YISHUN INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME			
CG		INDEX NO	

PHYSICS 9749/01

Paper 1 Multiple Choice **18 September 2023**

1 hour

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/tape.
Write your name and class on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** 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.
The use of an approved scientific calculator is expected, where appropriate.

[Turn over

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_o	=	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	=	$\rho g h$
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	=	$A n v q$
resistors in series,	R	=	$R_1 + R_2 + \ldots\ldots$
resistors in parallel,	$\frac{1}{R}$	=	$\frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots$
electric potential,	V	=	$\frac{Q}{4\pi\varepsilon_o r}$
alternating current/voltage,	x	=	$x_o \sin \omega t$
magnetic flux density due to a long straight wire,	B	=	$\frac{\mu_o I}{2\pi d}$
magnetic flux density due to a flat circular coil,	B	=	$\frac{\mu_o NI}{2r}$
magnetic flux density due to a long solenoid,	B	=	$\mu_o nI$
radioactive decay,	x	=	$x_o \exp(-\lambda t)$
decay constant,	λ	=	$\frac{\ln 2}{t_{\frac{1}{2}}}$

1 A micrometer screw gauge is used to measure the diameter of a small uniform steel sphere. The micrometer reading is 6.00 mm ± 0.01 mm.

What will be the percentage uncertainty in a calculation of the volume of the sphere, using these values?

A 0.2% **B** 0.3% **C** 0.5% **D** 2%

2 A goods train passes through a station at a steady speed of 10 m s^{-1}. An express train is at rest at the station. The express train leaves the station with a uniform acceleration of 0.5 m s^{-2} just as the goods train goes past. Both trains move in the same direction on straight, parallel tracks.

How much time passes before the express train overtakes the goods train?

A 6.0 s **B** 10 s **C** 20 s **D** 40 s

3 A cyclist is riding at a steady speed on a level road.

According to Newton's third law of motion, what is equal and opposite to the backward push of the back wheel on the road?

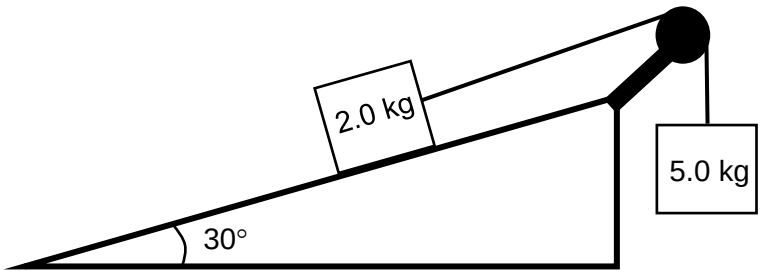
A the force exerted by the cyclist on the pedals

B the forward push of the road on the back wheel

C the backward push of the road on the front wheel

D the total air resistance and friction force

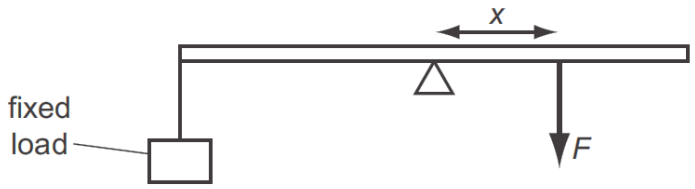
4 Two blocks of mass 2.0 kg and 5.0 kg are connected by a light string that is passed over a frictionless pulley. The 2.0 kg block is accelerating up the slope.



Given that the friction between the block and the surface of the slope is 7.0 N, what is the tension in the string?

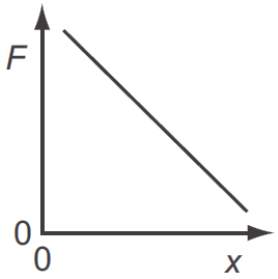
A 26 N **B** 31 N **C** 39 N **D** 49 N

5 A horizontal bar is supported on a pivot at its centre of gravity. A fixed load is attached to one end of the bar. To keep the bar in equilibrium, a force F is applied at a distance x from the pivot.



