	C	C	A
8	A	B	C	A	B	B	E	D	E	E	N	N
9	C	C	C	N	D	D	E	D	C	E	A	A
10	B	A	N	N	C	D	D	N	A	D	D	D
11	C	C	C	D	C	C	D	D	E	E	E	E
12	A	E	E	E	B	B	N	C	D	D	E	D
13	B	C	E	C	D	B	B	N	D	D	D	D
14	C	N	N	N	C	C	A	D	A	D	D	A
Correct (%)		35,71	14,28	21,42		71,42	14,28	28,57		28,57	14,28	28,57

Note: N indicates that given answer not acceptable or there is more than one answer. The web link of exam questions and related answers is given in related reference section.

Comparison of answers to AYT 2024 physics questions

ChatGPT answered 35.71% of the 2024 AYT Physics questions correctly, while Copilot answered 14.28% and Gemini answered 21.42%. (Note: The answers given by the bots to some questions are given in the appendix).

In the first question, two people are swimming in the same direction in a still pool, and another person is moving parallel to these swimmers. The speeds of Levent and Mert are $3v$ and $2v$, respectively, while the speed of Sarp outside the pool is v . Which of the following is true about the comparison of the relative speeds of Levent, Mert, and Sarp in this race? When the relative speeds are compared, the magnitudes of the speeds of Mert relative to Levent and Mert relative to Sarp are equal. This is given in option D. However, option E, which states that the speeds are equal (not the magnitudes of the speeds), is incorrect because speed is a vector quantity and cannot be equal without considering direction. In this question, ChatGPT selected E, Copilot selected A, while Gemini claimed that none of the options were correct. ChatGPT and Copilot ignored the vector nature of velocity and gave the answer as E, reflecting a general misconception.

In the second question, a ball with a mass of 1 kg and a bird with a mass of 1 g are released from a height of 5 m above the ground in an environment where air resistance is neglected. The question asks which of the quantities of force, acceleration, and fall time are expected to be equal for these two objects. The acceleration and fall time acting on the two bodies are the same, but the force acting on them cannot be the same. Accordingly, the correct answer is option E. In this question, ChatGPT performed the correct calculations and reached the correct result. Additionally, Gemini provided the correct explanation but incorrectly labeled the answer as B. This was accepted as correct due to the right solution and explanations. Copilot, on the other hand, explained the situation but failed to state that the net force acting on the objects was not equal, resulting in an incorrect answer.

In the third question, the trajectory of an object thrown obliquely at a certain angle on a flat surface where friction is neglected is given. Three points are marked on the trajectory: point K is located before L, the maximum height of the flight, and point M is located before the ground impact. Since the magnitude of the linear momentum is $p=mv$ and the mass does not change throughout the motion, the magnitude of the velocity at each point is used to compare the momenta at those points. Therefore, the correct comparison is given in option B: the largest momentum is at M and the smallest at L. All three chatbots gave wrong answers in this question. ChatGPT mistakenly focused on angular momentum, Copilot on potential energy, and Gemini attempted to find the velocities but misinterpreted the points K, L, and M, leading to an incorrect comparison of velocities and momentum.

In the fourth question, it is stated that in an environment where friction is neglected, a heavy stone block is pulled at constant speed up an inclined plane instead of being lifted to place it on a 2-meter-high wall. The question asks which of the following objectives are realized: I. saving path; II. applying smaller force; and III. doing less work? All three chatbots gave wrong answers. ChatGPT and Copilot both said the correct answer was D, while Gemini said the answer was E, stating that all Statements were correct. Here, saving work is not possible, and only force is gained at the expense of distance. Thus, the correct answer is B, meaning only Statement II is true.

In the fifth question, three-point charges with equal magnitudes are placed equally spaced in the same direction. Two of these charges are positive, and the one on the far right is negative. Between the charges, points L and M are given, and the ratio of the potentials at these points is asked. Since potential is a scalar quantity, the ratio can be found by summing the potentials of the three charges at the given points. When these calculations are performed, the ratio is 5. This is given in option E. Only ChatGPT solved this question correctly with the correct steps, while Copilot gave the wrong answer, and Gemini provided an answer not listed among the options, stating that the potential at each point was equal.

In the sixth question, the paths of four particles of equal mass are drawn as they enter a uniform magnetic field perpendicular to the plane of the page. Particle K rotates clockwise, particle L moves straight without deviation, particle M rotates counterclockwise, and particle N rotates clockwise. The question asks which of the given options correctly identifies the sign of the charges based on their movements. Since the direction of the magnetic field is not provided, it should be considered as either in or out of the plane of the page, and the right-hand rule should be applied to the particles accordingly. Considering these situations, K and N can be positive, M can be negative, and L can be neutral. This is given in option B. All three chatbots gave wrong answers to this question, indicating a failure to apply the right-hand rule correctly according to the magnetic field direction.

In the seventh question, it is stated that a resistor, a coil, and a capacitor are connected in series to an alternating voltage source. The question asks which of the following quantities will increase by increasing the frequency of the applied alternating voltage when this circuit is operating at resonance frequency: I. Impedance of the circuit, II. Effective current of the circuit, and III. Capacitance of the capacitor. Increasing the frequency will increase the inductance and decrease the capacitance, leading to an increase in impedance. Since the effective current depends on the maximum current, this value will remain the same. The only increasing quantity in the answer is the impedance of the circuit, that is, option A. ChatGPT and Gemini answered this question correctly, while Copilot gave the wrong answer by repeating the Statements and selecting C.

In the eighth question, three individuals compete in a race on a circular track with a common center. Each runner starts from a different point on the track and aims to reach the same finish line. Assuming all runners maintain constant speeds, the race commences simultaneously. The scenario reveals that Kardelen, who begins furthest behind, and Tulip, starting slightly ahead, complete the race at the same time. However, Violet, who had the initial lead, finishes last. The question then requires the comparison of the angular velocities of these runners with respect to the center of the circle. Given that Kardelen, despite starting from the furthest back, finishes first, and Violet, who began ahead, finishes last, it can be deduced that Kardelen possesses the highest angular velocity, while Violet exhibits the lowest. Tulip's angular velocity falls between these two extremes. This relationship is correctly identified in option A. Only Gemini provided the correct answer to this question, while ChatGPT and Copilot erred in their comparison of angular velocities.

In the ninth question, a satellite is depicted orbiting Earth at a constant speed R from the center, with external influences disregarded. Three Statements regarding the satellite's motion are presented, and the task is to determine their veracity. Statement-I states that the work done by gravity on the satellite during one complete revolution is zero. Statement-II asserts that the satellite's angular momentum remains constant. Statement-III claims that the net force acting on the satellite is zero. Since the satellite maintains a constant speed, it experiences a centripetal force, rendering statement III false. However, the satellite's angular momentum remains constant, and the work performed by gravity over one revolution is indeed zero. Therefore, Statements I and II are true. The correct answer is given in option C. ChatGPT, despite correctly identifying Statements I and II, incorrectly selected option D. Gemini, while correctly stating that Statements II and III are true, was classified as "N" as this combination was not among the provided options. Copilot initially failed to provide a solution when presented with the question accompanied by an image, likely due to language processing limitations. However, when the question was presented in textual format, Copilot successfully provided the correct answer.

In the tenth question, a metronome bar, considered massless, is equipped with a slider that can be treated as a point mass at its end. This system undergoes simple harmonic motion, akin to a simple pendulum. The slider's position can be adjusted, altering the oscillation period by varying the distance between the slider and the fixed points. The environment remains constant, and the period of oscillation of the rod is denoted as T_K when the slider is at point K (1 unit from the center) and T_L when the slider is at point L (3 units from the center). The question seeks the ratio of these periods (T_K/T_L). Recognizing that the period is directly proportional to the square root of the length, the ratio ($1/\sqrt{3}$) is determined. While ChatGPT selected option A, both Copilot and Gemini provided answers not listed among the options, resulting in their responses being classified as "N."

In the eleventh question, the siren of a stationary ambulance emits sound waves with a frequency of 1600 Hz. As the ambulance commences its journey along a linear path at a constant speed, it continues to emit sound waves at the same frequency. Simultaneously, the ambulance approaches Asuman while moving away from Altay. Ahmet, seated within the ambulance, observes the sound waves. The question inquires which of the given options accurately describes the frequencies of the sound waves perceived by Ahmet, Asuman, and Altay while the ambulance is in motion. The Doppler effect dictates that an observer approaching a sound source perceives a higher frequency, whereas an observer moving away from the source perceives a lower frequency. However, since Ahmet is within the ambulance, the frequency of the sound waves he perceives remains unchanged, matching the source frequency. Consequently, the correct answer is C, and the frequency heard by Asuman may indeed be 1700 Hz (indicating an increase). ChatGPT and Copilot correctly answered this question, while Gemini provided an incorrect response.

In the twelfth question, it is established that when a U-235 nucleus captures a low-energy neutron, it undergoes fission, resulting in the formation of two product nuclei, denoted as K and L, along with the release of a few neutrons. Numerous binary product combinations of different K and L nuclei can occur during this nuclear fission event. The question explores whether the sum of the atomic numbers, mass numbers, and neutron numbers of the K and L product nuclei in any of these combinations equals that of U-235. This statement is presented in option A. All three chatbots erroneously selected option E. Since neutrons are also released during the fission of uranium, the mass number and neutron number of the K and L nuclei will inevitably change. However, the atomic number (number of protons) remains constant. Therefore, only the atomic number of the K and L product nuclei in any combination will always equal that of U-235.

In the thirteenth question, a graph depicting the change in kinetic energy of electrons ejected from a metal surface as a function of the incident light frequency is presented. The question seeks to determine which values on the graph are sufficient to ascertain the metal's threshold energy without requiring any constants beyond those provided. According to the graph, point L, where the linear extension of the data intersects the frequency axis, corresponds to the threshold energy of the metal. Therefore, knowledge of this value alone is sufficient to determine

the threshold energy. The correct answer is B. ChatGPT and Gemini both selected option C, while Copilot chose option E.

