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Physics

Standard level

Paper 1A

29 April 2025

Zone A afternoon | Zone B afternoon | Zone C afternoon

1 hour 30 minutes [Paper 1A and Paper 1B]

Instructions to candidates

- 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 **[25 marks]**.
- The maximum mark for paper 1A and paper 1B is **[45 marks]**.

1. A car decelerates uniformly to rest. From an initial velocity v to a velocity $\frac{v}{2}$, it covers a distance d . How much further does it travel before coming to rest?

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

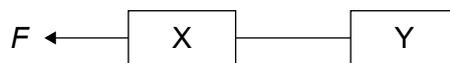
2. Two balls, P and Q, are projected from the edge of a cliff. P is projected horizontally at speed v and Q is projected vertically upwards at the same speed. The time taken for P to reach the ground is t_p and the speed at impact with the ground is v_p . **Air resistance is negligible.**

What is the time taken to reach the ground and the speed at impact with the ground for Q?

| | Time taken | Speed at impact |
|----|--------------------|--------------------|
| A. | t_p | v_p |
| B. | t_p | Greater than v_p |
| C. | Greater than t_p | v_p |
| D. | Greater than t_p | Greater than v_p |

3. Two identical blocks, X and Y, each of mass 2.0 kg are connected by a string. They move on the same surface.

A force F accelerates the blocks at 0.5 m s^{-2} . The frictional force on block X is 4.0 N.



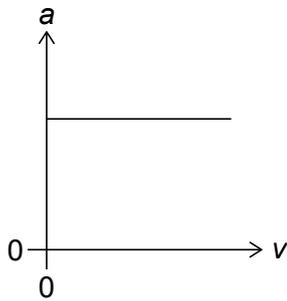
What is the tension in the string?

- A. 1 N
- B. 2 N
- C. 5 N
- D. 10 N

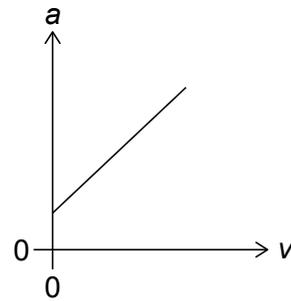
4. A raindrop falls from rest through air with velocity v and acceleration a .

Which graph best represents the variation of a with v ?

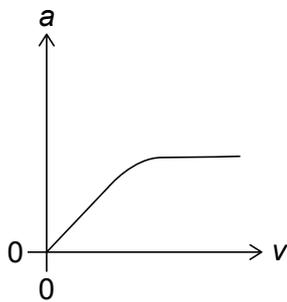
A.



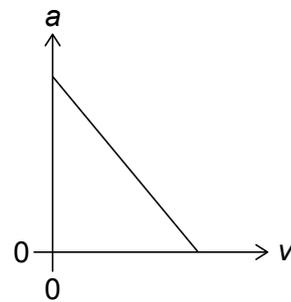
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C.



D.

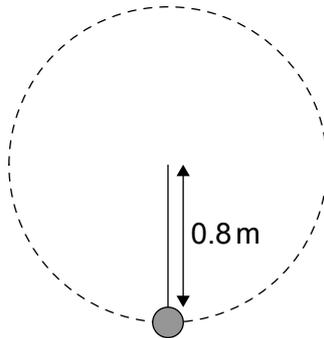


5. A ball of mass m collides with a stationary ball of mass $3m$. After colliding, the two balls move together.

What is the percentage loss in kinetic energy of the system?

- A. 0%
- B. 25%
- C. 50%
- D. 75%

6. A ball of mass 0.4 kg is attached to a string of length 0.8 m. The ball is rotated in a vertical circle such that the speed at the lowest position is 6.0 m s^{-1} .



What is the tension in the string when the ball is at the lowest position?

- A. 4.0 N
 - B. 14 N
 - C. 18 N
 - D. 22 N
7. A liquid is heated at a constant rate in an open container. The temperature of the liquid rises by 0.50°C per second until it boils. In a period of 10 minutes after reaching boiling point, half the mass of the liquid has vaporized.

What is $\frac{\text{specific heat capacity of the liquid}}{\text{specific latent heat of vaporization of the liquid}}$?

- A. $\frac{1}{600}$
- B. $\frac{1}{300}$
- C. $\frac{1}{10}$
- D. $\frac{1}{5}$

8. Star X has a surface temperature T , luminosity L and radius R .
The luminosity of star Y is $4L$ and the surface temperature is $2T$.

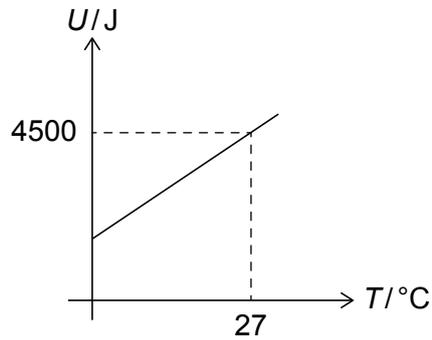
What is the radius of star Y?

