TEMASEK JUNIOR COLLEGE

2014 Preliminary Examination
Higher 1

PHYSICS

8866/01

Paper 1 Multiple Choice

19 September 2014
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.
Write your name, Civics group and Index Number on the Answer Sheet in the spaces provided.

There are **thirty** questions in 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.

Data

speed of light in free space,	c	=	3.00×10^{8} m s^{-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
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
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$

1 The unit of resistivity, expressed in terms of base units, is given by

$$\text{kg } x^3 y^{-2} z^{-3}.$$

Which base units are x, y and z?

	x	y	z
A	ampere	metre	second
B	metre	ampere	second
C	metre	second	ampere
D	second	ampere	metre

2 Which of the following estimation is correct?

A The angular velocity of the Singapore Flyer is 0.5 rad s^{-1}.

B The weight of a regular can of Coke is 10 N.

C The Earth's magnetic flux density is in the order of 10^{-9} T.

D The average kinetic energy of a 100 m sprinter finalist in recent Olympics is 4000 J.

3 Two lengths, *a* and *b*, are measured to be 51 ± 1 cm and 49 ± 1 cm respectively.

In which of the following quantities is the percentage uncertainty the largest?

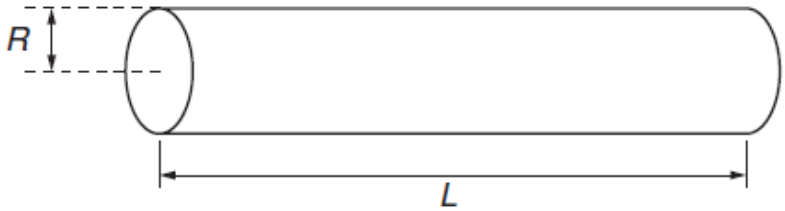
A $a + b$

B $a - b$

C a / b

D ab

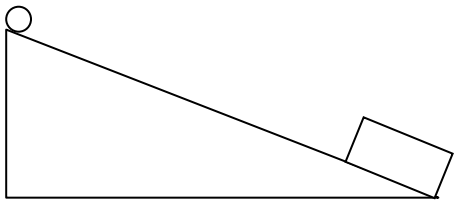
4 A cylinder of length *L* has a circular cross-section of radius *R* as shown below.



The volume *V* and length *L* of the cylinder are measured with fractional uncertainties of *x* and *y* respectively. If the radius *R* is calculated from *V* and *L*, its fractional uncertainty is at most

A $\frac{1}{2}x + \frac{1}{2}y$ **B** $2x + 2y$ **C** $\frac{1}{2}x - \frac{1}{2}y$ **D** $x - y$

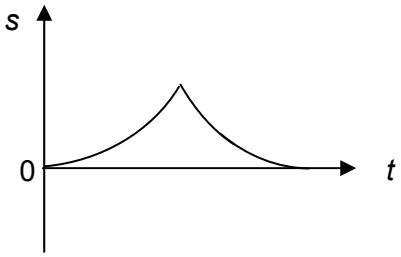
5 A marble is placed at the top of a rough slope that has a block fixed rigidly to its lower end, as shown below.



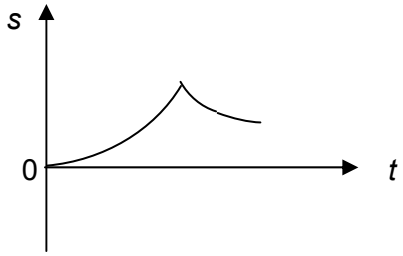
The marble is released from the top of the incline. It rolls down the slope, hits the block and moves up the slope till it comes to a momentary rest.

If the frictional force on the marble is constant in magnitude, which of the following graphs best shows the variation with time *t* of the displacement *s* of the marble along the slope from its original position?