In the fourteenth question, a graph illustrating the variation in resistance of a material with temperature is provided. A closed electrical circuit is constructed using this material to create a sliding rheostat. The rheostat's operation is tested at different temperatures, and the corresponding brightness of a lamp within the circuit is observed. Three Statements are presented, and the task is to identify the true statements based on the experimental observations and the provided graph. Statement I: At temperatures exceeding T_c , the bulb's brightness increases when the rheostat slide is moved from position 1 to position 2. Statement II: At temperatures above T_c , the battery in the circuit becomes unnecessary for the bulb to illuminate. Statement III: At temperatures below T_c , the bulb's brightness remains unchanged when the rheostat slide is moved from position 1 to position 2. The graph indicates that the material exhibits superconductivity at temperatures below T_c , maintaining a constant resistance. Conversely, at temperatures above T_c , the material's resistance increases. Based on these observations, Statement II is deemed false, while Statements I and III are true. The correct answer is given in option C. All three chatbots provided responses that were not among the listed options. ChatGPT asserted that only Statement III is true, Gemini claimed that Statements I and II are true, and Copilot stated that Statements I and III are true while also erroneously indicating that Statement II and IV are false. These explanations, however, lacked direct relevance to the question. Consequently, all three chatbot responses were categorized as "N".

Comparison of answers to AYT 2023 physics questions

ChatGPT demonstrated a superior performance, correctly answering 71.42% of the 2023 AYT Physics questions, while Gemini achieved 28.57% and Copilot 14.28%. A comparative analysis of the answers provided by these AI models to each question is presented below. (Note: The answers provided by the bots to some questions are included in the appendix.)

In the first question, a vector-based scenario involves a dog escaping from a garden hut. The dog initially travels 100 meters northeast (NE) and then 60 meters west on the horizontal plane. Ahmet, the dog's owner, runs 60 meters west from the hut to a cherry tree upon observing the dog's escape. The question requires the determination of the shortest distance and direction Ahmet must travel from the cherry tree to reach his dog. By graphically representing the movements as vectors, it is determined that Ahmet needs to travel 100 meters in the northeast direction from the tree. This solution is presented in option D. ChatGPT initially selected option C when the question was presented as an image but provided the correct answer when presented in text format. Gemini consistently selected option C for both image and text versions. Copilot, while recognizing the vector nature of the problem, incorrectly interpreted the scenario as involving an ice skater, leading to the selection of option A.

In the second question, a tray with a mass of 0.8 kg and a juice box with a mass of 0.4 kg are positioned on a horizontal, frictionless table. Ali exerts a constant, horizontal force on the tray, causing both objects to move together. Given that the juice box accelerates at 5 m/s^2 , the question asks for the magnitude of the force applied by Ali to the tray. Employing Newton's Second Law ($F=ma$), the magnitude of the force is calculated to be 8 N. The correct answer is C. All three AI models successfully arrived at the correct answer due to the straightforward application of this fundamental physics principle.

In the third question, the speed-time graphs of two automobiles, initially at rest, are provided. The question presents three statements regarding their motion: Statement I: Automobile K initially accelerates and then decelerates to a stop. Statement II: Automobile K returns to its starting position at the 30-second mark.

Statement III: At the 30-second mark, automobile L is positioned ahead of automobile K. An analysis of the graph reveals that Statement I is true, while Statements II and III are false. Consequently, the correct answer is option A. ChatGPT incorrectly asserted the veracity of all three statements. Gemini, after analyzing the question, inconsistently concluded that only Statement II is true, selecting option B. Copilot provided an inconclusive answer, demonstrating an incorrect processing of the question.

In the fourth question, a 1 kg block of play dough is utilized in an inelastic collision experiment. Identical 0.1 kg iron balls are horizontally thrown at 3 m/s towards the block. Upon impact, the balls adhere to the block, causing it to move at 2 m/s on a frictionless surface. The question seeks to determine the number of iron balls that become embedded in the block. By applying the principle of conservation of momentum, it can be determined that a total of 20 balls become embedded in the block. This solution is presented in option D. ChatGPT and Gemini both arrived at the correct answer, while Copilot provided an incorrect solution.

In the fifth question, Ayşe and Ali enter a revolving door within a store. The door comprises four identical wings (K, L, M, and P) that rotate around the central axis (O). Handles L and M are located 50 cm from the axis (O), while handles K and P are positioned 100 cm from the axis. Three statements are presented, and the question asks which scenarios would result in the rotation of the door around the axis O when forces are applied perpendicular to the door's surface: Statement I: Ayşe applies a 10 N force pushing at handle L and a 10 N force pulling at handle M. Statement II: Ayşe applies a 20 N force pulling at handle L and a 10 N force pulling at handle P. Statement III: Ayşe applies a 20 N force pushing at handle K and a 10 N force pushing at handle P.

By examining the torques (moments) generated, it can be determined that the door will rotate in scenarios I and III, while in scenario II, the net torque is zero. The correct answer is therefore I and III, which corresponds to option C. ChatGPT provided the correct answer, while Gemini provided an incorrect response. Copilot failed to provide a relevant answer, instead offering explanations unrelated to the question.

In the sixth question, an ammeter with a wire frame positioned within a uniform magnetic field rotates around an axis. The ammeter needle indicates zero when no current flows through the wire frame. When a current (i) passes through, the magnetic field exerts a force proportional to the current, causing the needle to deflect. The question inquiries about the changes that would result in a greater needle deflection: I: Using a magnet with stronger pole intensities. II: Decreasing the distance between the N and S poles of the magnet. III: Increasing the distance between the N and S poles of the magnet. Statements I and II are correct, while Statement III is incorrect. This combination is presented in option D. All three AI models correctly answered this question.

In the seventh question, a camera flash system is described, comprising a battery, capacitor, switch, and a specialized bulb. When the switch is activated, the energy stored in the capacitor by the battery is released, producing a bright flash of light. The question presents three statements: Statement I: Increasing the battery's potential difference decreases the capacitor's capacitance. Statement II: Utilizing a fully charged capacitor with a larger capacitance results in a more intense flash. Statement III: During the flash, the charge stored in the capacitor decreases. Statements II and III are correct, while Statement I is incorrect. This combination is presented in option E. ChatGPT provided the correct answer, while Copilot and Gemini provided incorrect responses. Gemini inconsistently concluded that all three statements were correct and selected an option that was not available, resulting in an incorrect classification. This analysis highlights the varying performance levels of the AI models across different physics question types. While ChatGPT demonstrated superior performance overall, all three models exhibited limitations in specific areas, such as vector analysis, graph interpretation, and nuanced conceptual understanding.

The eighth question addresses a simple transformer with primary and secondary windings. It states that when a voltage is applied to the primary circuit, a voltage is induced in the secondary circuit. The question then inquires which of the following quantities in the primary circuit are typically greater than their corresponding values in the secondary circuit: I. Voltage, II. Power, III. Number of turns. In an ideal transformer, power is conserved. However, in a real-world transformer, energy losses (such as those due to resistance and core losses) occur. Therefore, the power in the secondary circuit is generally less than the power in the primary circuit. Consequently, only explanation II (power) is correct. This is presented as option B. ChatGPT provided the correct answer, while Gemini and Copilot offered incorrect responses.

The ninth question involves a series of experiments designed to determine the type of three unknown circuit elements: K, L, and M. In these experiments, an alternating voltage with constant amplitude and variable frequency is applied to each element, and the resulting change in impedance is measured. The experimental results reveal the following: I. The resistance of K increases with frequency. II. The resistance of L remains constant. III. The resistance of M decreases with frequency. Based on these observations: K exhibits the characteristics of an inductor (coil), as the impedance of an inductor increases with increasing frequency. L demonstrates the behavior of a resistor, as its resistance remains constant regardless of frequency. M exhibits the characteristics of a capacitor, as the impedance of a capacitor decreases with increasing frequency. The correct answer is option D. ChatGPT and Gemini provided correct answers, while Copilot provided an incorrect response.

In the tenth question, the motions of a glass ball undergoing uniform circular motion on a string and an iron ball undergoing simple harmonic motion on a spring are compared. The question asks which of the following statements are true: I. The velocities of these two balls are always constant. II. Their acceleration is always perpendicular to the velocity. III. The work done by the net force on the balls in one period is zero. Uniform Circular Motion: Velocity is constant in magnitude but continuously changes direction. Acceleration (centripetal acceleration) is always directed towards the center of the circle and is perpendicular to the velocity. The net force (centripetal force) acts perpendicular to the displacement over one complete cycle, resulting in zero-net-work.

Simple Harmonic Motion: Velocity varies continuously. Acceleration is always directed towards the equilibrium position and is not always perpendicular to the velocity. The net force acts against displacement, resulting in zero-net-work over one complete cycle. Therefore, only Statement III is true for both types of motion. The correct answer is option C. None of the AI models provided the correct answer. ChatGPT and Copilot selected option D, while Gemini incorrectly stated that Statements I and III are true and selected option D, which was not a valid option, resulting in its response being classified as "N." This indicates a potential gap in the AI models' ability to compare different types of motion.

In the eleventh question, Ayşe observes an acrobat walking on a tightrope while balancing with a pole. Her physics teacher explains that this balancing act can be understood in terms of the concept of moment of inertia. The question asks which of the following changes would assist the tightrope walker in maintaining balance: I. Using a pole of the same mass but greater length. II. Attaching two identical weights to the ends of the same pole. III. Using a pole of the same length but less mass. Increasing the moment of inertia around the tightrope walker's center of mass would enhance stability. This can be achieved by: I. Increasing the length of the pole: This increases the distance of the pole's mass from the axis of rotation (the tightrope walker's center of mass), thereby increasing the moment of inertia. II. Attaching weights to the ends of the pole: This also increases the distance of the mass from the axis of rotation, increasing the moment of inertia. Therefore, Statements I and II are correct. The correct answer is option C. ChatGPT provided the correct answer, while Copilot and Gemini incorrectly stated that Statements II and III were correct.

In the twelfth question, the rings of a planet consist of particles orbiting in their own paths. Identical particles K and M orbit the planet, with K located closer to the planet than M. The question asks which of the following quantities are smaller for particle K compared to particle M: Linear velocity, Orbital period, Angular velocity, Magnitude of centripetal acceleration and Gravitational force. Kepler's Laws of Planetary Motion dictate that: Closer objects to the planet have shorter orbital periods. Closer objects to the planet have higher linear velocities. Closer objects to the planet experience greater gravitational forces. Therefore, only the orbital period of particle K is smaller than that of particle M. The correct answer is option B. Only ChatGPT provided the correct answer. Gemini and Copilot provided incorrect responses, with Copilot selecting option C without providing any explanation, resulting in its response being classified as "N."