- A. $\frac{R}{2}$
B. $\frac{R}{\sqrt{2}}$
C. $2R$
D. $4R$
9. A student makes three statements about Earth's albedo.
- I. It varies daily.
 - II. It depends on latitude.
 - III. It depends on cloud formation.

Which of the statements are correct?

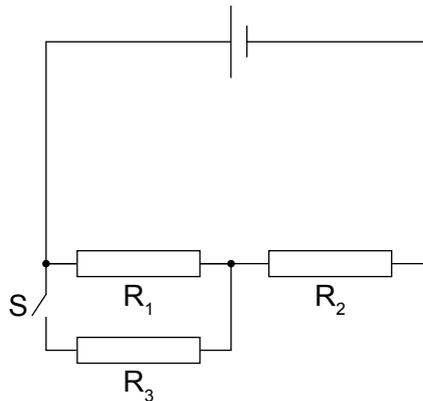
- A. I and II only
B. I and III only
C. II and III only
D. I, II and III

10. The graph shows the variation of the internal energy U with temperature T for a sample of an ideal monatomic gas. R is the gas constant.



How many moles of the gas are in the sample?

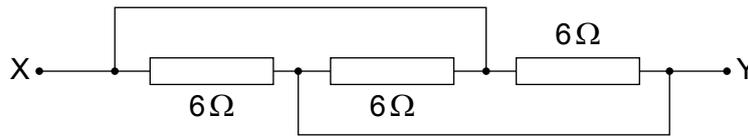
- A. $\frac{500}{3R}$
 B. $\frac{15}{R}$
 C. $\frac{1000}{9R}$
 D. $\frac{10}{R}$
11. Three identical resistors, R_1 , R_2 and R_3 , each of resistance 2Ω , are connected to a cell of negligible internal resistance as shown. When switch S is open, the power dissipated by R_1 is 18W .



What is the power dissipated by R_1 when S is closed?

- A. 8W
 B. 16W
 C. 18W
 D. 36W

12. Three identical resistors of $6\ \Omega$ are arranged as shown.

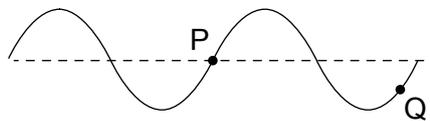


What is the resistance between X and Y?

- A. $2\ \Omega$
 - B. $4\ \Omega$
 - C. $9\ \Omega$
 - D. $18\ \Omega$
13. A simple pendulum oscillates with period T on Earth. The mass of the pendulum is doubled and oscillates on the Moon where the acceleration due to gravity is $\frac{1}{6}$ that of Earth. The length of the pendulum stays the same.

What is the period of the pendulum on the Moon?

- A. $\sqrt{12} T$
 - B. $\sqrt{6} T$
 - C. $\sqrt{3} T$
 - D. $\sqrt{2} T$
14. The diagram below shows a snapshot of a transverse wave on a rope. Points P and Q are two points on the rope at a position shown in the diagram. The subsequent motion of P is upwards.

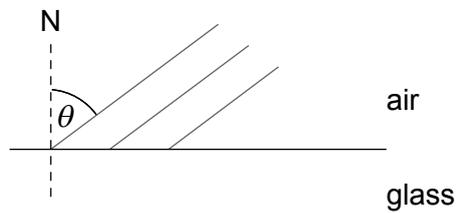


What is the direction of motion of Q and the direction of travel of the wave?

| | Direction of motion of Q | Direction of travel of the wave |
|----|--------------------------|---------------------------------|
| A. | Upwards | Left to right |
| B. | Downwards | Left to right |
| C. | Upwards | Right to left |
| D. | Downwards | Right to left |

15. The diagram shows wavefronts of light incident on an air–glass boundary.

The angle between the incident wavefront and the normal, N, is θ .



Which of the following gives the correct expression for the refractive index of the glass, where r is the angle of refraction?

- A. $\frac{\sin \theta}{\sin r}$
- B. $\frac{\sin(90 - \theta)}{\sin r}$
- C. $\frac{\sin r}{\sin \theta}$
- D. $\frac{\sin r}{\sin(90 - \theta)}$
16. S_1 and S_2 are two coherent sound sources with no phase difference. The wavelength of both waves is 0.20 m. P is a point 6.0 m away from S_1 and 6.5 m away from S_2 respectively. At P the amplitude of the wave from S_1 is x_0 and from S_2 is $2x_0$.

What is the resultant amplitude at P?

- A. 0
- B. x_0
- C. $2x_0$
- D. $3x_0$

17. The relationship between the period of a planet's orbit T and the distance to the Sun R can be expressed as $T^n \propto R^m$ where n and m are constants.