How does F vary with x?

A



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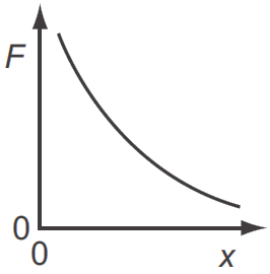

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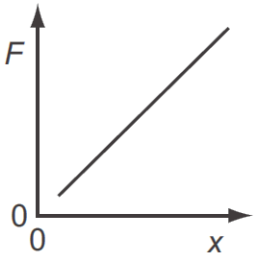

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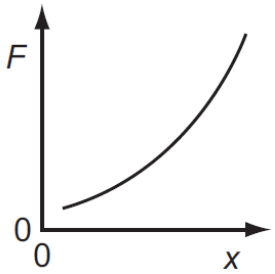
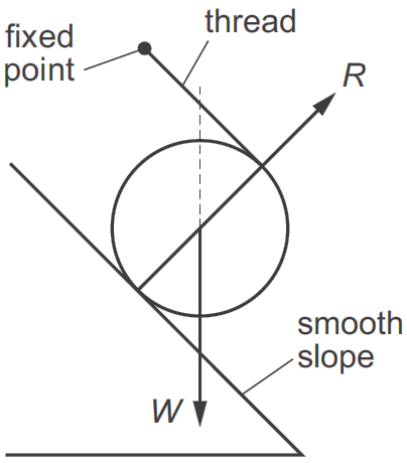


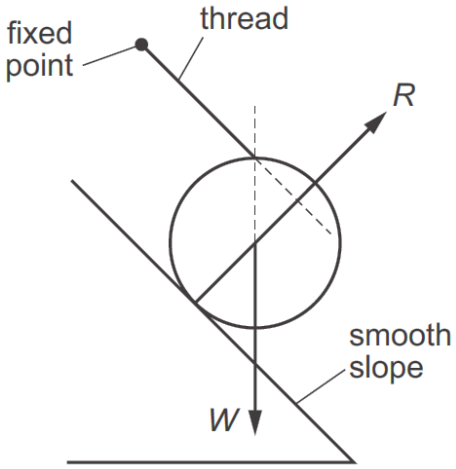
6 A cylinder of weight W is placed on a smooth slope. The contact force of the slope on the cylinder is *R*. A thread is attached to the surface of the cylinder. The other end of the thread is fixed.

Which diagram shows the cylinder in equilibrium?

