EUNOIA JUNIOR COLLEGE
JC1 Promotional Examination 2019
General Certificate of Education Advanced Level
Higher 2

PHYSICS

Paper 1 Multiple Choice

9749/01

04 October 2019

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use paper clips, glue or correction fluid.
Write your name, civics group and registration number on the Answer Sheet in the spaces provided.

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.

This document consists of **16** printed pages.

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	=	ρgh
gravitational potential,	ϕ	=	$-\frac{Gm}{r}$
temperature,	T/K	=	$T / ^{o}C + 273.15$
pressure of an ideal gas,	p	=	$\frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
mean translational kinetic energy of an ideal gas molecule	E	=	$\frac{3}{2}kT$
displacement of particle in s.h.m.	x	=	$x_o \sin \omega t$
velocity of particle in s.h.m.	v	=	$v_o \cos \omega t$
		=	$\pm \omega\sqrt{(x_o^2 - x^2)}$
electric current,	I	=	$Anvq$
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$
electric potential,	V	=	$\frac{Q}{4\pi\varepsilon_o r}$
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	=	$\frac{\mu_o N I}{2r}$
magnetic flux density due to a long solenoid	B	=	$\mu_o n I$
radioactive decay,	x	=	$x_o \exp(-\lambda t)$
decay constant	λ	=	$\frac{\ln 2}{t_{\frac{1}{2}}}$

1 The radius of the Earth is approximately 6.4×10^6 m, and the radius of the Moon is approximately 1.7×10^6 m. A student wishes to build a scale model of the Solar system in the classroom, using a football of radius 0.12 m to represent the Earth.

What object would best represent the Moon?

A basketball

B tennis ball

C golf ball

D cherry

2 A digital meter, which has an accuracy of ± 1%, is used to measure the current in an electrical circuit. The reading on the meter varies between 3.04 A and 3.08 A.

What is the value of the current, with its uncertainty?

A (3.06 ± 0.02) A

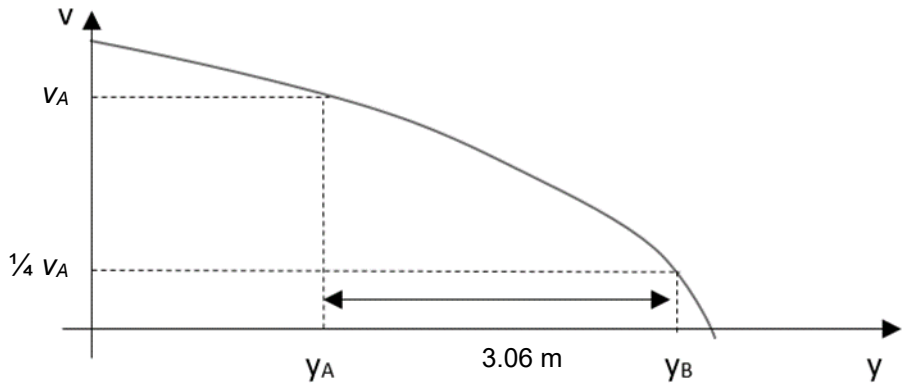
B (3.06 ± 0.04) A

C (3.06 ± 0.05) A

D (3.06 ± 0.07) A

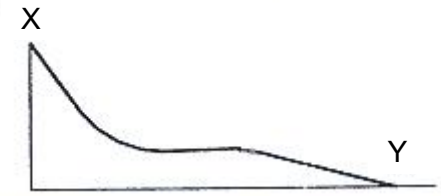
3 The figure shows the speed v versus vertical height y of a ball tossed directly upward. The speed at height y_A is v_A. The speed at height y_B is ¼ v_A. The difference between y_A and y_B is 3.06 m.

What is the speed v_A?



