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Physics

Higher level

Paper 1A

28 April 2026

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

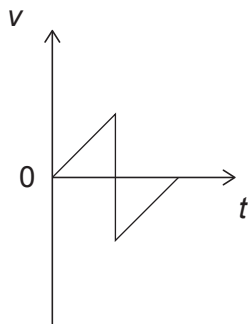
2 hours [Paper 1A and Paper 1B]

Instructions to students

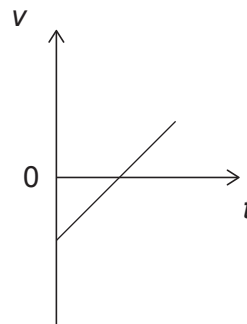
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for paper 1A is **[40 marks]**.
- The maximum mark for paper 1A and paper 1B is **[60 marks]**.

1. A ball is dropped from rest. The ball hits the ground and bounces back up. Which of the following diagrams shows the variation with time t of the velocity v of the ball?

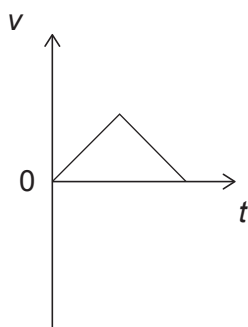
A.



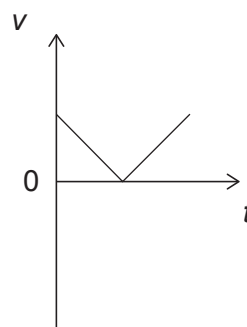
B.



C.



D.



2. A balloon of mass m falls vertically through the air with terminal velocity. The buoyancy force acting on the balloon has magnitude F_b . What is the magnitude of the drag force acting on the balloon?

A. mg

B. F_b

C. $mg + F_b$

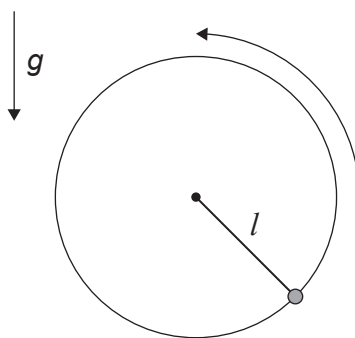
D. $mg - F_b$

3. A ball of mass 0.0030 kg is fired with a speed of 10 m s^{-1} from a toy gun of mass 0.60 kg , which is initially stationary. The net external force on the system is zero.

What are the impulse on the gun and the total momentum of the system just after it is fired?

	Impulse on the gun/ N s	Total momentum of the system/ kg m s^{-1}
A.	0.03	0.57
B.	0.03	0
C.	6	0.57
D.	6	0

4. A child ties a stone to a string of length l and swings it in a vertical circle. The stone has speed v at the highest point on the circle.

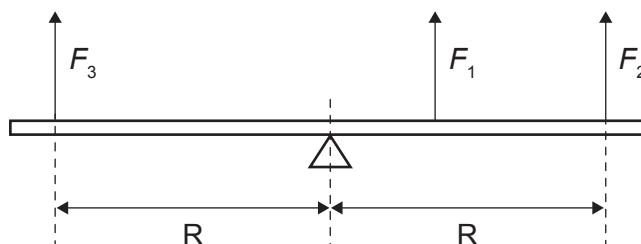


What is the minimum possible value of v for the string to remain taut?

- A. $\sqrt{gl}$
- B. $\sqrt{2gl}$
- C. $\frac{g}{l^2}$
- D. $\frac{l^2}{g}$

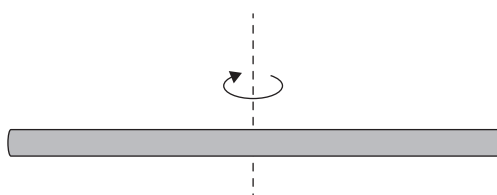
5. A car moves up a hill with initial kinetic energy K . W is the work done on the car by the net force in reaching the top of the hill. The change in gravitational potential energy of the car is U . What is the kinetic energy of the car at the top of the hill?
- A. K
 - B. $K - U$
 - C. $K + W$
 - D. $K + W - U$
6. An amount of energy E can be extracted from a mass m of fuel with volume V . What is the energy density of the fuel?
- A. $\frac{E}{m}$
 - B. $\frac{E}{V}$
 - C. $\frac{Em}{V}$
 - D. $\frac{EV}{m}$

7. Three forces, F_1 , F_2 and F_3 , are exerted on a uniform rigid bar. The forces on the diagram are not drawn to scale. R is the distance from the pivot point. The bar is in rotational equilibrium.



