EUNOIA JUNIOR COLLEGE
JC1 PROMO EXAMINATIONS 2023
General Certificate of Education Advanced Level
Higher 2

CANDIDATE NAME	
CIVICS GROUP	**2 3 -**
REGISTRATION NUMBER	

PHYSICS

9749/01

Multiple Choice

September / October 2023

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, civics group and registration number on all the work you hand in.
The use of an approved scientific calculator is expected where appropriate.
Answer **all** questions.

There are **thirty** questions in this section.
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.

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 document consists of **20** printed pages and **0** blank pages.

Data

speed of light in free space,	$c = 3.00 \times 10^{8}$ m s^{-1}
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space,	$\varepsilon_0 = 8.85 \times 10^{-12}$ 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,	$\phi = -\frac{Gm}{r}$
temperature,	$T\ /\ \mathrm{K} = T\ /\ ^\circ\mathrm{C} + 273.15$
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.	$x = x_0 \sin \omega t$
velocity of particle in s.h.m.	$v = v_0 \cos \omega t$ $= \pm\ \omega \sqrt{\left(x_0^2 - x^2\right)}$
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,	$V = \frac{Q}{4\pi\varepsilon_0 r}$
alternating current/voltage,	$x = x_0 \sin \omega t$
magnetic flux density due to a long straight wire	$B = \frac{\mu_0 I}{2\pi d}$
magnetic flux density due to a flat circular coil	$B = \frac{\mu_0 NI}{2r}$
magnetic flux density due to a long solenoid	$B = \mu_0 nI$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

1 Which of the following values is the best estimate for the volume of a metre rule found in the science laboratory?

A 1.5 cm^3 **B** 15 cm^3 **C** 150 cm^3 **D** 1500 cm^3

2 Which of the following statements is correct?

A A reading is inaccurate when it is not precise.
B Checking for zero error on a micrometer before making a measurement will help to reduce random error.
C Measuring the time taken for a larger number of oscillations will help to reduce the fractional uncertainty of the period of each oscillation.
D To determine the diameter of a sphere, taking more measurements and finding the average value of these measurements will reduce the fractional uncertainty of the diameter.

3 An aircraft is travelling with uniform acceleration along a runway. The runway has a marker board every 300 m. When the aircraft passes one board, it has a speed of 40 m s^{-1} and when it passes the next one, its speed is 70 m s^{-1}.

What is the acceleration of the aircraft?

A 5.5 m s^{-2} **B** 8.2 m s^{-2} **C** 10.8 m s^{-2} **D** 15 m s^{-2}

4 A small mass is thrown horizontally at a speed of 0.80 m s^{-1}, 5.0 m above ground.

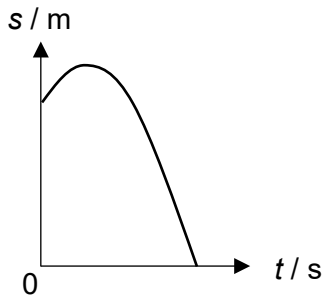
What is the horizontal distance travelled by the mass from the point it is thrown to just before it hits the ground?

A 0.2 m **B** 0.4 m **C** 0.6 m **D** 0.8 m

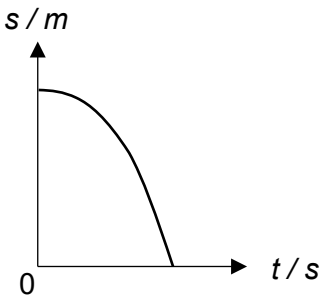
5 A sandbag is released from a hot air balloon when it is 10 m above the ground and moving vertically upwards at a velocity of 4.0 m s^{-1}.

Which of the following graphs best shows how the displacement *s* of the sandbag from the point of release will vary with time?

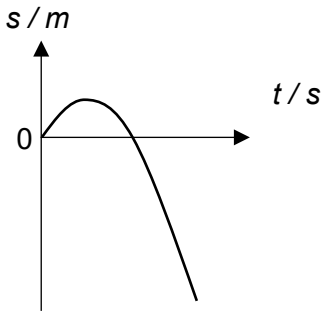
A



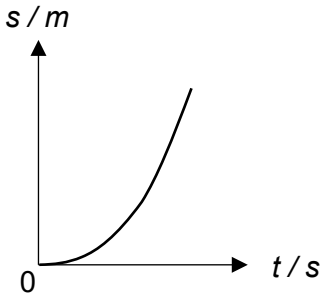
B



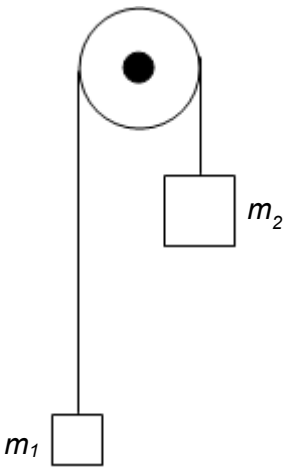
C



D



6 Two objects of mass m_1 and m_2 are connected by an inextensible massless string over a frictionless massless pulley as shown. m_1 is larger than m_2.