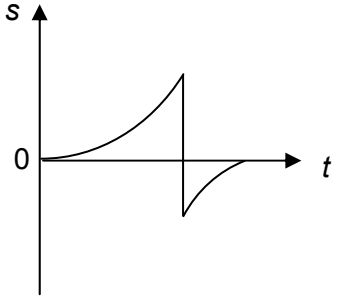
A



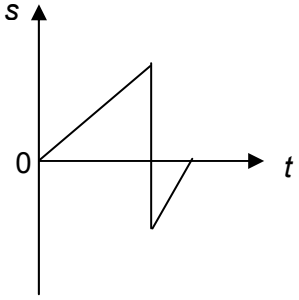
B



C

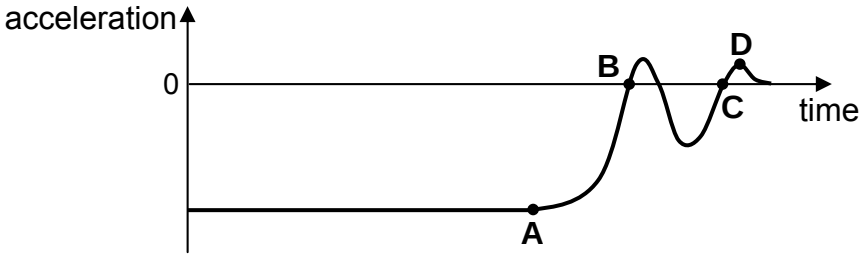


D

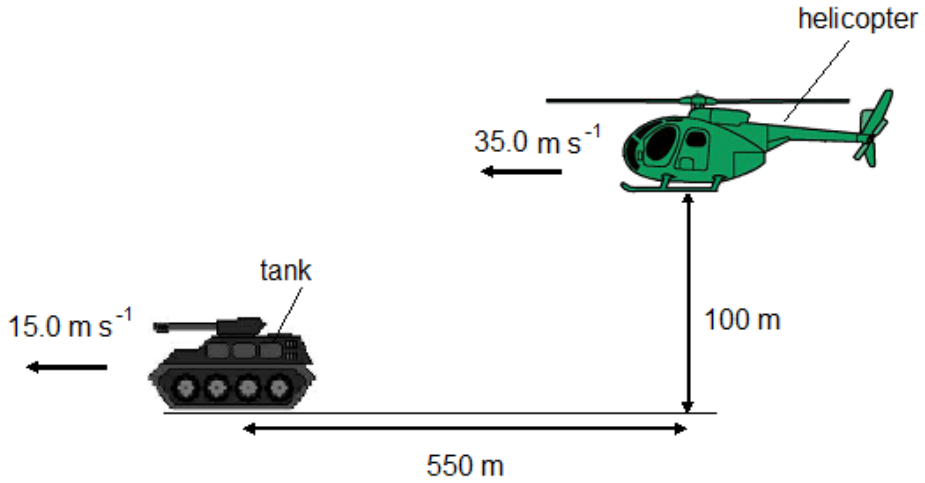


6 A particle starts from rest and moves in a straight line. Its motion is represented by the acceleration–time graph shown below.

At which point is its speed maximum?



7 In the figure below, a helicopter is flying with a constant horizontal speed of 35.0 m s^{-1} and is 100 m above the ground. A tank is traveling in the same direction with a constant horizontal speed 15.0 m s^{-1} and is 550 m away from the helicopter.

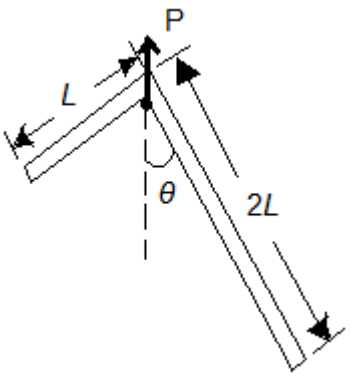


Assume that at t = 0 s, the helicopter and the tank are at the above position.

How many seconds later should the helicopter drop a bomb so that it will hit the tank? Ignore air resistance.

A 4.52 s **B** 10.2 s **C** 23.0 s **D** 27.5 s

8 A right-angle rule hangs at rest from a peg P as shown below. It is made from a metal sheet of uniform density. One arm is L cm long while the other is $2L$ cm long.



The angle θ at which it will hang is

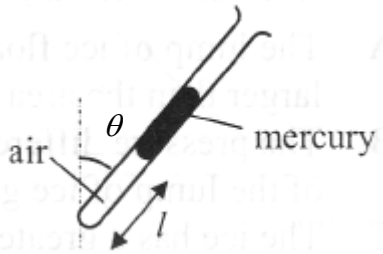
A 8° **B** 14° **C** 42° **D** 76°

9 With the effect of air resistance, a cyclist and his bicycle of total mass 80.0 kg can coast down a 5.0° (with respect to the horizontal) hill at a constant speed of 1.38 m s^{-1}.

