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Physics

Standard level

Paper 1

2 May 2023

Zone A afternoon | Zone B morning | Zone C morning

45 minutes

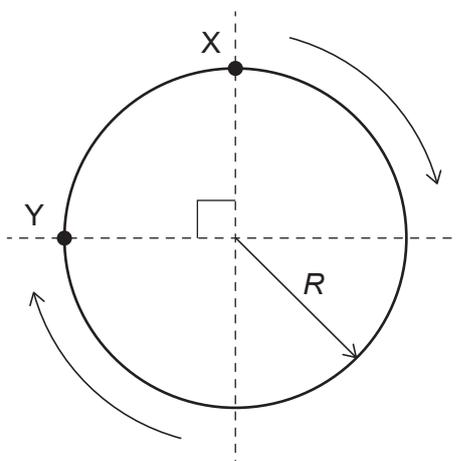
Instructions to candidates

- 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.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for this examination paper is **[30 marks]**.

1. What is a possible wavelength of a visible light photon?
 - A. $500\ \mu\text{m}$
 - B. $500\ \text{nm}$
 - C. $50\ \mu\text{m}$
 - D. $50\ \text{nm}$

2. Masses P and Q , are measured to be $(30 \pm 1)\ \text{g}$ and $(20 \pm 1)\ \text{g}$ respectively. Which of the following expressions gives the least percentage uncertainty?
 - A. $P + Q$
 - B. $P - Q$
 - C. $P \times Q$
 - D. $\frac{P}{Q}$

3. A car travels clockwise around a circular track of radius R . What is the magnitude of displacement from X to Y ?



- A. $R\frac{3\pi}{2}$
- B. $R\frac{\pi}{2}$
- C. $R\sqrt{2}$
- D. R

4. A car accelerates uniformly. The car passes point X at time t_1 with velocity v_1 and point Y at time t_2 with velocity v_2 . The distance XY is s .



The following expressions are proposed for the magnitude of its acceleration a :

I.
$$a = \frac{2s}{(t_2 - t_1)^2}$$

II.
$$a = \frac{v_2^2 - v_1^2}{2s}$$

III.
$$a = \frac{v_2 - v_1}{t_2 - t_1}$$

Which is correct?

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

5. A ball is projected at an angle to the horizontal on Earth reaching a maximum height H and a maximum range R . The same ball is projected at the same angle and speed on a planet where the acceleration due to gravity is three times that on Earth. Resistance effects are negligible.

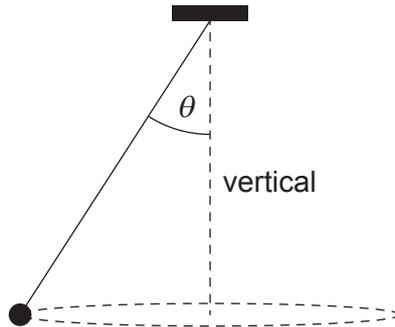
What is the maximum range and the maximum height reached on that planet?

	Maximum range	Maximum height reached
A.	$\frac{R}{3}$	$\frac{H}{3}$
B.	R	$\frac{H}{3}$
C.	R	$\frac{H}{9}$
D.	$\frac{R}{3}$	$\frac{H}{9}$

6. A ball falls with terminal velocity through air. What is correct about the kinetic energy and the total energy of the ball?

	Kinetic energy	Total energy
A.	constant	decreases
B.	increases	decreases
C.	constant	constant
D.	increases	constant

7. A ball attached to a string is made to rotate with constant speed along a horizontal circle. The string is attached to the ceiling and makes an angle of θ° with the vertical. The tension in the string is T .



What is correct about the horizontal component and vertical component of the net force on the ball?

	Horizontal component	Vertical component
A.	$T \cos \theta$	$T \sin \theta$
B.	$T \sin \theta$	$T \cos \theta$
C.	$T \cos \theta$	0
D.	$T \sin \theta$	0

8. A block of mass 2.0 kg accelerates uniformly at a rate of 1.0 m s^{-2} when a force of 4.0 N acts on it. The force is doubled while resistive forces stay the same. What is the block's acceleration?
- A. 4.0 m s^{-2}
- B. 3.0 m s^{-2}
- C. 2.0 m s^{-2}
- D. 1.0 m s^{-2}

