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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. At time $t = 0$ a car begins to move from rest with constant acceleration a .

At time t , the speed of the car is v . What is the displacement at time t ?

- A. vt
- B. $\frac{vt}{2}$
- C. at^2
- D. $vt + \frac{1}{2}at^2$

2. A rock and a ball are projected horizontally from the edge of a cliff, with the same initial velocity. Air resistance is negligible for the motion of the rock, but not for the motion of the ball.

Which projectile reaches the ground first and which has a larger range?

	Reaches the ground first	Larger range
A.	rock	rock
B.	rock	ball
C.	ball	rock
D.	ball	ball

3. A small bubble of oil is moving upwards inside water, at terminal speed. The weight of the bubble is 3×10^{-8} N and the viscous drag force on the bubble is 2×10^{-8} N.

What is $\frac{\text{density of oil}}{\text{density of water}}$?

- A. $\frac{3}{5}$
- B. $\frac{2}{3}$
- C. $\frac{3}{2}$
- D. $\frac{5}{3}$

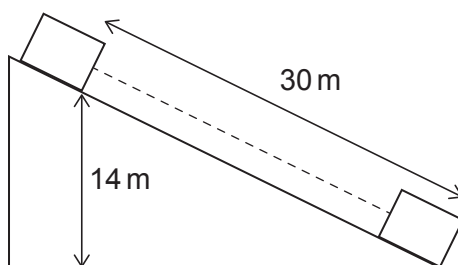
4. A force acts on a body for 3.0 s, so that its momentum increases by 12 kg m s^{-1} .

What is the impulse applied to the body?

- A. 4.0 Ns
- B. 12 Ns
- C. 24 Ns
- D. 36 Ns

5. A crate of weight 1.5 kN slides down a ramp at constant speed. The crate moves 30 m along the ramp and through a vertical distance of 14 m.

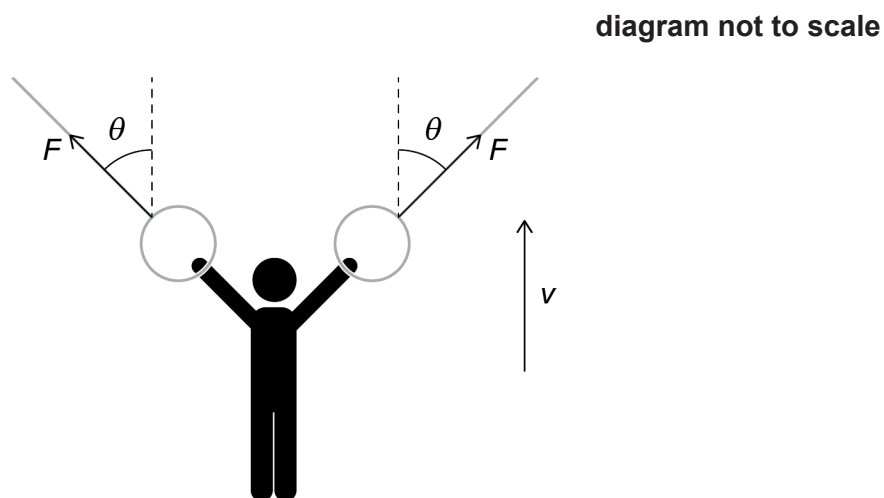
diagram not to scale



What is the average resistive force acting on the crate?

- A. $\frac{14}{1.5 \times 30} \text{ kN}$
- B. $\frac{30}{1.5 \times 14} \text{ kN}$
- C. $\frac{1.5 \times 30}{14} \text{ kN}$
- D. $\frac{1.5 \times 14}{30} \text{ kN}$

6. An acrobat is raised by two ropes, each making an angle θ with the vertical. The tension in each rope has magnitude F .



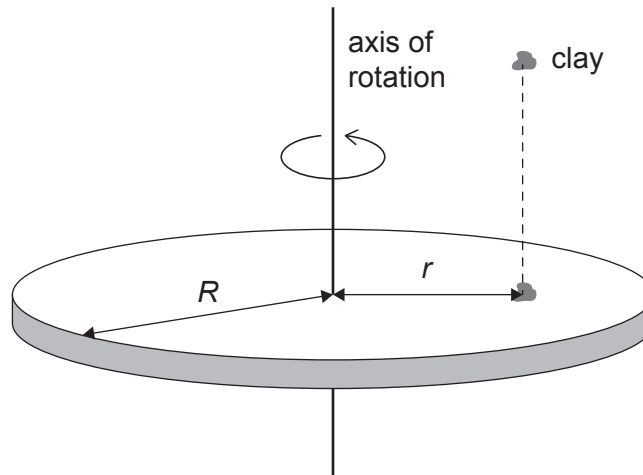
The acrobat moves vertically upwards with constant speed v . Air resistance is negligible.