In the thirteenth question, in an environment without air friction, a point target tied to a string undergoes simple harmonic motion between points A and C. An archer fires an arrow at a constant speed of 50 m/s parallel to the ground as the target begins its motion from point A. The arrow strikes the target at point B, which is located 100 meters away and represents the equilibrium position. The question asks for the oscillation period of the target. The horizontal travel time of the arrow is $100 \text{ m} / 50 \text{ m/s} = 2 \text{ seconds}$. Since the target travels from point A to point B (one-quarter of the oscillation) in 2 seconds, the full oscillation period is $2 \text{ seconds} \times 4 = 8 \text{ seconds}$. The correct answer is option D. ChatGPT and Copilot selected option C, while Gemini did not specify an option, stating only that the period is less than 2 seconds. Gemini's response was therefore classified as "N."

In the fourteenth question, an interference pattern is observed in water. The question requires the comparison of the vibration amplitudes at three different points (I, II, and III) within this pattern. Points I and III correspond to regions of constructive interference (peak + peak), resulting in maximum amplitude. Point II corresponds to a region of destructive interference (peak + trough), resulting in minimal or zero amplitude (damping point). Therefore, the amplitudes at points I and III are equal and greater than the amplitude at point II. The correct answer is option C. Only ChatGPT provided the correct answer. Copilot initially provided option A when the question was presented in Turkish but later provided option C when presented in English, without offering a detailed explanation. The response provided in Turkish was accepted as correct.

Comparison of answers given to AYT 2022 physics questions

In the first question, Ahmet pushes a parcel forward, while Ali pulls it towards him simultaneously. The question explores the possible directions of motion for the parcel given the combined forces. All three AI models provided incorrect answers. The correct answer is that the parcel can move in directions II and III, as the combined forces will result in a net force that does not solely align with the direction of either individual force. This is presented in option D.

The second question describes a truck traveling at a constant speed eastward on a horizontal, frictionless road. A crate rests on the horizontal plane of the truck. The question asks which of the following statements are true for an observer at rest relative to the ground: I. The truck exerts an easterly force on the crate in the horizontal direction. II. The crate exerts a downward force on the truck in the vertical direction. III. The net force acting on the crate is

zero. All three AI models provided incorrect answers. The correct answer is that statements II and III are true, while statement I is false. This is presented in option D.

The third question presents two experiments involving identical eggs. In the first experiment, an egg dropped from a height onto a hard surface break without bouncing. In the second experiment, the egg is surrounded by soft packaging foam before being dropped from the same height. In this case, the egg stops without breaking. The question asks which of the following quantities increased during the collision in the second trial compared to the first: I. The interaction time between the egg and the ground. II. The change in momentum of the egg. III. The average force exerted by the ground on the egg. The correct answer is that in the second experiment, the interaction time between the egg and the ground increased. This is presented in option A. All three AI models provided incorrect answers.

The fourth question presents a scenario where Ayşe is given three scissors of the same length but with different blade lengths and distances from the support point to the blade tip. She is asked to determine which pair of scissors would require the least force to cut a wire when applying force vertically to the handles. The correct answer is that the force required to cut the wire is minimized when the force arm (distance from the handle to the support point) is maximized and the load arm (distance from the support point to the blade tip) is minimized. This is presented in option A. All three AI models provided incorrect answers. Copilot's answer was deemed irrelevant and classified as "N."

The fifth question describes a positively charged particle moving through two regions. In region I, the particle moves without deviation in a uniform electric field. In region II, the particle deviates clockwise in a uniform magnetic field. The question asks for the directions of the applied electric and magnetic fields that would result in this observed motion. The correct answer is that the electric field must be in the direction of the particle's movement, and the magnetic field must be directed outward from the plane of the page, as determined by the right-hand rule. This is presented in option A. Both Copilot and Gemini failed to provide any answer, resulting in their responses being classified as "N." Only ChatGPT provided and explained the correct answer.

The sixth question addresses the Compton effect, specifically inquiring about the changes in the properties of a photon after undergoing Compton scattering. The question asks which of the following quantities decrease in magnitude for the scattered photon compared to the incident photon: I. Velocity, II. Momentum, III. Wavelength. ChatGPT and Copilot selected option C, and Gemini selected option D, all of which were incorrect. The correct answer is that the momentum of the scattered photon decreases, its speed remains constant, and its wavelength increases due to a decrease in energy. This is presented in option B.

The seventh question presents a scenario involving an electrical appliance, a socket, and a transformer. The transformer has primary and secondary windings with a turn ratio of 2:1 (KN: LM). The electrical appliance operates at 110 volts, and the socket provides 220 volts. The question asks how the cables should be connected for the appliance to function correctly. All three AI models provided incorrect answers. ChatGPT and Copilot selected option C, while Gemini selected option A. The correct answer is to connect the socket ends to the high-voltage winding part of the transformer (L to 1 and M to 2) and the appliance to the low-voltage winding part (K to 3 and N to 4). This is presented in option E."

The eighth question presents three arrows that are shot and embedded into a target board that is rotating at a constant angular velocity. Arrow K is closest to the center, arrow M is furthest away, and arrow N is positioned in the middle. The question asks to compare the angular and linear velocities of these arrows. All arrows share the same angular velocity as the rotating target board. However, their linear velocities differ. The outer arrow (M) possesses the highest linear velocity, while the inner arrow (K) has the smallest linear velocity. This relationship is correctly expressed in option E. Only ChatGPT provided the correct answer. Copilot and Gemini were unable to provide a complete answer, resulting in their responses being classified as "N."

The ninth question presents the Earth's orbit around the Sun depicted, with point B representing the perihelion (closest point) and point A representing the aphelion (farthest point). The question asks for a comparison of the magnitudes of Earth's angular momentum and linear velocity at these points. The angular momentum of the Earth-Sun system remains constant due to the conservation of angular momentum. However, Earth's linear velocity is greater at perihelion (point B) than at aphelion (point A) due to Kepler's laws of planetary motion. The correct answer is given in option C. All three AI models provided incorrect answers. For example, ChatGPT incorrectly identified the closest position as the farthest, leading to an opposite conclusion.

The tenth question presents an object attached to a spring undergoes simple harmonic motion on a frictionless horizontal plane. The question asks which of the following statements are true: I. The object's acceleration is greatest when its speed is lowest. II. The spring's potential energy is lowest when the object's velocity is lowest. III. The force exerted by the spring on the object is inversely related to its velocity throughout the motion. Statement I is true. At the turning points of the motion (maximum displacement), the object's speed is zero, and its acceleration is at a maximum. Statement II is false. The spring's potential energy is maximum when the object's displacement is maximum, and its velocity is zero. Statement III is false. The force exerted by the spring is directly proportional to the displacement from the equilibrium position, not inversely proportional to the velocity. Only statement I is correct. The correct option is A. All three AI models incorrectly selected option D, which stated that both I and II are true.

The eleventh question presents the Doppler effect as a phenomenon observed in various types of waves. The question asks about the types of waves in which this effect can be observed: I. Transverse waves, II. Longitudinal waves, III. Electromagnetic waves. The Doppler effect can be observed in all three types of waves: Transverse waves: Examples include electromagnetic waves (light, radio waves) and waves on a string. Longitudinal waves: Examples include sound waves. The correct answer is option E, indicating that the Doppler effect can be observed in all three types of waves. All three AI models correctly answered this question.

The twelfth question starts with the following explanation: Higgs boson, a fundamental particle predicted and discovered by the Standard Model, interacts with other particles to give them mass. Then, the question asks which particles interact with the Higgs boson: I. Photon, II. Electron, III. Up quark. Photons, being massless, do not interact with the Higgs boson. Electrons and up quarks, however, do interact with the Higgs boson and acquire mass through this interaction. The correct answer is option D. All three AI models correctly answered this question. The thirteenth question addresses the postulates of Einstein's special theory of relativity: I. The speed of light in a vacuum is constant for all observers, regardless of their relative motion. II. The laws of physics are the same for all observers in uniform motion relative to one another. Statement III, which states that the laws of physics change according to the motion of the observer, is incorrect. The correct option is D.

In the fourteenth question a conversation between friends about medical imaging techniques is given: Zeynep discusses not keeping metal objects near the device. Ömer mentions a method using potentially harmful light. Şule mentions a device that doesn't use electromagnetic waves. The correct interpretations are: Zeynep: This likely refers to an MRI (Magnetic Resonance Imaging) scan, which uses strong magnetic fields and requires the removal of metal objects. Ömer: This likely refers to an X-ray scan, which uses X-rays, a form of electromagnetic radiation. Şule: This likely refers to an ultrasound scan, which utilizes sound waves instead of electromagnetic radiation. The correct answer is option A. Gemini provided the correct answer, while ChatGPT and Copilot provided incorrect answers.

CONCLUSION AND DISCUSSION

This study aimed to analyze and compare the performance of three AI chatbots—ChatGPT, Gemini, and Copilot—in answering questions from the Turkish Physics Entrance Examination over the past three years. The findings revealed that ChatGPT correctly answered 38.09% of the TYT physics questions, while Gemini and Copilot each achieved a success rate of 28.57%. For the AYT physics questions, ChatGPT demonstrated superior performance with a correct response rate of 45.23%, compared to Gemini's 26.18% and Copilot's 14.28%. Although ChatGPT outperformed the other chatbots overall, Copilot exhibited the lowest success rate. Notably, the correct answer rates for all chatbots remained below an acceptable threshold for both the TYT and AYT questions.

Additionally, the analysis of TYT questions labeled as "N" (indicating irrelevant answers) showed that both ChatGPT and Copilot produced three such responses (14.28%), whereas Gemini had four (19.04%). For AYT questions, ChatGPT had one "N" response (2.38%), while Gemini had 12 (28.57%) and Copilot had seven (16.66%). These results suggest that Gemini and Copilot underperformed in providing relevant answers compared to ChatGPT. Specifically, Copilot frequently struggled with questions requiring image interpretation, often failing to comprehend and respond accurately (see Appendix).