If the air resistance F_{air} is proportional to the cyclist's speed v such that $F_{air} = kv$, where k is a constant, what is the additional force that the cyclist must apply in order to descend the hill at a steady speed of 5.55 m s^{-1} ?

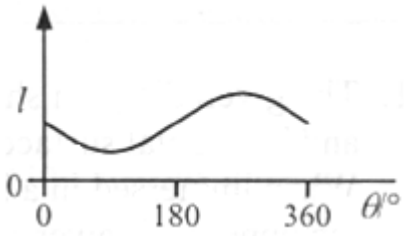
A 107 N **B** 207 N **C** 307 N **D** 407 N

10 The given diagram shows a column of dry air trapped by mercury in a narrow test tube.

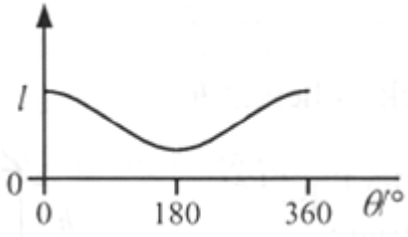


Which graph best shows how the length l of the air column varies with the angle θ of the tube to the vertical?

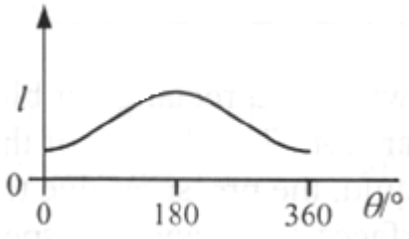
A



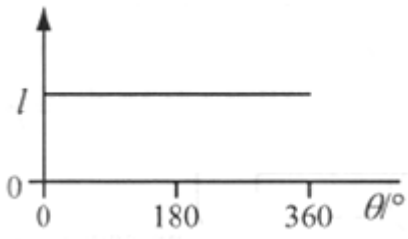
B



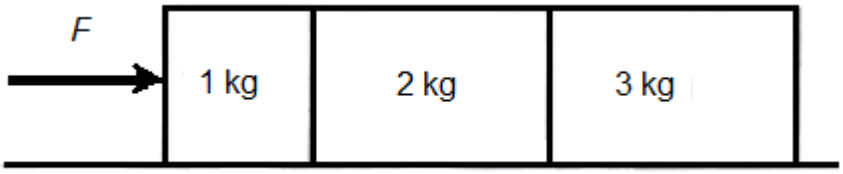
C



D



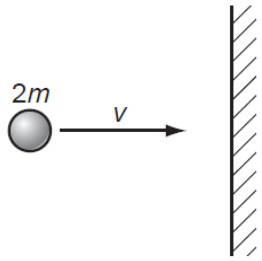
11 Three boxes of masses 1 kg, 2 kg, and 3 kg are pushed along a smooth surface by a force *F*.



What is the force that the 2 kg mass exerts on the 1 kg mass?