A 2.0 m s^{-1} **B** 4.0 m s^{-1} **C** 6.0 m s^{-1} **D** 8.0 m s^{-1}

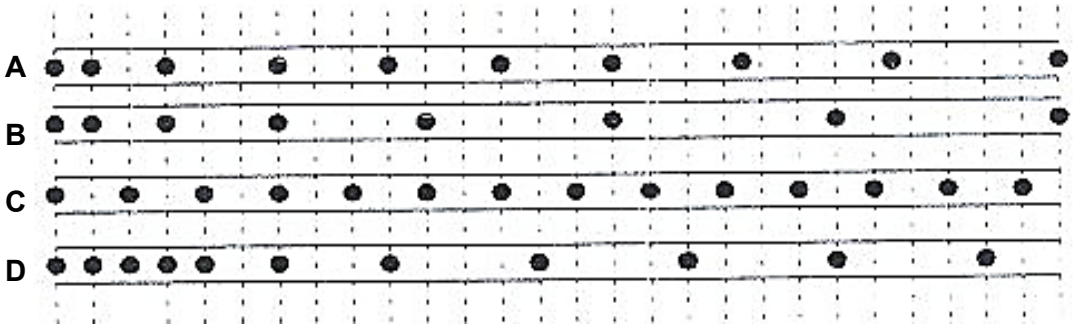
4 A cart is released from rest at point X of the track with side view as shown.



The cart makes dots at a constant time interval on a strip of paper laid along the track as the cart moves from point X to Y. The tape is then removed from the cart and laid flat.

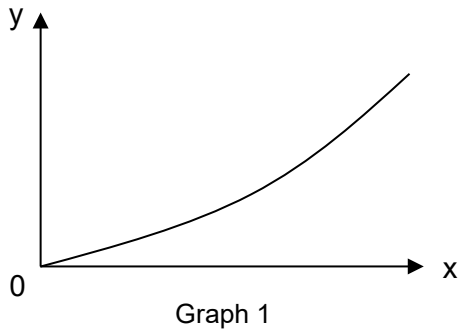
In each picture below, the tape is oriented so that the first dot that was made on the left. Vertical grid lines have also been added to help gauge the distance between the dots.

Neglecting friction, which of the pictures below would most possibly represent the pattern of dots that is made on the tape?

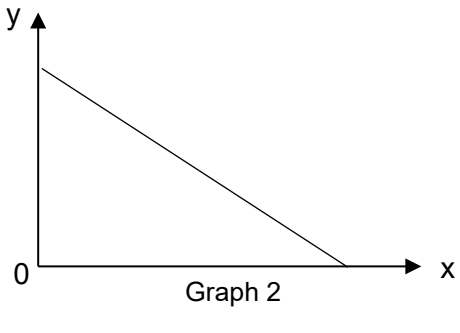


5 An object is projected at an acute angle θ above the horizontal.

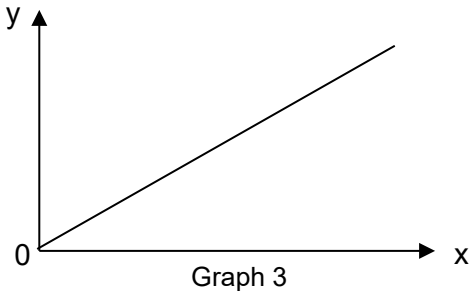
Which of the following graphs correctly shows the variation of the horizontal displacement with time, and the variation of the kinetic energy with vertical displacement of the object?