What can be concluded from this?

- A. $F_3 = F_1 + F_2$
 - B. $F_3 < F_1 + F_2$
 - C. $F_3 < F_1$
 - D. $F_3 < F_2$
8. A horizontal uniform rod of mass m and length L has moment of inertia $I = \frac{1}{12}mL^2$ about a vertical axis going through its centre, as shown in the diagram.



The rod is cut in half along the vertical axis. What is the moment of inertia of one half of the rod about a vertical axis through its centre?

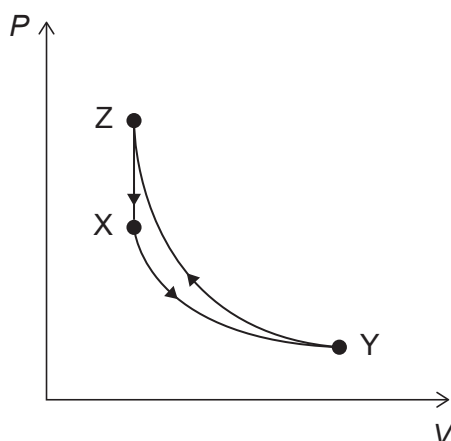
- A. I
- B. $\frac{I}{2}$
- C. $\frac{I}{4}$
- D. $\frac{I}{8}$

9. A spaceship travels with speed $\frac{c}{2}$ with respect to the Earth. The spaceship fires a projectile. The projectile has speed $\frac{c}{4}$ with respect to the Earth in the same direction as that of the spaceship. What is the speed of the projectile in the spaceship's reference frame?
- A. $\frac{c}{4}$
 - B. $\frac{3c}{4}$
 - C. $\frac{2c}{7}$
 - D. $\frac{6c}{7}$
10. An observer X measures the proper time interval between events P and Q. What must be true about this scenario?
- A. Observer X is at rest.
 - B. Observer X measures the longest time interval between P and Q in any reference frame.
 - C. P and Q occur at the same point in space in observer X's reference frame.
 - D. All observers measure the same time interval between P and Q.
11. Thermal energy is transferred to a gas inside a container of fixed volume and initial temperature 20°C . As a result, the pressure inside the container is doubled. What is the final temperature of the gas?
- A. 40°C
 - B. 293°C
 - C. 313°C
 - D. 586°C

12. A planet with an albedo of 0.2 orbits the Sun in a circular orbit. The solar constant at the position of the planet is S . The planet has no atmosphere and a constant temperature. What is the **average** intensity radiated by the planet's surface?
- A. $0.05S$
- B. $0.08S$
- C. $0.2S$
- D. $0.8S$
13. An ideal gas X at temperature T has internal energy U . A second ideal gas Y at temperature $2T$ has internal energy $\frac{U}{2}$. Which gas has more particles and what is the direction of heat flow between the gases once they are put into thermal contact?

	Gas with more particles	Direction of heat flow
A.	X	X to Y
B.	Y	X to Y
C.	X	Y to X
D.	Y	Y to X

14. Cycle XYZX is composed of an isothermal, an adiabatic and an isovolumetric process.



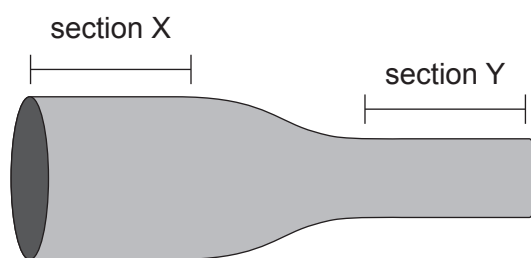
What can be said about the change in internal energy and the sign of the work done by the gas in process YZ?