What is the rate of change of gravitational potential energy of the acrobat?

- A. $Fv \sin \theta$
- B. $Fv \cos \theta$
- C. $2Fv \sin \theta$
- D. $2Fv \cos \theta$

7. A disc of radius R rotates about a vertical axis through the disc centre. A piece of clay falls and sticks onto the disc, a distance r from the axis.

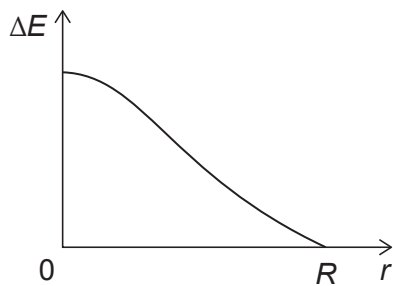
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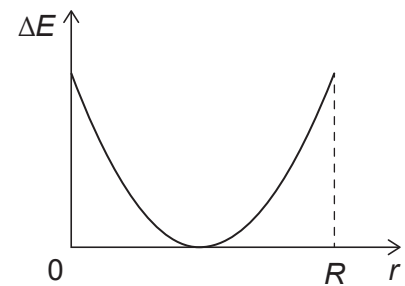
Rotational kinetic energy ΔE is lost in the collision.

Which graph shows the variation of ΔE with r ?

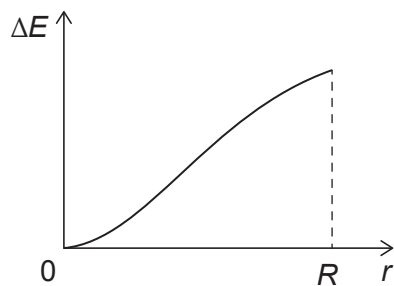
A.



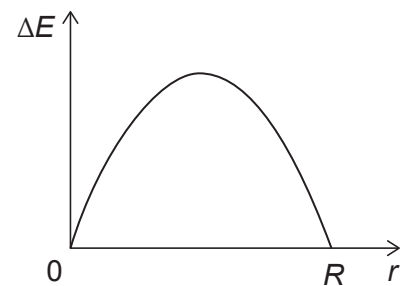
B.



C.



D.



8. A cylinder rolls without slipping down an incline.

Which quantity increases linearly with time?

- A. Resultant torque
- B. Angular acceleration
- C. Angular momentum
- D. Rotational kinetic energy

9. A spaceship is moving at constant velocity. Event E is the departure of the spaceship from planet X. Event F is the arrival of the spaceship on planet Z.

The proper time interval between E and F is measured by a clock

- A. in an inertial frame in deep space.
- B. at X.
- C. at Z.
- D. on the spaceship.

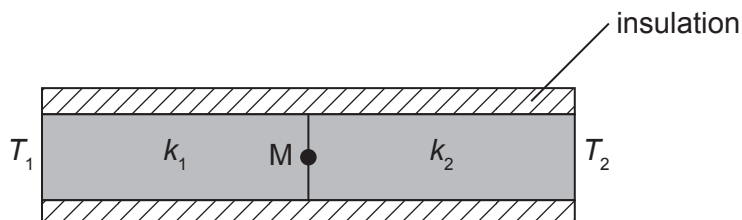
10. A black body of surface area A and surface temperature T radiates total power P_1 . Another body of surface area $\frac{A}{4}$, temperature $2T$ and emissivity ε , radiates total power P_2 .

What is $\frac{P_2}{P_1}$?

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

11. Two metal bars of the same dimensions and of thermal conductivities k_1 and k_2 are joined at M. The sides of the bars are insulated and their ends are maintained at temperatures T_1 and T_2 .

diagram not to scale



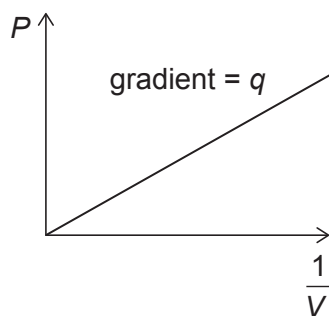
What is the temperature at M?

- A. $\frac{k_1 T_1 + k_2 T_2}{k_1 + k_2}$
- B. $\frac{k_1 T_1 - k_2 T_2}{k_1 + k_2}$
- C. $\frac{k_1 T_1 + k_2 T_2}{k_1 - k_2}$
- D. $\frac{k_1 T_1 - k_2 T_2}{k_1 - k_2}$
12. Consider the following quantities:
- I. Average intensity of solar radiation at the position of Earth
 - II. Average intensity radiated by the surface of Earth
 - III. Average surface temperature of Earth

Which quantities would be smaller if Earth had no atmosphere?

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

13. An ideal monatomic gas is held at a constant temperature. The graph shows how the pressure P of the gas varies with $\frac{1}{V}$, where V is the volume of the gas. The gradient of the graph is q .