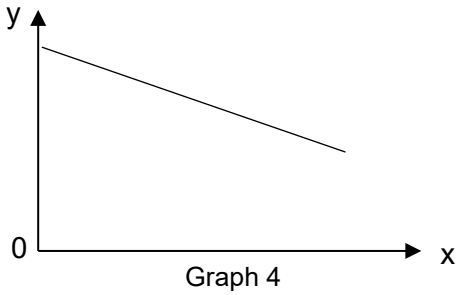
Graph 1



Graph 2



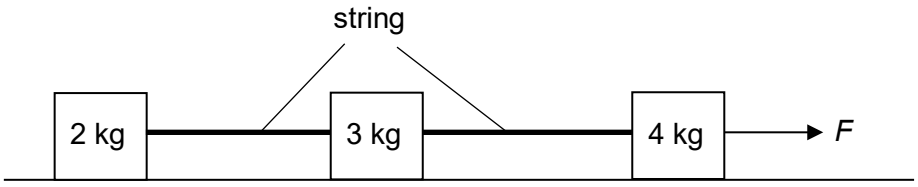
Graph 3



Graph 4

	horizontal displacement with time	kinetic energy with vertical displacement
A	Graph 1	Graph 2
B	Graph 1	Graph 4
C	Graph 3	Graph 2
D	Graph 3	Graph 4

6 Three blocks of masses 2 kg, 3 kg and 4 kg are connected by an inextensible string on a horizontal frictionless table as shown. The blocks are pulled to the right by an applied force *F*.



The acceleration of the blocks are 2 m s^{-2}.

What is the tension in the string which connects the 3 kg mass to the 4 kg mass?

A 4 N **B** 6 N **C** 10 N **D** 14 N

7 A 200 g bob hangs from the ceiling of a train when the train is moving at a constant velocity. Some time later, the train accelerates forward at 4.91 m s^{-2}.

What is the angle of inclination of the bob to the vertical?

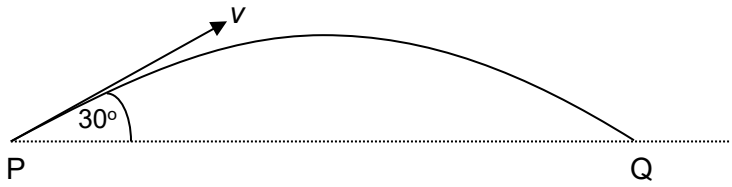
A 27°, with the bob moved forward

B 27°, with the bob moved backward

C 63°, with the bob moved forward

D 63°, with the bob moved backward

8 A particle of mass *m* is launched with an initial velocity *v* from a point P.



Neglecting air resistance, what is the magnitude of the change in momentum between leaving P and arriving at Q?

A zero **B** ½*mv* **C** *mv* **D** 2*mv*

9 In which example is it not possible for the underlined body to be in equilibrium?

A An aeroplane climbs at a steady rate.

B An aeroplane tows a glider at a constant altitude.

C Two boats tow a ship into harbour.

D A speedboat changes direction at constant speed.

10 A cylindrical block of wood has cross-sectional area *A* and weight *W*. It is totally immersed in water with its axis vertical. The block experiences pressures ρ_T and ρ_B at its top and bottom surfaces respectively.

Which expression is equal to the upthrust on the block?

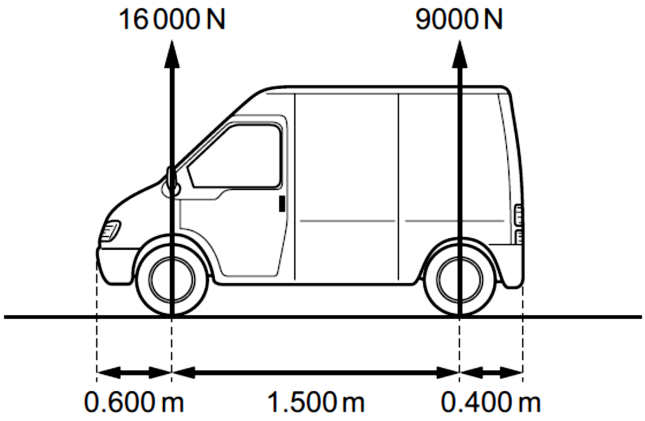
A $\rho_B - \rho_T$

B $(\rho_B - \rho_T)A$

C $(\rho_B - \rho_T)A - W$

D $(\rho_B - \rho_T)A + W$

11 The vertical forces that the ground exerts on a stationary van are shown.

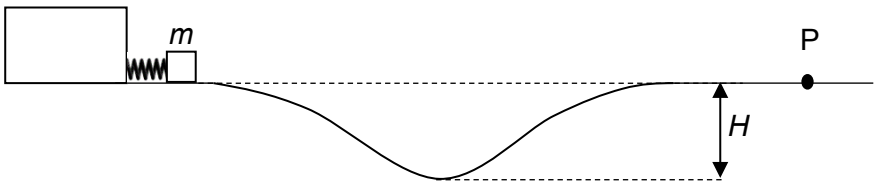


The van is 2.50 m long with its wheels at a distance of 0.600 m from the front of the van and 0.400 m from the rear of the van.

