JURONG JUNIOR COLLEGE
JC2 Preliminary Examination 2013

Name		Class	12S

PHYSICS 9646/1
Higher 2

Multiple Choice

20 Sept 2013

1 hour 15 min

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your **name** and **class** in the spaces provided at the top of this page.

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class 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 booklet.

(This question paper consists of 20 printed pages)

Data

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

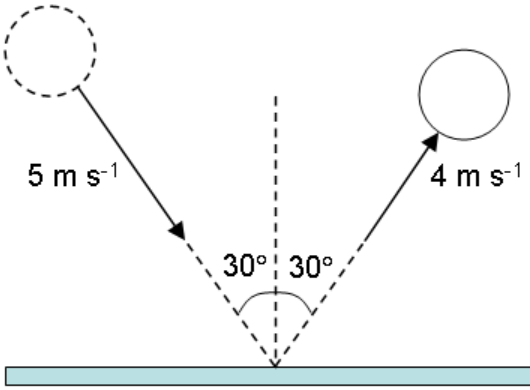
Formulae

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	$= \rho gh$
gravitational potential,	ϕ	$= -\dfrac{Gm}{r}$
displacement of particle in s.h.m.,	x	$= x_o \sin \omega t$
velocity of particle in s.h.m.,	v	$= v_o \cos \omega t$
	v	$= \pm \omega\sqrt{(x_o^2 - x^2)}$
mean kinetic energy of a molecule of an ideal gas	E	$= \frac{3}{2}kT$
resistors in series,	R	$= R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	$= 1/R_1 + 1/R_2 + \ldots$
electric potential,	V	$= \dfrac{Q}{4\pi\varepsilon_o r}$
alternating current / voltage,	x	$= x_o \sin \omega t$
transmission coefficient,	T	$\propto \exp(-2kd)$
		where $k = \sqrt{\dfrac{8\pi^2 m(U-E)}{h^2}}$
radioactive decay	x	$= x_o \exp(-\lambda t)$
decay constant	λ	$= \dfrac{0.693}{t_{1/2}}$

1 What is the tesla, the SI unit of magnetic flux density, expressed in SI base units?

A N A^{-1} m^{-1} **B** kg A^{-1} s^{-1} **C** kg A^{-1} s^{-2} **D** kg A^{-1} m^{-2} s^{-2}

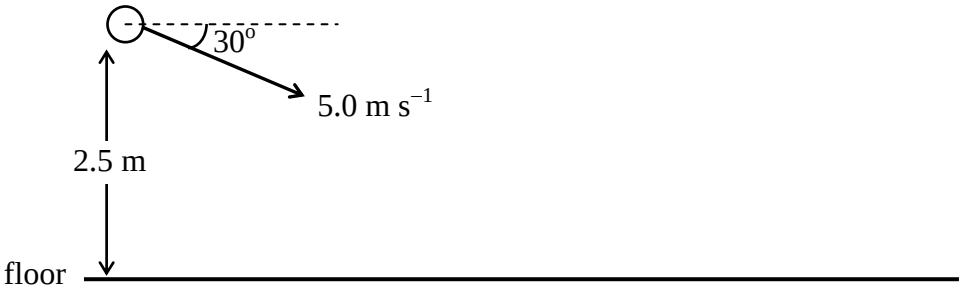
2 A rubber ball hits a horizontal surface at a velocity 5 m s^{-1} and bounces off at 4 m s^{-1} as shown below.



Which of the following indicates the direction of the force acting on the ball by the horizontal surface?

A  **B**  **C**  **D** 

3 A ball was thrown with a velocity 5.0 m s^{-1} at an angle of 30° below the horizontal from a height of 2.5 m as shown below.



What was the speed of the ball just before it hit the floor?

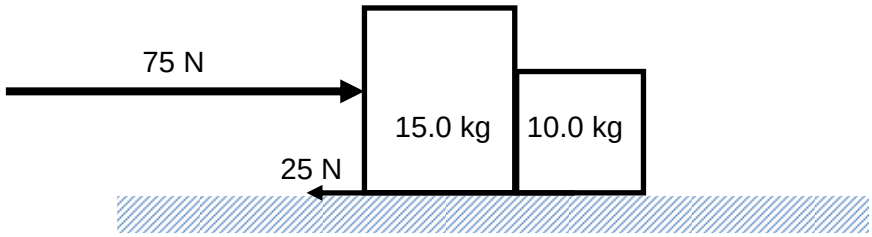
A 7.44 m s^{-1}

B 7.85 m s^{-1}

C 8.38 m s^{-1}

D 8.61 m s^{-1}

4 A force of 75 N pushes two blocks of mass 15.0 kg and 10.0 kg along a flat surface. The total frictional force between the blocks and the surface is 25 N.



What is the magnitude of the resultant force on the 10.0 kg mass?

