

**PHYSICS  
STANDARD LEVEL  
PAPER 1**

Thursday 2 May 2002 (afternoon)

45 minutes

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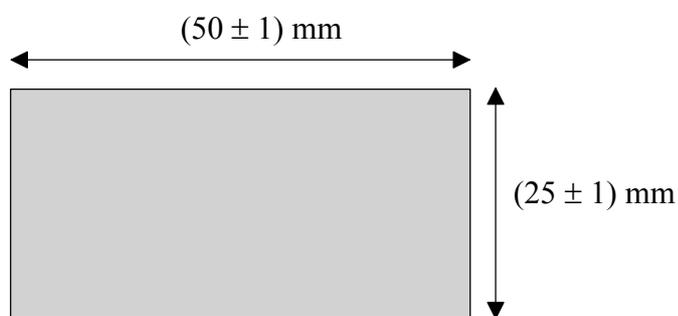
**INSTRUCTIONS TO CANDIDATES**

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

1. The mass of an object is measured to be 4.652 kg and its volume  $2.1 \text{ m}^3$ . If the density (mass per unit volume) is calculated from these values, to how many significant figures should it be expressed?

- A. 1
- B. 2
- C. 3
- D. 4

2. The lengths of the sides of a rectangular plate are measured, and the diagram shows the measured values with their uncertainties.



Which of the following is the best estimate of the percentage uncertainty in the calculated **area** of the plate?

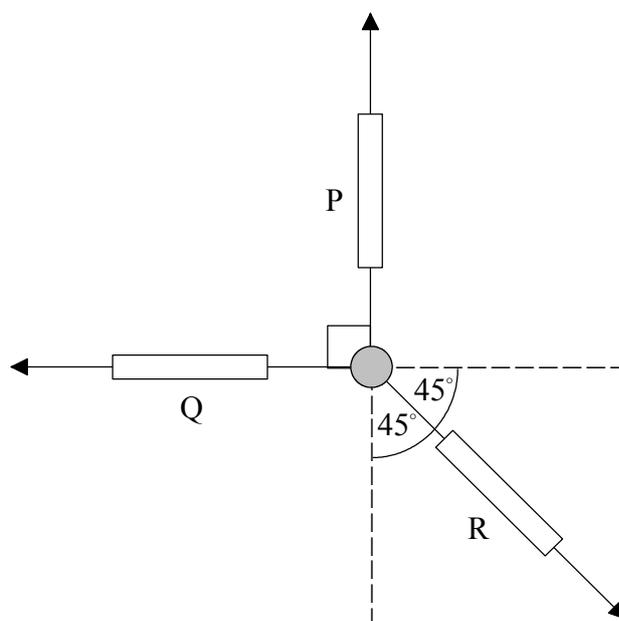
- A.  $\pm 2\%$
- B.  $\pm 4 \%$
- C.  $\pm 6\%$
- D.  $\pm 8 \%$

3. The orbital periods  $T$  of planets in the solar system are related to their mean distances  $r$  from the Sun by

$$T^2 = k r^3 \text{ where } k \text{ is a constant.}$$

What variables should be plotted in order to get a straight line graph?

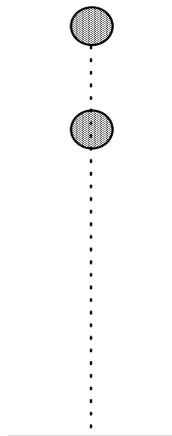
- A.  $T^2$  versus  $r^3$
  - B.  $T^2$  versus  $r$
  - C.  $T$  versus  $r$
  - D.  $T$  versus  $r^3$
4. A body on a smooth horizontal surface is attached to three spring scales P, Q and R as shown below. The body is in equilibrium with the scales pulling on it at the angles shown.



How do the **magnitudes** of the force readings  $F_P$ ,  $F_Q$  and  $F_R$  on the scales compare?

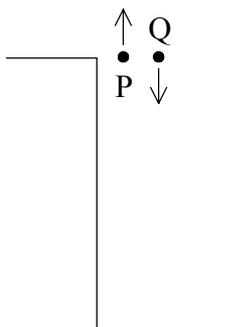
- A.  $F_P = F_Q = F_R$
- B.  $F_R > F_P = F_Q$
- C.  $F_R < F_P = F_Q$
- D.  $F_P + F_Q = F_R$

