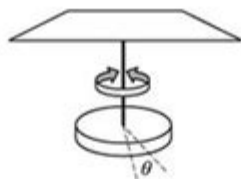


2011 Ap Physics C Free Response



Mech. 3.

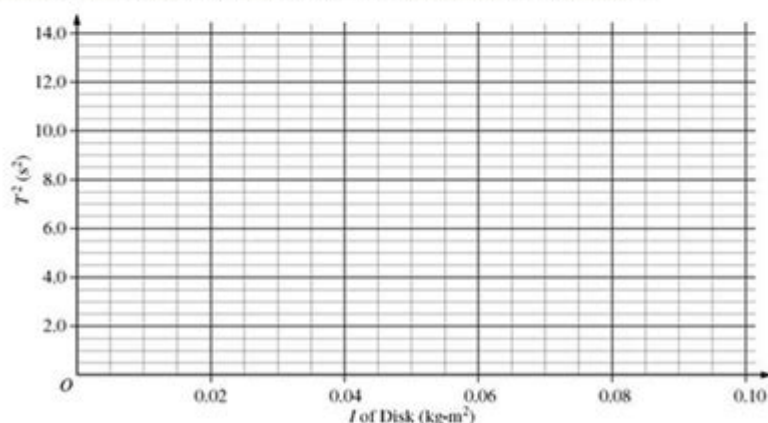
The torsion pendulum shown above consists of a disk of rotational inertia I suspended by a flexible rod attached to a rigid support. When the disk is twisted through a small angle θ , the twisted rod exerts a restoring torque τ that is proportional to the angular displacement: $\tau = -\beta\theta$, where β is a constant. The motion of a torsion pendulum is analogous to the motion of a mass oscillating on a spring.

- In terms of the quantities given above, write but do NOT solve the differential equation that could be used to determine the angular displacement θ of the torsion pendulum as a function of time t .
- Using the analogy to a mass oscillating on a spring, determine the period of the torsion pendulum in terms of the given quantities and fundamental constants, as appropriate.

To determine the torsion constant β of the rod, disks of different, known values of rotational inertia are attached to the rod, and the data below are obtained from the resulting oscillations.

Rotational Inertia I of Disk ($\text{kg}\cdot\text{m}^2$)	Average Time for Ten Oscillations (s)	Period T (s)	T^2 (s^2)
0.025	22.4	2.24	5.0
0.036	26.8	2.68	7.2
0.049	29.5	2.95	8.7
0.064	33.3	3.33	11.1
0.081	35.9	3.59	12.9

- On the graph below, plot the data points. Draw a straight line that best represents the data.



- Determine the equation for your line.
- Calculate the torsion constant β of the rod from your line.
- What is the physical significance of the intercept of your line with the vertical axis?

2011 AP Physics C Free Response questions provide an essential insight into the nature of the Advanced Placement Physics C exam, which is designed to challenge students' understanding of physics concepts and their ability to apply these concepts to solve complex problems. The 2011 exam, like its predecessors, consisted of two sections: Mechanics and Electricity and Magnetism. This article delves into the significant aspects of the free response questions from that year, the skills they test, and strategies for success.

Overview of the AP Physics C Exam

The AP Physics C exam is divided into two distinct parts:

1. Physics C: Mechanics - This section covers topics such as Newtonian mechanics, work, energy, momentum, and rotational dynamics.
2. Physics C: Electricity and Magnetism - This section focuses on electrostatics, circuits, magnetic fields, and electromagnetic induction.

Each section includes a multiple-choice segment and a free-response segment. The free response questions are particularly important as they assess students' ability to articulate their thought processes and apply theoretical knowledge to practical situations.

Structure of the 2011 Free Response Questions

The free response section of the 2011 AP Physics C exam consisted of several questions that required detailed explanations and calculations. The questions were designed to test a variety of skills, including problem-solving, analytical thinking, and the application of physics principles.

Mechanics Free Response Questions

The mechanics portion of the exam contained questions that dealt with the following key concepts:

- Kinematics and Dynamics: Students were asked to analyze motion in one or multiple dimensions, including the effects of forces on objects.
- Work and Energy: Questions required students to apply the work-energy theorem, calculate kinetic and potential energy, and analyze energy conservation.

- Systems of Particles and Linear Momentum: Problems involved collisions, impulse, and momentum conservation principles.
- Rotational Motion: Topics included torque, angular momentum, and rotational dynamics.