	Change in internal energy	Sign of work done
A.	Positive	Negative
B.	Positive	Positive
C.	Negative	Negative
D.	Negative	Positive

15. Consider a system of three coins. What is the entropy of a state in which two coins show heads and one coin shows tails?

- A. $k_B \ln(2)$
- B. $k_B \ln(3)$
- C. $k_B \ln(4)$
- D. $k_B \ln(6)$

16. A current-carrying wire has two sections with different radii.



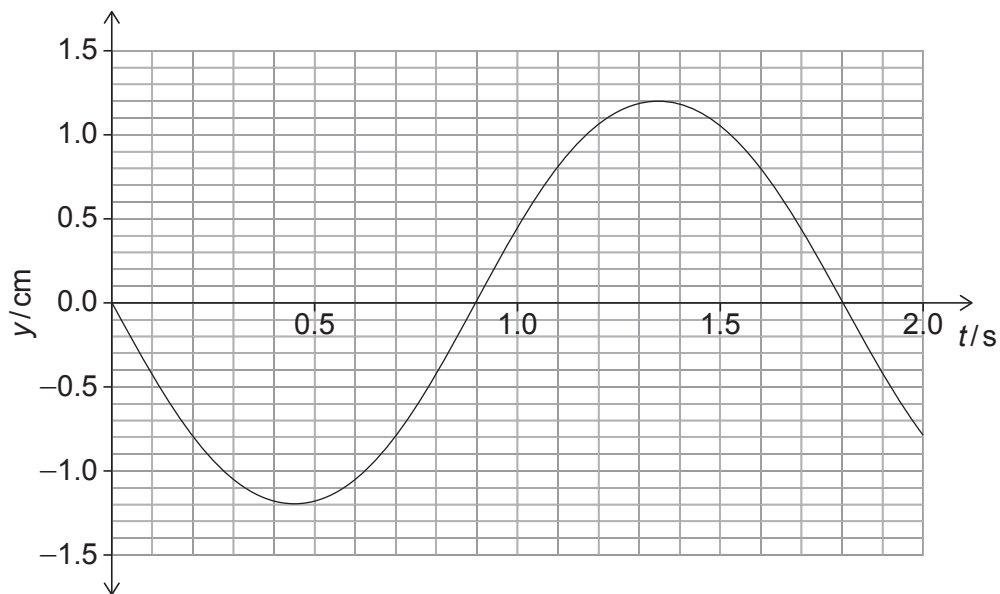
The radius of the wire in section X is twice that in section Y. The current in X is I_x and the current in Y is I_y . What is $\frac{I_x}{I_y}$?

- A. $\frac{1}{2}$
 - B. 1
 - C. 2
 - D. 4
17. A potential difference across a wire of length L dissipates 1000 W. A second wire of the same material and diameter has length $\frac{L}{2}$. What is the power dissipated in the second wire with the same potential difference across it?
- A. 250 W
 - B. 500 W
 - C. 2000 W
 - D. 4000 W

18. A simple pendulum of length 10 m is released from rest at time $t = 0$, at a small angle from the vertical. At what value of t , in seconds, will the pendulum reach its maximum speed?

