SERANGOON JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION
General Certificate of Education Advanced Level
Higher 2

CANDIDATE NAME							
CIVICS GROUP					**INDEX NUMBER**		

1234567S

PHYSICS 9646/01

Paper 1 Multiple Choice **24 August 2011**

1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, Civics Group and index number on the Answer Sheet in the spaces provided.

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

Read the instructions on the Answer Sheet very carefully.

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 question paper.

This document consists of **19** printed pages and **1** blank page.

DATA AND FORMULAE

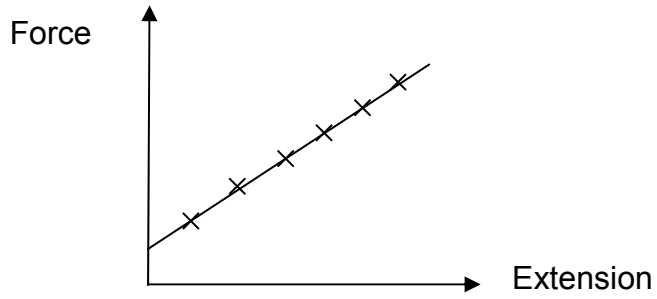
Data

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
permeability of free space,	μ_0	=	$4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space,	ε_0	=	8.85×10^{-12} F m^{-1}
			$(1 / (36\pi)) \times 10^{-9}$ 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	=	$-\frac{Gm}{r}$
displacement of particle in s.h.m.,	x	=	$x_0 \sin \omega t$
velocity of particle in s.h.m.,	v	=	$v_o \cos \omega t$
	v	=	$\pm \omega \sqrt{(x_0^2 - x^2)}$
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$
electric potential,	V	=	$Q / 4\pi\varepsilon_o r$
alternating current/voltage,	x	=	$x_0 \sin \omega t$
transmission coefficient,	T	$\propto$	$\exp(-2kd)$
			where $k = \sqrt{\frac{8\pi^2 m(U-E)}{h^2}}$
radioactive decay,	x	=	$x_0 \exp(-\lambda t)$
decay constant,	λ	=	$\frac{0.693}{t_{\frac{1}{2}}}$

1 In an attempt to find the spring constant of a spring whose theoretical value is 3.0 N m^{-1}, a student attached different weights to a spring, measured the corresponding extensions, and plotted his results on a force-extension graph. It was noted that while the gradient of the graph was 2.98 N m^{-1}, the line obtained was vertically displaced from its theoretical position. 5 out of the 6 points were also found to be located exactly on the best fit line. What kind of error could be present?



A Systematic error, due to consistent under-estimation of the extensions.

B Systematic error, due to consistent over-estimation of the extensions.

C Random error, due to limited sensitivity of ruler in measuring extensions.

D Both random and systematic errors due to poor experimental technique and limited sensitivity of ruler in measuring extensions.

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2 Which of the following is <u>not</u> a reasonable estimate?

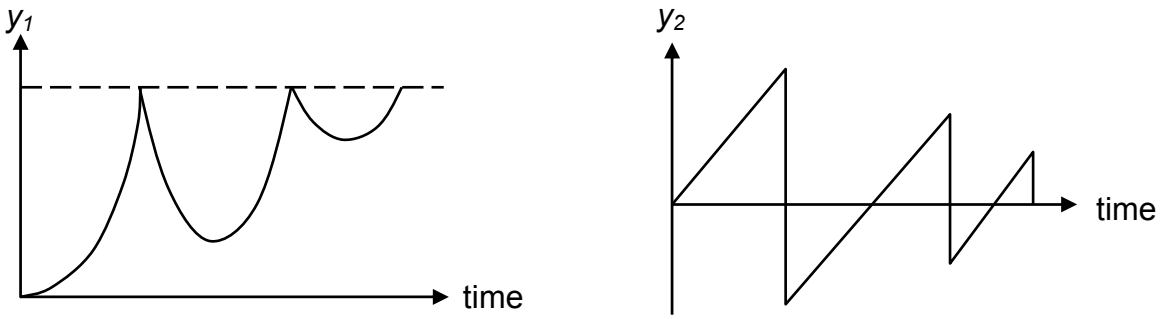
A The volume of a laptop is 1800 cm^3.
B The number of seconds taken to drive from the east to the west of Singapore by the Pan-Island Expressway is 1800 s.
C The average pressure on the seat of a chair when an SRJCian sits on it is 5 kPa.
D The rate at which a student loses gravitational potential energy in walking down the stairs from the fourth floor to the first floor of B block is 1500 W.

3 A stone released from rest from a height of 20.0 m on the surface of planet Earth reaches the ground level after a time T_0. The same stone is thrown from the same height at another planet and it also reaches the ground in a time T_0.

By taking the acceleration due to gravity on the surface of Earth and the planet to be 10.0 m s^{-1} and 15.0 m s^{-2} respectively, what is a possible value for its initial velocity on the planet?

A 2.2 m s^{-1} upwards
B 2.2 m s^{-1} downwards
C 5.0 m s^{-1} upwards
D 5.0 m s^{-1} downwards

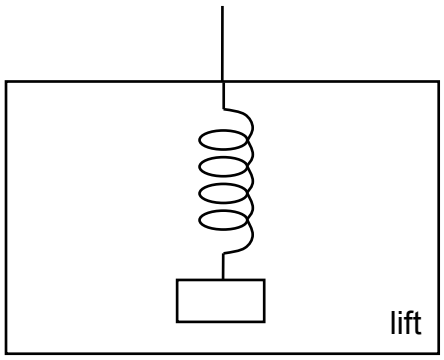
4 A ball is released from rest above a horizontal surface and bounces several times. The graph shows how, for this ball, a quantity y varies with time.