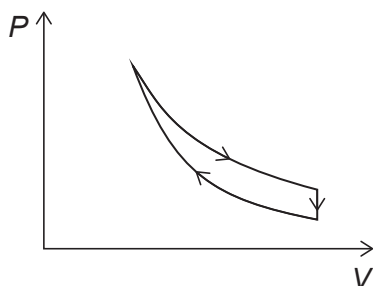
What is the internal energy of the gas?

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

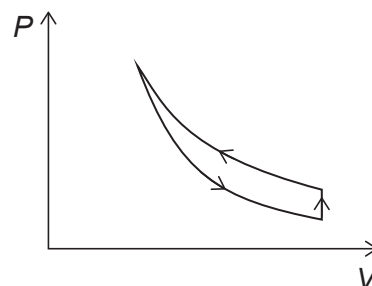
14. A monatomic ideal gas undergoes a cycle consisting of an isothermal compression, an adiabatic expansion and isovolumetric heating.

Which P – V (pressure–volume) diagram shows the cycle?

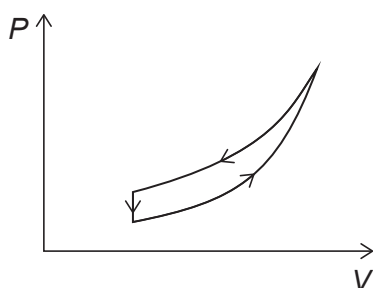
A.



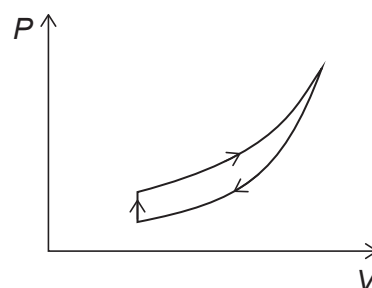
B.



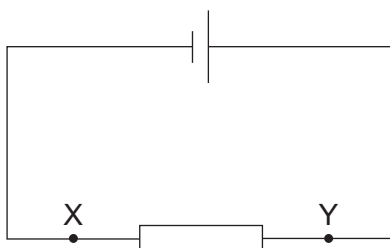
C.



D.



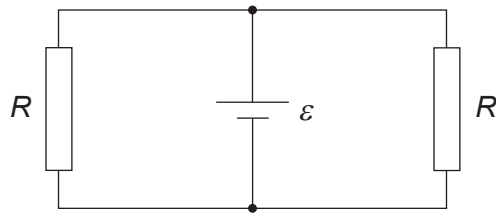
15. The potential difference between X and Y is 2.0 V.



The electric field does 2.0 J of work on moving, through the resistor,

- A. an electron from X to Y.
- B. an electron from Y to X.
- C. a charge equal to -1 C from X to Y.
- D. a charge equal to -1 C from Y to X.

16. Two resistors of resistance R are connected to a cell of negligible internal resistance and emf ε .



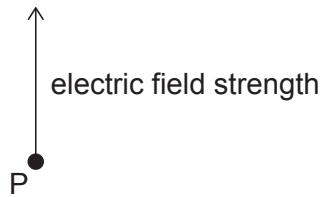
What is the power dissipated in the circuit?

- A. $\frac{\varepsilon^2}{2R}$
 - B. $\frac{2\varepsilon^2}{R}$
 - C. $\frac{\varepsilon^2 R}{2}$
 - D. $2\varepsilon^2 R$
17. The displacement x at time t of an object performing simple harmonic motion is $x = 0.04 \sin(5t + 0.1)$.

What is the acceleration of the object?

- A. $-0.2 \cos(5t + 0.1)$
- B. $-0.2 \sin(5t + 0.1)$
- C. $-\cos(5t + 0.1)$
- D. $-\sin(5t + 0.1)$

18. An electromagnetic wave passes through point P. At one instant in time, the electric field strength vector at P is directed upwards.



What are possible directions of propagation of the wave and of the corresponding magnetic field strength vector at P?

	Direction of propagation of wave	Direction of magnetic field strength
A.	to the right	to the right
B.	to the right	out of the page
C.	upwards	to the left
D.	upwards	out of the page

