

**PHYSICS  
STANDARD LEVEL  
PAPER 1**

Monday 19 May 2003 (afternoon)

45 minutes

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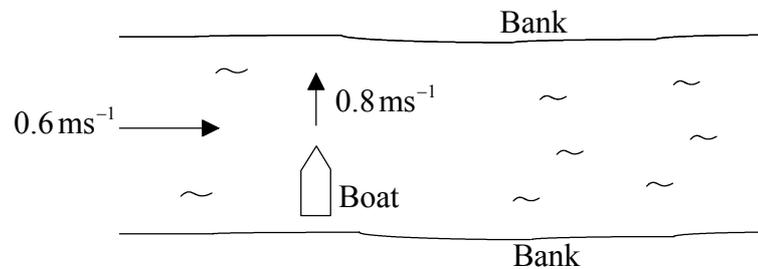
**INSTRUCTIONS TO CANDIDATES**

- 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. When a voltage  $V$  of 12.2 V is applied to a DC motor, the current  $I$  in the motor is 0.20 A. Which **one** of the following is the output power  $VI$  of the motor given to the correct appropriate number of significant digits?

- A. 2 W
- B. 2.4 W
- C. 2.40 W
- D. 2.44 W

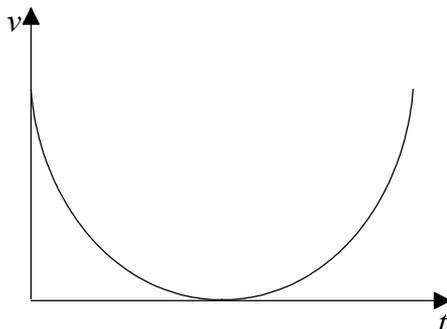
2. The diagram below shows a boat that is about to cross a river in a direction perpendicular to the bank at a speed of  $0.8\text{ ms}^{-1}$ . The current flows at  $0.6\text{ ms}^{-1}$  in the direction shown.



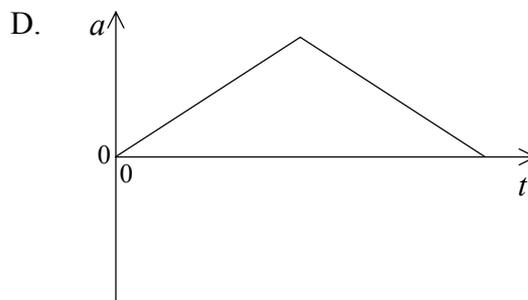
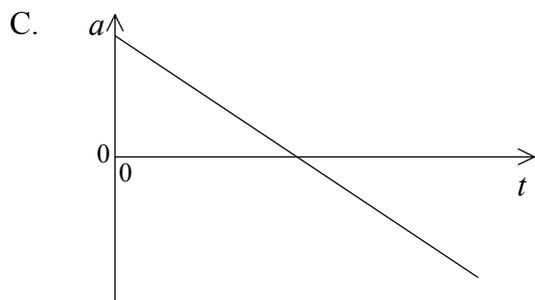
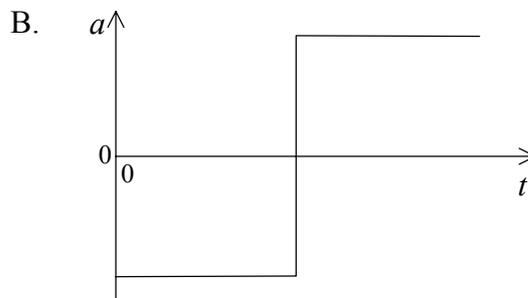
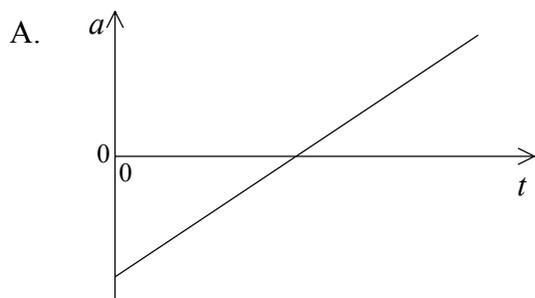
The magnitude of the displacement of the boat 5 seconds after leaving the bank is

- A. 3 m.
- B. 4 m.
- C. 5 m.
- D. 7 m.

3. The graph shows the variation with time  $t$  of the velocity  $v$  of an object.



Which **one** of the following graphs best represents the variation with time  $t$  of the acceleration  $a$  of the object?