A *F*/3 **B** *F*/2 **C** 3*F*/4 **D** 5*F*/6

12 A particle of mass $2m$ and velocity v strikes a wall.

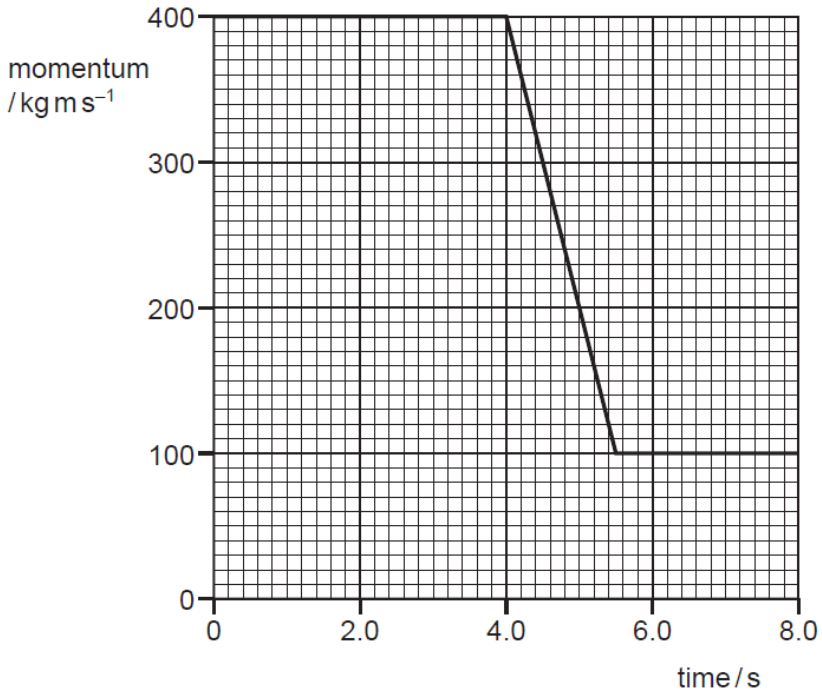


The particle rebounds along the same path after colliding with the wall. The collision is inelastic.

What is a possible change in the momentum of the ball during the collision?

A mv **B** $2mv$ **C** $3mv$ **D** $4mv$

13 The graph shows the momentum of a cyclist over a period of 8.0 s.

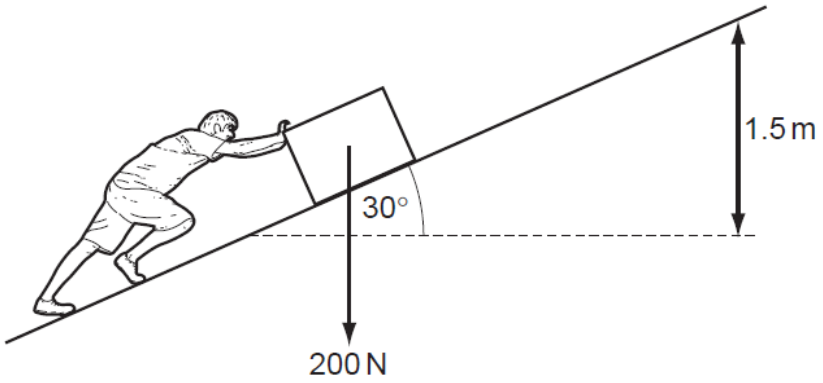


At time 4.0 s, she applies the brakes.

What is the resultant force on the cyclist during the period when the brakes are applied?

A 55 N **B** 200 N **C** 270 N **D** 450 N

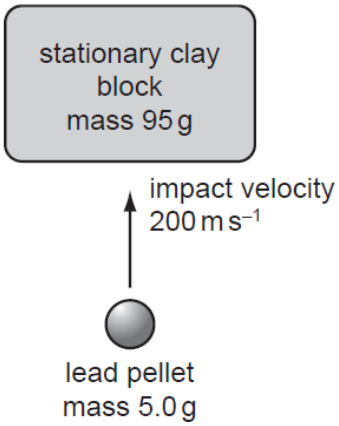
14 A person pushes a box of weight 200 N so that it moves at a steady speed along a ramp, through a height of 1.5 m. The ramp makes an angle of 30° with the ground. The frictional force on the box is 150 N while the box is moving.



What is the work done by the person?

A 170 J **B** 300 J **C** 450 J **D** 750 J

15 A lead pellet is shot vertically upwards into a clay block that is stationary at the moment of impact but is able to rise freely after impact. The mass of pellet is 5.0 g and the mass of clay block is 95 g.



The pellet hits the block with an initial velocity of 200 m s^{-1}. It embeds itself in the block and does not emerge.

How high above its initial position will the block rise?

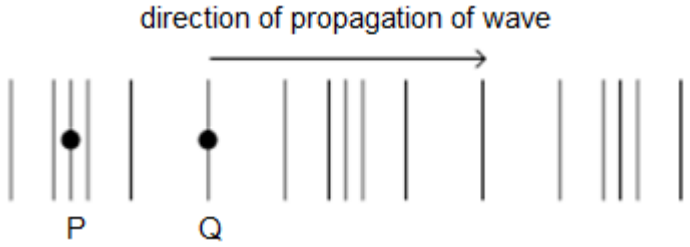
A 5.1 m **B** 10 m **C** 61 m **D** 102 m

16 Water from a reservoir is fed to the turbine of the hydroelectric system at a rate of 500 kg s^{-1}. The reservoir is 300 m above the level of the turbine. The electrical output from the generator driven by the turbine is 200 A at a potential difference of 6000 V.