What are the quantities corresponding to y_1 and y_2?

	y_1	y_2
A	displacement	momentum
B	velocity	acceleration
C	work done against gravity	displacement
D	kinetic energy	velocity

5 A light spring of natural length 25.0 cm is suspended from the ceiling of a lift. A mass is hung from the end of the spring, as shown in the figure below.



When the lift is moving downwards at a constant speed, the length of the spring is 50.0 cm. The lift then slows down with a constant acceleration of 2.0 m s^{-2}. Which of the following is correct? (Take g = 10.0 m s^{-2})

A The spring shortens by a length of 5.0 cm.

B The spring lengthens by a length of 5.0 cm.

C The spring shortens by a length of 10.0 cm.

D The spring lengthens by a length of 10.0 cm.

6 Two carts of different masses m_1 and m_2 move towards each other at different speeds u_1 and u_2 respectively and collide, producing a loud sound. Subsequently, the two carts move in opposite directions. Which of the following must be correct?

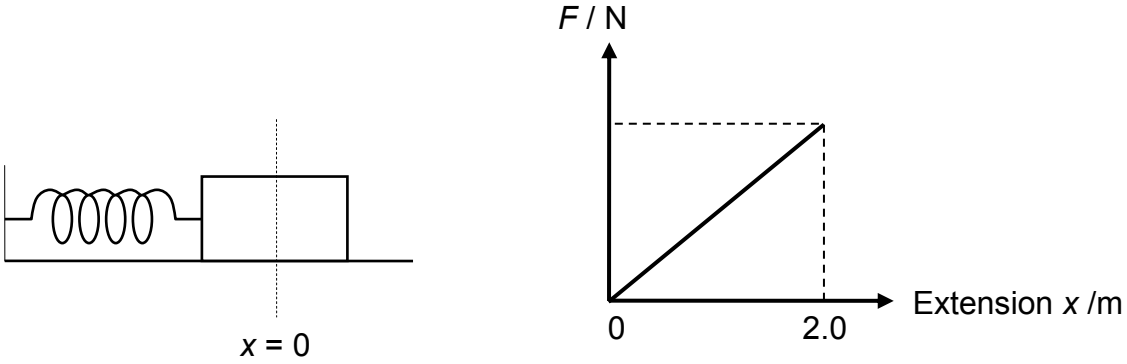
A The collision is elastic since the carts move in opposite directions after the collision.

B Each cart experiences a change in momentum, and thus the total momentum of the system changes.

C The sum of kinetic energies of the carts after the collision is less than that before the collision.

D The relative speed of approach and the relative speed of separation of the carts must be the same.

7 A 5.0 kg mass is placed on a horizontal frictionless surface, and is attached to the end of a spring. The restoring force in the spring F varies with its extension x as shown below.

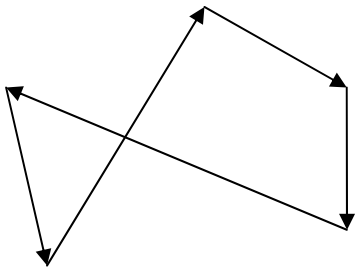


At the origin, the mass is given a sudden initial push such that it has a speed of 4.0 m s^{-1}. The mass comes to a stop at a distance of 2.0 m away from the origin. What is the speed of the mass when it is at x = 1.0 m?

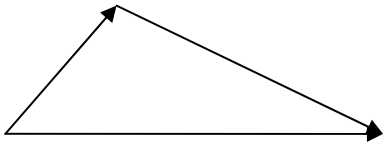
A 2.0 m s^{-1} **B** 2.8 m s^{-1} **C** 3.0 m s^{-1} **D** 3.5 m s^{-1}

8 Which of the following diagrams illustrate forces in equilibrium?

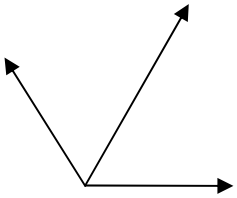
A



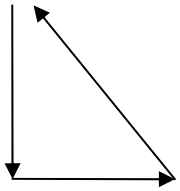
B



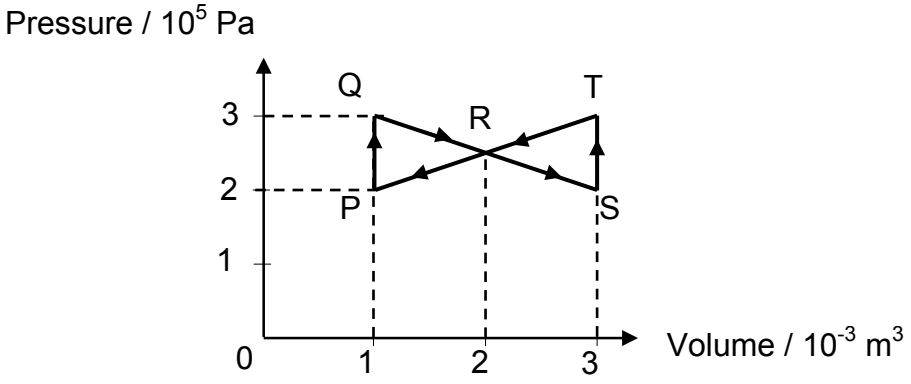
C



D



9 A gas undergoes a cycle of pressure and volume changes P→Q→R→S→T→R→P as shown in the diagram.



What is the net work done by the gas?