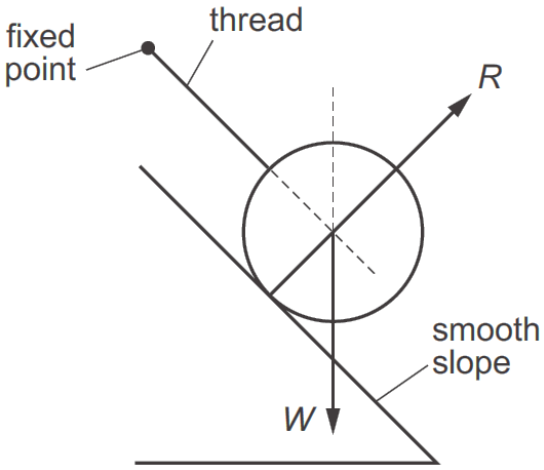
A



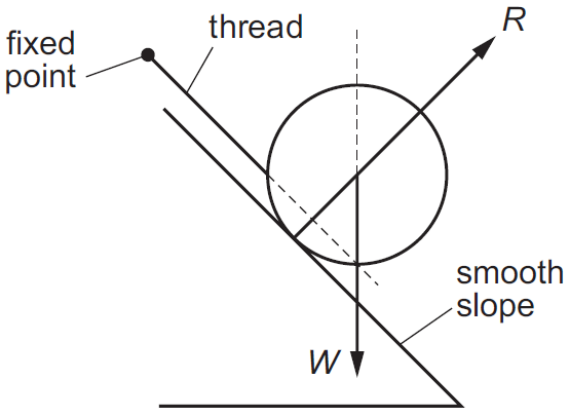
B



C



D



7 Which statement is correct?

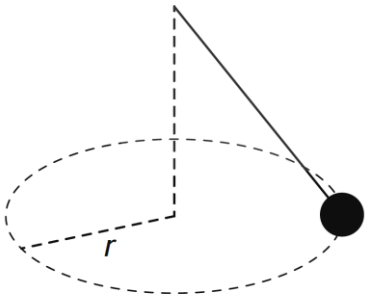
A A ball lands on the ground and bounces. The kinetic energy changes sign because the ball changes direction.

B A car drives up a rough slope at steady speed. The power generated by the engine equals the gravitational potential energy gained per unit time.

C It is possible for an electric heater to be 100% efficient.

D It is impossible for momentum to be conserved in a collision.

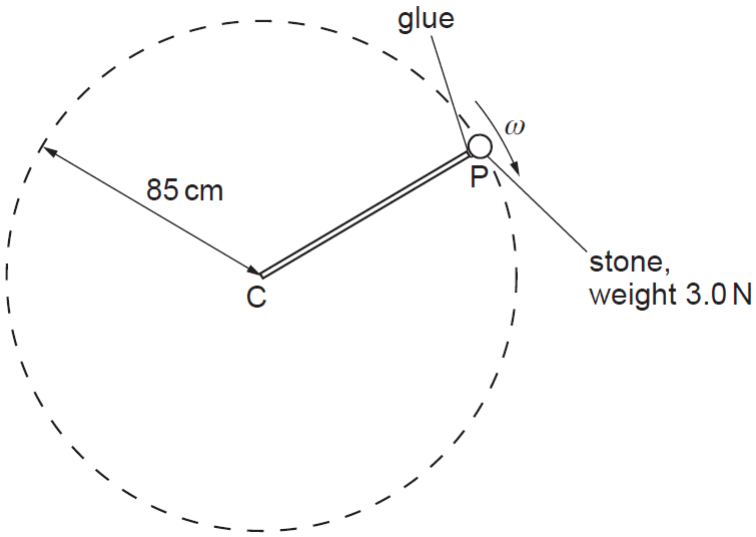
8 The mass at the end of a pendulum is made to move in a horizontal circle of radius r at constant speed. The magnitude of the net force on the mass is F.



What is the direction of F and the work done by F during half a revolution?

	direction of F	work done by F
A	towards centre of circle	zero
B	towards centre of circle	πrF
C	away from centre of circle	zero
D	away from centre of circle	πrF

9 A stone of weight 3.0 N is fixed, using glue, to one end P of a rigid rod CP as shown in the diagram. The rod is rotated about end C so that the stone moves in a vertical circle of radius 85 cm.



The angular speed ω of the rod and stone is gradually increased from zero until the glue snaps when the tension in it is 18 N.

What is the angular speed of the stone?

A 2.4 rad s^{-1} **B** 7.6 rad s^{-1} **C** 9.0 rad s^{-1} **D** 58 rad s^{-1}

10 An object is displaced horizontally to the right in a uniform vertical gravitational field.

Which statement describes the change in the gravitational potential energy of the object?