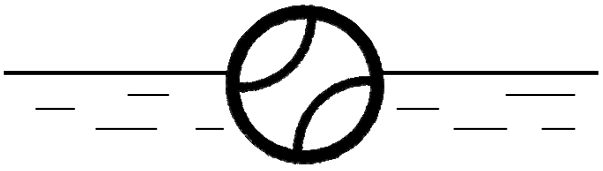
A 20 N **B** 30 N **C** 45 N **D** 50 N

5 A particle of mass m travelling with velocity u collides elastically and head-on with a stationary particle of mass M.

Which expression gives the velocity of the particle of mass m after the collision?

A u **B** $\frac{mu}{M}$ **C** $\frac{2mu}{M+m}$ **D** $\frac{(M-m)u}{M+m}$

6



A tennis ball is able to float on water because

A the mass of water displaced by the tennis ball is equal to the upthrust.

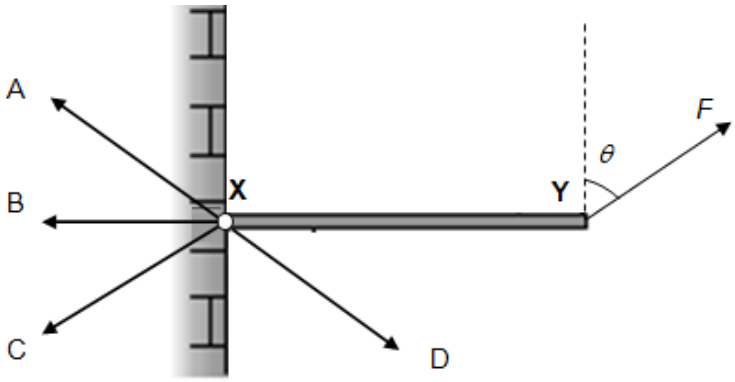
B the upthrust acting on the tennis ball is greater than the weight of the tennis ball.

C the pressure difference between the lower and the upper surfaces of the tennis ball gives rise to an upthrust equal to its weight.

D the area of its lower surface is larger than the area of its upper surface.

7 A uniform rod **XY** is freely hinged to the wall at **X**. It is held horizontal by a force *F* acting from **Y** at an angle θ to the vertical as shown in the diagram.

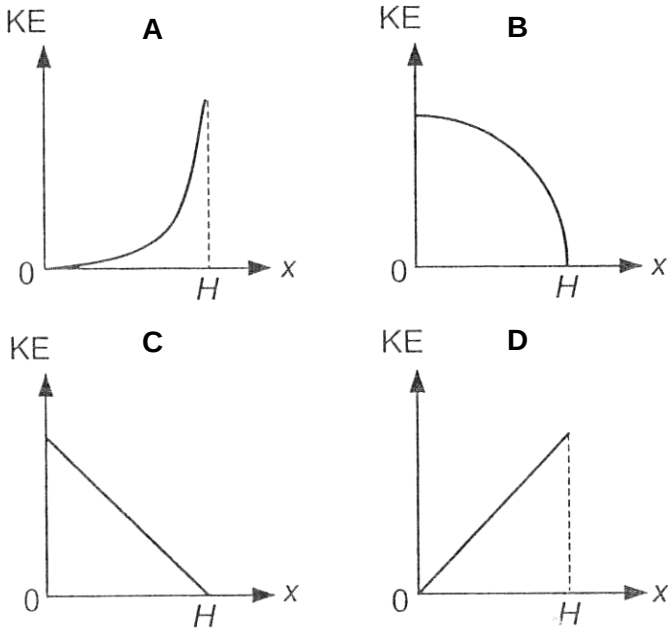
Which of the four options (A, B, C and D) best shows the direction of the force exerted by the rod **on the wall?**



8 A force of 3800 N is required to move a vehicle of mass 1500 kg at constant speed along a horizontal road. In travelling 300 m along the road, the work done against frictional force is

A 12.7 kJ **B** 450 kJ **C** 1140 kJ **D** 5700 kJ

9 A ball is dropped from the top of a tower of height *H*. Which graph shows the variation of the kinetic energy of the ball with distance *x* measured from the ground?



10 A body of mass 1 kg is supported from a fixed point by a light inextensible string of length 1 m. The body is made to rotate about the fixed point in a vertical circle so that its speeds at the highest and lowest points of the circle are the same. If the acceleration of free fall is 10 m s^{-2}, calculate the difference between the tension in the string at the highest and lowest points.

A 0 N

B 1 N

C 10 N

D 20 N

11 A small mass *m* is suspended from one end of a vertical string and then whirled in a horizontal circle, of radius *r*, at a constant speed *v*.

Which one of the following is true?

A The angle of inclination to the vertical of the string depends on *v* and *r* only.

B The angle of inclination to the vertical of the string depends on *v*, *r* and *g* only.

C The tension in the string depends on *m* only.

D The tension in the string depends on *m*, *r, g* and angle of inclination only.