4. A ball, initially at rest, takes time  $t$  to fall through a vertical distance  $h$ . If air resistance is ignored, the time taken for the ball to fall from rest through a vertical distance  $9h$  is

- A.  $3t$ .
- B.  $5t$ .
- C.  $9t$ .
- D.  $10t$ .

5. A raindrop falling through air reaches a terminal velocity before hitting the ground. At terminal velocity, the frictional force on the raindrop is
- A. zero.
  - B. less than the weight of the raindrop.
  - C. greater than the weight of the raindrop.
  - D. equal to the weight of the raindrop.
6. When a body is accelerating, the resultant force acting on it is equal to its
- A. change of momentum.
  - B. rate of change of momentum.
  - C. acceleration per unit of mass.
  - D. rate of change of kinetic energy.
7. An object is moved from the surface of the Earth to the surface of the Moon. The acceleration of free fall on the Moon is less than that on the Earth. Which **one** of the following describes the change, if any, in its gravitational mass and its weight?

	<b>Change in gravitational mass</b>	<b>Change in weight</b>
A.	unchanged	unchanged
B.	unchanged	decreases
C.	decreases	unchanged
D.	decreases	decreases

8. An object of mass  $m_1$  has a kinetic energy  $K_1$ . Another object of mass  $m_2$  has a kinetic energy  $K_2$ . If the momentum of both objects is the same, the ratio  $\frac{K_1}{K_2}$  is equal to

A.  $\frac{m_2}{m_1}$ .

B.  $\frac{m_1}{m_2}$ .

C.  $\sqrt{\frac{m_2}{m_1}}$ .

D.  $\sqrt{\frac{m_1}{m_2}}$ .

9. Which **one** of the following units is a unit of energy?

A. eV

B.  $\text{W s}^{-1}$

C.  $\text{W m}^{-1}$

D.  $\text{N m s}^{-1}$

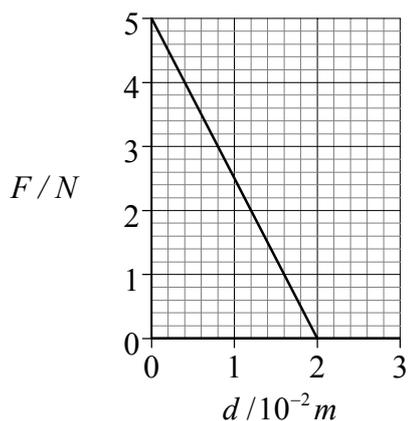
10. A rocket is fired vertically. At its highest point, it explodes. Which **one** of the following describes what happens to its total momentum and total kinetic energy as a result of the explosion?

	Total momentum	Total kinetic energy
A.	unchanged	increased
B.	unchanged	unchanged
C.	increased	increased
D.	increased	unchanged

11. Two satellites of equal mass,  $S_1$  and  $S_2$ , orbit the Earth.  $S_1$  is orbiting at a distance  $r$  from the Earth's centre at speed  $v$ .  $S_2$  orbits at a distance  $2r$  from the Earth's centre at speed  $\frac{v}{\sqrt{2}}$ . The ratio of the centripetal force on  $S_1$  to the centripetal force on  $S_2$  is

- A.  $\frac{1}{8}$ .
- B.  $\frac{1}{4}$ .
- C. 4.
- D. 8.

12. The graph below shows the variation with displacement  $d$  of the force  $F$  applied by a spring on a cart.



The work done by the force in moving the cart through a distance of 2 cm is

- A.  $10 \times 10^{-2}$  J.
- B.  $7 \times 10^{-2}$  J.
- C.  $5 \times 10^{-2}$  J.
- D.  $2.5 \times 10^{-2}$  J.

13. Thermal energy is transferred through the glass windows of a house mainly by
- A. conduction.
  - B. radiation.
  - C. conduction and convection.
  - D. radiation and convection.
14. The specific latent heat of vaporization of a substance is the quantity of energy required to
- A. raise the temperature of a unit mass of a substance by one degree Celsius.
  - B. convert a unit mass of liquid to vapour at constant temperature and pressure.
  - C. convert a unit mass of solid to vapour at constant temperature and pressure.
  - D. convert a unit mass of liquid to vapour at a temperature of 100 °C and a pressure of one atmosphere.
15. When a gas in a cylinder is compressed at constant temperature by a piston, the pressure of the gas increases. Consider the following three statements.
- I. The rate at which the molecules collide with the piston increases.
  - II. The average speed of the molecules increases.
  - III. The molecules collide with each other more often.