5. Two identical stones are dropped simultaneously from different heights. Air resistance is negligible.



As the stones fall, the distance between them will

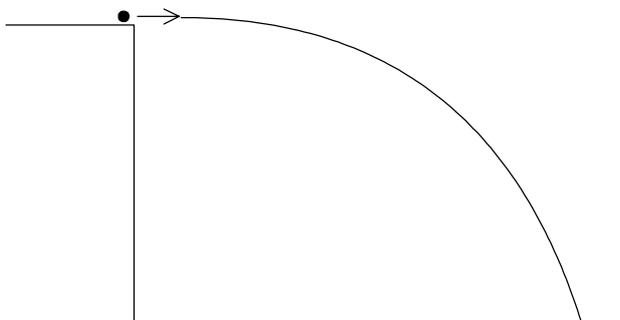
- A. increase continuously.
  - B. decrease until they touch.
  - C. remain the same.
  - D. increase initially then remain the same.
6. Two stones P and Q are thrown from the top of a building, P straight up and Q straight down at a **greater speed** than P, as indicated. Both stones eventually hit the ground.



If air resistance is negligible, which of the following statements is true?

- A. Stone P hits the ground with the greater speed.
- B. Stone Q hits the ground with the greater speed.
- C. Both stones hit with the same speed.
- D. It depends on the height of the building which stone hits the ground with the greater speed.

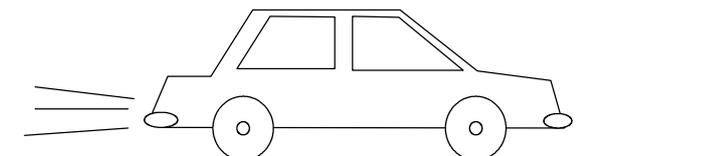
7. A projectile is launched horizontally from a cliff and eventually hits the ground below. Assume air resistance is negligible.



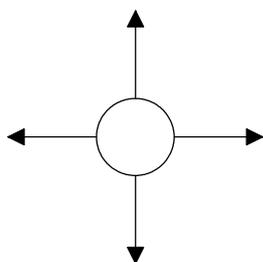
How do the downward and horizontal components of the projectile's velocity behave during the motion?

	<b>Downward component</b>	<b>Horizontal component</b>
A.	increases	increases
B.	increases	remains constant
C.	remains constant	increases
D.	remains constant	remains constant

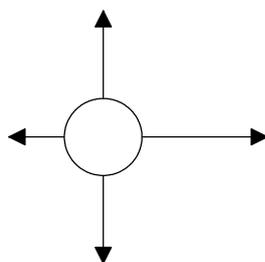
8. A car is travelling on a level highway at a constant velocity in a straight line. Air resistance is **not** negligible.



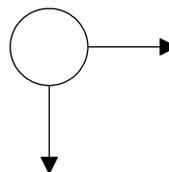
Which of the following is the correct free-body force diagram for the car?



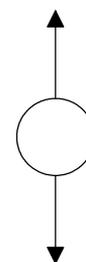
A.



B.

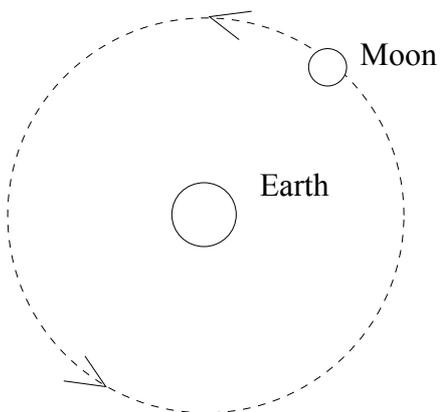


C.

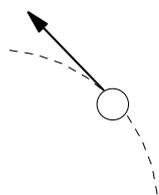


D.

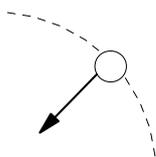
9. The Moon orbits the Earth in a nearly circular orbit at constant speed as shown.



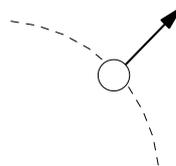
Which of the following diagrams correctly shows the force(s) acting on the Moon in the position shown above?



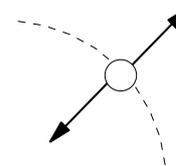
A.



B.

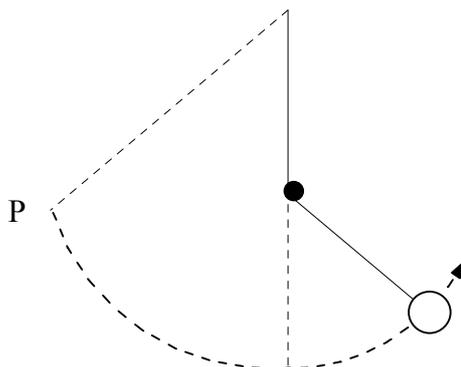


C.