Previous research supports these findings. Gregorcic and Pendrill (2023) noted that ChatGPT's responses to physics questions were often unreliable and inconsistent, rendering it inadequate as a primary resource for students and educators. Dahlkemper et al. (2023) reported that ChatGPT performed reasonably well on complex physics questions, whereas Kortemeyer (2023) found that ChatGPT-3.5's performance on the Force Concept Inventory (FCI) was comparable to that of novice students, with a correct answer rate of approximately 50–60%. Similarly, the average correct answer rate for all three chatbots on the TYT and AYT physics questions remained below 50%, indicating suboptimal performance. In contrast, dos Santos (2023) found that ChatGPT-4 outperformed Bing and

Bard in answering physics questions, offering more accurate and detailed responses. Yeadon and Hardy (2023) observed that ChatGPT-3.5 correctly answered only 30–40% of university entrance-level physics questions. Also, Aldazharova et al. (2024) reported that GPT-4 demonstrated impressive proficiency on numerous FCI items, especially those pertaining to Newton's third law, where it achieved perfect scores on several questions. However, it faced considerable challenges with items that required the interpretation of figures and spatial reasoning. While AI holds great potential as an educational tool, it still needs substantial improvement to fully align with human problem-solving abilities. Meanwhile Tong et al. (2024) reported that in comparison to the performance of ChatGPT-3.5 and the students, ChatGPT-4 demonstrated superior capabilities in tackling physics conceptual understanding and reasoning problems.

General limitations of large language models (LLMs) as AI agents have been highlighted by researchers such as McIntosh et al. (2024), Hadi et al. (2024), and Lappin (2024). These limitations extend to AI chatbots answering physics questions (Borji, 2023; Gregorcic & Pendrill, 2023; Liang et al., 2023; Polverini & Gregorcic, 2024). Liang et al. (2023) identified three key constraints: (1) LLMs generate text by predicting speech patterns rather than applying human-like reasoning, leading to deficiencies in numerical problem-solving; (2) while mathematical variables are used symbolically, physical variables correspond to real-world phenomena, making it difficult for LLMs to correctly translate problem statements into applicable physical concepts; and (3) physics problems often require vector-based reasoning rather than straightforward numerical calculations, posing additional challenges for LLMs.

These limitations may explain the chatbots' poor performance on physics-related questions. For example, when addressing questions about magnetic fields, the chatbots often fail to apply theoretical principles correctly. Similarly, when interpreting a mass-volume graph in TYT questions, the chatbots focused solely on graphical trends, overlooking fundamental physical principles such as the stratification of fluids based on density. Borji (2023) identified 11 common error types in ChatGPT's responses, including logical, mathematical, coding, and factual errors, as well as inherent biases. The accuracy of chatbot responses varies across domains, with higher performance observed in fields such as finance, programming, law, and health education (Lo, 2023). Improving LLMs' performance on conceptual physics tasks may require deeper insight into their operational mechanics and the application of effective engineering techniques. Persistent challenges include handling complex knowledge, ambiguous statements, deep analysis, and context-dependent questions.

To enhance AI performance in physics education, improvements in training methodologies are necessary. One approach is to integrate domain-specific datasets with targeted reinforcement learning techniques, ensuring that chatbots develop a deeper understanding of physics principles. Fine-tuning LLMs using expert-reviewed educational resources, including structured physics textbooks and problem sets, may enhance their ability to process and apply physical laws accurately. Moreover, hybrid AI models combining rule-based systems with deep learning can mitigate the inconsistencies observed in generative models by enforcing logical and mathematical consistency.

The constraints limiting chatbot performance can be further understood through established cognitive theories. Bloom's Taxonomy classifies cognitive learning into six levels, from basic knowledge recall to higher-order evaluation and creation. AI models generally excel at lower-level cognitive tasks, such as recalling definitions or summarizing information, but struggle with higher-order reasoning, such as synthesizing multiple concepts or evaluating physical scenarios. Enhancing AI's ability to function at higher cognitive levels would require incorporating reasoning-based training methodologies, such as logic-driven fine-tuning and problem-decomposition strategies.

Similarly, Cognitive Load Theory (CLT) posits that complex tasks requiring high cognitive effort can overwhelm a learner's working memory, hindering comprehension and problem-solving. AI-generated responses that provide overly detailed, yet incoherent explanations may contribute to extraneous cognitive load, reducing their educational effectiveness. Training AI models to prioritize clarity, coherence, and problem-relevant explanations could improve their usability in educational settings. Additionally, adaptive AI models that assess user proficiency and tailor explanations accordingly could enhance student learning experiences by reducing cognitive overload. To ensure that Turkish physics questions were correctly interpreted by the AI chatbots, some were also posed in English. The responses remained unchanged, suggesting that the chatbots understood the language but misinterpreted the underlying meaning, leading to incorrect answers - a phenomenon also reported by Kharchenko and Babenko (2024).

In this study, TYT and AYT questions were presented to the chatbots using simple prompts, resulting in varied response styles, ranging from concise answers to detailed solutions (see Appendix for examples). Future research

could explore whether more detailed prompts influence chatbot performance. Given the probabilistic nature of LLMs, their problem-solving abilities should be assessed with caution. The variability in responses to identical questions is influenced by a parameter known as "temperature." Most chatbots operate with a default temperature setting of 0.7, allowing for response variation, whereas a temperature of zero ensures consistency by selecting the highest-probability response. Higher temperature settings increase the likelihood of deviation from optimal answers (Borovský, Hanč, & Hančová, 2024).

Furthermore, general LLMs such as ChatGPT are trained on vast internet-based datasets, which may propagate misconceptions or AI hallucinations. To mitigate these issues, AI tools should be leveraged as facilitators rather than authoritative sources in active learning environments (Borovský, Hanč, & Hančová, 2024). Students must be encouraged to critically evaluate chatbot-generated responses and cross-verify information with reliable sources. Additionally, researchers, educators, and students should recognize that AI chatbot performance can be improved through prompt optimization (Kharchenko & Babenko, 2024).

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2024 TYT 1st physics question

[illegible]

2024 TYT 2nd physics question	Answer given by ChatGPT (Turkish)	Answer given by Copilot (Turkish)	Answer given by Gemini (Turkish)
2. Farklı maddelerden yapılmış m, $2m$ ve $4m$ kütleli K, L ve M blokları yatay olarak aynı yükseklikten aynı F kuvvetiyle aynı hızla itilerek aynı yatay zeminde hareket ettirilmektedir. Bloklar ile zemin arasındaki statik sürtünme katsayıları K bloğu için $\frac{1}{3}$, L bloğu için $0,5$ ve M bloğu için ise $0,8$ olduğudur. F kuvvetinin büyüklüğüne bağlı olarak K, L ve M bloklarının yatay yönde oluşan statik sürtünme kuvvetleri K_f, L_f ve M_f için büyüklük sıralaması aşağıdakilerden hangisidir? A) $K_f = L_f = M_f$ B) $K_f > L_f > M_f$ C) $K_f < L_f < M_f$ D) $K_f = L_f < M_f$ E) $K_f = L_f > M_f$	• Blokların hareket ettirilmesi için uygulanan F kuvveti aynı statik sürtünme kuvveti f_s ile dengelenmektedir. Statik sürtünme kuvveti f_s şu şekilde hesaplanır: $f_s = \mu_s \cdot N$ Burada μ_s statik sürtünme katsayısı ve N normal kuvveti (kuvvetin yatay bileşeni) olarak kabul edilebilir. Normal kuvveti $N = mg$ olarak alabiliriz. Bu durumda her blok için statik sürtünme kuvveti hesaplanabilir: - K bloğu: $\mu_s = \frac{1}{3}$, $N_K = m \cdot g$, $f_{sK} = \mu_s \cdot N_K = \frac{1}{3} \cdot m \cdot g = \frac{1}{3} m \cdot g$ - L bloğu: $\mu_s = 0,5$, $N_L = 2m \cdot g$, $f_{sL} = \mu_s \cdot N_L = 0,5 \cdot 2m \cdot g = m \cdot g$ - M bloğu: $\mu_s = 0,8$, $N_M = 4m \cdot g$, $f_{sM} = \mu_s \cdot N_M = 0,8 \cdot 4m \cdot g = 3,2m \cdot g$ Bu durumda statik sürtünme kuvvetleri büyüklük sıralaması şu şekilde olur: $f_{sM} > f_{sL} > f_{sK}$ Doğru cevap D) $K_f = L_f < M_f$ olacaktır.	• Etkiyen kuvvetlerin büyüklük sıralaması: - K bloğu için: $f_{sK} = \mu_K \cdot N_K = \frac{1}{3} \cdot m \cdot g$ - L bloğu için: $f_{sL} = \mu_L \cdot N_L = 0,5 \cdot 2m \cdot g = m \cdot g$ - M bloğu için: $f_{sM} = \mu_M \cdot N_M = 0,8 \cdot 4m \cdot g = 3,2m \cdot g$ Bu durumda statik sürtünme kuvvetleri büyüklük sıralaması şu şekilde olur: $f_{sM} > f_{sL} > f_{sK}$ Doğru cevap D) $K_f = L_f < M_f$ olacaktır.	• Statik sürtünme kuvveti $f_s = \mu_s \cdot N$ olarak hesaplanır. Burada μ_s statik sürtünme katsayısı ve N normal kuvveti (kuvvetin yatay bileşeni) olarak kabul edilebilir. Normal kuvveti $N = mg$ olarak alabiliriz. Bu durumda her blok için statik sürtünme kuvveti hesaplanabilir: - K bloğu: $\mu_s = \frac{1}{3}$, $N_K = m \cdot g$, $f_{sK} = \mu_s \cdot N_K = \frac{1}{3} \cdot m \cdot g = \frac{1}{3} m \cdot g$ - L bloğu: $\mu_s = 0,5$, $N_L = 2m \cdot g$, $f_{sL} = \mu_s \cdot N_L = 0,5 \cdot 2m \cdot g = m \cdot g$ - M bloğu: $\mu_s = 0,8$, $N_M = 4m \cdot g$, $f_{sM} = \mu_s \cdot N_M = 0,8 \cdot 4m \cdot g = 3,2m \cdot g$ Bu durumda statik sürtünme kuvvetleri büyüklük sıralaması şu şekilde olur: $f_{sM} > f_{sL} > f_{sK}$ Doğru cevap D) $K_f = L_f < M_f$ olacaktır.