19. A ray of light travels from medium 1 to medium 2. The angles between the ray and the interface are shown.

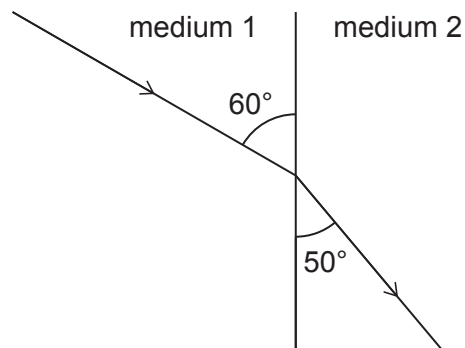


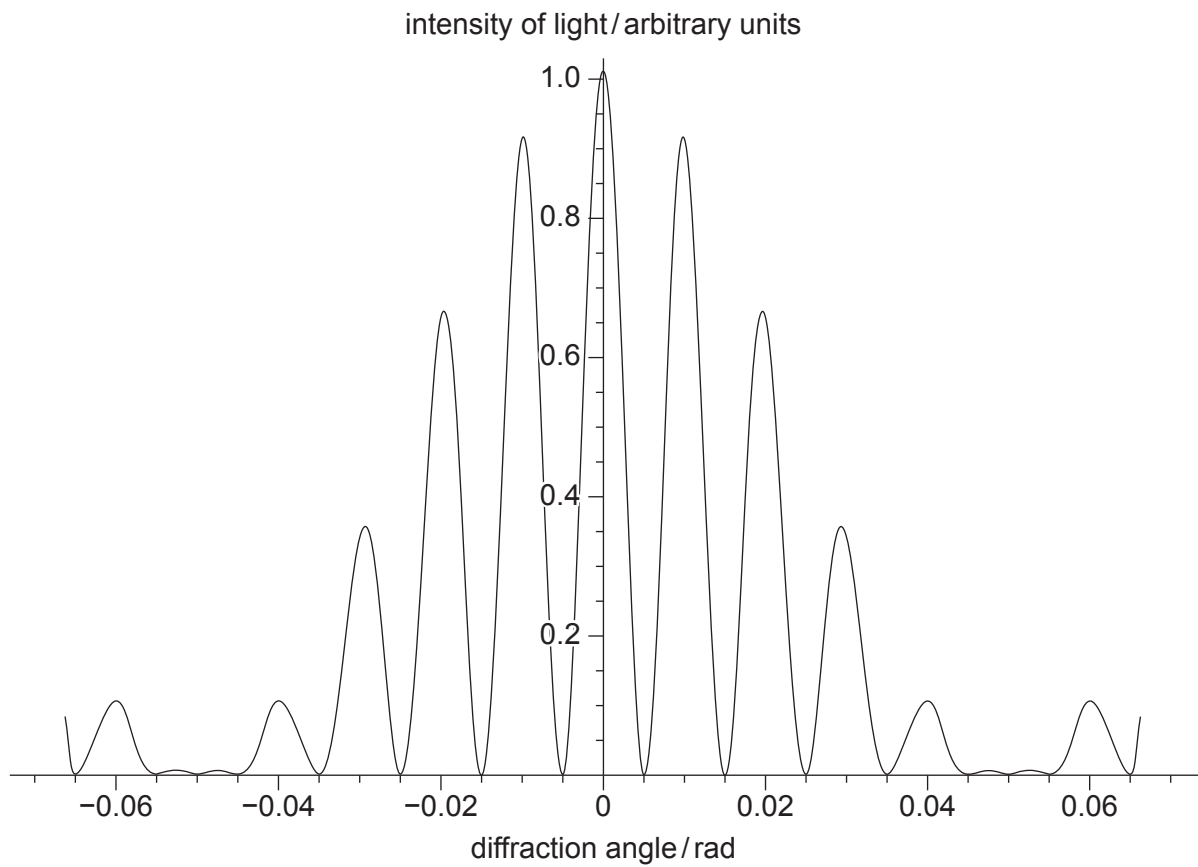
diagram not to scale

The refractive index of medium 1 is 1.5.

What is the refractive index of medium 2?

- A. $\frac{1.5 \sin 60^\circ}{\sin 50^\circ}$
- B. $\frac{1.5 \sin 40^\circ}{\sin 30^\circ}$
- C. $\frac{1.5 \sin 50^\circ}{\sin 60^\circ}$
- D. $\frac{1.5 \sin 30^\circ}{\sin 40^\circ}$

20. In a Young's double-slit interference experiment with monochromatic light, the following intensity pattern is observed.



What is $\frac{\text{slit width}}{\text{distance between slits}}$?

- A. $\frac{1}{5}$
- B. $\frac{1}{4}$
- C. 4
- D. 5

21. A first harmonic standing wave of wavelength 60 cm is set up in a pipe with one closed end and one open end.

What is another possible wavelength of a standing wave formed in this pipe?

- A. 10 cm
 - B. 15 cm
 - C. 20 cm
 - D. 45 cm
22. What is correct about the spectrum of a galaxy that is moving away from Earth?
- A. Spectral lines are shifted towards blue.
 - B. Spectral lines are shifted towards red.
 - C. Observed frequencies are larger than emitted frequencies.
 - D. Observed wavelengths are smaller than emitted wavelengths.

23. A train approaches a station at speed $\frac{v}{5}$, where v is the speed of sound in air. A sound of wavelength λ is emitted from the train.

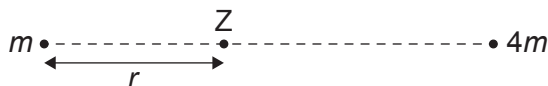
What is the wavelength of sound heard by a stationary observer at the station?

- A. $\frac{4\lambda}{5}$
 - B. $\frac{5\lambda}{6}$
 - C. $\frac{6\lambda}{5}$
 - D. $\frac{5\lambda}{4}$
24. A planet has the same average density as Earth but half the radius of Earth. What is the acceleration of free fall on the surface of the planet?
- A. 5 ms^{-2}
 - B. 8 ms^{-2}
 - C. 20 ms^{-2}
 - D. 40 ms^{-2}

25. The gravitational field strength, due to two isolated point objects of mass m and $4m$, is zero at point Z.

Z is a distance r from the object of mass m .

diagram not to scale



What is the gravitational potential at Z?

- A. $-\frac{Gm}{r}$
- B. $-\frac{2Gm}{r}$
- C. $-\frac{3Gm}{r}$
- D. zero
26. Two identical conducting spheres carry charges Q and $-2Q$. The electric force between the spheres has magnitude F .

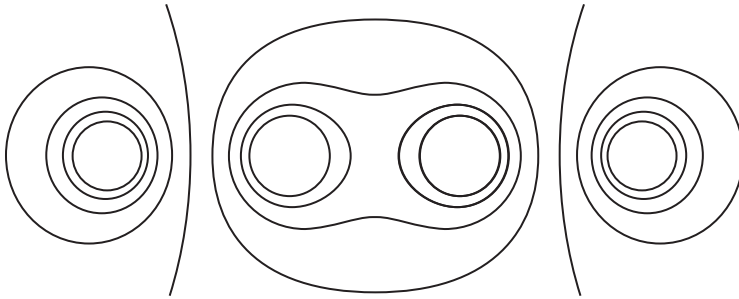
The spheres are brought into contact and then taken back to their original positions. What is the magnitude and direction of the new electric force between the spheres?

	Magnitude	Direction
A.	$\frac{F}{8}$	towards each other
B.	$\frac{F}{8}$	away from each other
C.	$\frac{F}{4}$	towards each other
D.	$\frac{F}{4}$	away from each other

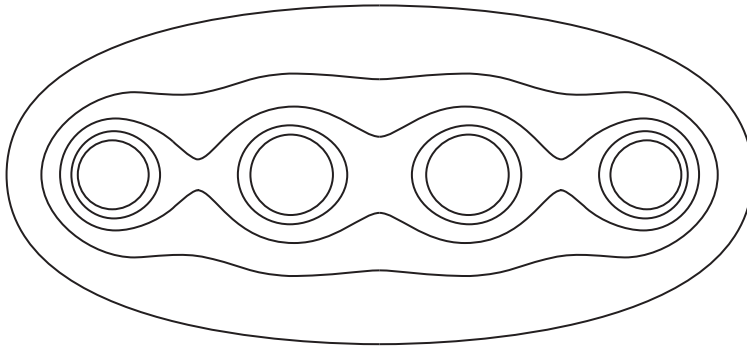
27. Which diagram shows equipotential surfaces arising from one negative and three positive point charges?

diagrams not to scale

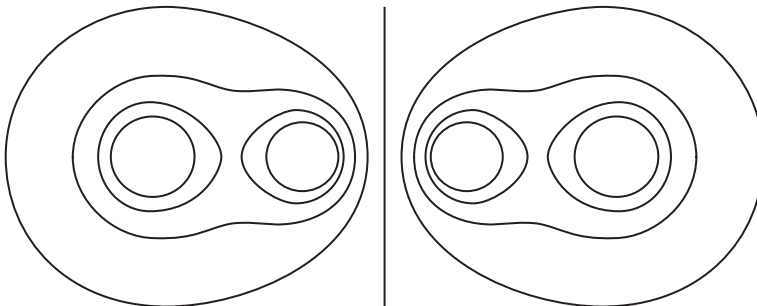
A.



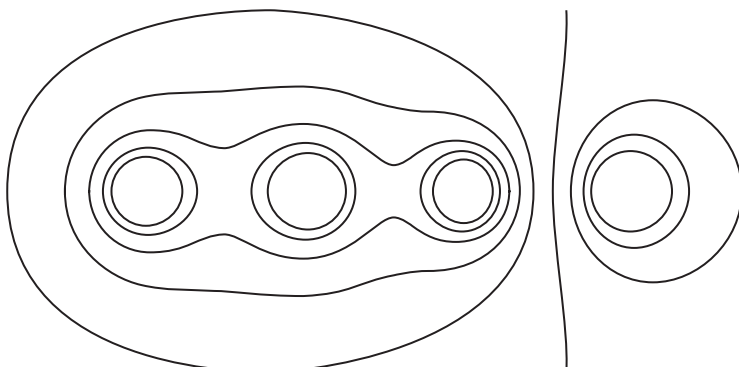
B.



C.



D.

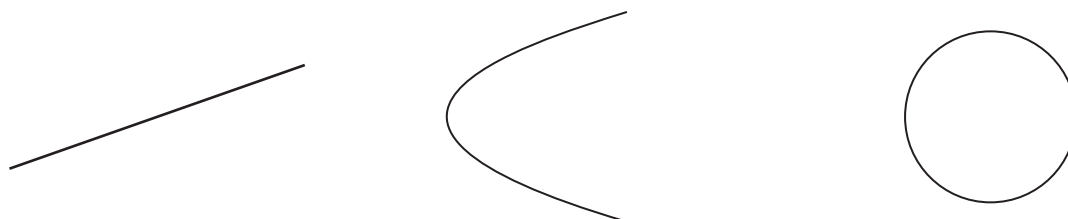


28. Three paths are:

I. a straight line

II. a parabola

III. a circle

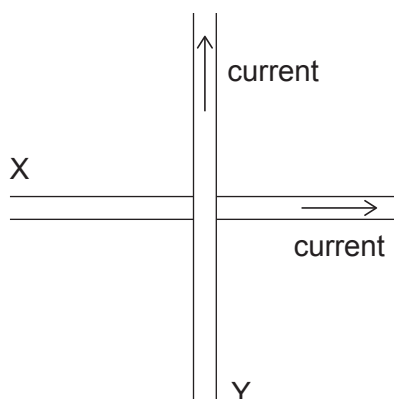


What are possible paths for an electron in a uniform electric field in a vacuum?

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

29. Two straight wires X and Y are fixed close to each other and at right angles. There is a current in each wire.

diagram not to scale

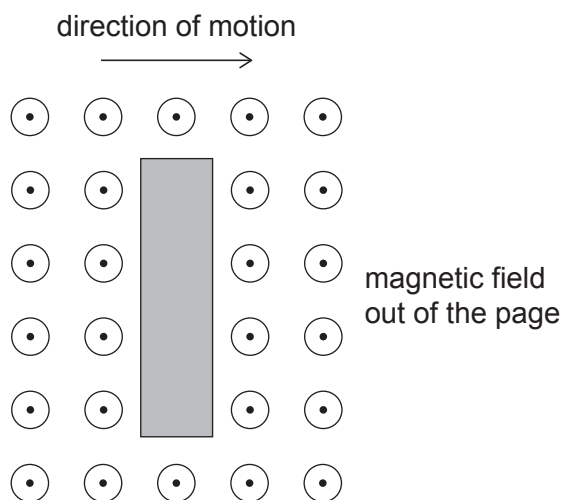


What are the resultant force and the resultant torque acting on X due to the currents in the wires?

	Resultant force	Resultant torque
A.	zero	zero
B.	zero	non-zero
C.	non-zero	zero
D.	non-zero	non-zero

30. A constant emf is induced in a conducting rod moving at right angles to a uniform magnetic field. The rod is moving to the right and the magnetic field is directed out of the page.

diagram not to scale



Which diagram shows the electric force F_e and the magnetic force F_m acting on a free electron in the rod?

diagrams not to scale

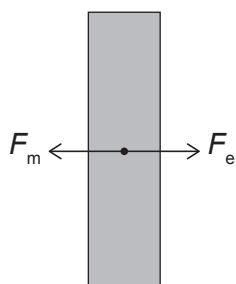
A.



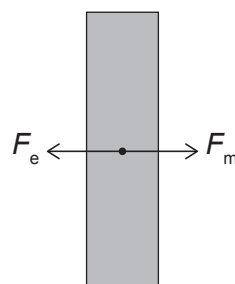
B.



C.

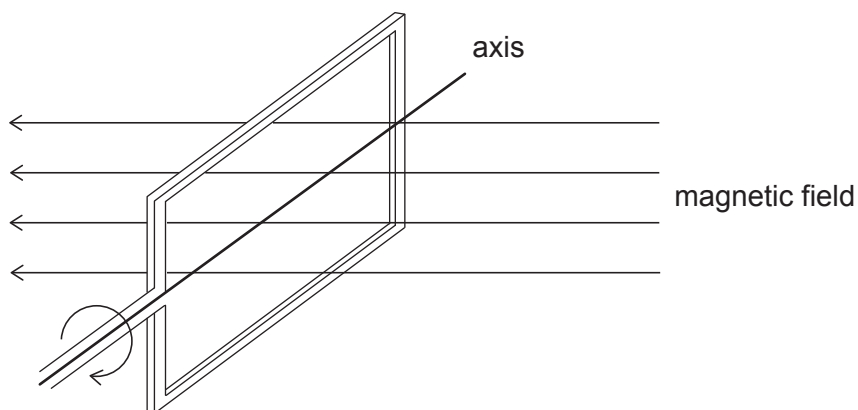


D.



31. A rectangular coil is in a uniform magnetic field. The coil rotates about an axis that is perpendicular to the magnetic field as shown.

diagram not to scale

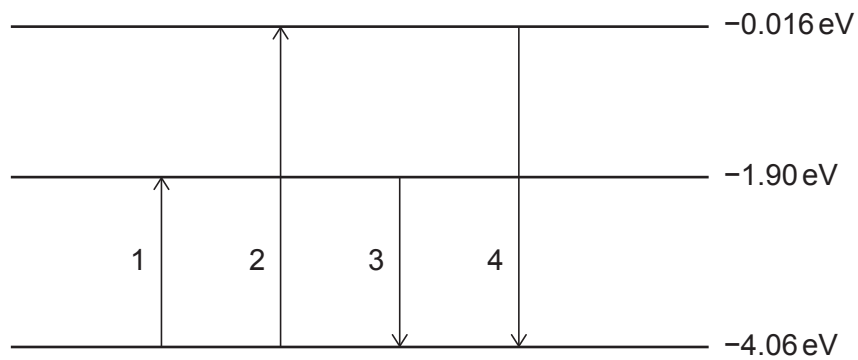


Which change will increase the maximum induced emf between the coil terminals?

- A. Decrease length of coil
 - B. Decrease width of coil
 - C. Decrease magnetic field strength
 - D. Decrease period of rotation
32. What is a conclusion of the Geiger–Marsden–Rutherford experiment?
- A. Alpha particles are positively charged.
 - B. Electrons are negatively charged.
 - C. Most of a gold nucleus is empty.
 - D. Most of a gold atom is empty.

33. Some energy levels in an atom are shown.

diagram not to scale



Which transition leads to the emission of visible light and which transition leads to the emission of UV light?

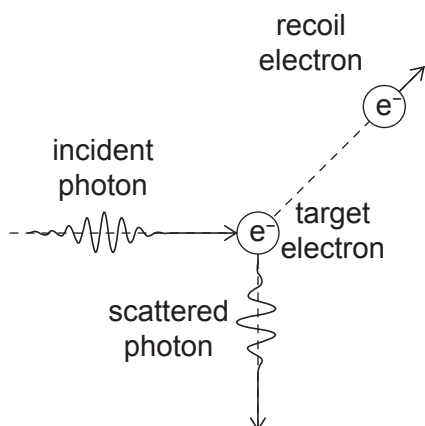
	Visible light	UV light
A.	1	2
B.	2	1
C.	3	4
D.	4	3

34. In a particular Compton scattering experiment, the difference in wavelength between the scattered photon and the incident photon is $\frac{h}{m_e c}$.

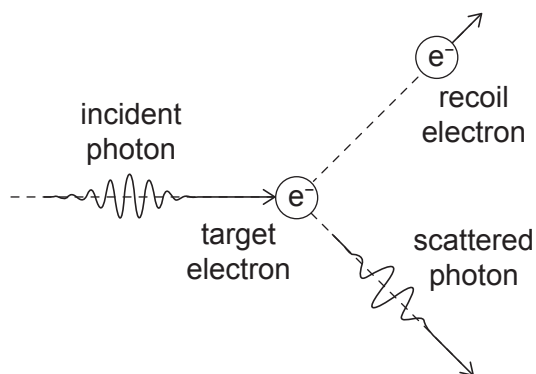
Which diagram represents this scattering process?

diagrams not to scale

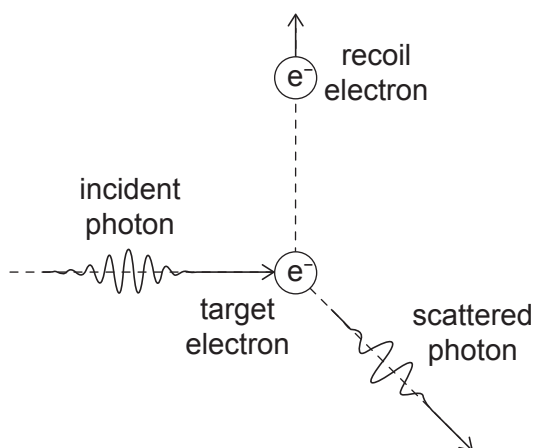
A.



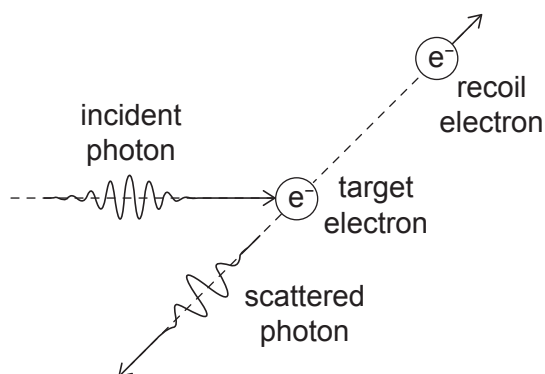
B.



C.



D.



35. A particle has kinetic energy K .

The de Broglie wavelength of the particle is proportional to

- A. $\frac{1}{K}$
- B. $\frac{1}{\sqrt{K}}$
- C. $\sqrt{K}$
- D. K

36. $^{225}_{89}\text{Ac}$ decays via alpha decay into a nuclide X.

How many protons and neutrons does X contain?

	Protons	Neutrons
A.	89	225
B.	89	136
C.	87	221
D.	87	134

37. Which change takes place inside a nucleus during β^+ (beta plus) decay?

- A. $n \rightarrow p^+ + e^- + \nu$
 B. $p^+ \rightarrow n + e^+ + \nu$
 C. $n \rightarrow p^+ + e^- + \bar{\nu}$
 D. $p^+ \rightarrow n + e^+ + \bar{\nu}$

38. The half-life of a radioactive isotope is 28 hours.

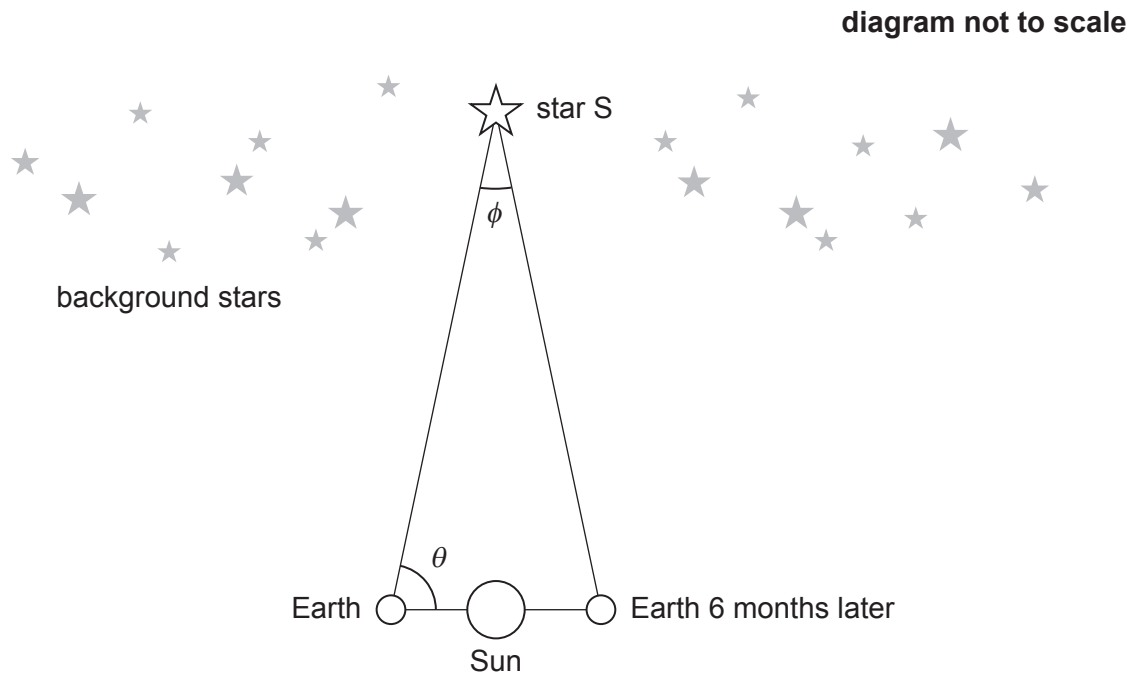
What is the probability that a particular nuclide of this isotope decays within the next second?

- A. $\frac{1}{28 \times \ln 2}$
 B. $\frac{1}{28 \times 3600 \times \ln 2}$
 C. $\frac{\ln 2}{28 \times 3600}$
 D. $\frac{\ln 2}{28}$

39. Which statement about nuclear power plants is correct?

- A. The fission process generates radioactive waste that is difficult to dispose of.
 B. Nuclear power plants use water from nearby rivers to control chain reactions.
 C. Nuclear power plants use control rods to cool down reactors.
 D. Chain reactions in fission reactors are unstoppable once they have started.

40. The diagram shows two positions of Earth six months apart. The angles θ and ϕ are measured in arc-seconds.



What is the distance to star S in parsec?

- A. $\frac{1}{\theta}$
 - B. $\frac{1}{\phi}$
 - C. $\frac{2}{\theta}$
 - D. $\frac{2}{\phi}$
-

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