D.

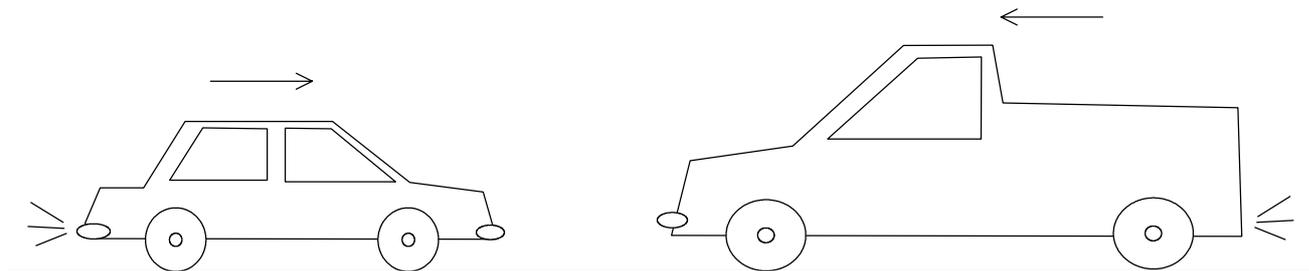
10. A pendulum bob is released from point P. As it swings down, the string strikes a peg and the bob swings up in a different arc on the other side as shown.



The bob will swing

- A. up to a lesser height than P.
- B. up to the same height as P.
- C. up to a greater height than P.
- D. round and round the peg.

11. A car collides with a more massive truck.



During the collision, each vehicle exerts a force on the other. How do the magnitudes of these forces compare?

- A. The forces cannot be compared without knowing how the initial speeds compare.
  - B. The magnitudes of the forces are equal.
  - C. The force exerted by the truck is the greater.
  - D. The force exerted by the car is the greater.
12. Two identical blocks connected by a light cord are on a frictionless surface. A force  $F$  is applied to one block as shown, and the system accelerates.



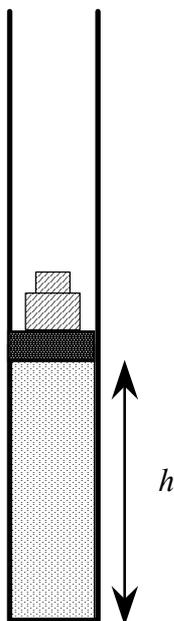
The force exerted by the cord on the second block will be

- A. zero.
- B.  $\frac{1}{2}F$ .
- C.  $F$ .
- D.  $2F$ .

13. A copper block is placed in thermal contact with a iron block at a higher temperature. The blocks have the same mass, and energy exchange with the surroundings is negligible.

Which of the following will be true of the magnitudes of the **internal energy change** and **temperature change** of each block when thermal equilibrium is reached?

- |    | Changes in internal energy | Changes in temperature |
|----|----------------------------|------------------------|
| A. | equal                      | equal                  |
| B. | unequal                    | equal                  |
| C. | equal                      | unequal                |
| D. | unequal                    | unequal                |
14. A gas is in a vertical cylinder fitted with a piston. Weights are placed on the piston. When the gas is at  $27^\circ\text{C}$  the piston is in equilibrium at height  $h$  above the base of the cylinder as shown below.



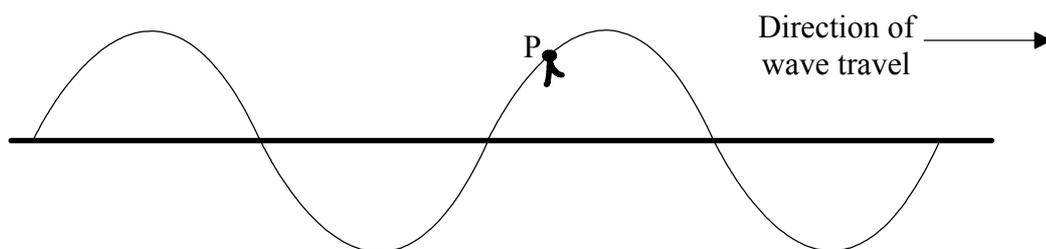
To what value should the gas temperature be increased for the piston to be in equilibrium at a height  $2h$  above the base?

- A.  $54^\circ\text{C}$
- B.  $150^\circ\text{C}$
- C.  $327^\circ\text{C}$
- D.  $600^\circ\text{C}$

15. A lead bullet is fired into an iron plate, where it deforms and stops. As a result, the temperature of the lead increases by an amount  $\Delta T$ . For a lead bullet having **twice** the mass but the same speed of impact, what would be the best estimate of its temperature increase?