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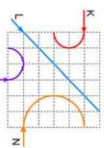
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2022 TYT 2nd physics question	Answer given by ChatGPT (Turkish)	Answer given by Copilot (Turkish)	Answer given by Gemini (Turkish)
2. Bir öğrencinin, kütlesi 1 kg olan kitabı sırtına, yatağı bir masanın üzerine bırakmadan önce, kitabın sırtına bir kuvvet uygular. Bu kuvvetin büyüklüğüne göre aşağıdaki öğrenci ifadelerinden hangisi yanlıştır? A) Kitabın Yatağına uyguladığı kuvvet 10 N'dir. B) Yatağın kitaba uyguladığı kuvvet 10 N'dir. C) Kitabın masaya uyguladığı kuvvet 10 N'dir. D) Masanın kitaba uyguladığı kuvvet 10 N'dir. E) Yatağın masaya uyguladığı kuvvet 10 N'dir.	Answer given by ChatGPT (ing. translation) Let's consider the system where the book is left stationary on a horizontal table in the classroom. - The only force acting on the book is the gravitational force, which is the weight of the book. Given that the mass of the book is $m = 1 \text{ kg}$ and the gravitational acceleration is $g = 10 \text{ N/kg}$, the weight of the book is $F_g = m \cdot g = 1 \text{ kg} \cdot 10 \text{ N/kg} = 10 \text{ N}$. - The gravitational force (the force that the book exerts on the Earth) is 10 N. This is correct. - The table applies an upward normal force on the book. According to Newton's third law of motion, this normal force is equal in magnitude and opposite in direction to the gravitational force acting on the book. Thus, the table applies an upward normal force of 10 N on the book. - The book, according to Newton's third law of motion, applies a downward normal force of 10 N on the table. Let's examine the student's statements: A) The force the book applies on the Earth is 10 N. This is correct. B) This is correct, as it is the weight of the book. C) The force the Earth applies on the book is 10 N. D) This is correct, as the Earth applies a gravitational force on the book. E) The force the book applies on the table is 10 N. As a result, statement E) cannot be concluded from the given information because the Earth does not directly apply a force on the table. The correct answer is E).	Answer given by Copilot (ing. translation) According to the given information, a book with a mass of 1 kg is stationary on a table and is not affected by any other force. In this case, we need to determine which of the following statements cannot be concluded: A) The force the book applies on the Earth is 10 N. This is calculated as the product of the book's mass and the acceleration due to gravity: $F = m \cdot g = 1 \text{ kg} \cdot 10 \text{ m/s}^2 = 10 \text{ N}$. Therefore, option A is correct. B) The force the Earth applies on the book must be equal in magnitude and opposite in direction. This is also calculated as 10 N. Therefore, option B is correct. C) The force the book applies on the table must be equal in magnitude and opposite in direction. This is also calculated as 10 N. Therefore, option C is correct. D) The force the table applies on the book must be equal in magnitude and opposite in direction. This is also calculated as 10 N. Therefore, option D is correct. E) The force the Earth applies on the table is calculated as the product of the table's mass and the acceleration due to gravity. However, since the mass of the table is not given, this statement cannot be concluded. As a result, option E is the statement that cannot be concluded from the given information.	Answer given by Gemini (Turkish) Çözüm Kitabın kütlesi 1 kg ve yerçekimi ivmesi $g = 10 \text{ m/s}^2$ olarak veriliyor. Kitabın ağırlığı $F_g = m \cdot g = 1 \cdot 10 = 10 \text{ N}$ olarak bulunur. Bu durumda, kitabın ağırlığı 10 N'dir. Bu kuvvet, kitabın yatağına uyguladığı kuvvettir. Yatağı kitaba uyguladığı kuvvet ise bu kuvvetin tersi ve büyüklüğü aynıdır, yani 10 N'dir. Kitabın masaya uyguladığı kuvvet ise kitabın ağırlığına eşittir, yani 10 N'dir. Masanın kitaba uyguladığı kuvvet ise kitabın ağırlığına eşittir, yani 10 N'dir. Yatağın masaya uyguladığı kuvvet ise yatağın ağırlığına eşittir, yani 10 N'dir. Yanıt: E) Yatağın masaya uyguladığı kuvvet 10 N'dir.

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2024 AYR 2 nd Physics question	Answer given by ChatGPT (Turkish)	Answer given by Copilot (Turkish)	Answer given by Gemini (Turkish)
2. Birisi bir sag elini sag elinde bulanan 1 kg kütlesi bir top ile 1 g kütlesi bir kuguyu havadan birimlik olarak aynı anda serbest bırakıyor. Bu durumda: 1. Hareket denklemleri aynı olacaktır. 2. Hareket denklemleri aynı olacaktır. 3. Hareket denklemleri aynı olacaktır. Doğru cevap: A) Yanlış I B) Yanlış II C) Yanlış III D) I ve II E) II ve III	Grup e) ve III Açıklama: 1. Hareket denklemleri aynı olacaktır (I): Her iki cisim de aynı net kuvvet (kuvvet) ve aynı kütle (kütle) ile hareket eder. Bu nedenle, her iki cisim de aynı ivme (ivme) ile hareket eder. Bu nedenle, her iki cisim de aynı yarıya düşer. Bu nedenle, her iki cisim de aynı yarıya düşer. 2. Hareket denklemleri aynı olacaktır (II): Her iki cisim de aynı net kuvvet (kuvvet) ve aynı kütle (kütle) ile hareket eder. Bu nedenle, her iki cisim de aynı ivme (ivme) ile hareket eder. Bu nedenle, her iki cisim de aynı yarıya düşer. Bu nedenle, her iki cisim de aynı yarıya düşer. 3. Hareket denklemleri aynı olacaktır (III): Her iki cisim de aynı net kuvvet (kuvvet) ve aynı kütle (kütle) ile hareket eder. Bu nedenle, her iki cisim de aynı ivme (ivme) ile hareket eder. Bu nedenle, her iki cisim de aynı yarıya düşer. Bu nedenle, her iki cisim de aynı yarıya düşer. Doğru cevap: A) Yanlış I B) Yanlış II C) Yanlış III D) I ve II E) II ve III	2. Soru Çözümü: Bu fizik problemi, serbest düşme hareketi ile ilgili bir sorudur. Soru, bir nesnenin serbest düşme hareketi sırasında ivmesi ve hızı hakkında bilgi soruyor. Serbest düşme hareketinde, bir nesnenin ivmesi (g) her zaman aynıdır ve yaklaşık 9.8 m/s²'dir. Bu nedenle, her iki nesnenin de aynı ivme ile düşeceği ve aynı zamanda aynı yarıya düşeceği anlamına gelir. Bu nedenle, doğru cevap A) Yanlış I, B) Yanlış II, C) Yanlış III, D) I ve II, E) II ve III'dir.	2. Birisi bir sag elini sag elinde bulanan 1 kg kütlesi bir top ile 1 g kütlesi bir kuguyu havadan birimlik olarak aynı anda serbest bırakıyor. Bu durumda: 1. Hareket denklemleri aynı olacaktır. 2. Hareket denklemleri aynı olacaktır. 3. Hareket denklemleri aynı olacaktır. Doğru cevap: A) Yanlış I B) Yanlış II C) Yanlış III D) I ve II E) II ve III Answer given by Gemini (Turkish) 2. Birisi bir sag elini sag elinde bulanan 1 kg kütlesi bir top ile 1 g kütlesi bir kuguyu havadan birimlik olarak aynı anda serbest bırakıyor. Bu durumda: 1. Hareket denklemleri aynı olacaktır. 2. Hareket denklemleri aynı olacaktır. 3. Hareket denklemleri aynı olacaktır. Doğru cevap: A) Yanlış I B) Yanlış II C) Yanlış III D) I ve II E) II ve III