What is the efficiency of the system?

A 8.6 % **B** 12 % **C** 24 % **D** 82 %

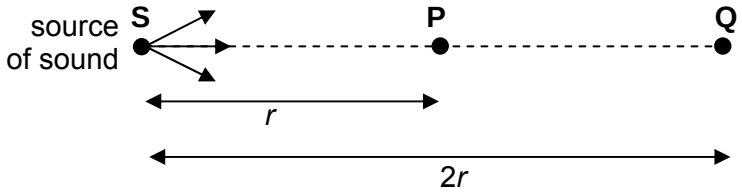
17 The figure below shows a sound wave travelling to the right in air. Air particles at positions P and *Q* are at the centre of a compression and a rarefaction respectively.



Which of the following gives correctly the directions of motion of P and Q at the moment shown?

	particle P	particle Q
A	at rest	at rest
B	at rest	to the right
C	to the left	to the right
D	to the right	to the left

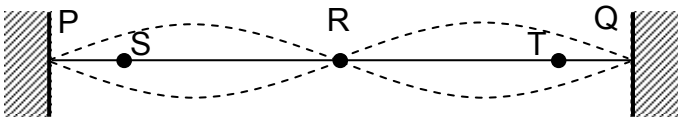
18 A source of sound is placed at position S. Air molecules at P, a distance *r* from S, oscillate with amplitude 6.0 μm. Point Q is situated a distance 2*r* from S.



What is the amplitude of oscillation of air molecules at Q?

A 0.8 μm **B** 1.5 μm **C** 3.0 μm **D** 6.0 μm

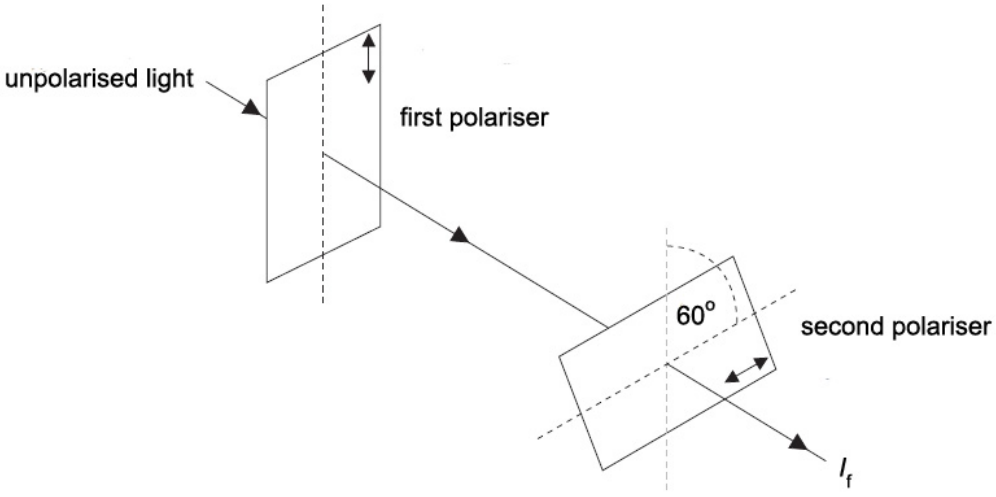
19 Figure below represents a guitar string with ends fixed to P and Q. The string is made to vibrate transversely so that P, Q and the mid-point R are the only points that are nodes.



What are the relation of the amplitudes, frequency and the phases of the vibrations of two points S and T that are equidistant from R?

	amplitude	frequency	phase
A	same	same	anti phase
B	different	same	anti phase
C	same	different	in phase
D	different	different	in phase

20 Unpolarised light is incident on a polariser. The light transmitted by the first polariser is then incident on a second polariser. The polarising axis of the second polariser is at 60° to that of the first polariser.