What is a possible pair of values for n and m ?

| | n | m |
|----|----------|----------|
| A. | 1.0 | 3.0 |
| B. | 1.0 | 1.5 |
| C. | 2.0 | 1.5 |
| D. | 2.0 | 1.0 |

18. Point X is at a distance d from the centre of Earth. d is larger than the radius of Earth. The gravitational field strength at X is g_x . Point Y is at a distance $3d$ from the centre of Earth.

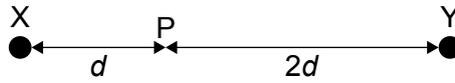
What is the difference in the magnitude of gravitational field strengths between X and Y?

- A. $\frac{8g_x}{9}$
- B. $\frac{3g_x}{4}$
- C. $\frac{g_x}{4}$
- D. $\frac{g_x}{9}$
19. Two isolated identical point charges, Q_1 and Q_2 , are separated by distance d . The electrostatic force on each charge is F . The charge of Q_1 is halved.

What is the electrostatic force on each charge?

| | Force on Q_1 | Force on Q_2 |
|----|----------------------------------|----------------------------------|
| A. | F | F |
| B. | F | $\frac{F}{2}$ |
| C. | $\frac{F}{2}$ | $\frac{F}{2}$ |
| D. | $\frac{F}{2}$ | F |

20. Two isolated point charges, X of charge $+Q$ and Y of charge $+2Q$, are separated by a distance $3d$. P is a point d from X and $2d$ from Y respectively.



What is the net electric field strength at P?

- A. 0
 - B. $\frac{kQ}{2d^2}$
 - C. $\frac{3kQ}{4d^2}$
 - D. $\frac{3kQ}{2d^2}$
21. The energy levels of an atom in which an electron transitions from E_1 to E_4 are shown. E_1 is the ground state.

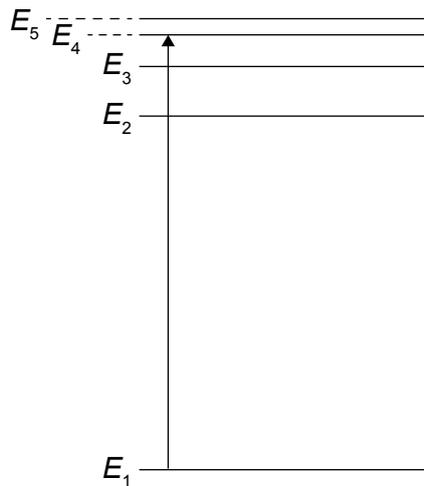


diagram to scale

How many different wavelengths can be emitted when electrons return to the ground state from E_4 ?

- A. 1
- B. 3
- C. 6
- D. 8

22. Thorium-232 ($^{232}_{90}\text{Th}$) is an unstable nuclide. It decays by emitting an alpha particle followed by a beta minus (β^-) particle.

What is the number of protons and neutrons in the final nuclide?

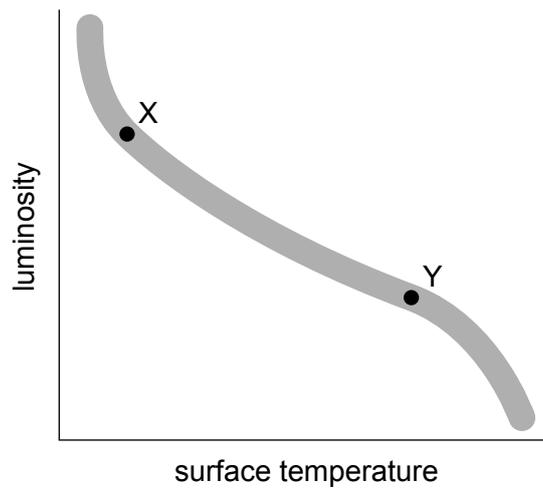
| | Number of protons | Number of neutrons |
|----|-------------------|--------------------|
| A. | 87 | 139 |
| B. | 87 | 141 |
| C. | 89 | 139 |
| D. | 89 | 141 |

23. A pure sample of radon-222 decays into polonium with a half-life of 4 days. A measurement is made of its radioactivity. The initial count rate is 420 counts per second. The measured background count is 20 counts per second.

What is the measured count rate after 8 days?

- A. 85
 - B. 100
 - C. 105
 - D. 120
24. Which component is responsible for slowing down neutrons in a nuclear reactor to increase the likelihood of nuclear fission?
- A. Moderator
 - B. Control rods
 - C. Fuel rods
 - D. Heat exchanger

25. The HR diagram shows two stars, X and Y.



Three statements are made about star X and star Y.

- I. Star X is hotter than star Y.
- II. Star X has a larger radius than star Y.
- III. Star X is more luminous than star Y.

Which of the statements are correct?

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