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

19. The graph shows the variation with time t of the displacement y from the equilibrium of a pendulum bob.

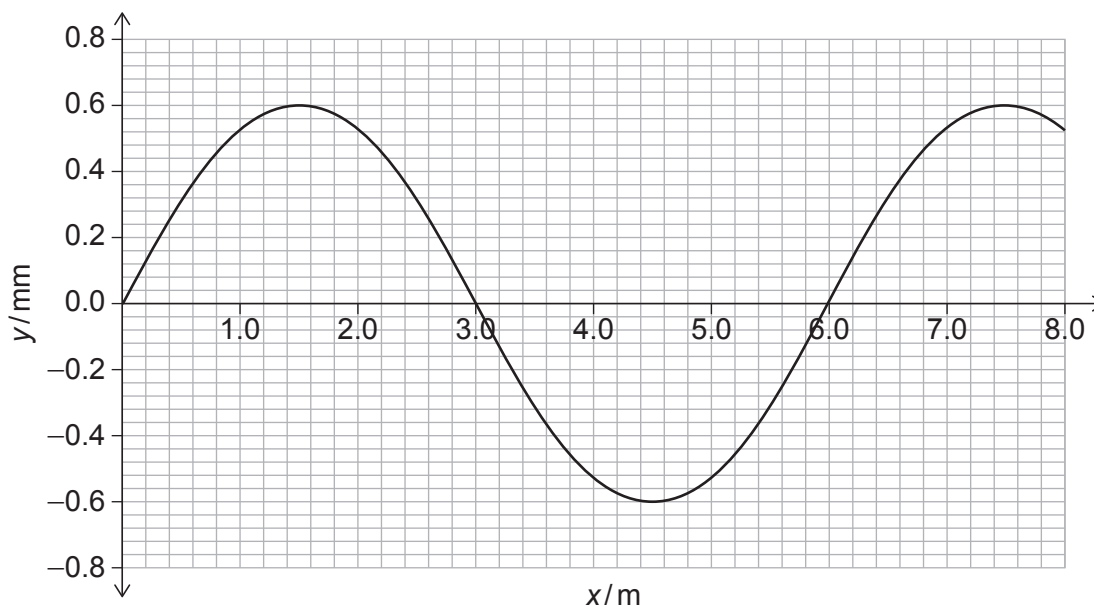


What will be the speed of the bob at $t = 1.0$ s?

- A. 4.4 cm s^{-1}
- B. 4.2 cm s^{-1}
- C. 3.9 cm s^{-1}
- D. 1.4 cm s^{-1}

20. A sound wave travels through the air to the right. The graph shows the variation of the displacement y of air molecules with position x along the wave at time $t = 0$.

Positive values represent displacements to the right and negative values represent displacements to the left.



Where will the compression be at $t = 0$?

- A. 1.5 m
- B. 3.0 m
- C. 4.5 m
- D. 6.0 m

21. Two identical sources emit sound of wavelength L in phase. The sources are separated by a distance equal to L .



How many points of destructive interference are there on the line joining the sources?

- A. None
 - B. One
 - C. Two
 - D. Infinite
22. Monochromatic light is incident on two parallel slits. An interference pattern is formed on a screen. The slits are replaced by wider slits with the same separation. What is the change in the interference pattern?
- A. Angular position of maxima decrease
 - B. Angular position of maxima increase
 - C. Central maximum intensity decreases
 - D. Central maximum intensity increases

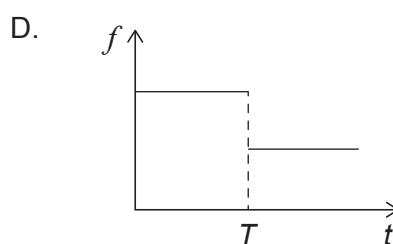
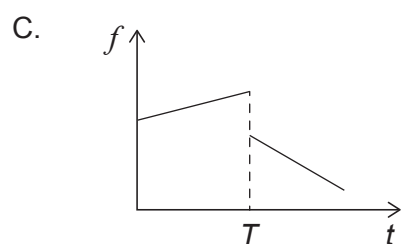
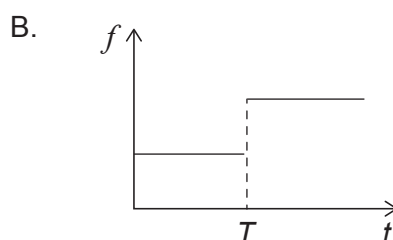
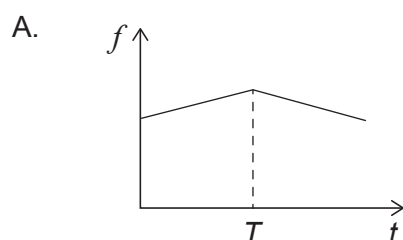
23. A first harmonic standing wave is formed in a pipe with one end open and one end closed. What is the phase difference between the middle point of the pipe and its open end?

- A. 0
- B. $\frac{\pi}{4}$
- C. $\frac{\pi}{2}$
- D. π

24. An observer moves with constant speed towards and then past a stationary sound source.



The speed of the observer is less than the speed of sound. At time T , the observer passes the source and starts moving away from it. Which graph shows how the frequency f measured by the observer varies with time t ?