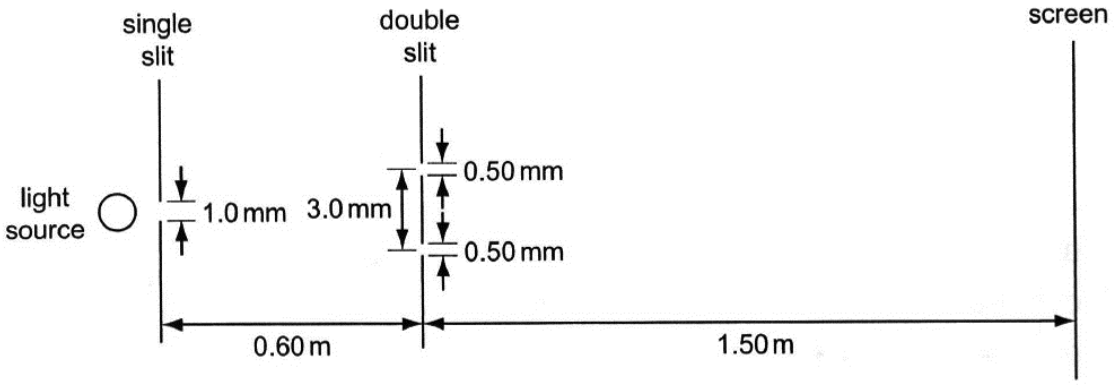


The intensity emerging from the second polariser is I_f .

Which of the following correctly gives the intensity incident on the first polariser?

A $\frac{I_f}{8}$ **B** $\frac{I_f}{4}$ **C** $4I_f$ **D** $8I_f$

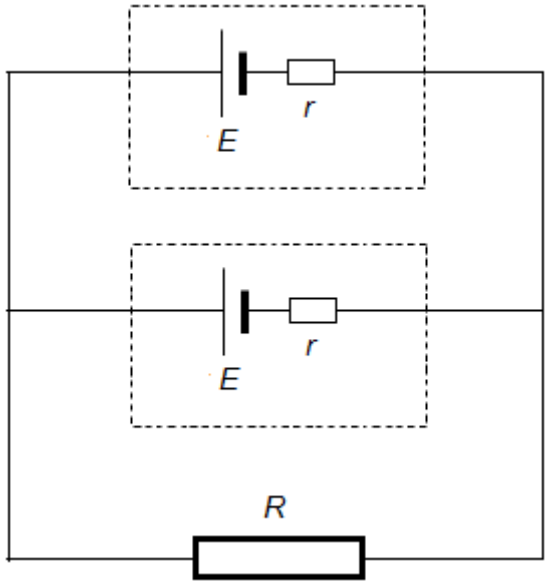
21 A student sets up an experiment to demonstrate double slit interference, using light of wavelength 6.0 x 10^{-7} m. The main features of the apparatus, and some of the dimensions, are shown in the diagram below.



What is the separation of the bright fringes on the screen?

A 0.12 mm **B** 0.30 mm **C** 0.90 mm **D** 1.80 mm

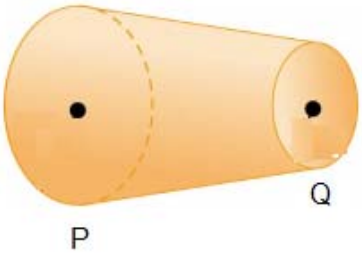
22 Two identical electrical sources are used to operate a lamp of resistance *R* as shown in the figure below. The internal resistance of each electrical source is *r*.



What is the fraction of the total power lost in the internal resistance of both sources?

A $\frac{2R-r}{2R}$ **B** $\frac{2R+r}{2R}$ **C** $\frac{r}{2R+r}$ **D** $\frac{2R}{2R+r}$

23 A composite wire is made into the shape of a truncated cone of varying diameter along its length as shown in the figure below. The wire is connected across a battery.



The resistance *R* of this composite wire is measured between P and Q at distances *d* from P.

Which statement is correct?