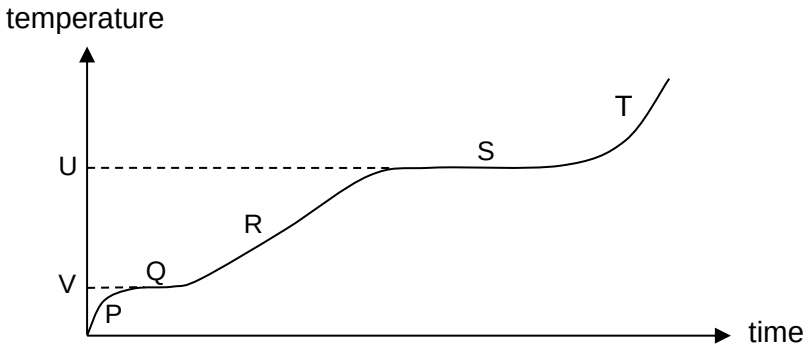
A It decreases in direct proportion to the displacement.

B It does not change with the displacement.

C It increases in direct proportion to the displacement.

D It increases in direct proportion to the square of the displacement.

11 A container of ice is heated by an electric heater. The graph below shows the variation of the temperature of the ice with time.



Which feature of the graph shows that the specific latent heat of vaporisation of water is greater than its specific latent heat of fusion?

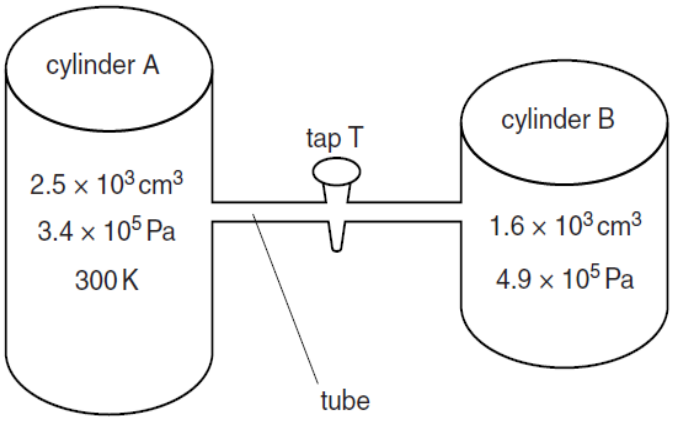
A The gradient of the graph at T is greater than the gradient at R.

B The length of line S is greater than the length of line Q.

C The gradient of the graph at P is greater than the gradient at R.

D The value of U is greater than the value of V.

12 Two thermally insulated cylinders A and B are connected by a tube of negligible volume, as shown.



Initially, tap T is closed and the cylinders contain an ideal gas at different pressures. Cylinder A contains 0.34 mol of gas and cylinder B contains 0.20 mol of gas. When tap T is opened, the pressure of the gas in both cylinders is 3.9×10^5 Pa.

What is the final temperature of the gas?

A 320 K **B** 360 K **C** 380 K **D** 390 K

13 A particle of mass 5.0×10^{-3} kg performing simple harmonic motion takes 47 s to make 50 oscillations. In each complete oscillation, the particle travels a total distance of 600 mm.

What is the maximum kinetic energy of the particle?

A 2.0×10^{-3} J **B** 2.5×10^{-3} J **C** 3.9×10^{-3} J **D** 5.0×10^{-3} J

14 A wave of frequency 15 Hz travels at 24 m s^{-1} through a medium.

What is the phase difference between two points 2.0 m apart?

A There is no phase difference.

B They are out of phase by a quarter of a cycle.

C They are out of phase by half of a cycle.

D They are out of phase by 0.80 of a cycle.

15 In a double-slit experiment, the distance between the fringes on a screen was too small to measure.

What would increase the distance between the fringes?

A increasing the distance between the light source and the slits

B increasing the distance between the slits and the screen

C increasing the distance between the slits

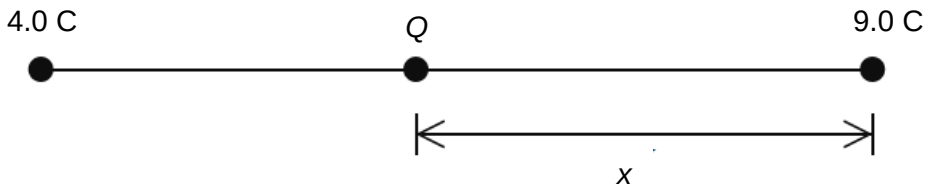
D increasing the frequency of the light source

16 In a single-slit diffraction experiment, a laser with a wavelength of 600 nm is aimed at a slit of width 0.20 mm and the resulting diffraction pattern is observed on a screen 2.0 m away.