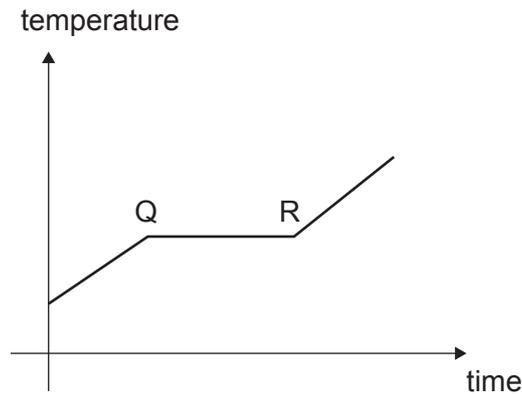
9. The input power of an electric motor is 200 W. It is used to raise a mass of 10 kg at constant speed. If the efficiency of the motor is 40 %, through what height will the mass be raised in 1 second?
- A. 0.5 m
 - B. 0.8 m
 - C. 1.2 m
 - D. 2.0 m

10. A tennis ball is dropped from rest from a height. It hits the ground and bounces back to a lower height. Air resistance is negligible.

What is correct about the collision of the tennis ball with the ground?

- A. Elastic because momentum of the system is conserved
 - B. Elastic because the kinetic energy of the system is conserved
 - C. Inelastic because momentum of the system is not conserved
 - D. Inelastic because the kinetic energy of the system is not conserved
11. The temperature of an object is changed from θ_1 °C to θ_2 °C. What is the change in temperature measured in kelvin?
- A. $(\theta_2 - \theta_1)$
 - B. $(\theta_2 - \theta_1) + 273$
 - C. $(\theta_2 - \theta_1) - 273$
 - D. $273 - (\theta_2 - \theta_1)$

12. A solid is heated at constant power in an insulated container. The graph shows the variation of temperature with time.



Why is the temperature constant for section QR?

- A. The intermolecular potential energy of the molecules is constant.
 - B. The kinetic energy of the molecules is constant.
 - C. The internal energy of the solid is constant.
 - D. The rate at which the solid absorbs heat is equal to the rate at which it loses heat.
13. Two blocks X and Y at different temperatures are placed in thermal contact with each other until they reach thermal equilibrium. Block X and block Y are of the same material. The mass of block Y is half that of block X. The change in temperature of block X has a magnitude ΔT and the change in internal energy of block X has a magnitude ΔU . What is the change in magnitude of temperature of block Y and the change in magnitude of internal energy of block Y?

	Magnitude of change in temperature of Y	Magnitude of change in internal energy of Y
A.	ΔT	$2\Delta U$
B.	$2\Delta T$	$2\Delta U$
C.	ΔT	ΔU
D.	$2\Delta T$	ΔU

14. A wave is polarized. What **must** be correct about the wave?

It is a...

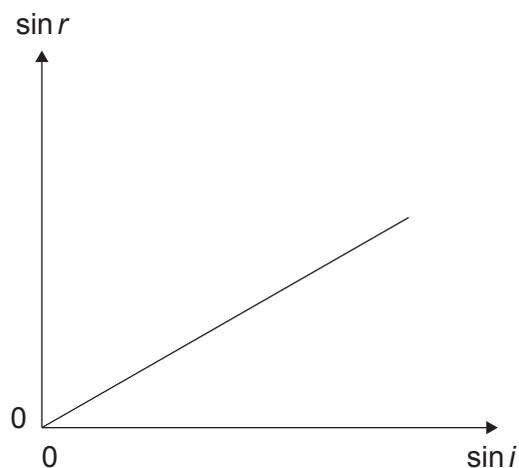
- A. transverse wave.
- B. longitudinal wave.
- C. standing wave.
- D. travelling wave.

15. Two identical sources oscillate in phase and produce constructive interference at a point P. The intensity recorded at P is I .

What is the intensity at P from one source?

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

16. A group of students perform an experiment to find the refractive index of a glass block. They measure various values of the angle of incidence i and angle of refraction r for a ray entering the glass from air. They plot a graph of the $\sin r$ against $\sin i$.

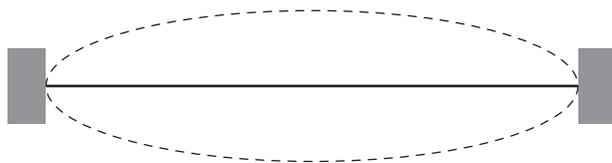


They determine the gradient of the graph to be m .

Which of the following gives the critical angle of the glass?

- A. $\sin^{-1}(m)$
- B. $\sin^{-1}\left(\frac{1}{m}\right)$
- C. m
- D. $\frac{1}{m}$

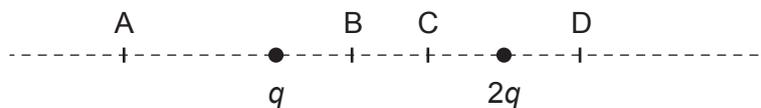
17. A standing wave with a first harmonic of frequency f_1 is formed on a string fixed at both ends.