Sample Mechanics Question Breakdown

One notable question revolved around a block sliding down a frictionless incline, which required students to:

1. Draw a Free Body Diagram: Students needed to illustrate all forces acting on the block, identifying gravitational force and the normal force.
2. Calculate Acceleration: They were expected to derive the acceleration of the block using Newton's second law and the geometry of the incline.
3. Determine the Speed at the Bottom: Finally, students had to find the block's speed at the bottom of the incline using energy conservation principles.

Electricity and Magnetism Free Response Questions

The electricity and magnetism section of the exam also presented questions that tested various principles, such as:

- Electrostatics: Questions involved electric fields, forces between charges, and potential energy.
- Circuits: Students were required to analyze series and parallel circuits, calculate equivalent resistances, and apply Ohm's law.
- Magnetic Fields and Forces: Problems included the calculation of forces on charged particles moving in magnetic fields and the applications of Ampere's law.

Sample Electricity and Magnetism Question Breakdown

An example from this section involved a charged particle moving through a magnetic field. Students were tasked to:

1. Identify the Direction of the Force: Using the right-hand rule, students had to determine the direction of the magnetic force acting on the particle.
2. Calculate the Force: They needed to apply the formula $F = qvB \sin(\theta)$ to find the magnitude of the force, where q is the charge, v is the velocity, B is the magnetic field strength, and θ is the angle between the velocity and the magnetic field.
3. Discuss Motion in the Field: Lastly, students were expected to describe the path of the charged particle as it moves through the magnetic field, demonstrating an understanding of circular motion.

Skills Tested by the Free Response Questions

The free response questions of the 2011 AP Physics C exam aimed to evaluate several skills critical for success in physics:

- Analytical Thinking: Students had to analyze complex problems, breaking them down into manageable parts and applying relevant physics concepts.
- Mathematical Proficiency: Many questions required students to perform calculations, demonstrating their ability to manipulate equations and understand mathematical relationships.
- Communication of Ideas: Students needed to articulate their thought processes clearly, using proper scientific language and notation to convey their understanding effectively.

Strategies for Success in Free Response Questions

To excel in the free response section of the AP Physics C exam, students can employ several

effective strategies:

1. **Practice Regularly:** Regular practice with past exam questions helps students become familiar with the format and types of questions asked.
2. **Understand the Concepts:** A deep understanding of underlying physics principles is crucial for solving problems accurately.
3. **Show All Work:** Writing down every step of the solution process not only helps in securing partial credit but also clarifies thought processes.
4. **Time Management:** Allocate time wisely during the exam to ensure that all questions are attempted.
5. **Review and Revise:** After solving a problem, revisiting the solution to check for errors can be invaluable.

Conclusion

The 2011 AP Physics C free response questions showcased the depth and breadth of knowledge required to succeed in this challenging exam. By focusing on the key concepts of mechanics and electricity and magnetism, students can better prepare themselves for future examinations. Utilizing effective study strategies, practicing problem-solving, and honing communication skills will ultimately lead to success on the AP Physics C exam and in further studies in physics.

Frequently Asked Questions

What topics were covered in the 2011 AP Physics C free response section?

The 2011 AP Physics C free response section covered topics such as mechanics, electricity, and magnetism, including concepts like motion, forces, electric fields, and circuits.

How many problems were included in the 2011 AP Physics C free response section?

The 2011 AP Physics C free response section included a total of 4 problems.

What is the format of the free response questions in the AP Physics C exam?

The free response questions typically require students to solve problems, show detailed work, and justify their answers using appropriate physics principles.

What is the significance of showing work in the AP Physics C free response answers?

Showing work is crucial because partial credit can be awarded for correct reasoning and intermediate steps, even if the final answer is incorrect.

Are calculators allowed in the 2011 AP Physics C free response section?

Yes, calculators are allowed, and students are encouraged to use them for computations in the free response questions.

What are common mistakes students make on the AP Physics C free response questions?

Common mistakes include not reading the questions carefully, failing to include units in their answers, and not clearly labeling diagrams or graphs.

How is the AP Physics C free response section scored?

The free response section is scored on a scale from 0 to 9, with points awarded for the correctness of the answer, the reasoning shown, and the clarity of the explanation.

What resources can students use to prepare for AP Physics C free response questions?

Students can use past exam questions, official College Board resources, review books, and practice exams to prepare for AP Physics C free response questions.

How can students improve their performance on the AP Physics C free response section?

Students can improve by practicing with previous exams, studying the underlying concepts thoroughly, and working on time management during the exam.

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