What is the width of the central maximum of the diffraction pattern?

A 0.0030 mm **B** 0.0060 mm **C** 6.0 mm **D** 12 mm

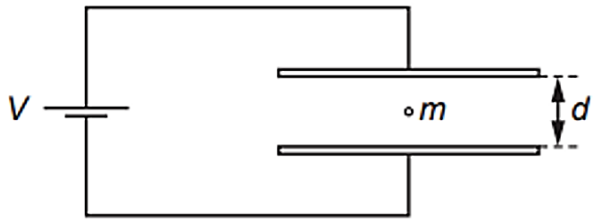
17 Two isolated point charges of charge 4.0 C and 9.0 C are separated by a distance of 1.0 m. A point charge of charge Q is placed at a distance x from the point charge of 9.0 C. The net electric force on the charge Q is zero.



What is x?

A 0.31 m **B** 0.40 m **C** 0.60 m **D** 0.69 m

18 A charged oil drop of mass m, with a charge of ne, is held stationary in the uniform electric field between two horizontal plates separated by a distance d.



The voltage between the plates is V, the elementary charge is e and the acceleration of free fall is g.

What is the value of n?

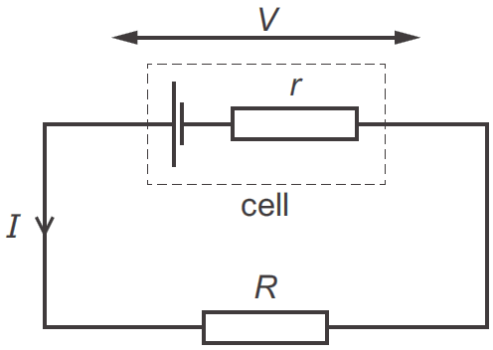
A $\frac{eV}{mgd}$ **B** $\frac{mgd}{eV}$ **C** $\frac{meV}{gd}$ **D** $\frac{gd}{meV}$

19 A cylindrical metal wire X has resistance R. The same volume of the same metal is made into a cylindrical wire Y of double the length.

What is the resistance of wire Y?

A R **B** $2R$ **C** $4R$ **D** $8R$

20 A cell of constant electromotive force drives a current I through an external resistor of resistance R. The terminal potential difference (p.d.) across the cell is V.

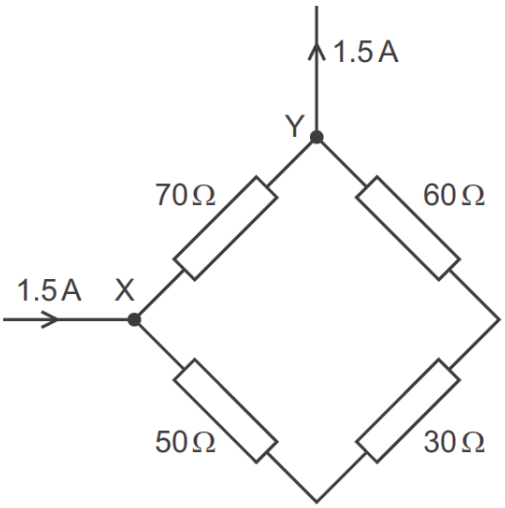


When the internal resistance r of the cell increases, what is the effect on V and on I?

	V	I
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

21 Four different resistors are arranged as shown.

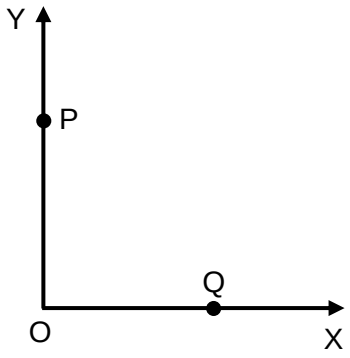
A current of 1.5 A enters the network at junction X and leaves through junction Y.