12 Which statement about a geostationary satellite is true?

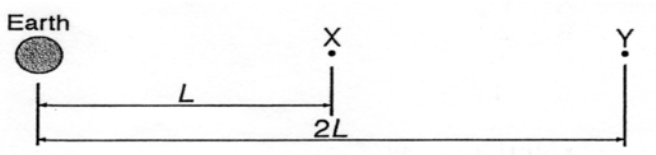
A It can remain vertically above any chosen fixed point on Earth.

B Its linear speed is equal to the speed of a point on the Earth's equator.

C It has the same angular velocity as the earth's rotation about its axis.

D It is always travelling from east to west.

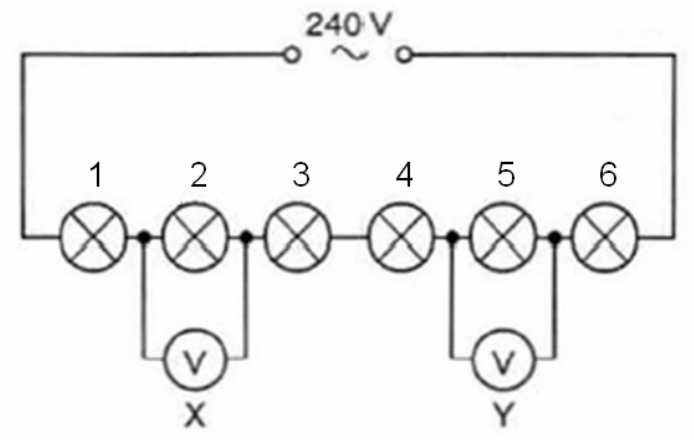
13 The diagram shows two points X and Y at distances *L* and 2*L*, respectively, from the centre of the Earth. The gravitational potential at X is -8 kJ kg^{-1}.



What is the change in gravitaitonal potential energy of a 2 kg mass when it is moved from X to Y?

A -8 kJ **B** -4 kJ **C** +8 kJ **D** +16kJ

14 A mains circuit contains six similar lamps connected in series. At least one of the lamps has a broken filament. Voltmeters X and Y of infinite resistance placed in the circuit show readings of 0 V and 240 V respectively.



Which statement about the filaments of the lamps is correct?

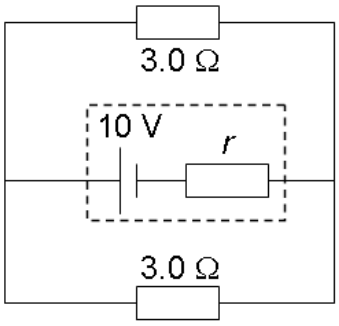
A Only filament 2 is broken.

B Only filament 5 is broken.

C Either filament 3 or filament 4 is broken.

D Either filament 1 or filament 6 is broken.

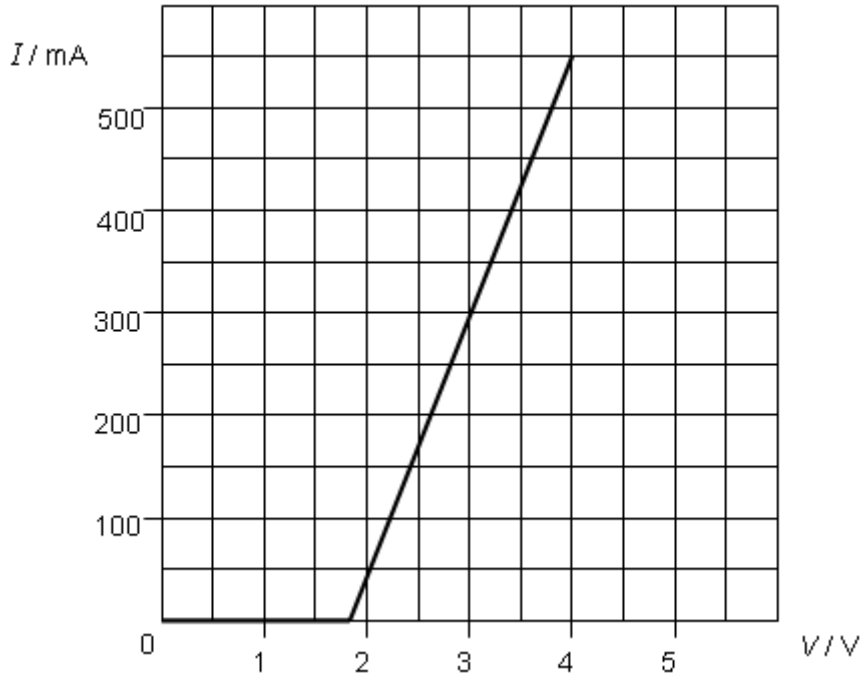
15 A 10 V battery is connected to a 3.0 Ω resistor. The battery has an internal resistance *r* and the power dissipated in each of the 3.0 Ω resistor is 12 W.