Which statement(s) correctly explain the increase in pressure?

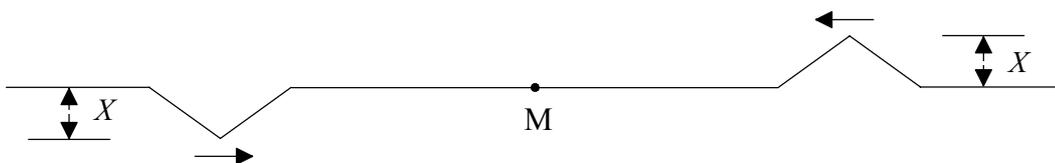
- A. I only
- B. II only
- C. I and II only
- D. I and III only

16. Water waves at the surface of a pond pass a floating log of length  $L$ . The log is at rest relative to the bank. The diagram shows wave crests at one instant.



The number of crests passing the log per unit time is  $N$ . The speed of the water waves relative to the log at rest is

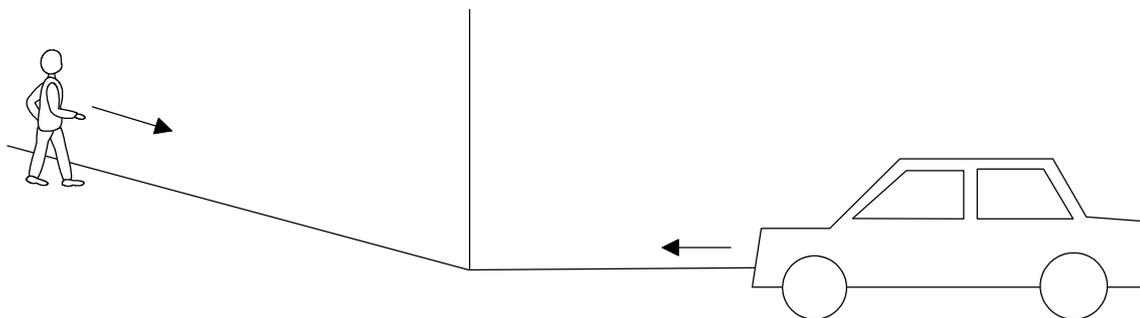
- A.  $\frac{L}{7}(N-1)$ .
- B.  $\frac{L}{6}(N-1)$ .
- C.  $\frac{L}{7}(N)$ .
- D.  $\frac{L}{6}(N)$ .
17. Two identical triangular pulses of amplitude  $X$  travel toward each other along a string. At the instant shown on the diagram below, point M is midway between the two pulses.



The amplitude of the disturbance in the string as the pulses move through M is

- A.  $2X$ .
- B.  $X$ .
- C.  $\frac{X}{2}$ .
- D.  $0$ .

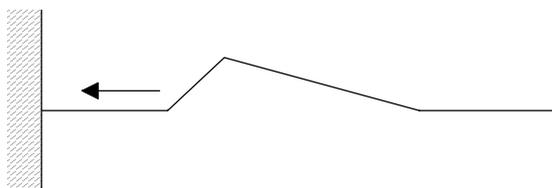
18. A person is walking along one side of a building and a car is driving along another side of the building.



The person can hear the car approach but cannot see it. This is explained by the fact that sound waves

- A. travel more slowly than light waves.
- B. are diffracted more at the corner of the building than light waves.
- C. are refracted more at the corner of the building than light waves.
- D. are longitudinal waves.