What is the horizontal distance of the van's centre of gravity from the front of the van?

A 0.540 m **B** 0.960 m **C** 1.14 m **D** 1.36 m

12 A small mass *m* is launched by a spring and travels along a rough track to a point P. The spring constant is *k* and the initial compression of the spring was *x*. As it travels to P, it goes through a dip of depth *H*. The mass experiences a constant force of friction *f* for the entire distance of *d*.



What is the kinetic energy of the mass at point P?

A $\frac{1}{2}kx^2 - fd - mgH$

B $\frac{1}{2}kx^2 - fd$

C $\frac{1}{2}kx^2 + fd$

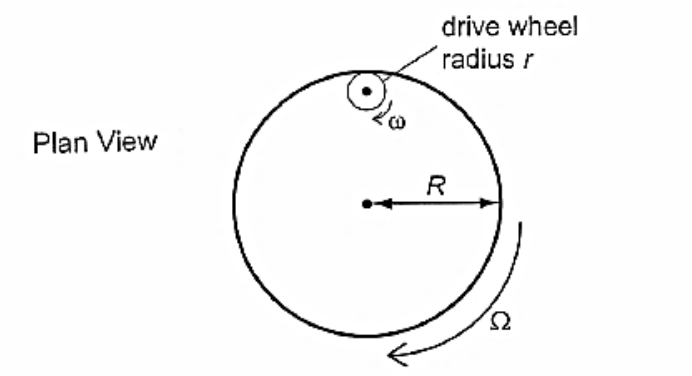
D $\frac{1}{2}kx^2 + fd + mgH$

13 The engine of a boat supplies a constant power of 110 kW to propel the boat forward. The boat attains a maximum speed of 21.0 m s^{-1}.

If the magnitude of the resistive force acting on the boat is proportional to the square of the boat's speed, what is the resultant force acting on the boat when it is moving at the instant when its speed is 15.0 m s^{-1}?

A 2.7 kN **B** 3.6 kN **C** 4.7 kN **D** 7.3 kN

14 A turntable has radius R. It is driven by a rubber drive wheel of radius *r* in contact with the inner rim of the turntable as shown.

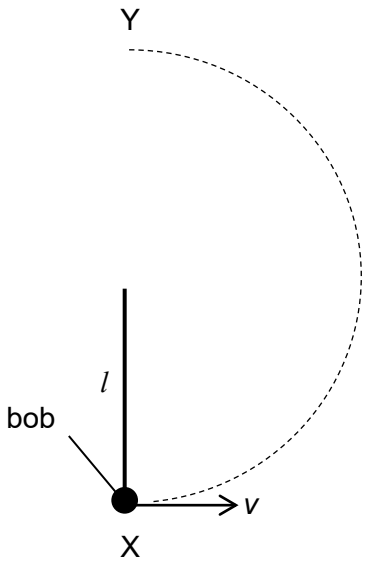


The turntable rotates with angular velocity Ω and the linear speed of a point on its rim is v_1. The drive wheel rotates with angular velocity ω and the linear speed of a point on its rim is v_2.

If there is no slippage between the rubber drive wheel and the turntable, which pair of equations show the relationship between the angular velocities and the linear speeds of the turntable and the wheel?

	angular velocity	linear speed
A	$\Omega = \omega$	$v_1 = v_2$
B	$\Omega = \omega$	$v_1 = (r/R)v_2$
C	$\Omega = (r/R)\,\omega$	$v_1 = v_2$
D	$\Omega = (R/r)\,\omega$	$v_1 = (r/R)v_2$

15 A bob is suspended from a point O by an inextensible string of length l. It is then projected horizontally from X, causing the bob to travel in a vertical circular path as shown.