What is the value of the internal resistance *r*?

A 0.50 Ω **B** 1.0 Ω **C** 2.0 Ω **D** 3.0 Ω

16 The diagram shows the relation between the current I in a circuit element and the potential difference V across it.



Which statement about the circuit element is correct?

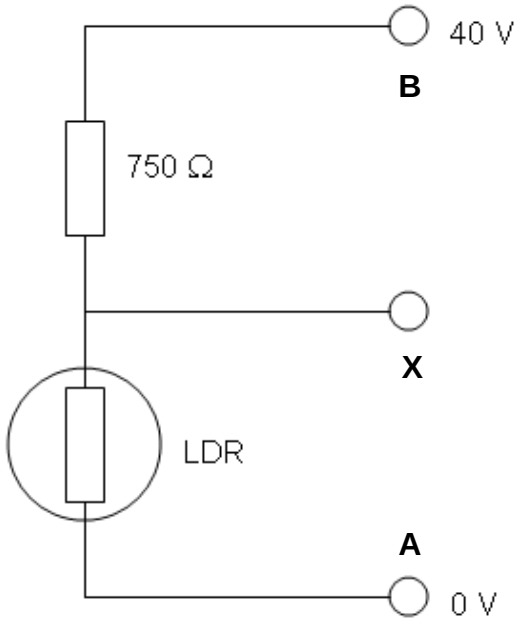
A It does not obey Ohm's law but when V > 1.8 V, its resistance is constant.

B It does not obey Ohm's law and when V > 1.8 V, its resistance is not constant.

C It obeys Ohm's law and when V > 1.8 V, its resistance is constant.

D It obeys Ohm's law but when V > 1.8 V, its resistance is not constant.

17 The diagram shows a potential divider formed using a light dependent resistor (LDR) and a 750 Ω resistor. The ends A and B of the potential divider are maintained at 0 V and +40 V respectively. The resistance of the LDR is 2000 Ω in darkness and 200 Ω in bright light.



What range of potential difference can be obtained between B and X?

A 0 V to 8.4V

B 0 V to 29 V

C 8.4 V to 29 V

D 11 V to 32 V

18 Four different solids A, B, C and D of equal masses at 20°C are separately heated at the same rate. Their melting points and specific heat capacities are as shown below.

Which of these solids will start to melt first?

Solid	Melting point/ °C	Specific heat capacity/ J kg^{-1} K^{-1}
A	80	1200
B	100	800
C	150	600
D	300	250

19 The piston of an air-tight syringe containing an ideal gas is pulled outwards quickly. Which of the following changes is incorrect?

A The density of the ideal gas decreases.

B The pressure of the ideal gas decreases.

C The temperature of the ideal gas decreases.

D The root-mean-square speed of the atoms increases.

20 Which of the following is not an example of resonance?

A Sound made by guitar strings.

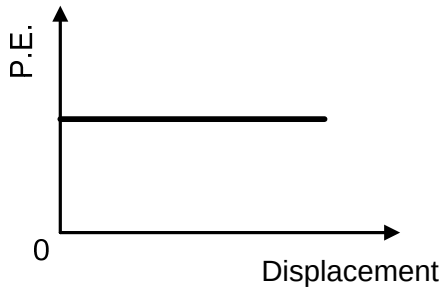
B Radio tuning to pick up a particular frequency from a radio station.

C Car suspension system.

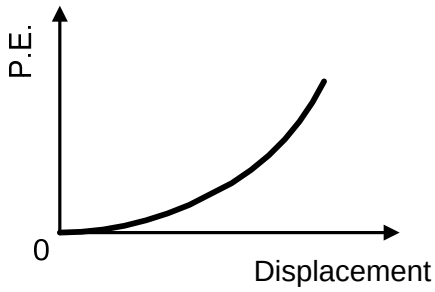
D Pushing someone on a swing.

21 Which one of the following graphs best represents the variation of potential energy (P.E.) with displacement from its equilibrium position of a mechanical simple harmonic motion?

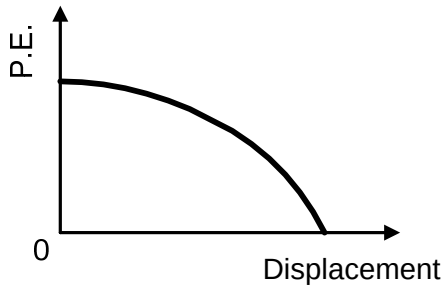
A



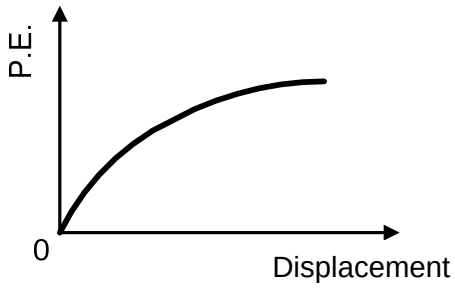
B



C



D



22 Which of the following observations provides direct evidence that light is a transverse, rather than a longitudinal wave?