What is the current in the 30 Ω resistor?

A 0.21 A **B** 0.50 A **C** 0.75 A **D** 1.0 A

22 A plane OXY with axes OX and OY at right angles to each other is shown. A straight wire conductor may be placed at point P or Q.



Which of the following will produce a magnetic field at O in the direction OY?

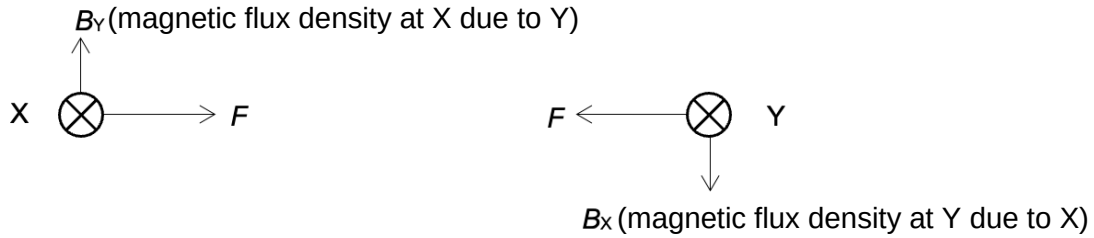
A Conductor carrying a current into the plane at P.

B Conductor carrying a current out of the plane at P.

C Conductor carrying a current into the plane at Q.

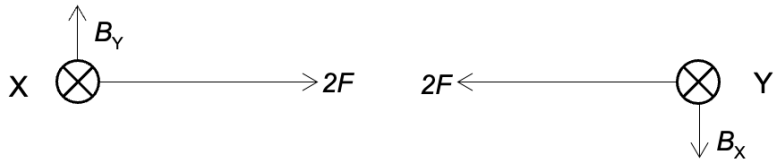
D Conductor carrying a current out of the plane at Q.

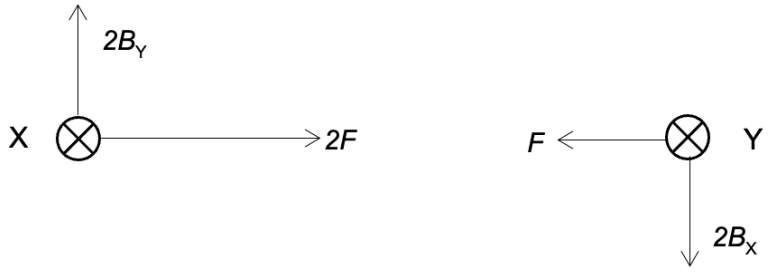
23 Two long, parallel, straight wires X and Y carry equal currents into the plane of the page as shown. The diagram shows arrows representing the magnetic flux density B at the position of each wire and the magnetic force F on each wire.

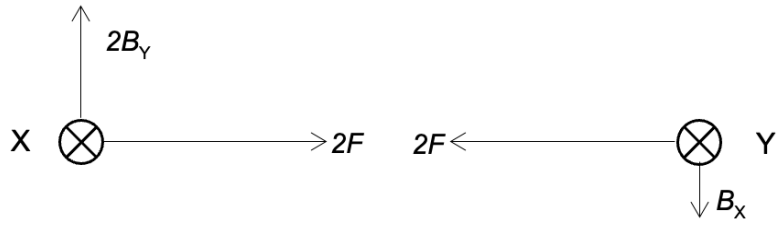


The current in wire Y is doubled.
Which diagram best represents the magnetic flux density and forces?