A – 100 J **B** zero **C** 50 J **D** 100 J

10 A small electric motor is used to raise a weight of 3.0 N through a vertical height of 90.0 cm in 6.0 s. The efficiency of the motor is 25%.

What is the electrical power supplied to the motor?

A 0.45 W **B** 1.80 W **C** 10.8 W **D** 17.7 W

11 Which of the following is true about an object undergoing uniform circular motion?

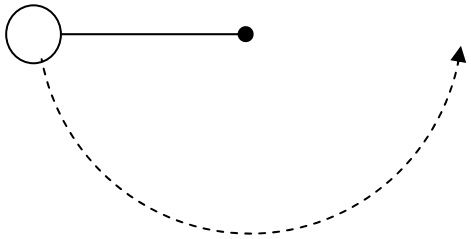
A The resultant force acting on the object remains unchanged.

B There is no resultant force acting on the object since its speed is constant.

C The resultant force acts in the same direction as the centripetal acceleration.

D The resultant force acting on the object is always in the same direction as its motion.

12 A pendulum bob undergoes oscillation through an angle of 180^{o}. What is the pendulum bob's centripetal acceleration when it is at the position shown below?



A zero **B** 4.91 m s^{-2} **C** 9.81 m s^{-2} **D** 19.6 m s^{-2}

13 The Earth has a mass of 5.97×10^{24} kg and a radius of 6370 km. What is the difference in gravitational potential between the Earth's surface and a point at an altitude of 3000 km?

A 5.28 J kg^{-1}

B 2.00×10^{7} J kg^{-1}

C 7.02×10^{7} J kg^{-1}

D 6.25×10^{8} J kg^{-1}

14 Which of the following is true about geostationary orbits around Earth?

A There is more than one possible orbital radius.

B The period of the orbit is independent of the satellite's mass.

C The satellite experiences no acceleration since it is not moving.

D The satellite moves away from a spot above the Earth and returns to it exactly 24 hours later.

15 A body performing simple harmonic motion has a displacement x/ m given by the equation $x = 30 \cos (50t)$, where t is the time in seconds.

What is the maximum velocity of the body during its motion?

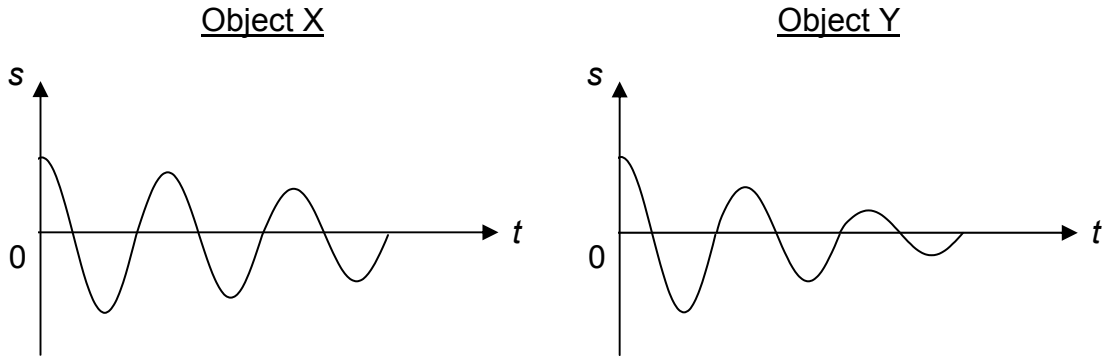
A 30 m s^{-1}

B 50 m s^{-1}

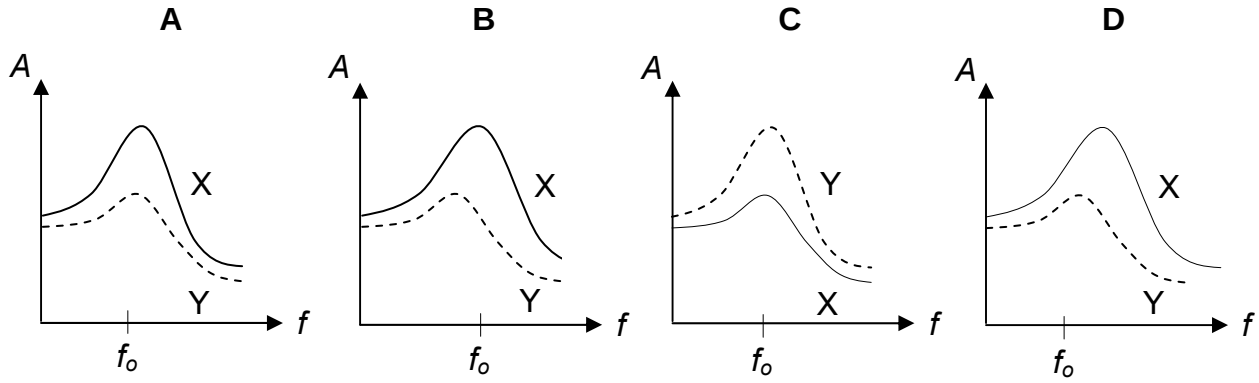
C 1500 m s^{-1}

D 2500 m s^{-1}

16 Two objects X and Y are given the same initial displacement and are then released. The graphs show the variation with time t of their displacements s.