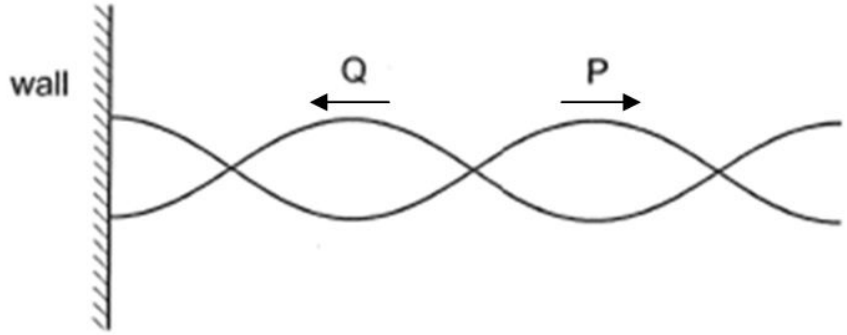
A We can hear but not see around corners.

B Lightning is seen before thunder is heard.

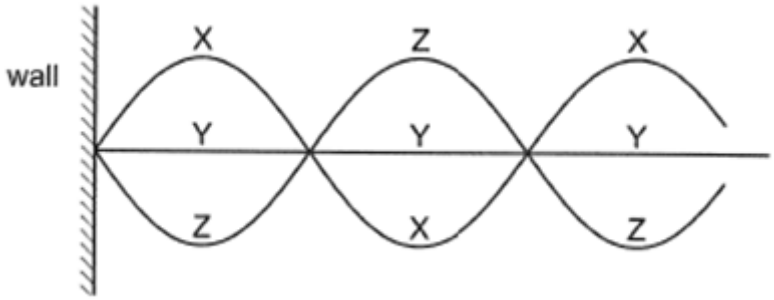
C Light reflected off the sea is cut-off when a sailor puts on a pair of sunglasses.

D Light can cause emission of electrons from the surface of a metal.

23 A water wave Q is incident on a wall. A reflected wave P moves away from the wall. The diagram illustrates the position of P and Q at time zero.



X, Y and Z represent three positions of the resulting stationary wave.



In which order does the stationary wave have these positions, beginning at time zero?

A X Y Z Y

B Y X Y Z

C Y Z Y X

D Z Y X Y

24 The figure below shows a setup where a laser beam is directed towards two Polaroids. The Polaroids are adjusted such that zero intensity is detected by the light sensor. **Without changing the orientation of either Polaroid A or Polaroid B**, how can we adjust the setup such that the sensor may detect a *non-zero* intensity?

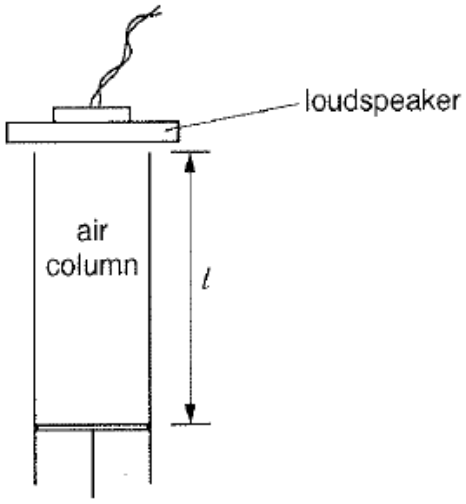
A Place another Polaroid between the laser and Polaroid A.

B Place another Polaroid between Polaroid A and Polaroid B.

C Place another Polaroid between Polaroid B and the light sensor.

D There is no possible method.

25 The length *l* of an air column is slowly increased from zero while a note of constant frequency is produced by a loudspeaker placed above it.



When *l* reaches 17 cm the sound increases greatly in volume.

What is the wavelength of the soundwave produced by the loudspeaker?

A 8.5

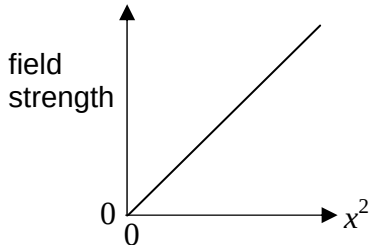
B 17

C 34

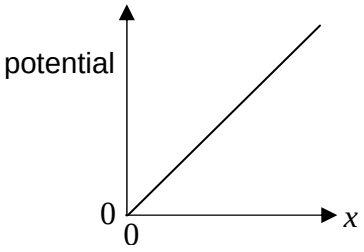
D 68

26 Which graph correctly relates the electric field strength or electric potential in the field of a point charge, with distance *x* from the charge?