The frequency of the third harmonic is f_3 .

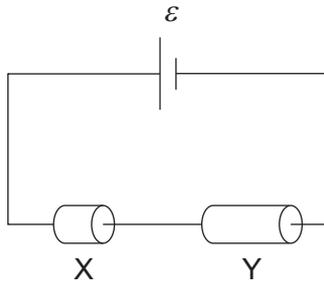
What is $\frac{f_1}{f_3}$?

- A. 3
 - B. $\frac{3}{2}$
 - C. $\frac{2}{3}$
 - D. $\frac{1}{3}$
18. Two positive charges of magnitude q and $2q$ are fixed as shown. At which position is the electric field, due to these charges, equal to zero?



19. X and Y are two conductors with the same diameter, made from the same material. Y is twice the length of X. They are connected in series to a cell of emf ε .

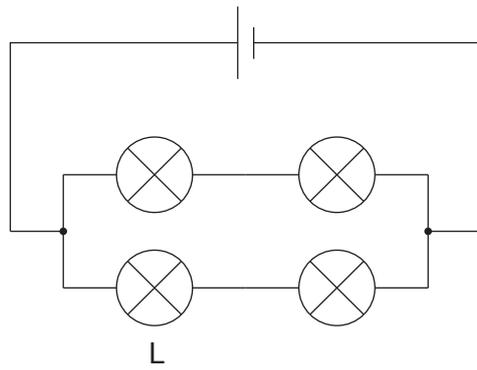
X dissipates power P .



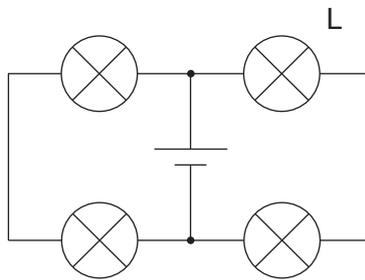
What is the power dissipated by Y?

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

20. Four identical lamps are connected in a circuit. The current through lamp L is I .



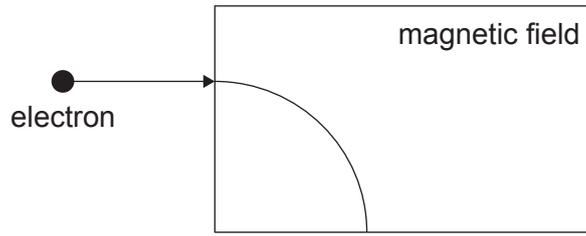
The lamps are rearranged using the same cell.



What is the current through L?

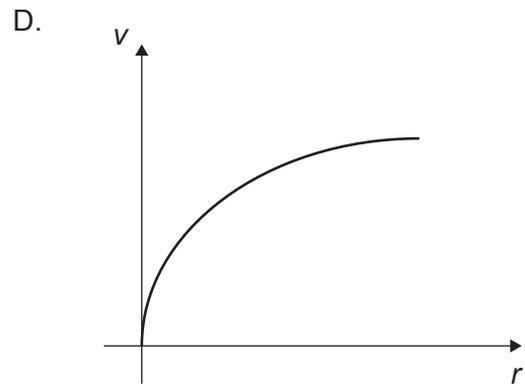
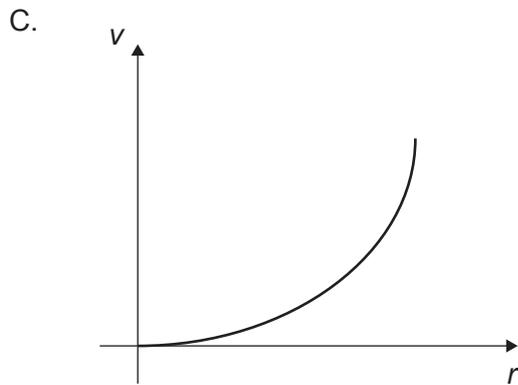
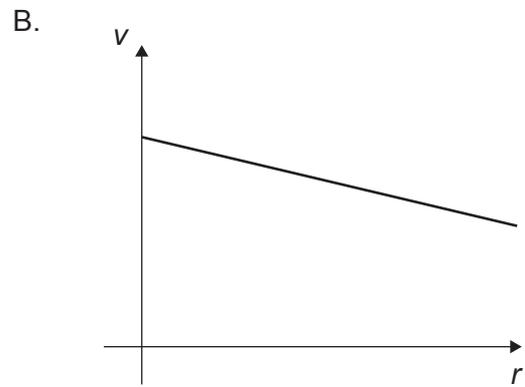
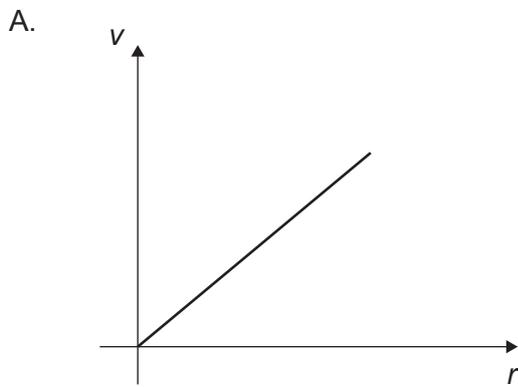
- A. $\frac{I}{4}$
- B. $\frac{I}{2}$
- C. I
- D. $2I$