X and Y are then subjected to driving forces of the same constant amplitude and of variable frequency f. Which of the following set of graphs represents the variation with f of the amplitudes A of X and Y?



17 An ideal gas at a temperature of 230 ^{o}C exerts a pressure of 80 Pa. The number of molecules present per unit volume is 10^{21}. The same type of gas is stored in another container at 100 ^{o}C exerting a pressure of 30 Pa. What is the number of molecules present if the volume of this container is 2.0 m^3?

A 1.01×10^{21} **B** 1.73×10^{21}

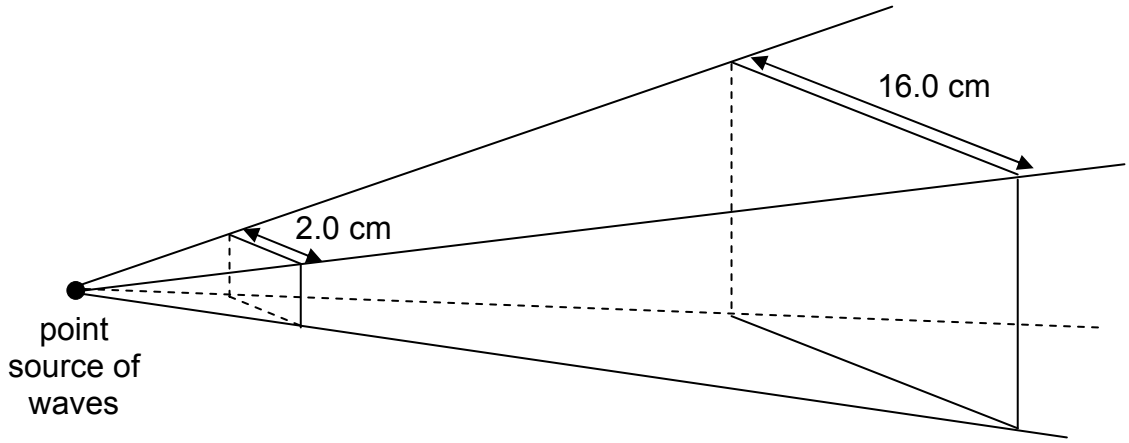
C 1.80×10^{21} **D** 3.07×10^{21}

18 The molecules of an ideal gas at thermodynamic temperature T have a root-mean-square speed of v. If the gas is now heated to a temperature of $4T$, what is the new root-mean-square speed of the molecules?

A $1.41v$ **B** $2v$

C $2.83v$ **D** $4v$

19 Waves from a point source pass through an area that is 2.0 cm wide as shown.



Within this area, the intensity of the waves is I and their amplitude is A. The waves reach a second area of width 16.0 cm. What will be the intensity and amplitude of the waves when they reach the second area?

	Intensity	Amplitude
A	$\frac{I}{8}$	$\frac{A}{4}$
B	$\frac{I}{16}$	$\frac{A}{4}$
C	$\frac{I}{64}$	$\frac{A}{8}$
D	$\frac{I}{256}$	$\frac{A}{16}$

20 Which of the following statements is correct?

A Radio waves cannot be polarised because their wavelength is much larger than the atomic separation of the molecules within the polariser.

B Sound waves cannot be polarised because the direction of vibration of the particles is parallel to the direction of propagation of the wave.

C Light waves can be polarised because it travels at a very high speed in air.

D Electromagnetic waves of high frequency cannot be polarised.

21 Which one of the following is necessary for a stable interference pattern to be observed using laser?

A The room must be completely dark.

B A single beam of laser source must pass through two slits.

C Two beams of laser sources can be used.

D If two laser sources are used, they must be in phase.

22 A student observes interference fringes produced by red light of wavelength 700 nm using a Young's double-slit arrangement. The slits are 1.0 m away from the screen.

How should the student move the slits such that fringes of the same separation can be observed when using blue light of wavelength 400 nm?

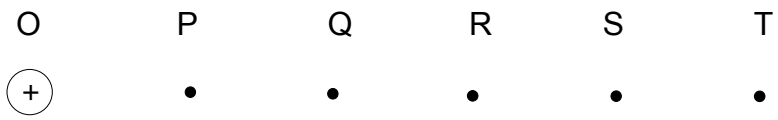
A Move the slits 0.43 m towards the screen.

B Move the slits 0.43 m away from the screen**.**

C Move the slits 0.75 m towards the screen.

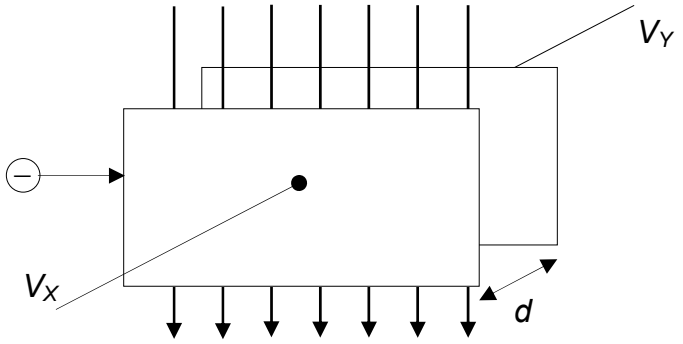
D Move the slits 0.75 m away from the screen.