When the bob reaches Y, the string is just taut.

What is the speed v with which the bob is projected?

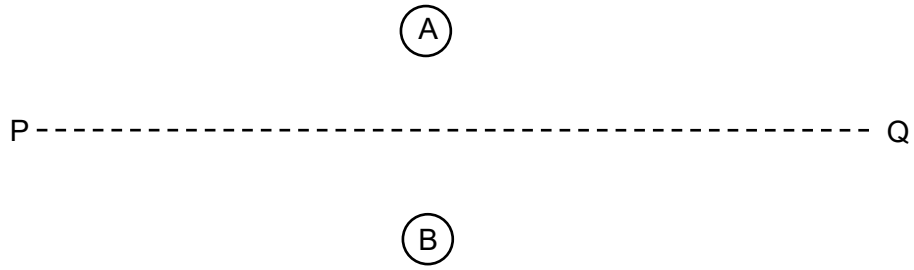
A $\sqrt{gl}$ **B** $\sqrt{2gl}$ **C** $\sqrt{4gl}$ **D** $\sqrt{5gl}$

16 Jupiter has a number of moons which orbits the planet at various radii. The moon Europa orbits at a radius of 6.7 x10^5 km with a period of 85 hours.

What is the mass of Jupiter?

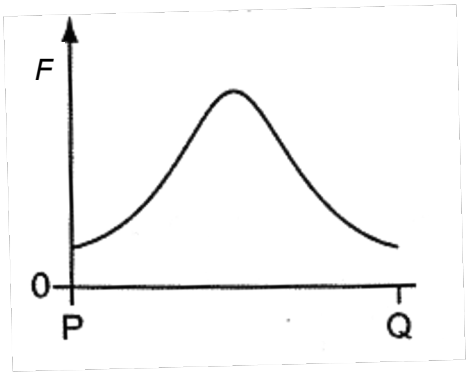
A 4.2 x10^9 kg **B** 1.9 x10^{27} kg **C** 9.3 x10^{31} kg **D** 2.5 x10^{34} kg

17 A and B are two stars of equal mass. The points P and Q are equidistant from A and B.

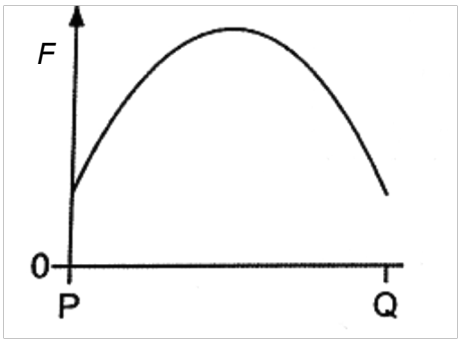


Which graphs best show the variation in magnitude of the total gravitational force *F* due to the stars when a mass moves along a straight line from P to Q.

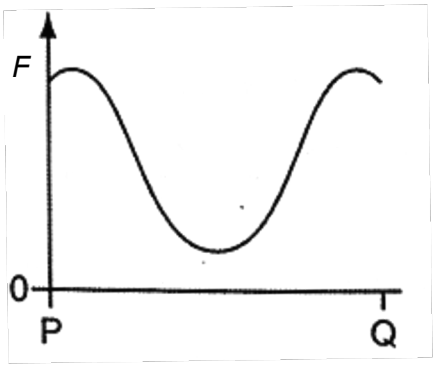
A



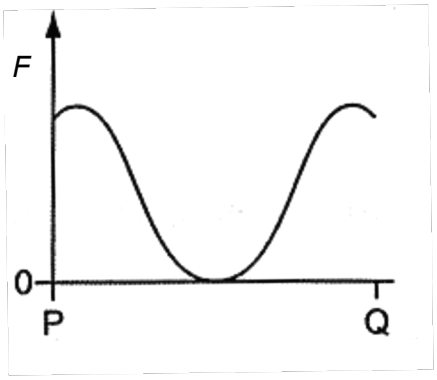
B



C



D



18 Two satellites A and B are moving in circular orbits round the earth. Satellite A is nearer to the Earth than satellite B. Both satellites have the same total energy.