What is the acceleration a of the two objects in terms of m_1, m_2 and the acceleration of free fall g?

A $a = \dfrac{m_1 g - m_2 g}{m_1 + m_2}$

B $a = \dfrac{m_1 g + m_2 g}{m_1 - m_2}$

C $a = \dfrac{m_1 + m_2}{m_1 g - m_2 g}$

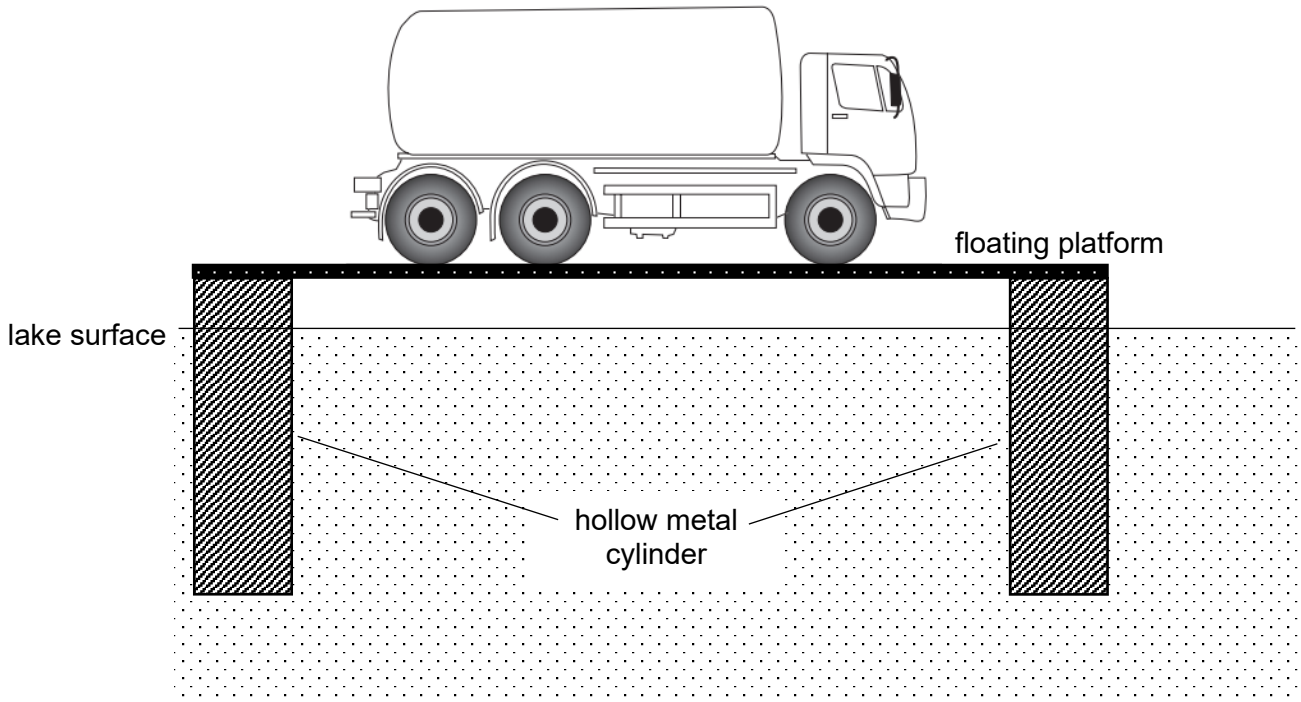
D $a = \dfrac{m_1 - m_2}{m_1 g + m_2 g}$

7 A 2.0 kg mass travelling at 3.0 m s^{-1} on a frictionless surface collides inelastically with a 1.0 kg mass travelling at 6.0 m s^{-1} in the opposite direction.

Which line in the table shows the total momentum and the total kinetic energy of the two masses after the collision?

	Total Momentum / kg m s^{-1}	Total Kinetic Energy / J
A	0	27
B	12	27
C	0	20
D	12	20

8 A floating platform supports a vehicle of mass of 2.0×10^4 kg above a lake surface. Four hollow metal cylinders of equal volume are installed vertically below the four corners of the floating platform as shown.