- A.  $\frac{1}{2} \Delta T$
- B.  $\Delta T$
- C.  $\sqrt{2} \Delta T$
- D.  $2 \Delta T$

16. The diagram represents, at a particular instant of time, a transverse wave travelling to the right along a rope. One section of rope has been marked by tying a ribbon around it at point P.



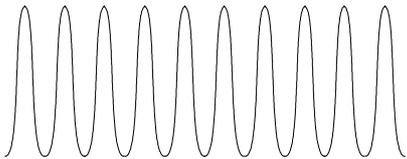
In what direction is the ribbon moving at the instant shown in the diagram?

- A. 
- B. 
- C. 
- D. 

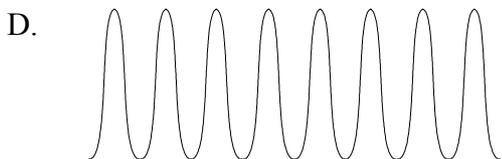
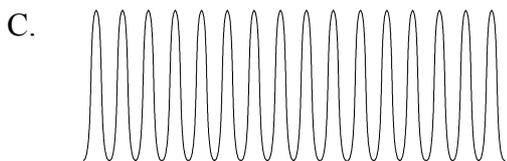
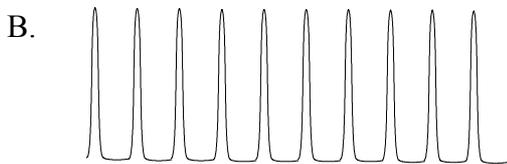
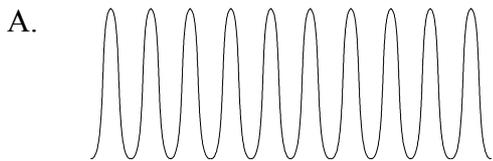
17. Light is incident from air onto on a glass block. What happens to the frequency and wavelength of the light on entering the glass?

	<b>Frequency</b>	<b>Wavelength</b>
A.	changes	changes
B.	changes	unchanged
C.	unchanged	changes
D.	unchanged	unchanged

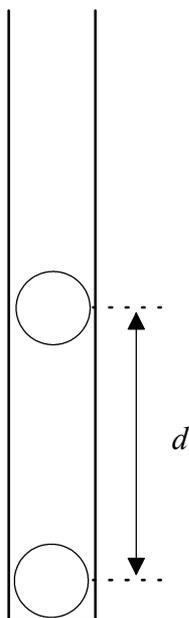
18. Monochromatic light incident on two narrow parallel slits produces a fringe pattern on a screen, with the intensity distribution shown below.



If the same slits were spaced **further apart**, which of the following diagrams best shows the intensity distribution pattern that would result?



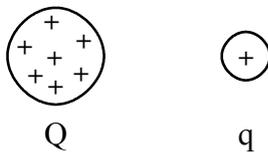
19. Two charged plastic balls in a vertical test tube are in equilibrium a distance  $d$  apart as shown.



If the charge on **each** ball were to be doubled, the distance between the balls in the test tube would become

- A.  $\sqrt{2}d$ .
- B.  $2d$ .
- C.  $4d$ .
- D.  $8d$ .

20. A positive test charge  $q$  is released near a positive fixed charge  $Q$ .



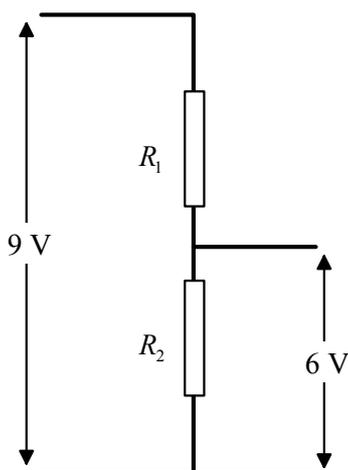
As  $q$  moves away from  $Q$ , it will move with

- A. constant velocity.
- B. constant acceleration.
- C. increasing acceleration.
- D. decreasing acceleration.

21. To start a car with a flat battery, the battery can be connected to the battery in another car using two cables. These are called “jumper cables” or “jump leads” and have low resistance. Suppose a good quality jumper cable has resistance  $R$ . A cheaper cable of the same length but half the cable diameter would have resistance

- A.  $\frac{R}{4}$ .
- B.  $\frac{R}{2}$ .
- C.  $2R$ .
- D.  $4R$ .