25. A planet has two moons, X and Y, orbiting it in circular orbits. Moon X has a mass m and an orbital radius R . Moon Y has mass $2m$ and orbital radius $\frac{R}{2}$. What is the ratio between the centripetal force acting on X and the centripetal force acting on Y?

- A. $\frac{1}{8}$
- B. $\frac{1}{4}$
- C. $\frac{1}{2}$
- D. 1

26. A spherical planet of radius R has a satellite of mass m that orbits it a distance $2R$ from its centre with kinetic energy K . What is the escape speed from the surface of the planet?

- A. $\sqrt{\frac{8K}{m}}$
- B. $\sqrt{\frac{4K}{m}}$
- C. $\sqrt{\frac{2K}{m}}$
- D. $\sqrt{\frac{K}{m}}$

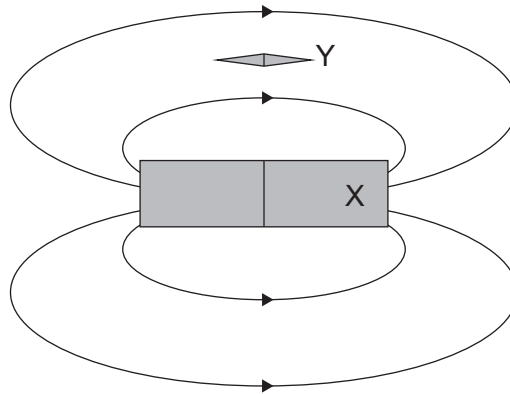
27. Two identical conducting spheres have charges 3 mC and 9 mC . The force between the spheres is F .



The spheres are put into contact and then returned to their initial positions. What is the new magnitude of the force between the spheres?

- A. $\frac{F}{2}$
- B. $\frac{27F}{36}$
- C. F
- D. $\frac{36F}{27}$

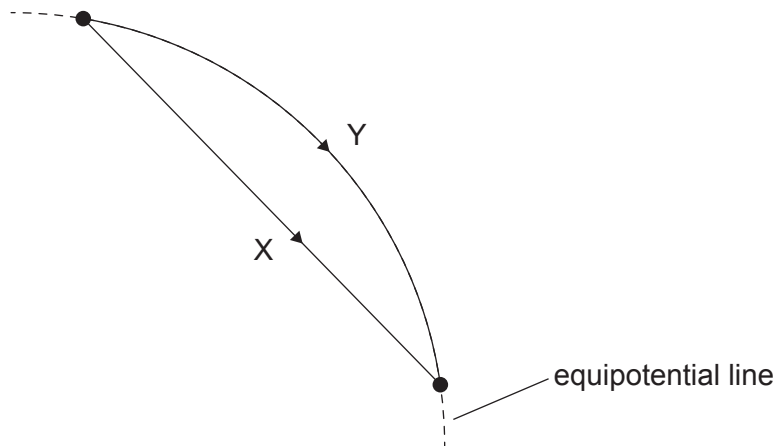
28. The diagram shows some magnetic field lines of a magnet and a compass needle placed near it. The needle aligns as shown.



What is the nature of the magnetic poles X and Y?

	X	Y
A.	North	North
B.	North	South
C.	South	North
D.	South	South

29. A point charge is moved at constant speed between two points in the same equipotential line along two paths, X and Y.



The total work done on the charge when it moves through path X is W_X and through path Y is W_Y . Which comparison between these is correct?

- A. $W_X = W_Y = 0$
- B. $W_X = W_Y \neq 0$
- C. $W_X < W_Y$
- D. $W_X > W_Y$

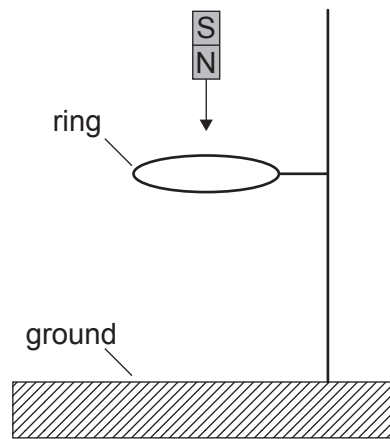
30. The same current is established in two long parallel wires, X and Y, as shown.