21. An electron enters a region of uniform magnetic field at a speed v . The direction of the electron is perpendicular to the magnetic field. The path of the electron inside the magnetic field is circular with radius r .

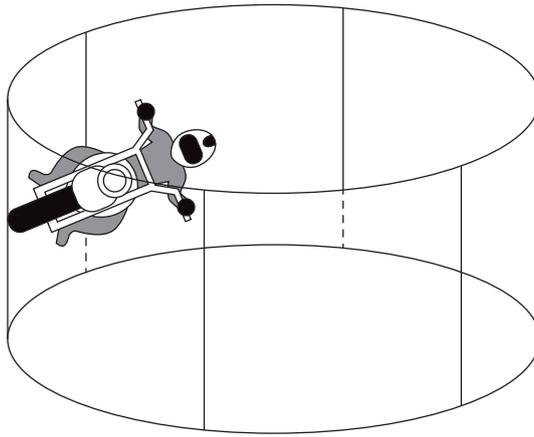


The speed of the electron is varied to obtain different values of r .

Which graph represents the variation of speed v with r ?

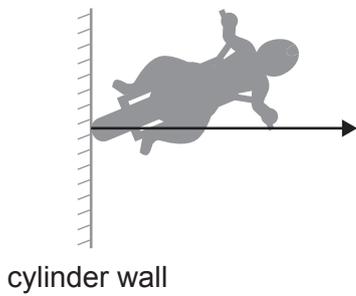


22. A stuntman rides a motorcycle on the inside surface of a cylinder.

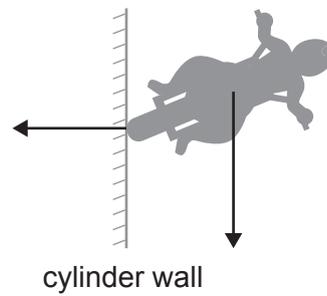


Which is the correct free-body diagram showing all the forces acting on the cyclist at that position?

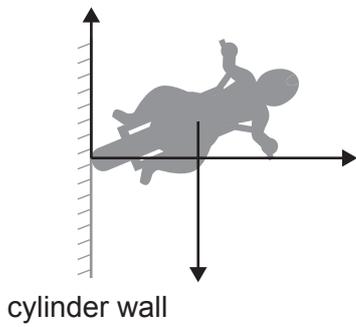
A.



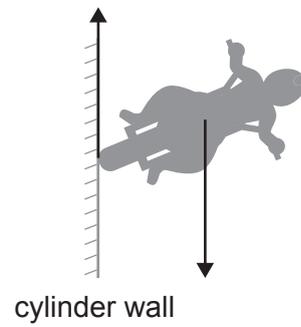
B.



C.



D.