23 A point charge is placed at O in free space. If the intervals between the OPQRST are equal, which of the following set of values is likely to be the electric field strengths at these points?



	P	Q	R	S	T
A	24	12	6	3	1.5
B	24	20	16	12	8
C	24	6	2.7	1.5	1.0
D	24	12	8	6	4.8

24 The diagram shows an electron beam entering the region between two metal plates in which there are uniform electric and magnetic fields. If the speed of the electrons in the beam is 6.0×10^5 m s^{-1}, and the strength of the magnetic field is 0.238 mT, which of the following values of V_X, V_Y and d will allow the beam to pass through undeflected?

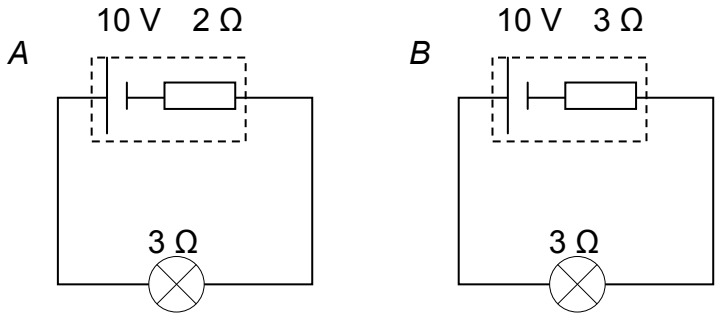


	V_X / V	V_Y / V	d / m
A	–5	+5	0.035
B	+5	–5	0.035
C	–5	–15	0.070
D	+5	+15	0.070

25 A wire of length l and cross-sectional area A has resistance R. It is then stretched to twice its length. If its cross-sectional area is uniform, what is its new resistance?

A 0.25 R **B** 0.5 R **C** 2 R **D** 4 R

26 A student wishes to maximise the brightness of a 3 Ω bulb using either Battery A (of e.m.f. 10 V and internal resistance 2 Ω) or Battery B (of e.m.f. 10 V and internal resistance 3 Ω). Which battery should he use and why?



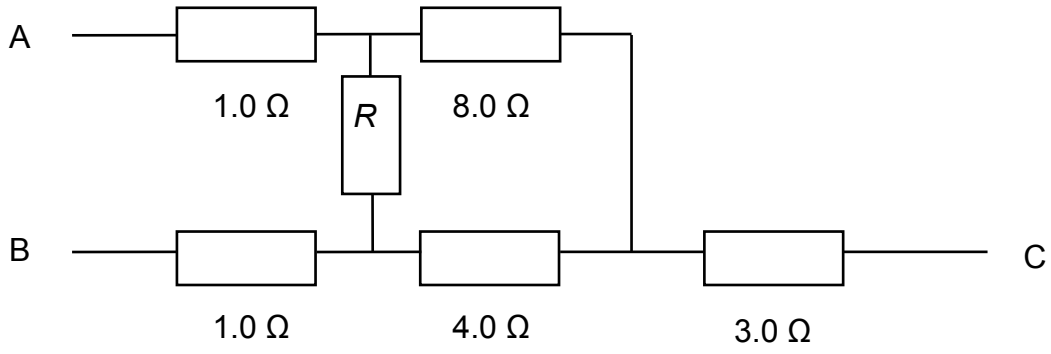
A Battery A, because less current flows through the bulb when connected to Battery A.

B Battery A, because the power dissipated by Battery A's internal resistance is less than that dissipated by Battery B's internal resistance.

C Battery B, because maximum power is transferred to the bulb when its resistance is equal to the internal resistance of the battery.

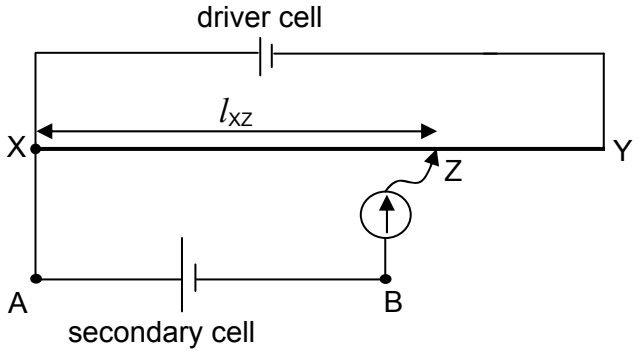
D Battery B, because the larger effective resistance results in a higher total power dissipated compared to Battery A.

27 The diagram shows a network of six resistors. The resistance between A and C is 8.0 Ω. What is the value of resistance R?



A 1.0 Ω **B** 4.0 Ω **C** 6.0 Ω **D** 8.0 Ω

28 In a typical potentiometer circuit as shown below, the balance length l_{XZ} can be increased by the following methods except:



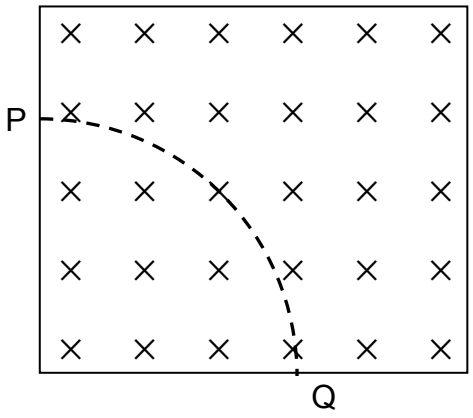
A Adding a fixed resistor in series with the driver cell.