The current in Y is increased. What happens to the magnetic force acting on each wire?

	Force acting on X	Force acting on Y
A.	Remains the same	Remains the same
B.	Remains the same	Increases
C.	Increases	Remains the same
D.	Increases	Increases

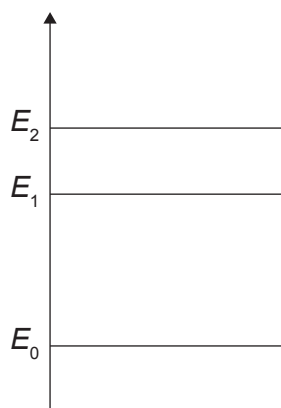
31. A falling magnet approaches a conducting circular ring above the ground.



What is correct about the direction and magnitude of the current induced in the ring as the magnet approaches it, as seen from the ground?

	Direction of the current	Magnitude of the current
A.	Counter-clockwise	Constant
B.	Counter-clockwise	Variable
C.	Clockwise	Constant
D.	Clockwise	Variable

32. The diagram shows three energy levels of an atom.



The photons emitted in transitions between these levels have energies of e_1 , e_2 and e_3 , where $e_1 < e_2 < e_3$. What are E_1 and E_2 ?

	E_1	E_2
A.	$E_0 + e_2$	$E_0 + e_3$
B.	$E_0 + e_2$	$E_0 + e_2 + e_3$
C.	$E_0 + e_1 + e_2$	$E_0 + e_3$
D.	$E_0 + e_1 + e_2$	$E_0 + e_2 + e_3$

33. An electron inside a hydrogen-like atom absorbs a photon of energy 54 eV to make a transition from the $n = 1$ to the $n = 2$ state. The energy levels in the atom are given by $E = -\frac{k}{n^2}$.

What photon energy is required for a transition from the $n = 2$ to the $n = 3$ state?

- A. 72 eV
- B. 26 eV
- C. 18 eV
- D. 10 eV

34. Red light incident on a metallic surface causes the emission of electrons from the surface. The red light is then replaced by green light of the same intensity. What change, if any, will be observed in the emitted electrons?
- A. Less delay in emission of electrons
 - B. Higher maximum kinetic energy of the electrons
 - C. No change
 - D. Higher rate of emission of electrons
35. What will be the shift in wavelength for a photon that scatters off an electron at an angle of 60° ?
- A. $\frac{2h}{m_e c}$
 - B. $\frac{h}{m_e c}$
 - C. $\frac{2h}{3m_e c}$
 - D. $\frac{h}{2m_e c}$

36. A nucleus X with mass defect δ_x undergoes nuclear fusion with another nucleus Y with mass defect δ_y . The reaction releases energy to the environment, resulting in a nucleus Z with mass defect δ_z . What is the correct relation between these mass defects?
- A. $\delta_z = \delta_x + \delta_y$
 - B. $\delta_z < \delta_x + \delta_y$
 - C. $\delta_x < \delta_z < \delta_y$
 - D. $\delta_z > \delta_x + \delta_y$
37. In an experiment, the count rate of a radioactive sample is measured to be 64 Bq. After two half-lives have passed, the count rate is measured to be 34 Bq. What is the background count rate in this experiment?
- A. 10 Bq
 - B. 24 Bq
 - C. 30 Bq
 - D. 40 Bq
38. A radioactive sample has N nuclei with a half-life of T . What is the initial activity of the sample?
- A. $\frac{N \ln(2)}{T}$
 - B. $\frac{\ln(2)}{NT}$
 - C. $\frac{N}{T \ln(2)}$
 - D. $\frac{TN}{\ln(2)}$

- 39.** Which part of a nuclear fission reactor is designed to reduce the kinetic energy of neutrons produced in the reaction?
- A. Control rods
 - B. Moderators
 - C. Turbine
 - D. Heat exchanger
- 40.** A main sequence star has a mass equal to three solar masses. What is the most likely final stage in the evolution of the star?
- A. Black hole
 - B. Neutron star
 - C. Red giant
 - D. White dwarf
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