Which of the following descriptions is wrong?

A Satellite A has a smaller mass than satellite B.

B Satellite B has a larger gravitational potential energy than satellite A.

C Satellite B has a smaller angular velocity.

D Both satellites have the same kinetic energy.

19 Earth has a mass M and radius R.

X is a point $5R$ from the center of the Earth.

When a stationary object of mass m falls from X towards the Earth, which of the following statement is false?

A The speed of impact is $\sqrt{\frac{8}{5}\frac{GM}{R}}$

B The work done by the gravitational field is $\frac{4}{5}\frac{GMm}{R}$.

C The change in the magnitude of gravitational field strength is $\frac{24}{25}\frac{GM}{R^2}$.

D The change in gravitational potential is $\frac{4}{5}\frac{GM}{R}$.

20 Which of the following is not an example of a system in simple harmonic motion?

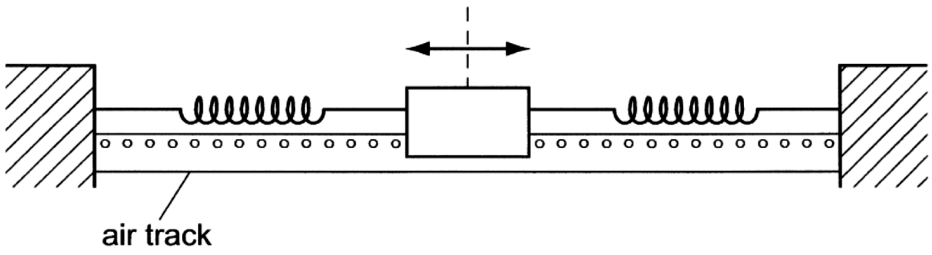
A A ball bouncing on the floor.

B A ball rolling in a curved dish.

C A child swinging on a playground swing.

D An ice cube bobbing in water.

21 A linear air track vehicle held centrally on an air track by two springs makes small simple harmonic oscillations.



When its displacement from equilibrium is 20 mm, its speed is 30 mm s^{-1}.
When its displacement is 30 mm, its speed is 20 mm s^{-1}.

What is its speed when its displacement is 25 mm?

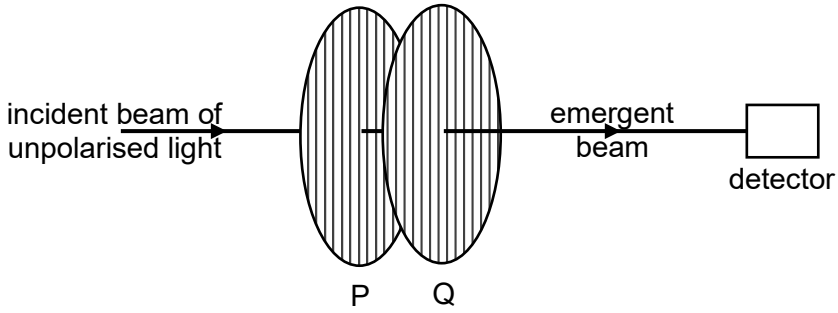
A 24 mm s^{-1} **B** 25 mm s^{-1} **C** 26 mm s^{-1} **D** 29 mm s^{-1}

22 A body of mass 1.5 kg undergoes simple harmonic motion such that its potential energy E_P depends on its displacement x from a fixed point according to the equation $E_P = 4.1\,x^2$.

What is the period of oscillation?

A 0.63 s **B** 1.1 s **C** 1.5 s **D** 2.7 s

23 Two sheets of polaroid P and Q are placed such that their planes of polarisation are parallel as shown. A beam of unpolarised light passes through them and is incident on the detector. The intensity detected is I.