19. A pulse is sent down a string fixed at one end.



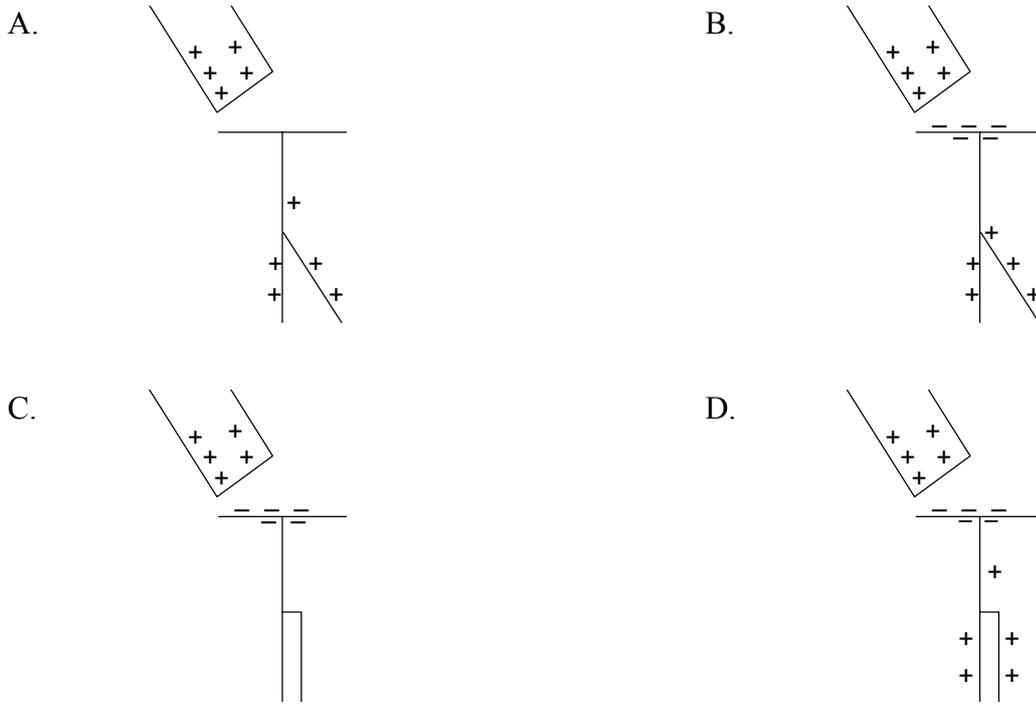
Which **one** of the following diagrams best represents the reflected pulse?

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

20. Waves can be reflected, refracted and diffracted. Which of these effects can be explained using Huygens' principle?

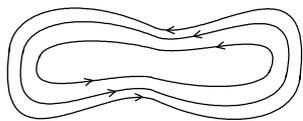
- A. reflection, refraction and diffraction
- B. reflection and refraction only
- C. refraction and diffraction only
- D. reflection and diffraction only

21. A positively charged rod is placed near to the cap of an uncharged gold leaf electroscope. Which **one** of the following diagrams correctly shows the distribution of charges on the electroscope as well as the deflection of the gold leaf?

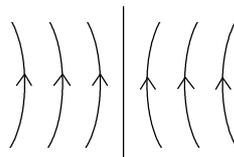


22. Which **one** of the field patterns below could be produced by two point charges?

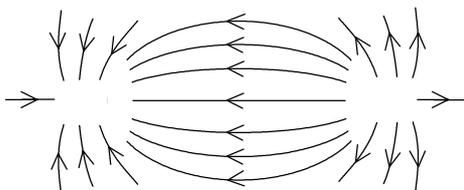
A.



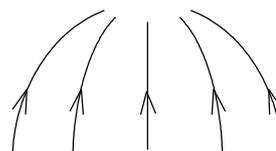
B.



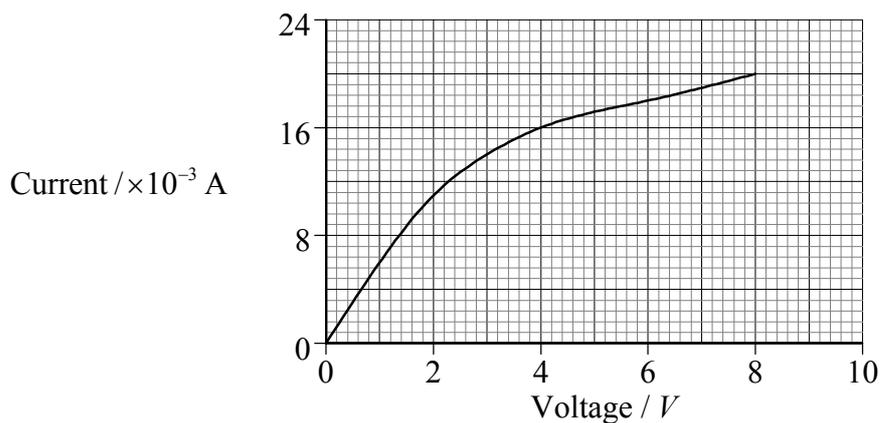
C.



D.