B Adding a fixed resistor in series with the secondary cell.

C Decreasing the emf of the driver cell.

D Increasing the emf of the secondary cell.

29 The figure below shows the track of a charged particle in a magnetic field.

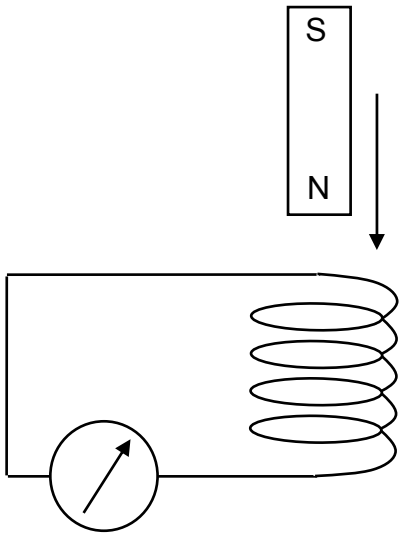


Which of the following shows the particle's charge and point of entry?

	Charge	Point of Entry
(i)	Positive	P
(ii)	Positive	Q
(iii)	Negative	P
(iv)	Negative	Q

A (i) and (ii)
B (ii) and (iii)
C (iii) and (iv)
D (i) and (iv)

30 A bar magnet is dropped vertically above a coil that is connected to a galvanometer. As the magnet approaches the coil, the galvanometer deflects to the right by 10 units.



What is the deflection of the galvanometer as the magnet leaves the coil?

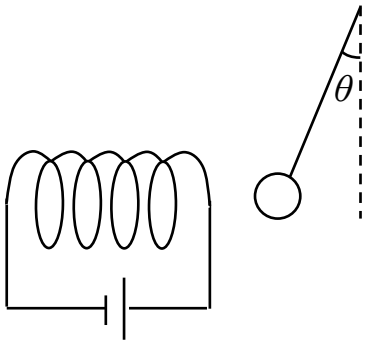
A to the left by less than 10 units

B to the left by more than 10 units

C to the right by less than 10 units

D to the right by more than 10 units

31 When a current flows through the solenoid, a iron pendulum bob rises slightly towards it, as shown in the figure below.



Which of the following statements correctly describes the iron bob if a ferrous core were inside the solenoid?

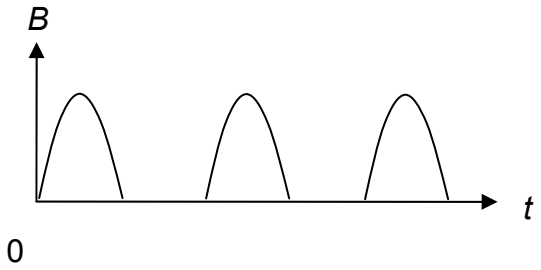
A The attraction would be the same and hence θ would remain the same.

B The attraction would be larger and hence θ would be larger.

C The attraction would be smaller and hence θ would be smaller.

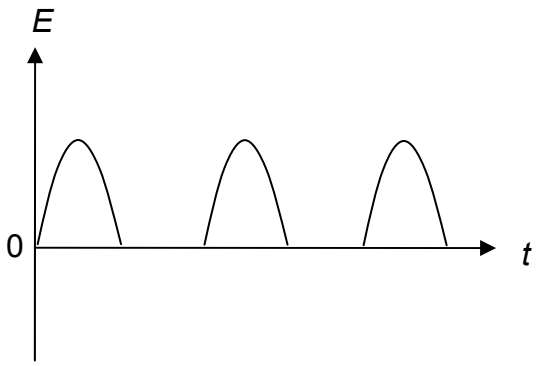
D There would be repulsion and hence the bob would be displaced in the other direction.

32 A magnetic field has a flux density *B* which varies with time, as shown in the diagram below.

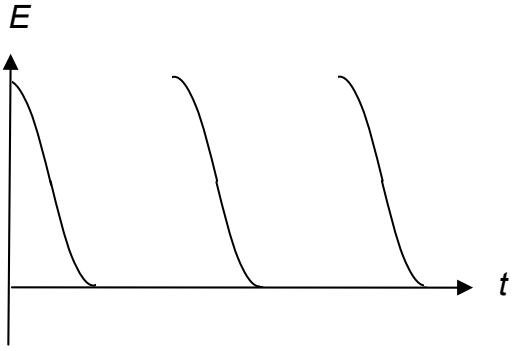


A flat circular coil is placed with its plane perpendicular to the field at time *t* = 0. Which of the following shows how the induced e.m.f. in the coil varies with time?