2024 AYI 4 th Physics question		Answer given by ChatGPT (Turkish)	Answer given by Copilot (Turkish)	Answer given by Gemini (Turkish)
4. Şu şekilde bir hareket ediyor. Bir cisim, dikey olarak aşağıya doğru bir eğri boyunca 2 m yükseklikteki noktadan başlıyarak aşağıya doğru hareket ediyor. Aşağıdaki ifadelerden hangisi yanlıştır? I. yoldan kazanç sağlanıyor. II. daha küçük kuvvet uygulanıyor. III. daha az iş yapılıyor. A) Yalnız I B) Yalnız II C) Yalnız III D) I ve II E) I ve III		ChatGPT I ve II Açıklama: 1. Yoldan kazanç sağlanıyor (I): Eğri, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor. Yoldan kazanç, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor. 2. Daha küçük kuvvet uygulanıyor (II): Eğri, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor. Yoldan kazanç, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor. 3. Daha az iş yapılıyor (III): İş, kuvvetin cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor. Yoldan kazanç, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor. Bu nedenle, işin değeri, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor. Yoldan kazanç, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor.	Copilot I ve II Soru: Bir cisim, dikey olarak aşağıya doğru bir eğri boyunca 2 m yükseklikteki noktadan başlıyarak aşağıya doğru hareket ediyor. Aşağıdaki ifadelerden hangisi yanlıştır? I. yoldan kazanç sağlanıyor. II. daha küçük kuvvet uygulanıyor. III. daha az iş yapılıyor. Bu durumda, doğru cevap I ve II'dir. Çünkü yoldan kazanç sağlanıyor ve daha küçük kuvvet uygulanıyor. İşin değeri ise, cismin hareketi boyunca daha uzun bir yoldan geçmesini sağlar. Bu nedenle, yoldan kazanç sağlanıyor.	Answer: D) I and II Explanation: 1. To gain distance (I): Using an inclined plane means the block travels a longer path compared to directly falling vertically. Therefore, there is a gain in distance. 2. To apply a smaller force (II): An inclined plane reduces the weight of the force needed to lift the block. When pulling the block up at a constant speed, the required force is less than lifting it directly. 3. To do less work (III): Work is the product of force and the distance over which the force is applied. For a given weight, the work done is the same regardless of the path taken. Therefore, using an inclined plane does not result in less work being done. Hence, using an inclined plane to pull the stone block up serves the purposes of I, gaining distance and II, applying a smaller force, but not III, doing less work.
		Answer given by ChatGPT (Ing. translation)	Answer given by Copilot (Ing. translation)	Answer given by Gemini (Ing. translation)
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2024 AYR 6th Physics question Küçük bir K, L, M ve N parçacıkları aynı düzlemde hareket ederken bir elektrik alan E tarafından etkilenmektedir. Bu parçacıkların hareketleri aşağıdaki gibidir: Buna göre K, L, M ve N parçacıklarının elektriksel yük durumlarıyla ilgili aşağıdaki eşleştirmeden hangisi doğru olabilir? K L M N A) $+$ $+$ $+$ $+$ B) $+$ $+$ $-$ $+$ C) $+$ $+$ $-$ $-$ D) $-$ $+$ $-$ $-$ E) $-$ $+$ $+$ $-$ 	Answer given by ChatGPT (Turkish) Sorunun çözümü için, parçacıkların hareketi alan yönünde hareketlerine bakarak, yük durumlarını belirleyebiliriz. Alan yukarıya doğru olduğu için, pozitif yükler aşağıya doğru hareket ederken, negatif yükler yukarıya doğru hareket eder. Bu durumda, K parçacığı yukarı doğru hareket ederken, L parçacığı aşağı doğru hareket eder. M parçacığı yukarı doğru hareket ederken, N parçacığı aşağı doğru hareket eder. Bu durumda, K parçacığı pozitif, L parçacığı negatif, M parçacığı pozitif ve N parçacığı negatif olabilir. Doğru cevap C şıkkıdır. • C) $+$ $+$ $-$ $-$		
Answer given by ChatGPT (Ing. translation) To solve the problem, it is necessary to determine the charge states of the particles by examining their movements in the magnetic field. Using the right-hand rule (Right Hand Rule 3), we can determine the direction in which the particles will deflect according to the sign of the charge. If the deflection direction is in the direction of the magnetic field, the particle is positively charged. If the deflection direction is opposite to the direction of the magnetic field, the particle is negatively charged. We will now analyze the direction of the force (deflection direction). By looking at the deflections of the particles based on their movement directions and the direction of the magnetic field, we can determine their charge states: - Particle A: Deflected downwards while moving from right to left. Deflection charge is opposite to the magnetic field, which is directed upwards. Therefore, A is positively charged. - Particle B: Deflected to the right while moving from top to bottom. Deflection charge is opposite to the magnetic field, which is directed upwards. Therefore, B is positively charged. - Particle C: Deflected to the left while moving from right to left. Deflection charge is opposite to the magnetic field, which is directed upwards. Therefore, C is negatively charged. - Particle D: Deflected downwards while moving from right to left. Deflection charge is opposite to the magnetic field, which is directed upwards. Therefore, D is negatively charged. Accordingly, C is negative, L is positive, M is positive, and N is negative. The option that matches this finding is: • C) $+$ $+$ $-$ $-$ The correct answer is option C.	Answer given by Copilot (Turkish) Sorunun Çözümü: Bu fizik problemi, manyetik alanın etkisi altında giren yüklü parçacıkların hareketiyle ilgili. Soru, pozitif yüklü bir parçacığın manyetik alanın etkisi altında hareket ederken, diğer üç parçacığın hareketiyle aynı şekilde hareket etmesi için doğru olanı bulmamızı istiyor. Manyetik alan yukarıya doğru olduğu için, pozitif yüklü bir parçacık, manyetik kuvvetin etkisiyle aşağıya doğru hareket ederken, negatif yüklü bir parçacık, manyetik kuvvetin etkisiyle yukarıya doğru hareket eder. Bu durumda, parçacığın yükü, manyetik alanın yönüne bağlı olarak değişir. Verilen bilgilerden, parçacıkların yük durumunu ve hareketlerini belirlemek için aşağıdaki adımları izleyebiliriz: - Manyetik alanın yönü: Yukarıya doğru. - Parçacıkların hareketi: K parçacığı yukarıya doğru hareket eder, L parçacığı aşağıya doğru hareket eder, M parçacığı yukarıya doğru hareket eder, N parçacığı aşağıya doğru hareket eder. - Parçacıkların yükü: K parçacığı pozitif, L parçacığı negatif, M parçacığı pozitif, N parçacığı negatif olabilir. Cevap: C) $+$ $+$ $-$ $-$		
Answer given by Copilot (Ing. translation) Solution to the Problem: This physics problem involves the paths followed by charged particles entering a magnetic field perpendicular to the plane of the paper. The question asks about the path of a positively charged particle when it enters the magnetic field. Inside a magnetic field, a charged particle follows a circular path. The direction of the magnetic field, the path of the particle depends on the direction of the magnetic field. To find the correct option that matches the charge states and paths of the particles from the given choices, we need to consider the direction of the magnetic field and the direction of the particles' motion. Based on the paths and charge states provided in the options, the correct answer is: Answer: C) $+$ $+$ $-$ $-$	Answer given by Gemini (Ing. translation) Solution: According to the information provided in the question, particles K, L, M and N enter a uniform magnetic field perpendicular to the page and they all have the same mass. In this scenario, the paths followed by the particles depend on their electric charge and the direction of the magnetic field. - Particle K: Particle K follows a circular path. This indicates that Particle K is positively charged and moving with a velocity in the same direction as the magnetic field. Therefore, Particle K is positively charged. - Particle L: Particle L follows a straight path. This suggests that Particle L is either electrically neutral or moving with a velocity opposite to the magnetic field. Assuming Particle L is electrically neutral. - Particle M: Particle M follows a circular path. This indicates that Particle M is negatively charged and moving with a velocity opposite to the magnetic field. Therefore, Particle M is negatively charged. - Particle N: Particle N follows a straight path. This suggests that Particle N is either electrically neutral or moving with a velocity in the same direction as the magnetic field. Assuming Particle N is electrically neutral. From this, we can conclude that the electric charge states of particles K and M are positive and the electric charge states of particles L and N are neutral. Explanation: - A particle's electric charge and velocity have a significant effect on its motion in a magnetic field. - A positively charged particle moving in the same direction as the magnetic field follows a circular path. - A negatively charged particle moving in the opposite direction to the magnetic field also follows a circular path. - A particle that is electrically neutral or moving in the same direction to the magnetic field follows a straight path. Based on the provided information, since K and M particles follow a circular path (indicating K and M particles follow a straight path), it can be concluded that particles K and M are electrically charged and particles L and N are electrically neutral. Thus, the correct answer is E) $-$ $+$ $+$ $-$.	Answer given by Gemini (Turkish) Sorunun cevabı E) $-$ $+$ $+$ $-$ Çözüm: Soruda verilen manyetik alan E, K, L, M ve N parçacıkları aynı düzlemde hareket ettiren bir manyetik alandır. Bu manyetik alanın yönü yukarıya doğru olduğu için, pozitif yüklü parçacıklar aşağıya doğru hareket ederken, negatif yüklü parçacıklar yukarıya doğru hareket eder. Bu durumda, parçacıkların hareketleri aşağıdaki gibidir: K parçacığı: Yukarıya doğru hareket eder. Bu, K parçacığının manyetik alana karşı pozitif yüklü olduğunu gösterir. L parçacığı: Aşağıya doğru hareket eder. Bu, L parçacığının manyetik alana karşı negatif yüklü olduğunu gösterir. M parçacığı: Yukarıya doğru hareket eder. Bu, M parçacığının manyetik alana karşı pozitif yüklü olduğunu gösterir. N parçacığı: Aşağıya doğru hareket eder. Bu, N parçacığının manyetik alana karşı negatif yüklü olduğunu gösterir. Buna göre, K, L, M ve N parçacıklarının elektriksel yük durumları aşağıdaki gibidir: K: Pozitif (+) L: Negatif (-) M: Pozitif (+) N: Negatif (-) Aşağıdaki eşleştirmeden doğru olanı seçiniz: A) $+$ $+$ $+$ $+$ B) $+$ $+$ $-$ $+$ C) $+$ $+$ $-$ $-$ D) $-$ $+$ $-$ $-$ E) $-$ $+$ $+$ $-$ Doğru cevap E) $-$ $+$ $+$ $-$ dir.	

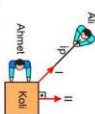
2024 AYR 8th Physics question O merkezli ve farklı yarıçaplı dört konik yoldan hareket eden bir cisim, bir an için aynı hızla hareket etmektedir. Bu cisimlerin yarıçapları r_1, r_2, r_3 ve r_4 olarak verilmektedir. Bu cisimlerin açısal hızları $\omega_1, \omega_2, \omega_3$ ve ω_4 olarak verilmektedir. Bu cisimlerin açısal hızları arasındaki ilişkiyi aşağıdaki seçeneklerden birini seçiniz. Şekil: Dört konik yola sahip bir sistem. Merkez O'dur. Yolların yarıçapları r_1, r_2, r_3, r_4 olarak verilmektedir. Cisimlerin açısal hızları $\omega_1, \omega_2, \omega_3, \omega_4$ olarak verilmektedir. Seçenekler: A) $\omega_1 > \omega_2 > \omega_3 > \omega_4$ B) $\omega_1 = \omega_2 = \omega_3 = \omega_4$ C) $\omega_4 > \omega_3 > \omega_2 > \omega_1$ D) $\omega_4 > \omega_3 > \omega_2 > \omega_1$ E) $\omega_4 > \omega_3 = \omega_2 = \omega_1$	Answer given by ChatGPT (Turkish) Sorunun çözümü için açısal hız (ω) kavramını ve konik yolları üzerindeki hareketi anlamak önemlidir. Açısal hız, bir cismin birim zamanda döndüğü açıya eşittir. Konik yollar üzerinde hareket eden bir cismin açısal hızı, yarıçapı ile ters orantılıdır. Yani, yarıçapı büyük olan cisimlerin açısal hızları daha düşüktür. Verilen yarıçaplar r_1, r_2, r_3, r_4 ve açısal hızlar $\omega_1, \omega_2, \omega_3, \omega_4$ arasında aşağıdaki ilişki geçerlidir: $\omega \propto \frac{1}{r}$ Bu ilişkiyi kullanarak, yarıçapların büyüklük sırasına göre açısal hızların büyüklük sırasını belirleyebiliriz. Eğer $r_1 < r_2 < r_3 < r_4$ ise, o zaman $\omega_1 > \omega_2 > \omega_3 > \omega_4$ olacaktır. Doğru cevap B'dir: $\omega_1 = \omega_2 = \omega_3 = \omega_4$.	Answer given by Copilot (Turkish) Sorunun çözümü için, açısal hız (ω) kavramını ve konik yollar üzerindeki hareketi anlamak önemlidir. Açısal hız, bir cismin birim zamanda döndüğü açıya eşittir. Konik yollar üzerinde hareket eden bir cismin açısal hızı, yarıçapı ile ters orantılıdır. Yani, yarıçapı büyük olan cisimlerin açısal hızları daha düşüktür. Verilen yarıçaplar r_1, r_2, r_3, r_4 ve açısal hızlar $\omega_1, \omega_2, \omega_3, \omega_4$ arasında aşağıdaki ilişki geçerlidir: $\omega \propto \frac{1}{r}$ Bu ilişkiyi kullanarak, yarıçapların büyüklük sırasına göre açısal hızların büyüklük sırasını belirleyebiliriz. Eğer $r_1 < r_2 < r_3 < r_4$ ise, o zaman $\omega_1 > \omega_2 > \omega_3 > \omega_4$ olacaktır. Doğru cevap B'dir: $\omega_1 = \omega_2 = \omega_3 = \omega_4$.	Answer given by Gemini (Turkish) Sorunun çözümü için, açısal hız (ω) kavramını ve konik yollar üzerindeki hareketi anlamak önemlidir. Açısal hız, bir cismin birim zamanda döndüğü açıya eşittir. Konik yollar üzerinde hareket eden bir cismin açısal hızı, yarıçapı ile ters orantılıdır. Yani, yarıçapı büyük olan cisimlerin açısal hızları daha düşüktür. Verilen yarıçaplar r_1, r_2, r_3, r_4 ve açısal hızlar $\omega_1, \omega_2, \omega_3, \omega_4$ arasında aşağıdaki ilişki geçerlidir: $\omega \propto \frac{1}{r}$ Bu ilişkiyi kullanarak, yarıçapların büyüklük sırasına göre açısal hızların büyüklük sırasını belirleyebiliriz. Eğer $r_1 < r_2 < r_3 < r_4$ ise, o zaman $\omega_1 > \omega_2 > \omega_3 > \omega_4$ olacaktır. Doğru cevap B'dir: $\omega_1 = \omega_2 = \omega_3 = \omega_4$.
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2023 AYI 3 rd Physics question	Answer given by ChatGPT (Turkish)	Answer given by Copilot (Turkish)	Answer given by Gemini (Turkish)
3. Başlangıçta $t = 0$ anında) yönünü düzlemde hareket eden bir araba hızı zamanla değişmektedir. K ve L arabalarının hızları zamanla değişimini gösteren grafikler aşağıdaki gibidir. K ve L arabalarının hareketi ile ilgili: - K arabası önce hızlanıyor daha sonra yavaşlıyor durmaktadır. - K arabası 30. saniyede başlangıç konumuna geri dönmüştür. 30. saniyede L arabası K arabasından daha ileridedir. A) Yalnız I B) Yalnız II C) Yalnız III D) I ve II E) I ve III	Answer given by ChatGPT (Turkish) Soruyu çözmek için grafikten verilen bilgileri inceleyelim. I. K arabası önce hızlanıyor daha sonra yavaşlıyor durmaktadır. Grafikte K arabasının hızı zamanla artarak 20 m/s'ye ulaşır (0-15 saniye) ve sonra yavaşlayarak durur (15-30 saniye). Bu nedenle bu ifade doğrudur. II. K arabası 30. saniyede başlangıç konumuna geri dönmüştür. Hareket grafiğinden, hızın alanı (hız x zaman) sıfır olduğunda, araba başlangıç konumuna geri döner. K arabasının hız-zaman grafiğinin alanı, 15 saniye boyunca pozitif ve 15 saniye boyunca negatif olarak eşit olduğundan, K arabası 30. saniyede başlangıç konumuna geri dönmüştür. III. 30. saniyede L arabası K arabasından daha ileridedir. L arabasının hız-zaman grafiğinden, hızın alanı (hız x zaman) sıfır olduğunda, araba başlangıç konumuna geri döner. L arabasının hız-zaman grafiğinin alanı, 15 saniye boyunca pozitif ve 15 saniye boyunca negatif olarak eşit olduğundan, L arabası 30. saniyede başlangıç konumuna geri dönmüştür. Sorumu özetleyelim: I ve II doğrudur, III yanlıştır. Doğru cevap: E) I ve II	Answer given by Copilot (Turkish) Soruyu analiz ederken, Grafikte verilen bilgileri kullanacağız. Hız zaman grafiğinden, hızın alanı (hız x zaman) sıfır olduğunda, araba başlangıç konumuna geri döner. I. Yargı: Doğrudur. K arabası 0 anında başlangıç konumunda, hızı zamanla artarak 20 m/s'ye ulaşır (0-15 saniye) ve sonra yavaşlayarak durur (15-30 saniye). Bu nedenle bu ifade doğrudur. II. Yargı: Doğrudur. K arabası 30. saniyede başlangıç konumuna geri dönmüştür. Hız zaman grafiğinden, hızın alanı (hız x zaman) sıfır olduğunda, araba başlangıç konumuna geri döner. K arabasının hız-zaman grafiğinin alanı, 15 saniye boyunca pozitif ve 15 saniye boyunca negatif olarak eşit olduğundan, K arabası 30. saniyede başlangıç konumuna geri dönmüştür. III. Yargı: Yanlıştır. L arabası 30. saniyede başlangıç konumuna geri dönmüştür. Hız zaman grafiğinden, hızın alanı (hız x zaman) sıfır olduğunda, araba başlangıç konumuna geri döner. L arabasının hız-zaman grafiğinin alanı, 15 saniye boyunca pozitif ve 15 saniye boyunca negatif olarak eşit olduğundan, L arabası 30. saniyede başlangıç konumuna geri dönmüştür. Sorumu özetleyelim: I ve II doğrudur, III yanlıştır. Doğru cevap: E) I ve II	Answer given by Gemini (Turkish) Doğru Cevap: B) Yalnız II Açıklama: Soruda verilen anıtlar ve zamanı kullanarak, her bir yargıyı inceleyelim: I. Yargı: "K arabası önce hızlanıyor daha sonra yavaşlıyor durmaktadır." Bu yargı doğrudur. Grafiğe bakıldığında, K arabasının hızı zamanla artarak 20 m/s'ye ulaşır (0-15 saniye) ve sonra yavaşlayarak durur (15-30 saniye). Bu nedenle bu ifade doğrudur. II. Yargı: "K arabası 30. saniyede başlangıç konumuna geri dönmüştür." Bu yargı doğrudur. Grafiğin altında kalan alanı (hız x zaman) hesapladığımızda, K arabasının hız-zaman grafiğinin alanı, 15 saniye boyunca pozitif ve 15 saniye boyunca negatif olarak eşit olduğundan, K arabası 30. saniyede başlangıç konumuna geri dönmüştür. III. Yargı: "30. saniyede L arabası K arabasından daha ileridedir." Bu yargı doğrudur. Grafiğin altında kalan alanı (hız x zaman) hesapladığımızda, L arabasının hız-zaman grafiğinin alanı, 15 saniye boyunca pozitif ve 15 saniye boyunca negatif olarak eşit olduğundan, L arabası 30. saniyede başlangıç konumuna geri dönmüştür. Sorumu özetleyelim: I ve II doğrudur, III yanlıştır. Doğru cevap: B) Yalnız II
	Answer given by ChatGPT (Ing. translation) Solution: Let's analyze the given information based on the velocity-time graph. - The car K initially accelerates, then decelerates and stops. - From the graph, it is observed that car K accelerates to a velocity of 20 m/s between 0 and 15 seconds and then decelerates to a stop between 15 and 30 seconds. This statement is correct. - The car K has returned to the starting position at the 30th second. The area under the velocity-time graph represents the distance traveled. Car K moved forward during the acceleration phase and then moved backward during the deceleration phase, covering the same distance in the opposite direction. Hence, at the 30th second, car K returns to its starting position. This statement is correct. III. At the 30th second, car L is further ahead than car K. Car L's velocity-time graph shows a continuously positive velocity, indicating that it is always moving forward. In contrast, car K returns to the starting position by the 30th second after moving forward and then backward. Therefore, at the 30th second, car L is further ahead than car K. This statement is also correct. Conclusion: All three statements are correct. The correct answer is E) I, II, and III.	Answer given by Copilot (Ing. translation) Analyzing the speed-time graph: Statement I: "Car K started moving earlier than Car L." - To verify this statement, we need to compare when Car K and Car L's speeds began to increase on the graph. If Car K's speed started increasing earlier, then this statement is true. Statement II: "Car K's speed began to decrease earlier than Car L's speed." - To verify this statement, we need to look at when Car K and Car L's speeds began to decrease on the graph. If Car K's speed began decreasing earlier, then this statement is true. Statement III: "At 30 seconds, Car L is further north from the starting point." - To verify this statement, we need to check if Car L's speed at 30 seconds is zero. If Car L's speed is zero, then it indicates that Car L is at a position further from the starting point at 30 seconds. Conclusion: The validity of the statements depends on the analysis of the graph. If: - Car L's speed started increasing earlier (Statement I is true). - Car K's speed began decreasing earlier (Statement II is true). - Car L's speed is zero at 30 seconds (Statement III is true). Then the correct answer is E) I and II are true. However, if there was an incorrect evaluation of Statement II, the answer will be E) I and III are correct.	Answer given by Gemini (Ing. translation) Correct Answer: B) Only II Explanation: Let's examine each statement based on the given description and the image: Statement I: "Car K accelerated first and then slowed down and stopped." - This statement is true. As seen in the image, Car K's speed increases initially, then decreases, and reaches zero at the 30-second mark. Statement II: "Car K returned to the starting position at 30 seconds." - This statement is false. As seen in the image, Car K's position is below zero at the 30-second mark. Statement III: "At 30 seconds, Car L is further ahead than Car K." - This statement is true. As shown in the image, Car L's position at 30 seconds is greater than Car K's position. This indicates that Car L is further ahead than Car K at 30 seconds. Conclusion: Only Statement II is correct. Therefore, the correct answer is B) Only II.

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2023 AYI 7 th Physics question	Answer given by ChatGPT (Turkish)	Answer given by Copilot (Turkish)	Answer given by Gemini (Turkish)
7. Fiziksel maddelerde elektrik akışının nedeni nedir? Aşağıdaki ifadelerden hangisi doğrudur? A) Yalnız I B) Yalnız II C) I ve II D) I ve III E) II ve III Buna göre, I. Elektrik akışı, potansiyel farkı nedeniyle oluşur. II. Farklı maddelerde elektrik akışının hızı aynıdır. III. Farklı maddelerde elektrik akışının yönü aynıdır. Yargılardan hangileri doğrudur?	Answer given by ChatGPT (Turkish) 7. Fiziksel maddelerde elektrik akışının nedeni nedir? Aşağıdaki ifadelerden hangisi doğrudur? A) Yalnız I B) Yalnız II C) I ve II D) I ve III E) II ve III Buna göre, I. Elektrik akışı, potansiyel farkı nedeniyle oluşur. II. Farklı maddelerde elektrik akışının hızı aynıdır. III. Farklı maddelerde elektrik akışının yönü aynıdır. Yargılardan hangileri doğrudur? Doğru cevap: c) I ve II Answer given by ChatGPT (Ing. translation) In this question, we need to understand how a flash system works and the effect of the components in this system. Let's examine the statements given in the question one by one. I. If the potential difference of the battery in the flash system is increased, the capacitance of the capacitor decreases. Increasing the potential difference of a battery does not affect the capacitance of a capacitor. The capacitance of a capacitor depends on its physical properties (plate area, distance between plates, and dielectric material), not on the potential difference. Therefore, this statement is incorrect. II. If a capacitor with a larger capacitance is used in the flash system, a more intense light is produced in the bulb. A capacitor with a larger capacitance can store more energy. The energy stored in a capacitor is calculated as: $E = \frac{1}{2} CV^2$ where E is the energy, C is the capacitance, and V is the potential difference. A larger capacitor can store more energy, and if this energy is discharged quickly by the flash bulb, it will produce a more intense light. This statement is correct. III. When the flash of light, the charge stored in the capacitor begins to decrease. When the flash occurs, the energy stored in the capacitor is used, and thus the charge is rapidly discharged through the bulb. This means the charge in the capacitor decreases. This statement is correct. In conclusion, the correct statements are II and III. The correct answer is c) II and III.	Answer given by Copilot (Turkish) 7. Fiziksel maddelerde elektrik akışının nedeni nedir? Aşağıdaki ifadelerden hangisi doğrudur? A) Yalnız I B) Yalnız II C) I ve II D) I ve III E) II ve III Buna göre, I. Elektrik akışı, potansiyel farkı nedeniyle oluşur. II. Farklı maddelerde elektrik akışının hızı aynıdır. III. Farklı maddelerde elektrik akışının yönü aynıdır. Yargılardan hangileri doğrudur? Doğru cevap: c) I ve II Answer given by Copilot (Ing. translation) Answers are being generated for you. The flash system is used in cameras to produce sufficient light intensity. Here are the correct statements for this question: I. If the potential difference of the battery in the flash system is increased, the capacitance of the capacitor decreases. This is correct because a higher potential difference leads to more energy being stored. II. If a fully charged capacitor with a larger capacitance is used in the flash system, a more intense light is produced in the bulb. This is correct because a larger capacitor stores more energy. III. When the flash of light, the charge stored in the capacitor begins to decrease. This is correct because when the flash occurs, the stored energy is depleted. Therefore, the correct statements are C) I and II.	Answer given by Gemini (Turkish) 7. Fiziksel maddelerde elektrik akışının nedeni nedir? Aşağıdaki ifadelerden hangisi doğrudur? A) Yalnız I B) Yalnız II C) I ve II D) I ve III E) II ve III Buna göre, I. Elektrik akışı, potansiyel farkı nedeniyle oluşur. II. Farklı maddelerde elektrik akışının hızı aynıdır. III. Farklı maddelerde elektrik akışının yönü aynıdır. Yargılardan hangileri doğrudur? Doğru cevap: c) I ve II Answer given by Gemini (Ing. translation) Correct Answer: (I) and III. Explanation: I. Statement: If the potential difference of the battery in the flash system is increased, the capacitance of the capacitor decreases. This is correct. The capacitance of a capacitor is proportional to the amount of charge it can store. As the potential difference of the battery increases, the amount of charge stored in the capacitor decreases. Therefore, as the potential difference of the battery increases, the capacitance of the capacitor decreases. II. Statement: If a capacitor with a larger capacitance is used in the flash system, the light produced in the bulb will be more intense. This is correct. The intensity of the light produced in the bulb is proportional to the current flowing through the capacitor. If the capacitance of the capacitor is larger, it can store more charge when fully charged. More charge means more current. Therefore, if a capacitor with a larger capacitance is used, the light produced in the bulb will be more intense. III. Statement: When the flash light burns, the charge stored in the capacitor begins to decrease. This is correct. When the flash light burns, the charge stored in the capacitor is discharged through the bulb, converting the energy into light. During this process, the stored charge in the capacitor decreases. Therefore, when the flash light burns, the charge stored in the capacitor begins to decrease. (Conclusion: Statements I and III are correct, and Statement II is also correct. Therefore, the correct answer is C) I and III.)

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2022 AYI 1 ^{ci} Physics question	Answer given by ChatGPT (Turkish)	Answer given by Copilot (Turkish)	Answer given by Gemini (Turkish)
1. Süratlenen önemsenmediği ve uatın potansiyel şiddetli gilo olan yalıy bir zeminden atılan bir kolye Ahmet elyerye ileri doğru iterken Ali de bir ip yardımıyla kolyeyi geri çekmektedir.  Ahmet ve Ali aynı anda kuvvet uygulamayı başlarsa kolye; şiddetli il, l ve III yönlerinden hangilerine doğru hareket edebilir? A) Yalnız I B) Yalnız II C) I ve III D) II ve III E) I, II ve III	Answer given by ChatGPT (Turkish) 180 Bu soruyu çözmek, Ahmet ve Ali'nin uyguladıkları kuvvetlerin büyüklük ve yönlerinin belirlenmesine bağlıdır. Eğer Ahmet ve Ali aynı anda ve aynı yönde kuvvet uygularlarsa, kolye o yöne doğru hareket edecektir. Eğer Ahmet ileri doğru itiyorsa ve Ali geri çekiyorsa, kolyenin hareketi bu iki kuvvetin net sonucuna bağlı olacaktır. Soruyu çözmek için, Ahmet ve Ali'nin uyguladıkları kuvvetlerin büyüklük ve yönlerini bilmemiz gerekir. Örneğin: • Ahmet ileri doğru itiyorsa (pozitif yönde) ve Ali geri çekiyorsa (negatif yönde), kolyenin hareketi bu iki kuvvetin net sonucuna bağlı olacaktır. Eğer Ahmet'in kuvveti Ali'nin kuvvetinden büyükse, kolye ileri doğru hareket edecektir. Aksi takdirde, kolye geri doğru hareket edecektir. • Ahmet ileri doğru itiyorsa (pozitif yönde) ve Ali de ileri doğru itiyorsa (pozitif yönde), kolye ileri doğru hareket edecektir. • Ahmet geri çekiyorsa (negatif yönde) ve Ali de geri çekiyorsa (negatif yönde), kolye geri doğru hareket edecektir. Doğru cevap: C) I ve III	Answer given by Copilot (Ing. translation) ✓ İleri doğru hareket edebilir. Bu soruyu çözmek için, Ahmet ve Ali'nin uyguladıkları kuvvetlerin büyüklük ve yönlerini bilmemiz gerekir. Eğer Ahmet ileri doğru itiyorsa ve Ali geri çekiyorsa, kolyenin hareketi bu iki kuvvetin net sonucuna bağlı olacaktır. Soruyu çözmek için, Ahmet ve Ali'nin uyguladıkları kuvvetlerin büyüklük ve yönlerini bilmemiz gerekir. Örneğin: • Ahmet ileri doğru itiyorsa (pozitif yönde) ve Ali geri çekiyorsa (negatif yönde), kolyenin hareketi bu iki kuvvetin net sonucuna bağlı olacaktır. Eğer Ahmet'in kuvveti Ali'nin kuvvetinden büyükse, kolye ileri doğru hareket edecektir. Aksi takdirde, kolye geri doğru hareket edecektir. • Ahmet ileri doğru itiyorsa (pozitif yönde) ve Ali de ileri doğru itiyorsa (pozitif yönde), kolye ileri doğru hareket edecektir. • Ahmet geri çekiyorsa (negatif yönde) ve Ali de geri çekiyorsa (negatif yönde), kolye geri doğru hareket edecektir. Doğru cevap: C) I ve III	Answer given by Gemini (Turkish) ✓ Kolye ileri doğru hareket edebilir. Bu soruyu çözmek için, Ahmet ve Ali'nin uyguladıkları kuvvetlerin büyüklük ve yönlerini bilmemiz gerekir. Eğer Ahmet ileri doğru itiyorsa ve Ali geri çekiyorsa, kolyenin hareketi bu iki kuvvetin net sonucuna bağlı olacaktır. Soruyu çözmek için, Ahmet ve Ali'nin uyguladıkları kuvvetlerin büyüklük ve yönlerini bilmemiz gerekir. Örneğin: • Ahmet ileri doğru itiyorsa (pozitif yönde) ve Ali geri çekiyorsa (negatif yönde), kolyenin hareketi bu iki kuvvetin net sonucuna bağlı olacaktır. Eğer Ahmet'in kuvveti Ali'nin kuvvetinden büyükse, kolye ileri doğru hareket edecektir. Aksi takdirde, kolye geri doğru hareket edecektir. • Ahmet ileri doğru itiyorsa (pozitif yönde) ve Ali de ileri doğru itiyorsa (pozitif yönde), kolye ileri doğru hareket edecektir. • Ahmet geri çekiyorsa (negatif yönde) ve Ali de geri çekiyorsa (negatif yönde), kolye geri doğru hareket edecektir. Doğru cevap: C) I ve III

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