22. A student constructs a “voltage divider” which will provide an output voltage of 6 V from an input voltage of 9 V. She connects two resistors  $R_1$  and  $R_2$  as shown.



The ratio of the resistances  $R_1 : R_2$  must be

- A. 1 : 2.
- B. 2 : 1.
- C. 2 : 3.
- D. 3 : 2.

23. The element of an electric heater consists of a coil of resistance wire wound on a ceramic rod. The wire breaks at a point in the left half of the element as shown.



To get the heater working again temporarily, prior to buying a new element, a householder (unwisely) uses a piece of wire to “short across” the broken half as shown below.



Compared to the original heater the modified heater would generate approximately

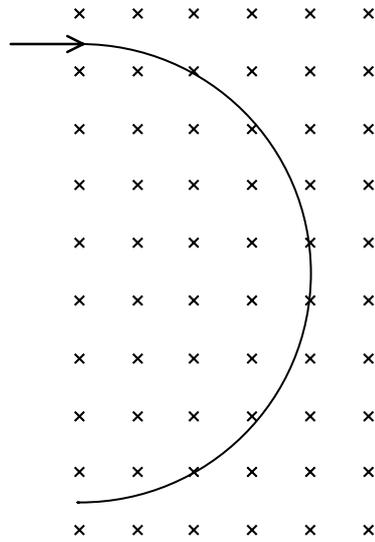
- A. a quarter of the power.
  - B. half the power.
  - C. twice the power.
  - D. four times the power.
24. An electron and a proton start from rest near oppositely charged parallel plates in vacuum as shown.



Which of the following will be true of the kinetic energies of the two particles when they reach the opposite plates?

- A. The proton will have the greater kinetic energy.
- B. The electron will have the greater kinetic energy.
- C. The kinetic energies of the two particles will be equal.
- D. The kinetic energies of the two particles will be equal, but opposite in sign.

25. A charged particle is injected into a region of uniform magnetic field and travels in a circular arc.



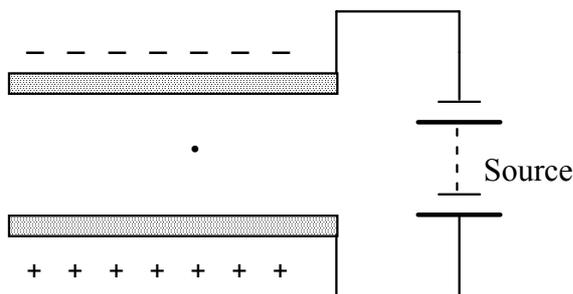
If the particle were to be injected with a **greater speed**, what would be true of the magnetic force on it and the radius of its path?

- |    | <b>Force</b> | <b>Arc radius</b> |
|----|--------------|-------------------|
| A. | greater      | greater           |
| B. | greater      | smaller           |
| C. | smaller      | greater           |
| D. | smaller      | smaller           |

26. The function of the commutator of a d.c. electric motor is

- A. to reverse the current through the rotating coils each half turn.
- B. to step up the voltage from the electrical source.
- C. to convert the motor into an a.c. motor.
- D. to enable the rotational speed of the motor to be varied.

27. A charged oil drop is being observed between two horizontal parallel plates. The potential difference between the plates is adjusted so that the drop is at rest.



The drop is observed to suddenly start moving upwards. What could be the reason for this?

- A. The oil drop may have gained an electron.
- B. The oil drop may have lost an electron.
- C. The oil drop may have coalesced (joined) with another, uncharged, drop.
- D. The source of potential difference may have been switched off.
28. All the **isotopes** of an element have nuclei with the same
- A. mass.
- B. number of nucleons.
- C. number of protons.
- D. number of neutrons.
29. A sample consists of a mixture of two radioactive nuclides X and Y, each of which decay to stable products. The half-life of X is about a day, while that of Y is about a week. If the activities due to X and Y are **equal** at a particular time, then a few days later the activity of the sample will be
- A. due to nuclides X and Y equally.
- B. entirely due to nuclide Y.
- C. predominantly due to nuclide X.
- D. predominantly due to nuclide Y.

30. Which of the following best describes the principle of operation of a Geiger-Muller tube used to detect alpha particles?
- A. The electric charge of the alpha particle is recorded as an electric pulse as it strikes the inside of the tube.
  - B. The alpha particle ionizes gas atoms or molecules along its path, the ions and electrons are separated and are detected as an electric pulse.
  - C. The alpha particle causes a flash of light in the tube, and each flash is counted electronically.
  - D. The alpha particle causes a nuclear reaction with a gas atom in the tube, and the reaction products produce an electric pulse.
-