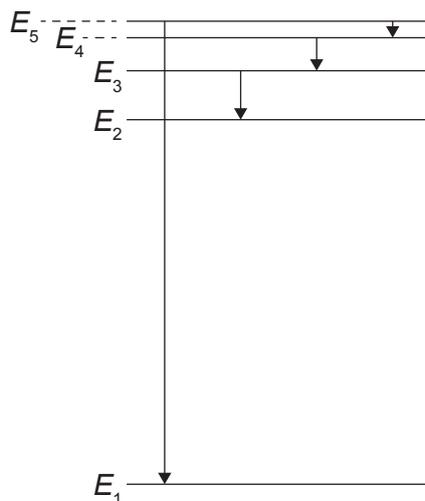


23. The radius of the Earth is R . A satellite is launched to a height $h = \frac{R}{4}$ above the Earth's surface.

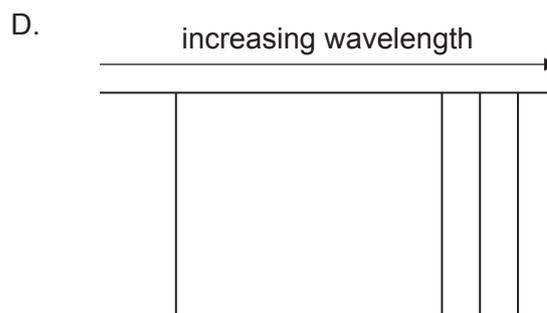
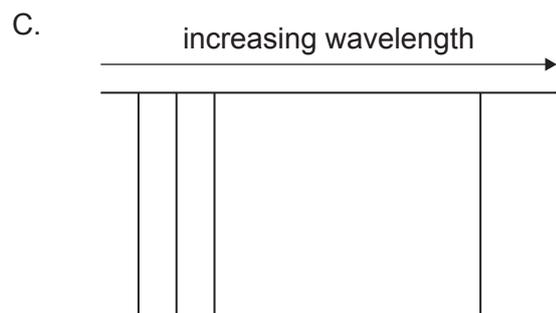
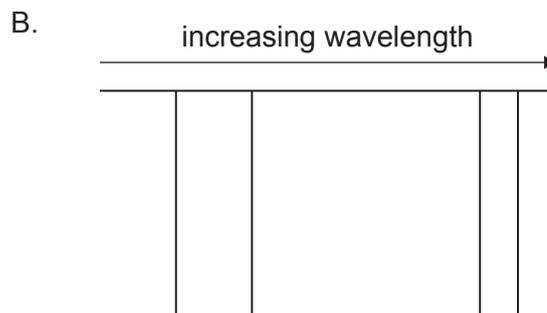
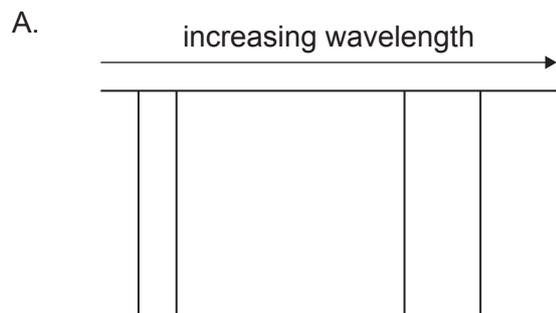
What is $\frac{\text{gravitational force on satellite at the surface}}{\text{gravitational force on satellite at height } h}$?

- A. $\frac{4}{5}$
- B. $\frac{16}{25}$
- C. $\frac{25}{16}$
- D. $\frac{5}{4}$

24. The energy levels E of an atom are shown.



Which emission spectrum represents the transitions?



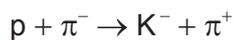
25. Three claims are made about the structure of the atom.

- I. Most of the atom is empty space.
- II. The positive charge of the atom is concentrated in a small volume.
- III. The electrons have discrete energy levels.

Which of these claims can be deduced from the Rutherford-Geiger-Marsden scattering experiment?

- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
26. A radioactive material has a half-life of 6 days. How long will it take for 75% of a pure sample of the material to decay?
- A. 3 days
 - B. 6 days
 - C. 12 days
 - D. 18 days

27. This interaction between a proton and a pion violates two or more conservation laws.



Quark composition of particles:

$$\pi^- = d\bar{u}, \pi^+ = u\bar{d}, K^- = s\bar{u}, p = uud$$

Which laws are violated by this interaction?

- I. Conservation of charge
 - II. Conservation of strangeness
 - III. Conservation of baryon number
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

28. A student claims that the following three factors may affect the rate of global warming.

- I. Increased volcanic activity
- II. Increased solubility of carbon dioxide (CO₂) in the ocean
- III. Increased rate of deforestation

Which factors can **increase** the rate of global warming?

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

29. Two surfaces X and Y emit radiation of the same surface intensity. X emits a radiation of peak wavelength twice that of Y.

What is $\frac{\text{emissivity of X}}{\text{emissivity of Y}}$?

- A. $\frac{1}{16}$
 - B. $\frac{1}{2}$
 - C. 2
 - D. 16
30. Light of intensity 500 W m^{-2} is incident on concrete and on snow. 300 W m^{-2} is reflected from the concrete and 400 W m^{-2} is reflected from the snow.

What is $\frac{\text{albedo of concrete}}{\text{albedo of snow}}$?

- A. $\frac{1}{2}$
 - B. $\frac{3}{4}$
 - C. $\frac{4}{3}$
 - D. 2
-

References: