TAMPINES MERIDIAN JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION

CANDIDATE NAME	( )
CIVICS GROUP	

H2 PHYSICS 9749/01

Paper 1 Multiple Choice **25 September 2025**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

You do not need to submit this Booklet at the end of the examination.

Write in soft pencil.
Do not use paper clips, glue or correction fluid.
Write your name, class and centre/index number on the Multiple Choice Answer Sheet in the spaces provided.
Shade the last four digits of your centre/index number on the Multiple Choice Answer Sheet. (e.g. if your centre/index number is 30541234, shade 1234).

There are **thirty** questions on this paper. Answer **all** questions.
For each question there are four possible answers **A**, **B**, **C**, **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the Multiple Choice Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

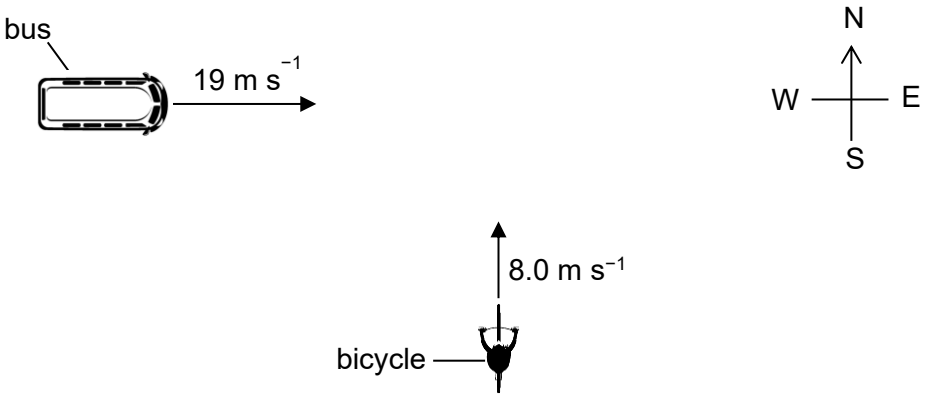
Data

speed of light in free space	c	=	3.00×10^{8} m s^{-1}
permeability of free space	μ_o	=	$4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space	ε_0	=	8.85×10^{-12} F m^{-1}
		=	$\left(1/\left(36\pi\right)\right) \times 10^{-9}$ F m^{-1}
elementary charge	e	=	1.60×10^{-19} C
the Planck constant	h	=	6.63×10^{-34} J s
unified atomic mass constant	u	=	1.66×10^{-27} kg
rest mass of electron	m_e	=	9.11×10^{-31} kg
rest mass of proton	m_p	=	1.67×10^{-27} kg
molar gas constant	R	=	8.31 J K^{-1} mol^{-1}
the Avogadro constant	N_A	=	6.02×10^{23} mol^{-1}
the Boltzmann constant	k	=	1.38×10^{-23}J K^{-1}
gravitational constant	G	=	6.67×10^{-11} N m^2 kg^{-2}
acceleration of free fall	g	=	9.81 m s^{-2}

Formulae

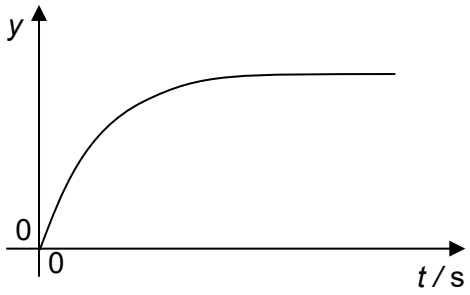
uniformly accelerated motion	s	=	$ut + \frac{1}{2}at^2$
	v^2	=	$u^2 + 2as$
work done on / by a gas	W	=	$p\Delta V$
hydrostatic pressure	p	=	ρgh
gravitational potential	ϕ	=	$-\frac{GM}{r}$
temperature	T /K	=	T /°C + 273.15
pressure of an ideal gas	p	=	$\frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
mean translational kinetic energy of an ideal gas molecule	E	=	$\frac{3}{2}kT$
displacement of particle in s.h.m.	x	=	$x_o \sin \omega t$
velocity of particle in s.h.m.	v	=	$v_o \cos \omega t$
		=	$\pm \omega\sqrt{x_o^{\,2} - x^2}$
electric current	I	=	$Anvq$
resistors in series	R	=	$R_1 + R_2 + \ldots$
resistors in parallel	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$
electric potential	V	=	$\frac{Q}{4\pi\varepsilon_0 r}$
alternating current / voltage	X	=	$x_o \sin \omega t$
magnetic flux density due to a long straight wire	B	=	$\frac{\mu_0 I}{2\pi d}$
magnetic flux density due to a flat circular coil	B	=	$\frac{\mu_0 NI}{2r}$
magnetic flux density due to a long solenoid	B	=	$\mu_0 nI$
radioactive decay	x	=	$x_0 \exp(-\lambda t)$
decay constant	λ	=	$\frac{\ln 2}{t_{\frac{1}{2}}}$

1 A bicycle moves at 8.0 m s^{-1} due north. A bus moves at 19 m s^{-1} due east.



At this instant, which arrow represents the velocity of the bicycle relative to the bus?

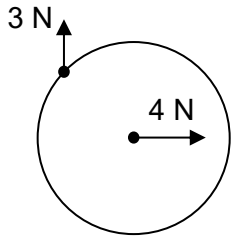
2 The graph below shows the variation with time *t* of a quantity *y* for a falling object released from rest.



Which of the following is correct?

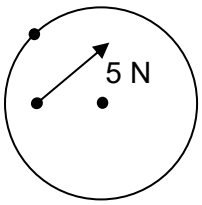
	quantity *y*	presence of air resistance
A	velocity	no
B	velocity	yes
C	displacement	no
D	displacement	yes

3 Two forces act on a circular disc as shown.

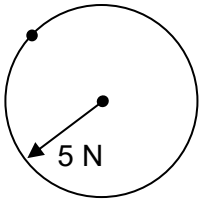


Which diagram shows the third force that must be applied such that the circular disc is in equilibrium?

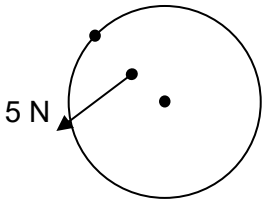
A



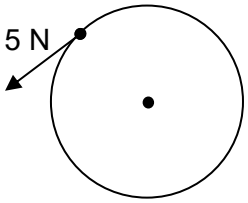
B



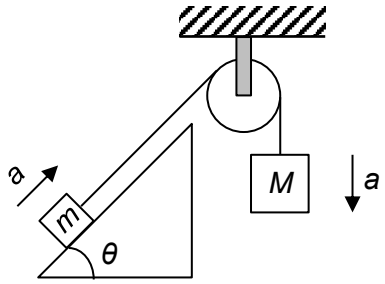
C



D



4 Two blocks of masses *M* and *m* are joined by a light inextensible string through a frictionless pulley as shown. Mass *m* lies on a smooth slope of angle *θ*.



The acceleration of free fall is *g*.

What is the acceleration *a* of the two blocks?

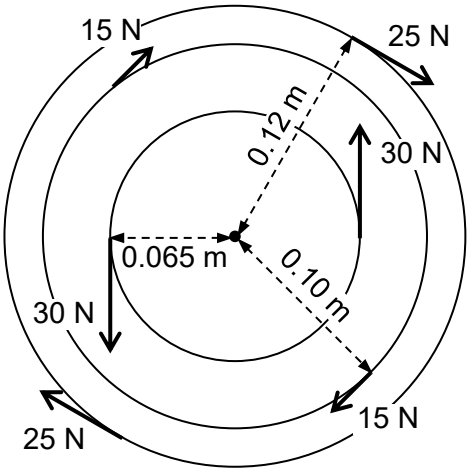
A $\dfrac{(M+m\cos\theta)}{(M+m)}g$

B $\dfrac{(M+m\sin\theta)}{(M+m)}g$

C $\dfrac{(M-m\cos\theta)}{(M+m)}g$

D $\dfrac{(M-m\sin\theta)}{(M+m)}g$

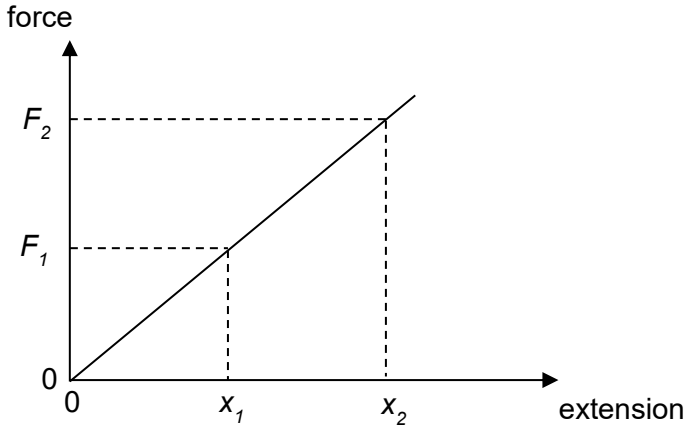
5 In a machine, many couples act on a rotating object as shown.



What is the resultant torque acting on the rotating object?

A 2.6 N m **B** 5.1 N m **C** 6.5 N m **D** 12.9 N m

6 The force-extension graph of a spring is as shown.



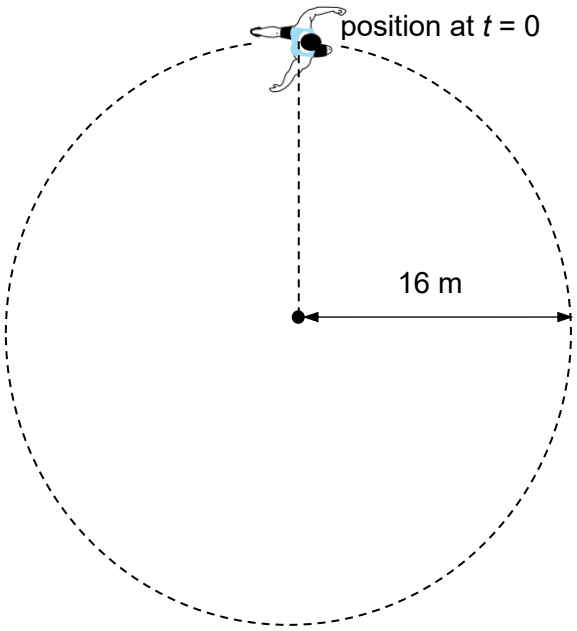
What is the change in elastic potential energy when the extension of the spring is increased from x_1 to x_2?

A $F_2x_2 - F_1x_1$ **B** $0.5\ (F_2x_2 - F_1x_1)$

C $F_2x_2^2 - F_1x_1^2$ **D** $0.5\ (F_2x_2^2 - F_1x_1^2)$

7 A man runs around a circular track of radius 16 m. His position at $t = 0$ s is as shown.

It may be assumed that he maintained a constant speed of 8.4 m s^{-1} throughout the run.



What is the angular displacement of the man at $t = 8.0$ s?

A 2.1 rad **B** 4.2 rad **C** 5.8 rad **D** 8.4 rad

8 A stone tied to a string is moving in a circular path. The speed of rotation is increased.

Which statement is correct?

A The increase in angular speed causes the linear speed to increase.

B The increase in linear speed causes the angular speed to increase.

C The increase in angular speed causes the force applied to increase.

D The increase in force applied causes the angular speed to increase.

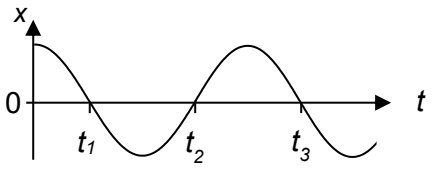
9 The International Space Station (I.S.S.) and a satellite orbit around the Earth at radii of 6.8×10^3 km and 4.2×10^4 km from the centre of Earth respectively.

If the satellite has a speed of 3.1 km s^{-1}, what is the speed of the I.S.S.?

A 0.20 km s^{-1} **B** 1.2 km s^{-1} **C** 7.7 km s^{-1} **D** 19 km s^{-1}

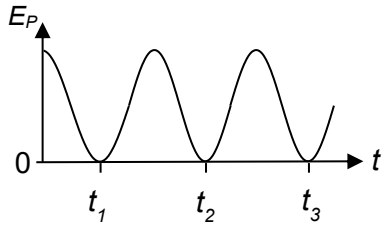
10 The oscillations of a mass suspended on a spring are simple harmonic.

The variation with time t of the displacement x of the mass is shown.

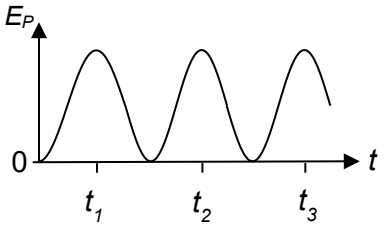


Which graph shows the variation with time t of the potential energy of the oscillation E_P of the mass?

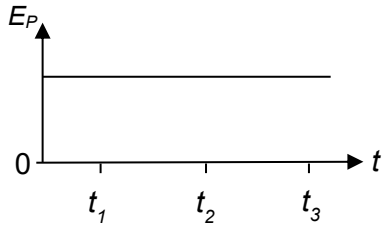
A



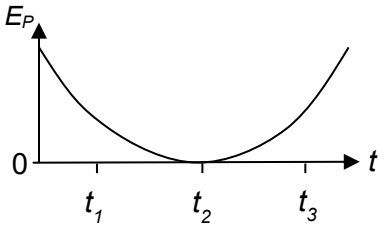
B



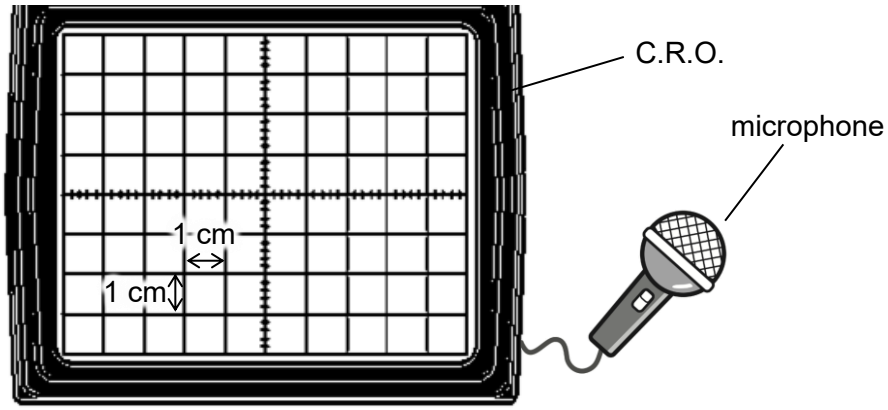
C



D



11 A student is investigating the frequency of a sound wave by using a microphone connected to a cathode-ray oscilloscope (C.R.O.) as shown below.

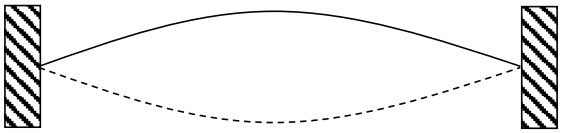


The frequency of the sound is 2 kHz.

Which time-base setting on the oscilloscope will be appropriate?

A 10 ms cm^{-1} **B** 0.1 ms cm^{-1} **C** 1 μs cm^{-1} **D** 10 ns cm^{-1}

12 A wire is stretched between two supports and plucked. A stationary wave is formed as shown.



Given that the frequency of the stationary wave shown above is *f*, what is the next possible frequency for a stationary wave to be formed in the setup?

A $2f$ **B** $3f$ **C** $\frac{1}{2}f$ **D** $\frac{3}{2}f$

13 Two monochromatic radiations X and Y of wavelengths λ_X and λ_Y respectively, are incident normally on a diffraction grating. The third order intensity maximum for X coincides with the fifth order intensity maximum for Y.

What is the ratio of $\frac{\lambda_X}{\lambda_Y}$?

A $\frac{1}{2}$

B $\frac{3}{5}$

C $\frac{5}{3}$

D Not able to determine with given information.

14 Which statement is true for an ideal gas undergoing compression in an insulated container?

A Internal energy remains constant.

B Temperature increases.

C Heat is supplied to the gas.

D Negative work is done on the gas.

15 Two identical blocks of copper, each of mass 0.20 kg, are at temperatures of 80 °C and 20 °C respectively. They are placed in thermal contact in an insulated container.

The specific heat capacity of copper is 390 J kg^{-1} K^{-1}.

What is the amount of heat lost by the block that was initially at a higher temperature when thermal equilibrium is reached?

A 2300 J **B** 4700 J

C 7000 J **D** 12000 J

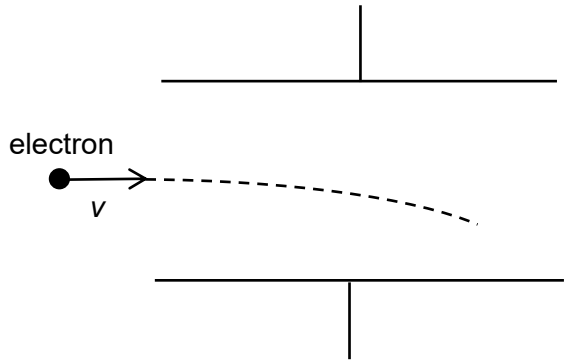
16 The root-mean-square speed of molecules of an ideal gas which is at an initial temperature of 350 K, is increased by 20%.

What is the new temperature of the ideal gas?

A 370 K **B** 400 K **C** 420 K **D** 500 K

17 An electron, of velocity *v*, enters a uniform electric field between two parallel plates at right angles to the field. The region between the plates is a vacuum.

The electron experiences a vertical deflection downwards as shown.



When a proton enters the field with the same velocity *v,* it experiences a deflection upwards.

Ignoring the effects of gravitational field, which statement is incorrect?

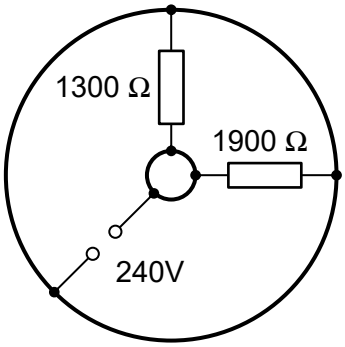
A Both the electron and proton lose electric potential energy.

B The proton experiences a smaller absolute value of change in electric potential energy.

C The force exerted by the electric field on the proton is smaller.

D The proton gains less kinetic energy.

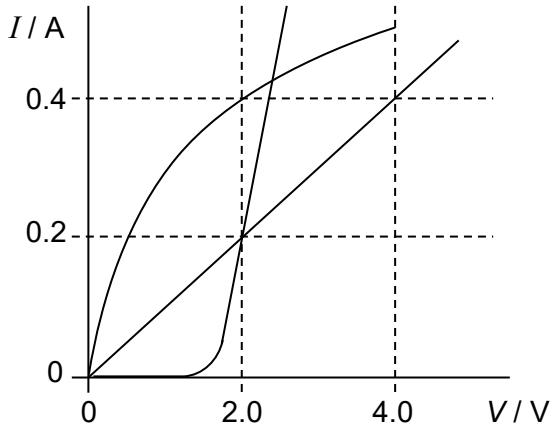
18 The diagram shows two resistors connected to a 240 V power supply of negligible internal resistance.



What is the current supplied by the power supply and total power dissipated by the resistors?

	current / A	total power dissipated / W
A	0.075	18
B	0.075	75
C	0.31	18
D	0.31	75

19 The graph shows the *I*-*V* characteristics of three electrical components, a diode, a filament lamp and a resistor, plotted on the same axes.



Which statement is correct?

A The resistance of the diode is constant above 1.8 V approximately.

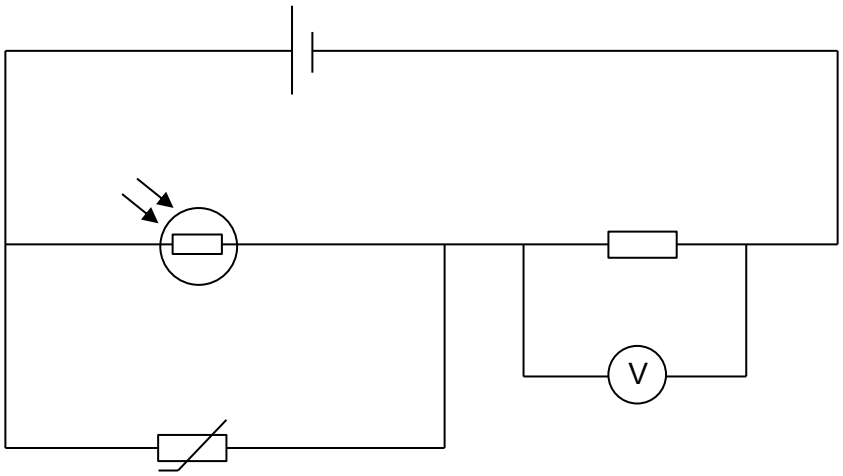
B The resistance of the lamp is twice that of the resistor at 2.0 V.

C The resistance of the lamp is equal to that of the diode at approximately 2.4 V.

D All three components have the same resistance at one particular *V*.

20 NTC thermistors and light-dependent resistors (LDR) are often used in circuits which requires resistance to vary according to temperature and light intensity respectively.

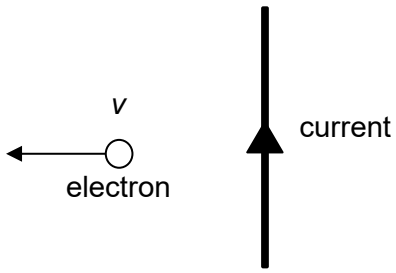
Below shows such a circuit.



What conditions will produce the highest reading on the voltmeter?

	brightness	temperature
A	high	low
B	high	high
C	low	low
D	low	high

21 An electron is moving with speed *v* beside a current carrying wire as shown.



What is the direction of the magnetic force acting on the electron?

A into paper

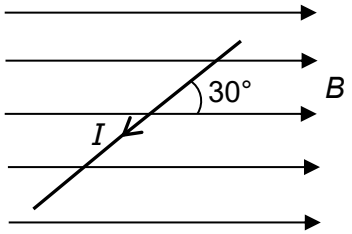
B out of paper

C vertically downwards

D vertically upwards

22 A wire 30 cm long with a mass of 4.0 g, is placed on a horizontal platform in a magnetic field of flux density 0.040 T. The diagram shows the top view of the set-up.

The current I in the wire is slowly increased until the wire starts to lift off from the platform when $I = I_o$.

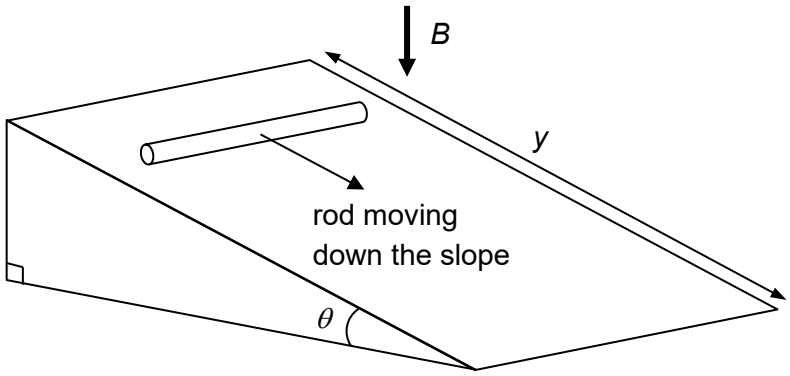


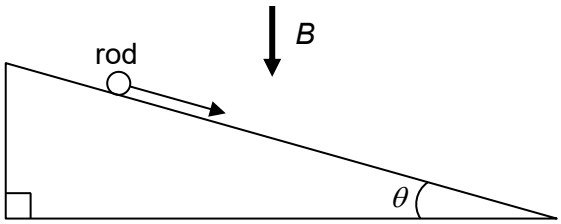
top view

What is value of I_o?

A 3.3 A **B** 6.5 A **C** 33 A **D** 65 A

23 A conducting rod of length *L* is released from rest at the top of a smooth sloping surface. The surface has a fixed length *y*, but the angle θ of the slope to the horizontal can be varied. There is a uniform magnetic field of flux density *B* throughout the region of the sloping surface directed vertically downwards.



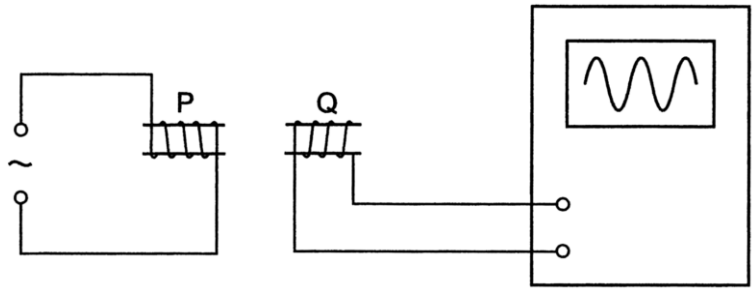


side view

Which value of θ will induce the largest e.m.f. in the rod when it reaches the bottom of the slope?

A 35° **B** 40° **C** 45° **D** 50°

24 A coil P is connected to a 50 Hz alternating supply of constant peak voltage. Coil P lies close to a separate coil Q which is connected to the Y-input terminals of a cathode-ray oscilloscope. A sinusoidal trace appears on the screen of the oscilloscope.



Which change will cause the trace to have a larger amplitude while the number of cycles per unit time remains unchanged?

A increase the frequency of the alternating supply

B decrease the cross-sectional area of coil P

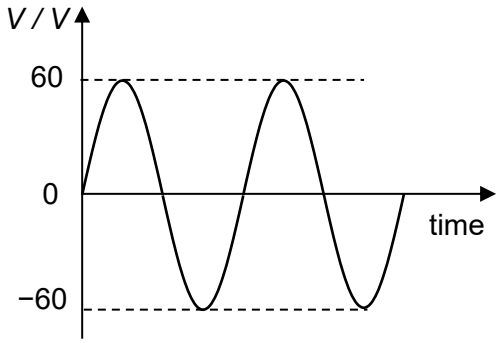
C decrease the number of turns in coil Q

D insert an iron core through both coils

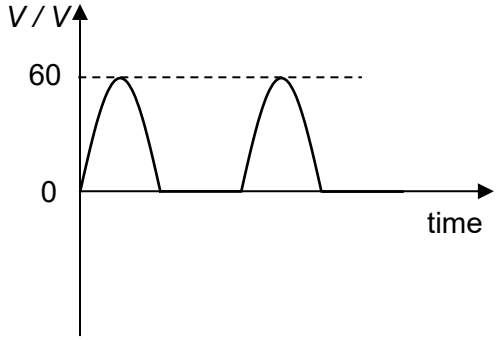
25 When a varying voltage is connected across a resistor of resistance 8.0 Ω, the mean power dissipated in the resistor is 450 W.

Which graph shows a possible variation of the voltage with time?

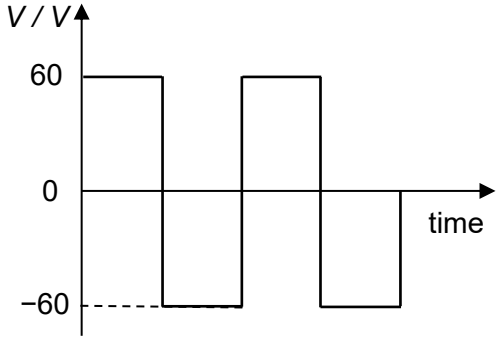
A



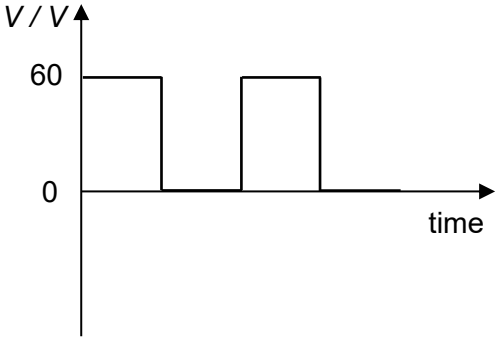
B



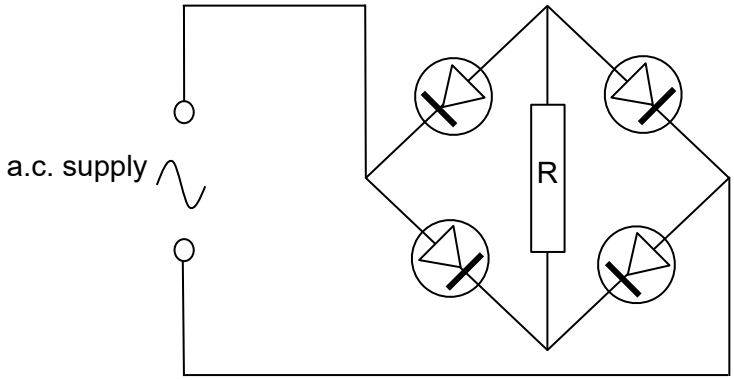
C



D

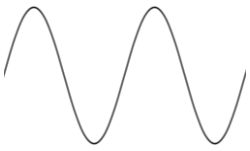


26 A circuit is made of up of a number of ideal diodes and a load R, as shown below. It is connected to an a.c. supply.



Which of the following traces would be seen on an oscilloscope connected across R?

A



B

C

D

27 An electron is accelerated from rest through a potential difference to achieve a final kinetic energy of 9.3×10^{-16} J.

What is the de Broglie wavelength of the electron after being accelerated through this potential difference?

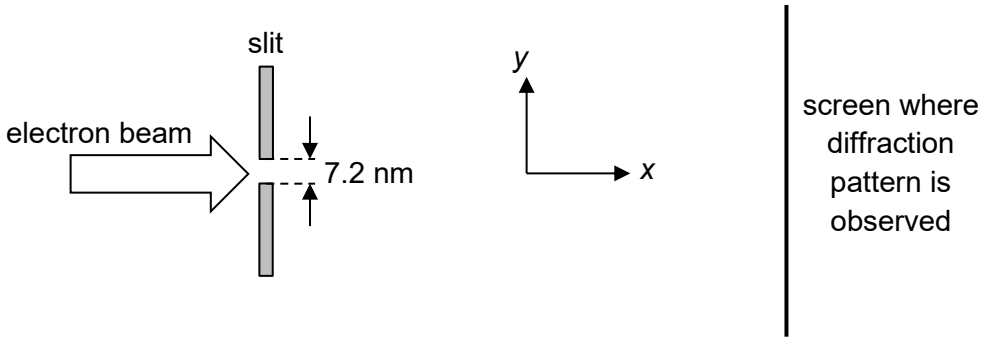
A 5.1×10^{-10} m

B 1.6×10^{-11} m

C 5.1×10^{-12} m

D 3.6×10^{-19} m

28 When an electron beam passes through a slit, a diffraction pattern is observed on a suitable screen. This phenomenon can be explained using Heisenberg position-momentum uncertainty principle.



The slit width is 7.2 nm.

For an electron passing through the slit, what is the uncertainty in the momentum of the electron and its direction that best relates to the phenomenon?

	uncertainty in momentum / kg m s^{-1}	direction
A	9.2×10^{-35}	*x*
B	9.2×10^{-35}	*y*
C	9.2×10^{-26}	*x*
D	9.2×10^{-26}	*y*

29 It is observed that α-particles incident on a thin gold foil are mostly undeflected, while a small proportion of them are deflected at very large angles.

Which statement provides the explanation for these observations?

A The α-particles are scattered by electrons.

B The α-particles are diffracted by the crystal lattice.

C The α-particles collide with small but massive nuclei.

D The α-particles undergo nuclear fission.

30 A radioactive sample is placed in a vacuum together with a Geiger Muller (GM) tube.

The GM tube is placed 10 cm from the sample and the initial count rate is 1000 s^{-1}.

Several materials are then placed between the sample and GM tube, and the results are shown below.

material	count rate / s^{-1}
0.1 mm aluminium sheet	500
7 mm aluminium sheet	500
10 cm of lead	near zero

What radiation is being emitted by the sample?

A alpha radiation only

B beta radiation only

C beta and gamma radiation

D alpha and gamma radiation

End of Paper

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