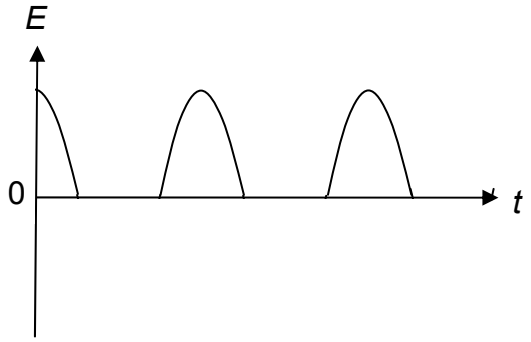
A



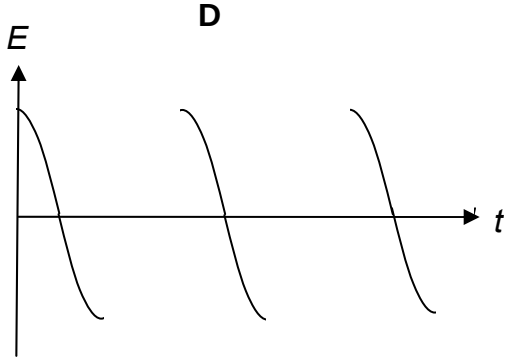
B



C



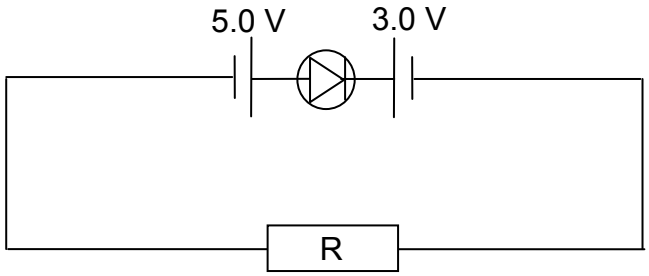
D



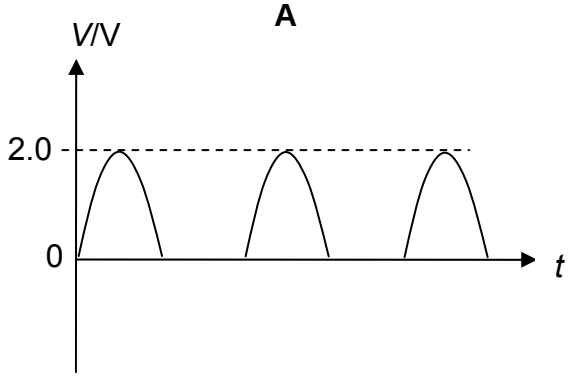
33 A sinusoidal current with a maximum value of I_o flows through a fixed resistor with resistance *R*. The peak power dissipated in the resistor is *P*. What is the maximum value of a sinusoidal current flowing in another circuit with a resistor of resistance $\frac{R}{2}$ which dissipates a mean power of *P*?

A I_o **B** $\sqrt{2}\,I_o$ **C** $2I_o$ **D** $2\sqrt{2}\,I_o$

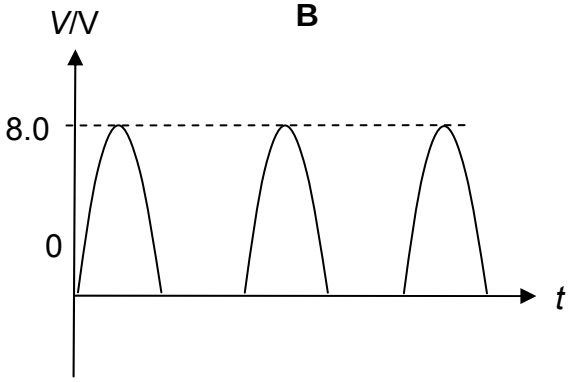
34 Which of the following graphs correctly shows how the voltage across the resistor R varies with time?



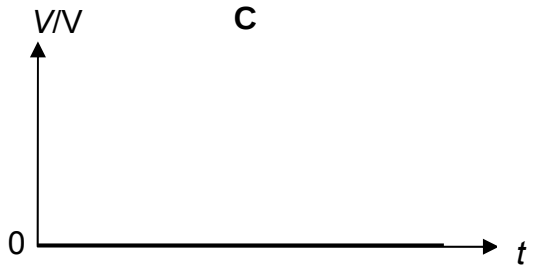
A



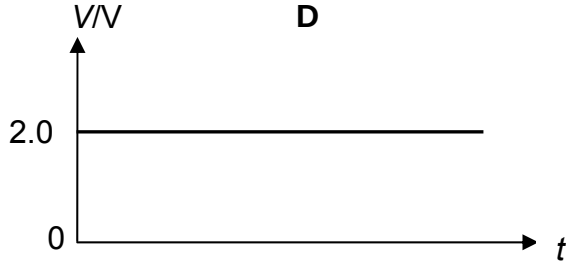
B



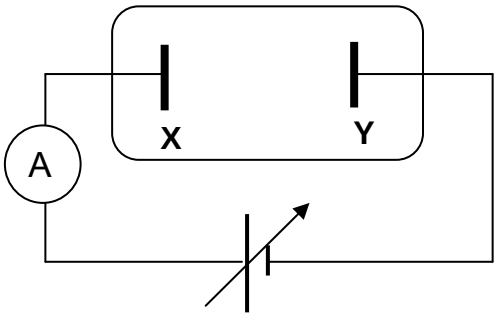
C



D

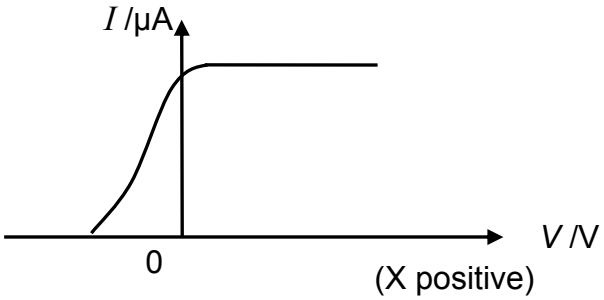


35 The diagram shows a circuit used for photoelectric emission experiments.



The 2 electrodes X and Y are made of different metals. T he work function of electrode X is greater than the work function of electrode Y.