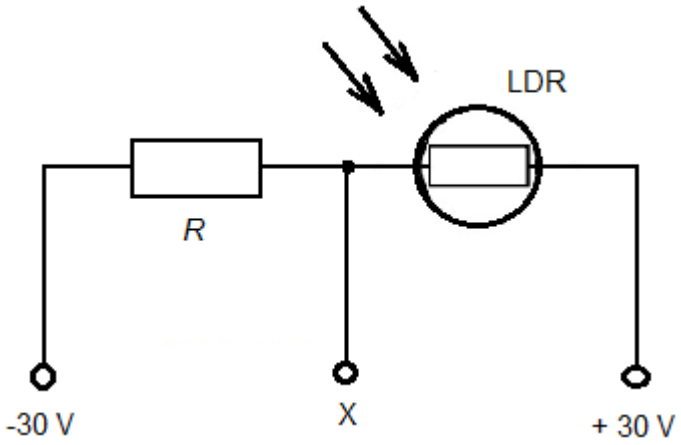
A The resistance per unit length of the wire is constant.

B As distance *d* increases, resistance *R* increases exponentially.

C The potential gradient along the wire is uniform.

D The current at P is the same as Q.

24 A light dependent resistor (LDR) and a fixed resistor *R* is arranged as shown below.



If the resistance of the LDR is 2*R* in the dark but then it drops to *R* in bright light, what is the corresponding change in the potential at X?

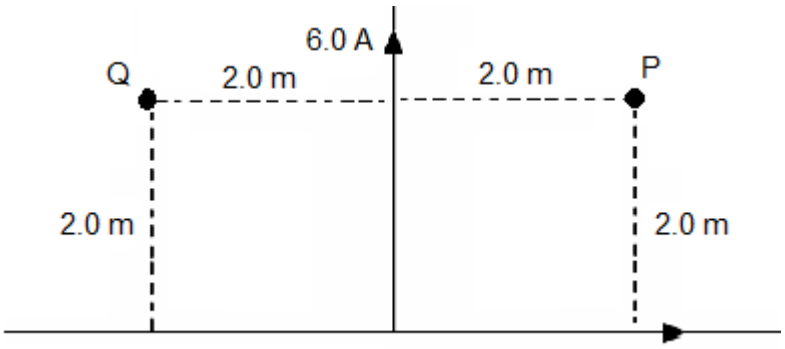
A 0.0 V **B** 10 V **C** 20 V **D** 30 V

25 A generator produces 100 kW of power at a p.d. of 10 kV. The power is transmitted through cables of total resistance 5 Ω.

What is the power loss in the cables?

A 50 W **B** 250 W **C** 500 W **D** 1000 W

26 Two long current carrying conductors are placed perpendicular to each other. The current flowing through one of the wires is 6.0 A upwards, while the current through the other wire is of unknown magnitude but direction is towards the right.



The magnitude of the magnetic flux density at point P, which is 2.0 m perpendicularly away from both wires, is 1.00 x 10^{-7} T out of the plane of the page.

Given that magnetic flux density at a distance *d* from a long straight conductor carrying current *I* is $B = \frac{\mu_0 I}{2\pi d}$, what is the magnitude and direction of the resultant magnetic field at point Q? Ignore the Earth's magnetic field.

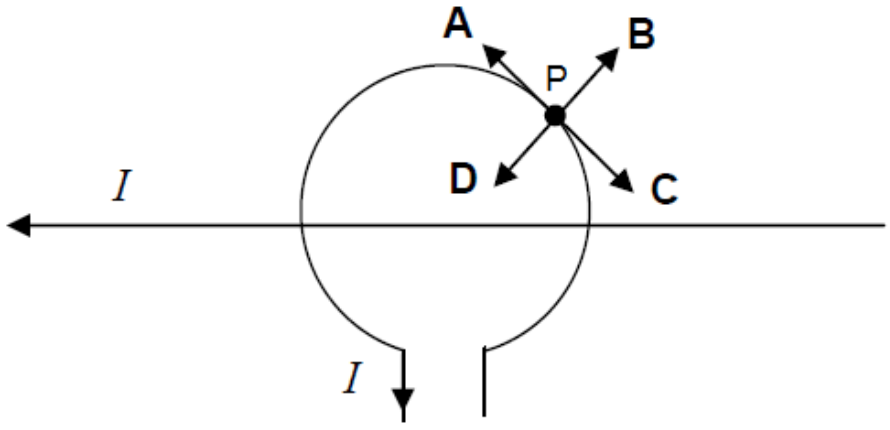
A 1.00 x 10^{-7} T out of the plane of the page