23. The graph below shows the current/voltage characteristics of a filament lamp.



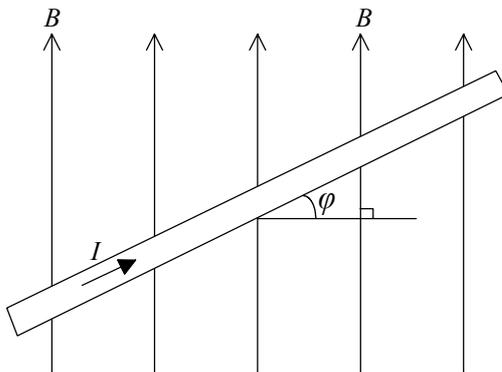
The resistance of the filament at 4.0 V is

- A. 250  $\Omega$ .
- B. 4000  $\Omega$ .
- C. 8000  $\Omega$ .
- D. 64000  $\Omega$ .

24. An electric motor is used to raise a weight of 2.0 N. When connected to a 4.0 V supply, the current in the motor is 1.5 A. Assuming no energy losses, the best estimate for the maximum steady speed at which the weight can be raised is

- A.  $0.3 \text{ ms}^{-1}$ .
- B.  $3.0 \text{ ms}^{-1}$ .
- C.  $9.0 \text{ ms}^{-1}$ .
- D.  $12.0 \text{ ms}^{-1}$ .

25. The diagram below shows a current  $I$  in a wire placed at an angle  $\varphi$  inside a uniform magnetic field of field strength  $B$ .



The magnetic force per unit of length of wire is  $M$ . The magnetic field strength  $B$  is given by

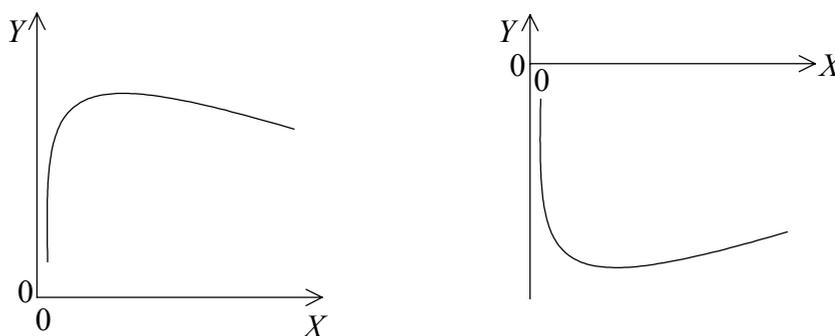
- A.  $\frac{M}{I \sin \varphi}$ .
- B.  $\frac{M}{I \cos \varphi}$ .
- C.  $\frac{M \cos \varphi}{I}$ .
- D.  $\frac{M \sin \varphi}{I}$ .

26. Which **one** of the following correctly gives the number of electrons, protons and neutrons in a neutral atom of the nuclide  $^{65}_{29}\text{Cu}$ ?

	Number of electrons	Number of protons	Number of neutrons
A.	65	29	36
B.	36	36	29
C.	29	29	65
D.	29	29	36

27. In the Geiger-Marsden experiment,  $\alpha$  particles are scattered by gold nuclei. The experimental results indicate that most  $\alpha$  particles are
- A. scattered only at small angles.
  - B. scattered only at large angles.
  - C. absorbed in the target.
  - D. scattered back along the original direction.
28. A sample of radioactive carbon-14 decays into a stable isotope of nitrogen. As the carbon-14 decays, the **rate** at which the amount of nitrogen is produced
- A. decreases linearly with time.
  - B. increases linearly with time.
  - C. decreases exponentially with time.
  - D. increases exponentially with time.

29. Either of the two following graphs is useful in predicting nuclear energy changes in fission and fusion processes.



Which **one** of the following correctly identifies the quantities  $X$  and  $Y$ ?

	$X$	$Y$
A.	atomic number	total binding energy
B.	mass number	total binding energy
C.	atomic number	average binding energy per nucleon
D.	mass number	average binding energy per nucleon

30. The unified mass unit is defined as

- A. the mass of one neutral atom of  $^{12}_6\text{C}$ .
- B.  $\frac{1}{12}$  of the mass of one neutral atom of  $^{12}_6\text{C}$ .
- C.  $\frac{1}{6}$  of the mass of one neutral atom of  $^{12}_6\text{C}$ .
- D. the mass of the nucleus of  $^{12}_6\text{C}$ .