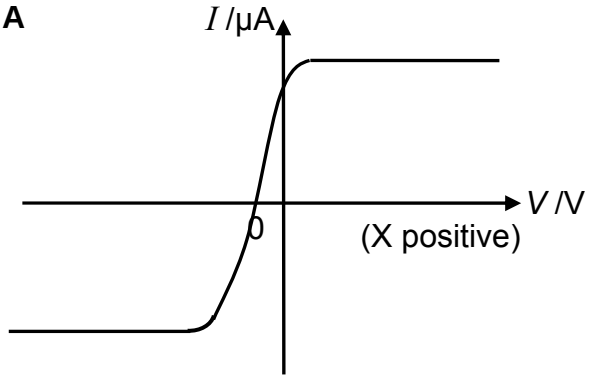
Current-voltage (I-V) characteristics are obtained when both electrodes are illuminated with monochromatic light. When the wavelength of the light is λ_1, the I-V characteristic is as shown.



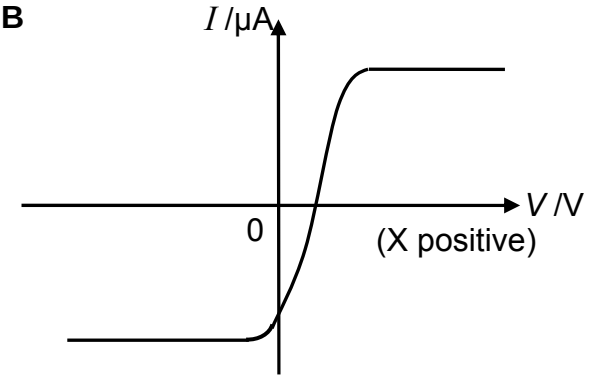
Light of wavelength of λ_2 shorter than λ_1, is then used to illuminate the setup.

Which of the following graphs shows the corresponding I-V characteristic?

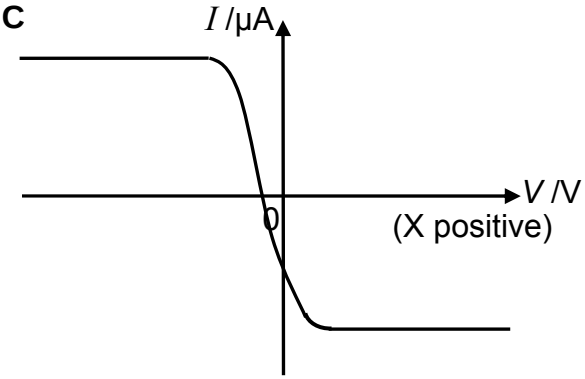
A



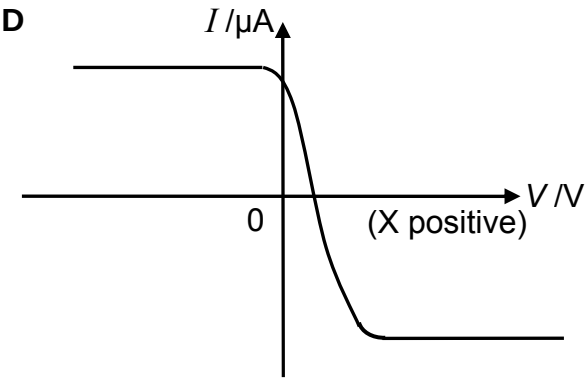
B



C



D



36 An electron with total energy of 5.1 eV approaches a barrier of height 6.8 eV. When the barrier thickness is 750 pm, the approximate transmission coefficient T is 4.51×10^{-5}. What is the barrier thickness when the approximate transmission coefficient T is 6.10×10^{-6}?

A 400 pm **B** 600 pm **C** 900 pm **D** 1100 pm

37 Which one of the following statements about electron energy bands in solids is true?

A Only insulators have energy bands.

B Within a given band, all electron energy levels are equal to each other.

C Electrical conduction arises from the motion of electrons in completely filled bands.

D An insulator has a large energy separation between the highest filled band and the lowest empty band.

38 Which of the following is true when donor atoms are introduced into an intrinsic semiconductor at room temperature?

A The electrical resistivity increases.

B The semiconductor becomes negatively charged.

C The number of holes in the valence band increases.

D The number of electrons in the conduction band increases.

39 In the following induced nuclear reaction, when one Li-7 nuclide reacts with one hydrogen nuclide, X number of He-4 nuclides are produced.

$$^{7}_{3}\text{Li} + ^{1}_{1}\text{H} \rightarrow \text{X}\left(^{4}_{2}\text{He}\right) + \text{energy}$$

During the reaction, 1.6×10^{12} J of energy is released when 1.0 g of hydrogen nuclide (mass of H-1 = 1.008 *u*) and sufficient Li-7 are used. The binding energy of a He-4 nuclide is 28.3 MeV.

What is the binding energy of Li-7?

A 11.6 MeV **B** 39.9 MeV **C** 56.6 MeV **D** 68.2 MeV

40 Alpha particle, beta particle and gamma radiation are produced during radioactive decay. Which of the following correctly describes the ionizing and penetrative power of the three products of radiation?

	Highest Ionising power	Highest penetrative power
A	Alpha particle	Gamma radiation
B	Beta particle	Gamma radiation
C	Gamma radiation	Alpha particle
D	Gamma radiation	Beta particle

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