B 4.00 x 10^{-7} T out of the plane of the page

C 7.00 x 10^{-7} T out of the plane of the page

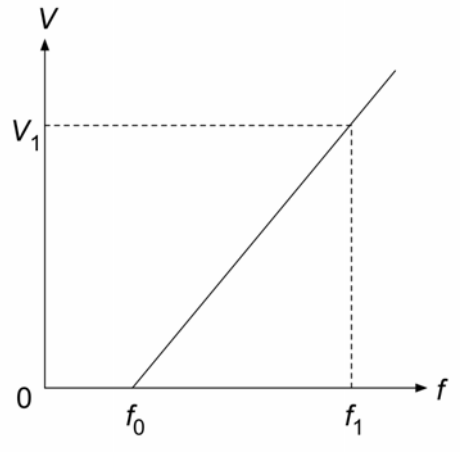
D 13.0 x 10^{-7} T out of the plane of the page

27 A long horizontal straight wire is placed close and parallel to the plane of a coil as shown in the diagram. Both the coil and the wire carry current I in the directions indicated.



What is the direction of the force at point P on the coil due to these currents?

28 In a photoelectric experiment, the stopping potential V is determined for different frequencies f of the incident radiation. The graph below is obtained.



Which of the following gives the work function of the metal and the maximum kinetic energy of the emitted electrons when the radiation frequency is f_1?

	work function	maximum kinetic energy
A	hf_0	V_1
B	hf_0	$h(f_1 - f_0)$
C	hf_1	eV_1
D	hf_1	$h(f_1 - f_0)$

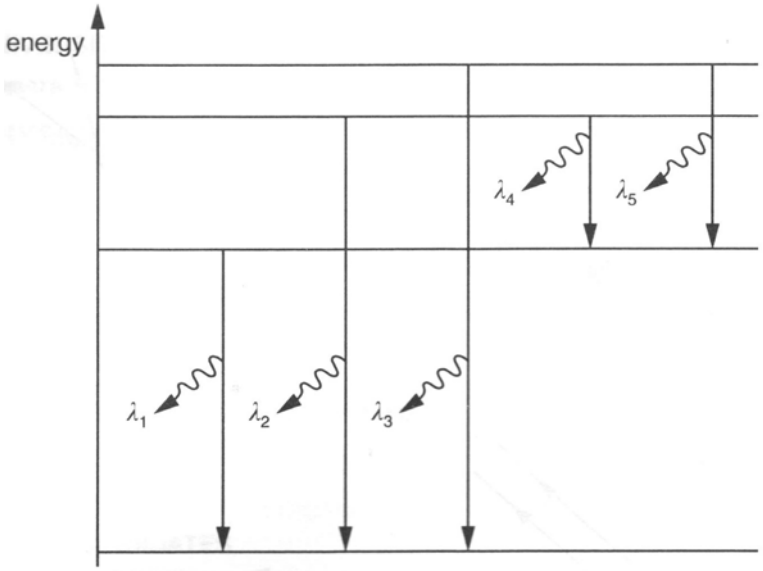
29 In 2010 the world's first interplanetary solar sail spacecraft, called IKAROS works on the principle that photons reflected from the sail, of area A, undergo a change of momentum and, by Newton's third Law, exert a forward force on the sail.

A beam of light of frequency f and intensity I, traveling at speed c, is reflected at right angles to a solar sail.

What is the force exerted on the sail?

A $\frac{IA}{hf}$ **B** $\frac{2hf}{c}$ **C** $\frac{I}{c}$ **D** $\frac{2IA}{c}$

30 An energy level diagram for an atom is shown. The electron transitions give rise to the emission of a spectrum of lines of wavelength λ_1, λ_2, λ_3, λ_4 and λ_5.



What can be deduced from this diagram?

A $\lambda_1 < \lambda_2$

B $\frac{1}{\lambda_3} = \frac{1}{\lambda_1} + \frac{1}{\lambda_5}$

C λ_4 is the shortest of the five wavelengths.

D The transition corresponding to wavelength λ_3 represents the ionisation of the atom.