Which of the following is a possible angle through which Q can be rotated such that the intensity detected is reduced by 30%?

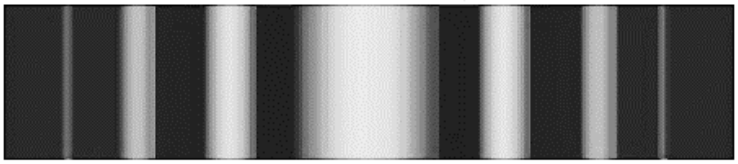
A 213° **B** 226° **C** 237° **D** 253°

24 A wave has frequency of 5.0 Hz. It travels through a medium at a speed of 8.0 km s^{-1}.

What is the phase difference, in radians, between two points 2.0 km apart?

A zero **B** $\frac{\pi}{4}$ **C** $\frac{\pi}{2}$ **D** π

25 When monochromatic light is passed through a single slit, the pattern below is seen on a screen.



What is the best explanation for the interference pattern seen on the screen?

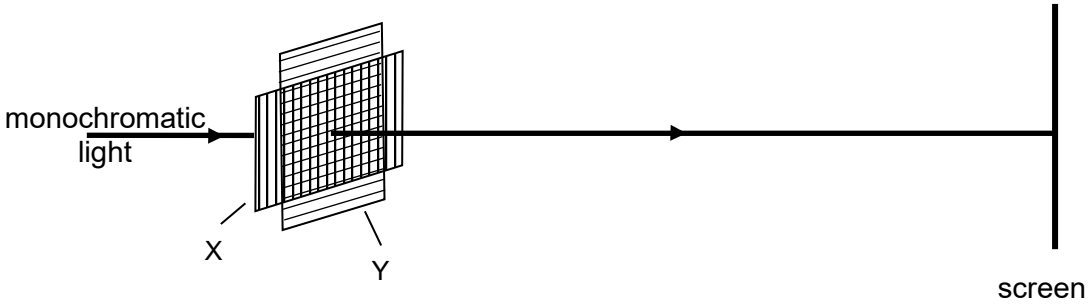
A There are secondary wavelets within the single slit.

B There are secondary wavelengths within the plane wave.

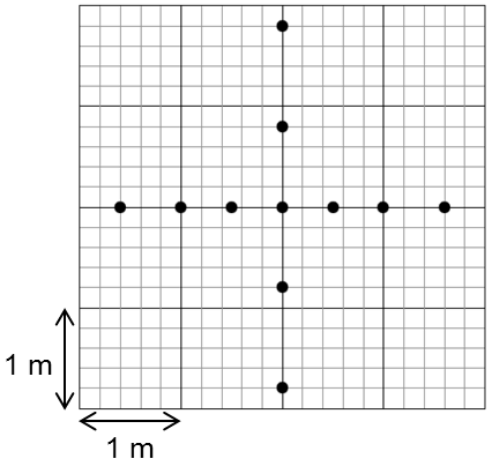
C The waves reflected from the surrounding walls.

D The waves are not coherent.

26 A beam of monochromatic light of wavelength 450 nm passes through 2 diffraction gratings X and Y that are positioned perpendicular to one another.



Part of the interference pattern on the screen 3.6 m away from X and Y is as shown.



If the distance between the two gratings is negligible, what is the approximate number of lines per metre for grating X?