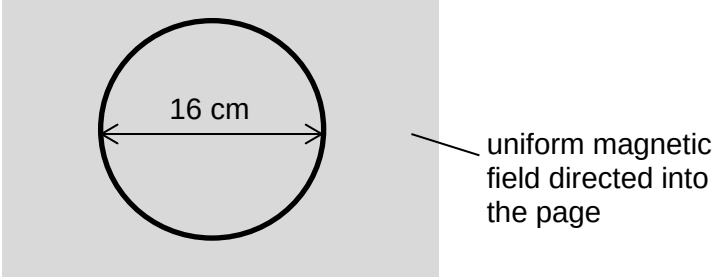
A


B


C


D


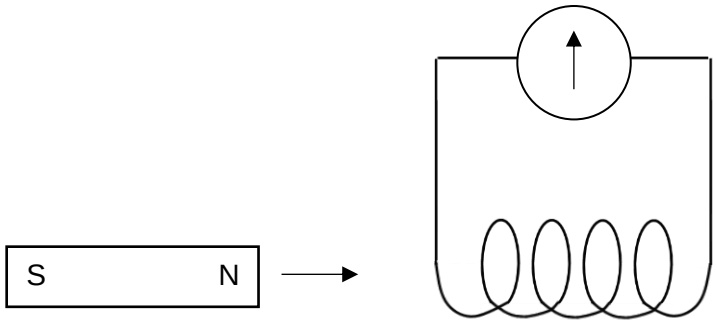
24 A circular ring of diameter 16 cm and resistance 4.0 Ω is placed in a uniform magnetic field of flux density 5.0 T directed perpendicularly into the ring.



If the magnetic flux density is reduced to zero at a constant rate over 10 ms, what can be deduced about the current flowing in the ring during this change?

	magnitude of current / A	direction of current
A	2.5	clockwise
B	2.5	anti-clockwise
C	10	clockwise
D	10	anti-clockwise

25 When the North pole of a bar magnet is pushed into the end of a coil of wire, the maximum movement of the meter needle is 10 units to the left.



The South pole of the magnet is then pushed into the other end of the coil at half the speed.

What is the maximum movement of the meter needle?

A Less than 10 units to the left

B Less than 10 units to the right

C More than 10 units to the left

D More than 10 units to the right

26 The r.m.s. value of an alternating sinusoidal current in a load resistor is 2.0 A and the mean power dissipated in the resistor of resistance R is the same as that of a steady current I in another resistor of resistance $2R$.

What is the value of the steady current I?

A 0.71 A **B** 1.4 A **C** 2.0 A **D** 4.0 A

27 What provides evidence for the particulate nature of electromagnetic radiation?

A Electrons can be diffracted by a carbon film.

B Light can be diffracted by an obstacle.

C Light from two coherent sources can produce an interference pattern.

D Photoelectric emission occurs only for incident radiation frequencies above a minimum frequency.

28 Electrons are only just emitted from a metal surface when illuminated with light of frequency 4.0×10^{14} Hz.

When illuminated with light of frequency f, the stopping potential is found to be 1.5 V.

What is the value of the frequency f?

A 3.8×10^{13} Hz **B** 3.6×10^{14} Hz **C** 4.2×10^{14} Hz **D** 7.6×10^{14} Hz

29 The deviation of α-particles by thin metal foils through angles that range from 0° to 180°.

Which of the following could explain this observation?

A scattering from bound electrons in the foil

B reflection from the foil surface

C diffraction from the crystal lattice in the foil

D scattering from small and heavy positively charged regions in the foil

30 The value of the ^{14}C : ^{12}C ratio of living material is constant whereas the value of the ratio decreases after death because the radioactive ^{14}C is not replenished. The half-life of ^{14}C is 5600 years.

From a 5.0 g sample of living wood, it was found that the ^{14}C content causes a radioactive count rate of 100 counts per minute. What is the age of a 10 g sample of ancient wood, given that the ancient wood causes a count rate of 50 counts per minute?

A 1400 years **B** 5600 years **C** 11200 years **D** 22400 years

End of Paper

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