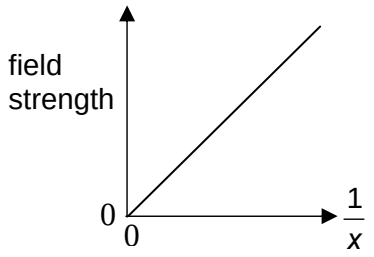
A



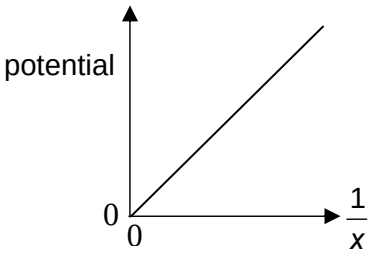
B



C



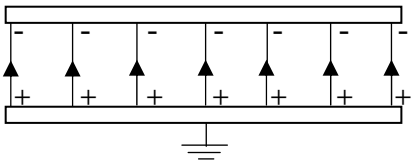
D



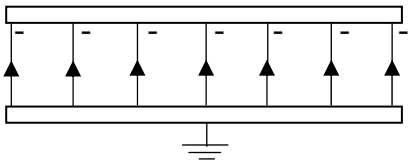
27 Two parallel, conducting plates with air between them are placed close to one another. The top plate is given a negative charge and the bottom one is earthed.

Which diagram best represents the field and distribution of charges in this situation?

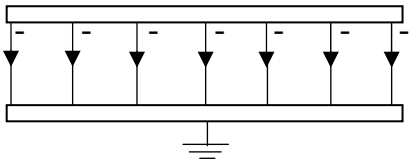
A



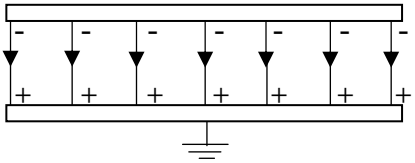
B



C



D



28 Which of the following statements is correct for a charged particle moving in a circular orbit inside a uniform magnetic field ?

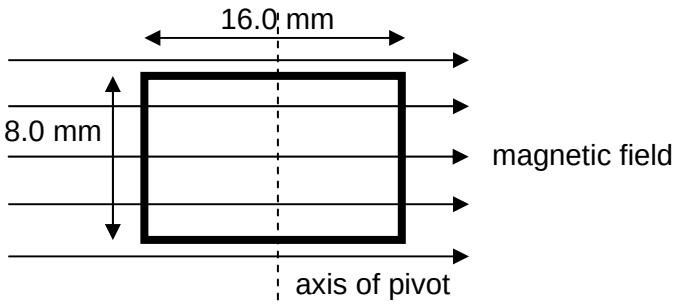
A The period of the orbit is independent of the speed of the electron.

B The momentum of the electron is dependent on its charge.

C The radius of the orbit is directly proportional to its charge.

D The magnetic force on the electron is dependent on the mass of the electron.

29 A 40-turn rectangular coil of sides 16.0 mm and 8.0 mm is pivoted at the centre and placed in a magnetic field of flux density 0.010 T such that two sides of the coil are parallel to the field and two sides are perpendicular to the field, as shown in the figure. A current of 5.0 mA is passed through the coil.



What is the maximum torque created on the coil?

A 6.4×10^{-9} N m

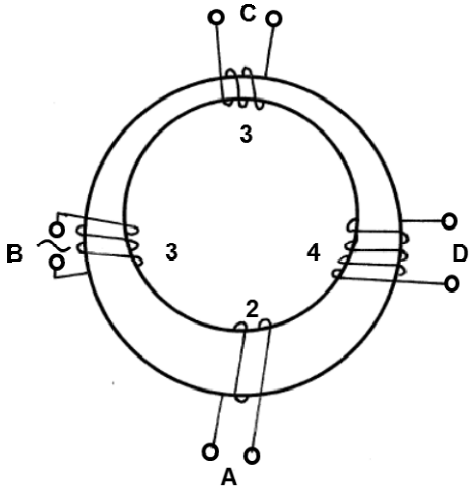
B 1.3×10^{-7} N m

C 2.6×10^{-7} N m

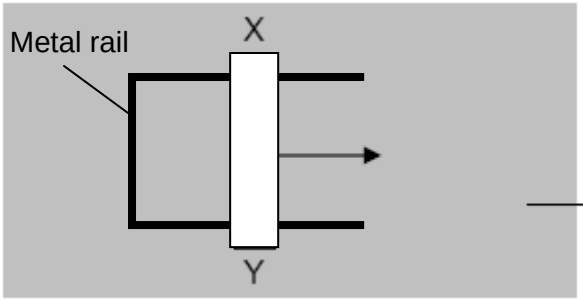
D 1.6×10^{-5} N m

30 A soft-iron ring of variable cross-section has four coils wound round it at the positions shown. The coils have 2, 3, 3 and 4 turns. The 3-turn coil is connected to an a.c. supply.

In which coil does the magnitude of the magnetic flux density have the largest variation?



31 A metal rod XY is moving to the right on a metal rail, perpendicular to a magnetic field as shown below.



Which of the following correctly describes the magnetic force acting on the rod and the potential of the rod XY?

