

MID-TERM EXAMINATION

PHYSICS - SENIOR FOUR

Duration: 2:30 Hrs

Question One

- a) When an object is projected vertically upwards into the air, how do the acceleration and speed of the object change as it ascends? Illustrate the motion by sketching the speed and velocity-time graphs up to a certain point in its trajectory.
- b) A **10 kg** object is dropped from rest. How far will it drop in **2 seconds**?
- c) Victor has a feather and Joshua has a coin. They release them from the same height above the ground and at the same time.
 - i. Which one reaches the ground first
 - ii. Support your answer with scientific reasons
- d) Explain the shape of the velocity-time graph for the parachutist during free fall. What does each segment of the graph represent in terms of the parachutist's motion?



- e) A ticker timer records **999 dots** on the tape in **6 seconds**. If each dot represents a distance of **0.02 meters**, what is the average velocity of the object being tracked?
- f) Two trolleys each of mass **40 kg** and **20 kg** are traveling towards each other with velocities **5 ms⁻¹** and **2 ms⁻¹** respectively. If after the collision, the trolley with a mass of **40 kg** travels at a velocity of **2ms⁻¹** in its original direction, calculate the velocity of the second trolley after collision. Is kinetic energy conserved?

- g) Explain why passengers in a bus *jerk backward* when the bus starts to move and *jerk forward* when the bus suddenly stops moving

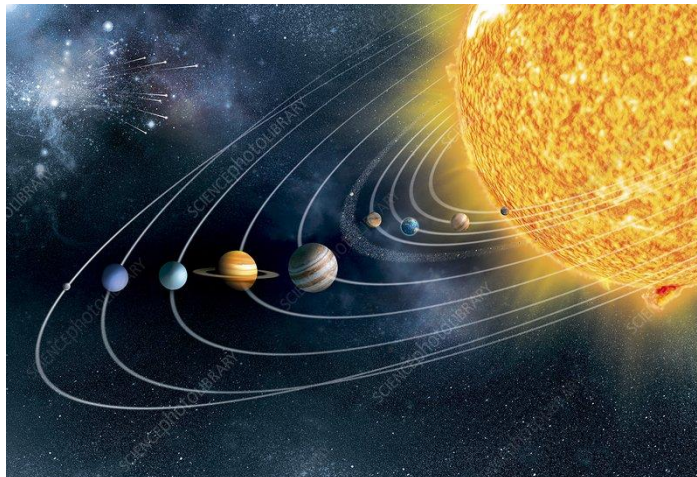
Question Two

- a) When a balloon is rubbed with fur, it becomes negatively charged. Can you explain how this is possible? And explain how charging by this method differs from other methods of charging objects, such as induction or conduction. why is charging by rubbing commonly used in certain scenarios?
- b) Imagine you are outside on a hot day, enjoying a picnic with your friends. Suddenly, dark clouds start to roll in and you hear distant rumbling. As you look up, you see flashes of light in the sky and hear the loud crackling of thunder. What do you think is happening in the atmosphere around you? How would you explain this phenomenon to someone unfamiliar with it?
- c) A student is experimenting to test the nature of charge using a gold leaf electroscope. The student sets up the gold leaf electroscope on a table and rubs a plastic rod with a piece of wool to create a static charge. They then bring the charged rod close to the metal cap of the electroscope and observe the behavior of the gold leaf.

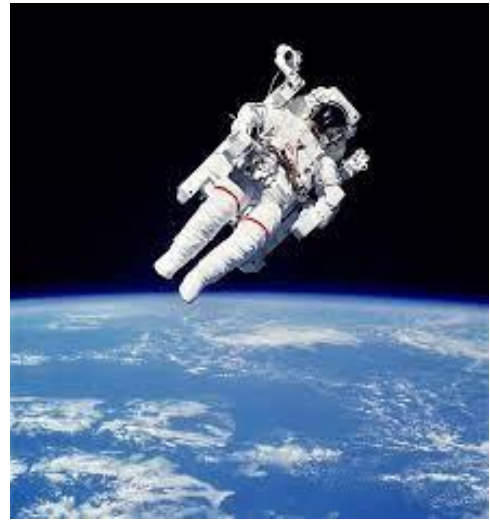
Task: Describe the steps the student should take to test the nature of the charge using the gold leaf electroscope. Explain how the gold leaf electroscope can indicate whether the charge on the rod is positive or negative based on the observed deflection of the gold leaf.

Question Three

- a) Imagine you are an **alien** visiting our solar system for the first time. Describe what you observe about the different planets and their compositions as you travel from the inner to the outer regions of the solar system.



- b) Assuming you are an astronaut on a space mission observing the Earth from afar. Describe how the Earth's rotation leads to the occurrence of *day* and *night* on the planet.



- c) Discuss the factors contributing to the significant variation in *ocean tides* between day and night along the *coast of Mombasa*. Explain why tides are notably higher at night and lower during the daytime in this region.

Question four

- a) A light ray travels from a medium with a refractive index $n_1 = 1.50$ to a medium with an unknown refractive index n_2 . If the angle of incidence is 60° and the angle of refraction is 45° , what is the refractive index of the second medium? Furthermore, what does this refractive index value indicate about the speed of light in the second medium?
- b) Discuss how the refraction of light at the *water-air* interface affects the observation of objects underwater when viewed from above the water surface. Explain the concept of *apparent depth* and the role of *refractive index* in this optical phenomenon.
- c) A convex mirror with a focal length of 15 cm is used to form an image of an object placed 30 cm in front of the mirror. Using a scale of $2\text{ cm} : 5\text{ units}$ draw a ray diagram and determine the image distance. State whether the image is upright or inverted.
- d) An object is placed 10 cm in front of a plane mirror. How far behind the mirror will the image be located? Use a ray diagram for illustration and state the characteristics of this image formed.