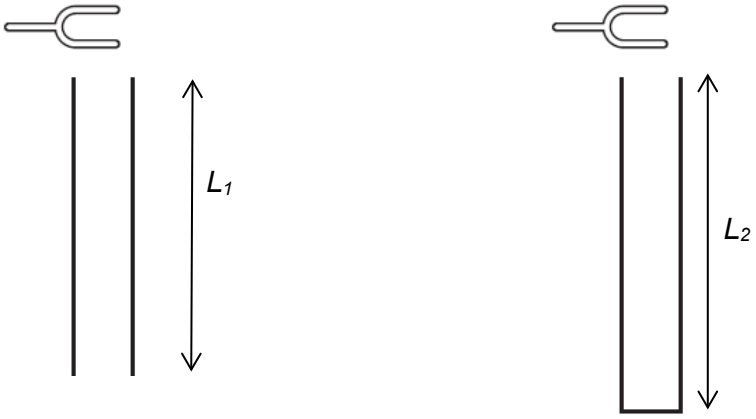
A 2×10^5 lines per metre

B 3×10^5 lines per metre

C 4×10^5 lines per metre

D 5×10^5 lines per metre

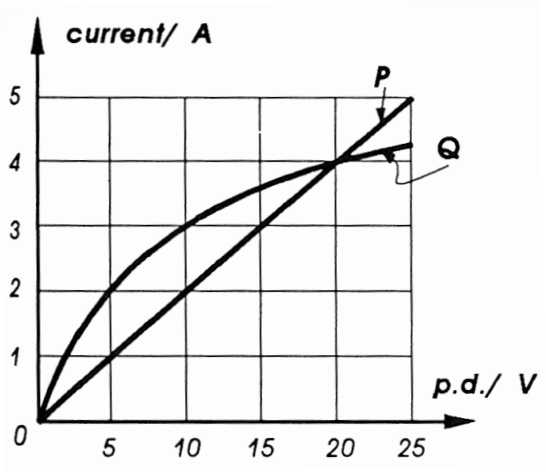
27 Two identical tuning forks are placed above two resonance tubes: one of length L_1 that is open at both ends and another of length L_2 closed at one end. In both cases, resonance is observed.



Which of the following expressions, where m and n are positive integers, give the ratio of $\frac{L_2}{L_1}$?

A $\frac{2m-1}{2n}$ **B** $\frac{2m-1}{4}$ **C** $\frac{2}{m}$ **D** 1

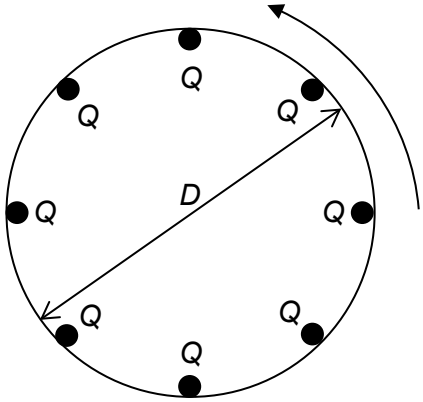
28 The figure shows the graph of current against potential difference for two electrical devices P and Q.



P and Q are joined in series. If the potential difference across P is 10 V, which of the following is correct?

	potential difference across Q / V	potential difference across P and Q / V
A	5	10
B	5	15
C	15	15
D	15	25

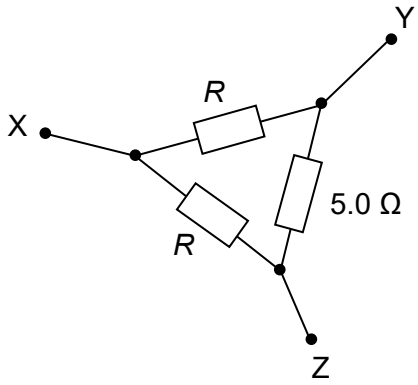
29 Eight small conductors of charge Q are placed on the edge of an insulating disc of diameter D. The angular frequency of rotation of the disc is ω.



What is the equivalent electric current at the edge of the disc?

A $\frac{4Q\omega}{\pi}$ **B** $\frac{8Q\omega}{\pi D}$ **C** $8Q\omega$ **D** $\frac{16Q\pi}{\omega}$

30 The diagram shows a network of three resistors. Two of which, marked R, are identical. The other one has a resistance of 5.0 Ω. The resistance between Y and Z is found to be 2.5 Ω.



What is the resistance between X and Y?

A 0.21 Ω **B** 0.53 Ω **C** 1.9 Ω **D** 4.8 Ω