	Magnetic force on rod	Potential of rod
A	directed to the left	X is higher than Y
B	directed to the right	X is higher than Y
C	directed to the left	Y is higher than X
D	directed to the right	Y is higher than X

---

32 A sinusoidal potential difference V_1 as shown in Fig. 32.1 is applied across a resistor R and produces heat at a mean rate W. What is the mean rate of heat produced when another potential difference V_2 as shown in Fig. 32.2 is applied across the same resistor?

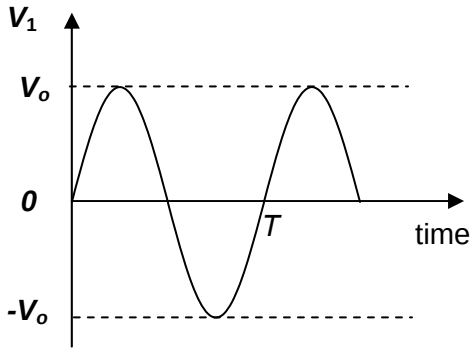


Fig. 32.1

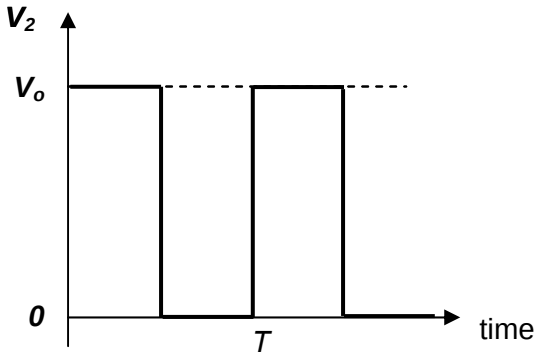


Fig. 32.2

A W **B** $\sqrt{2}\,W$ **C** $2W$ **D** $4W$

33 An electric oil heater has the following label as shown in Fig. 33.

Which of the following is a probable expression of the current that passes through the oil heater when used in Singapore?

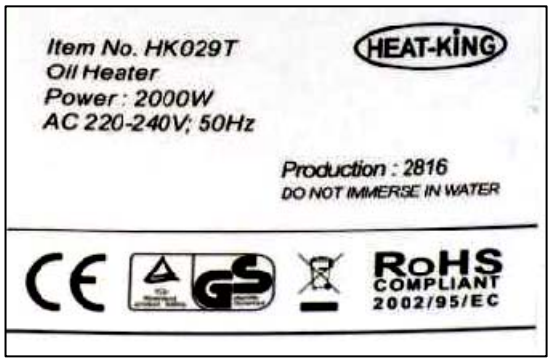


Fig. 33

A $I = 8.33 \sin (314t)$

B $I = 11.9 \sin (314t)$

C $I = 14.1 \sin (375t)$

D $I = 16.0 \sin (375t)$

34 Transitions between three energy levels in a particular atom give rise to three spectral lines of frequencies, in increasing magnitudes f_1, f_2 and f_3.

Which of the following equations correctly relates f_1, f_2 and f_3?

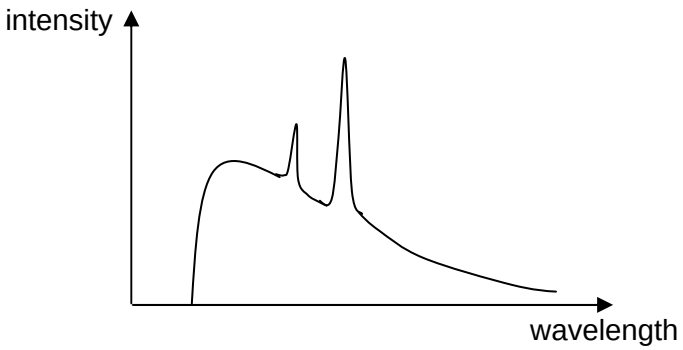
A $\frac{1}{f_1} = \frac{1}{f_2} + \frac{1}{f_3}$

B $f_1 = f_2 + f_3$

C $f_1 = f_3 - f_2$

D $f_1 = f_2 - f_3$

35 The following graph shows the spectrum of X-rays emitted from an X-ray tube.



If the potential difference between the target and cathode is increased, which one of the following combinations represents a possible change in wavelength and intensity of the **spikes**?

	Wavelength	Intensity
A	Remain the same	Increase
B	Decrease	Remain the same
C	Remain the same	Remain the same
D	Decrease	Increase

36 An electron moves with a constant velocity of 3.0×10^{6} m s^{-1}. If its momentum is measured to a precision of 0.30 percent, find the minimum uncertainty in its position.

A 2.0×10^{-11} m

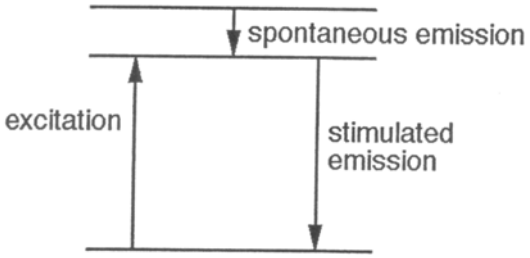
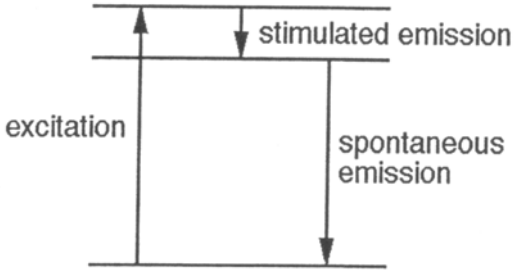
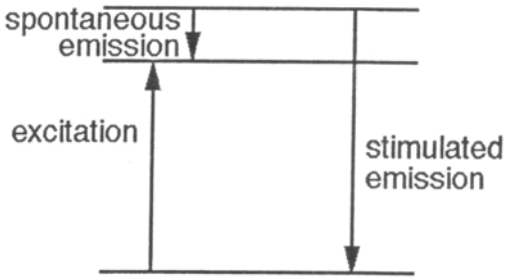
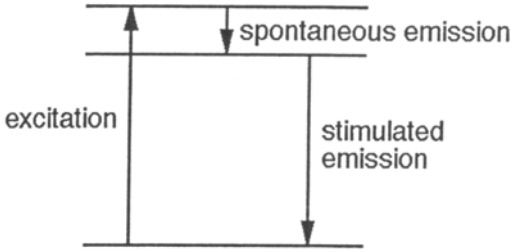
B 6.4×10^{-11} m

C 6.4×10^{-9} m

D 4.1×10^{-8} m

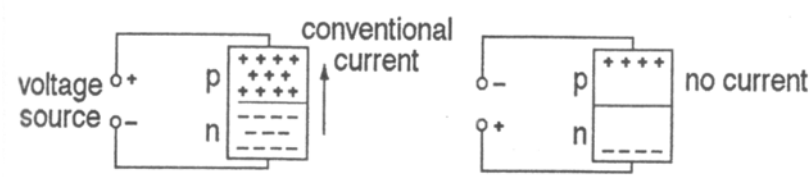
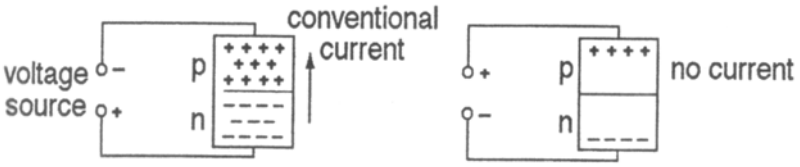
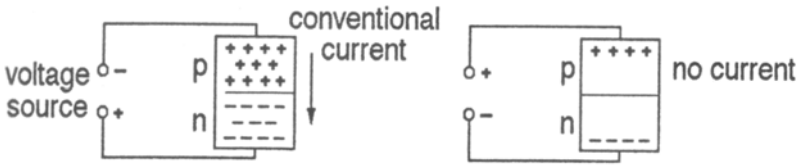
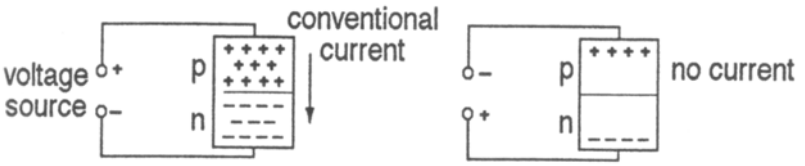
37 In a helium-neon laser, helium atoms collide with neon atoms and excite them. This produces a population inversion which allows stimulated emission.

Which neon energy level diagram correctly shows the excitation of the neon atoms by the helium atoms, the spontaneous infra-red emission from the neon, and the stimulated emission of red light?

A	
B	
C	
D	

38 In the diagrams below, the symbols + + + and - - - represent the majority carriers in the p-type and n-type sides of a p-n junction.

Which pair of diagrams illustrates how a p-n junction acts as a rectifier?

A	
B	
C	
D	

39 A radioactive nucleus decays to form an isotope of the original nucleus.

What could be the other products of this radioactive decay?

A one α-particle and four β-particles

B one α-particle and two β-particles

C two α-particles and two β-particles

D four α-particles and one β-particle

40 A radioactive source contains two species. One has a half-life of 4 days and decays by the emission of alpha particles while the other has a half-life of 3 days and emits beta particles. The initial count-rate is 352 min^{-1}, but when a sheet of paper is placed between the source and the detector this becomes 256 min^{-1}. The background count-rate is 16 min^{-1}.

What would be the count-rate without the paper present after 12 days?

A 27 min^{-1}

B 28 min^{-1}

C 43 min^{-1}

D 44 min^{-1}

End of Paper