The cross-sectional area of each cylinder is 12.5 m^2.

Lake water has density 1000 kg m^{-3}.

How much does the platform rise in the lake when the vehicle is removed from it?

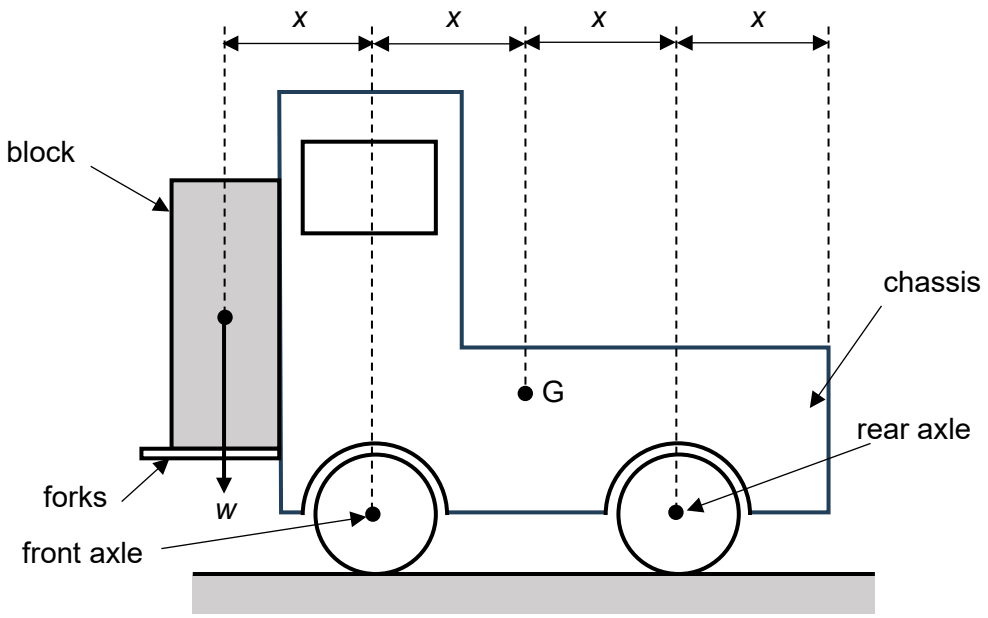
A 1.6 m

B 0.40 m

C 0.20 m

D 0.10 m

9 A forklift truck has a chassis resting on its axles. The chassis has weight *W* and its centre of gravity G is a distance *x* from both the front and the rear axles.



When a uniform block of weight *w* (< *W*) is placed on the front forks as shown in the diagram above, the force exerted by the front axle on the chassis increases by

A $\frac{w}{2}$

B $\frac{(W-w)}{2}$

C $\frac{3w}{2}$

D $\frac{(W+3w)}{2}$

10 A wire of length L obeys Hooke's Law. It is of length x when it is under a tension T.

What tension is the wire under when its length is increased to y?

A $\frac{Tx}{y}$

B $\frac{Ty}{x}$

C $\frac{T(x-L)}{(y-L)}$

D $\frac{T(y-L)}{(x-L)}$

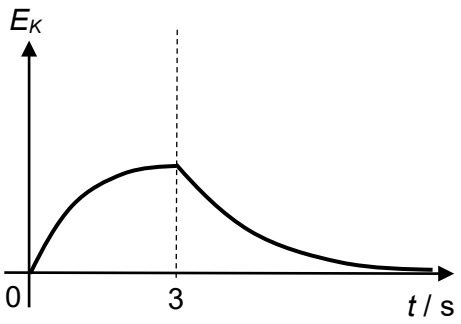
11 An airplane has two jet engines. If each of the jet engines has an efficiency of 80%, what is the power input of each engine required to allow the plane to fly with a thrust of 200 kN at a speed of 250 m s^{-1}?

A 20.0 MW
B 31.3 MW
C 40.0 MW
D 62.5 MW

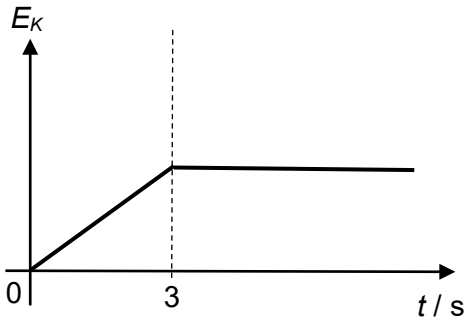
12 A parachutist steps off the edge of a tall cliff and falls without significant drag for 3.0 s before opening the parachute.

Which of the following best shows the variation of kinetic energy E_K with time t?

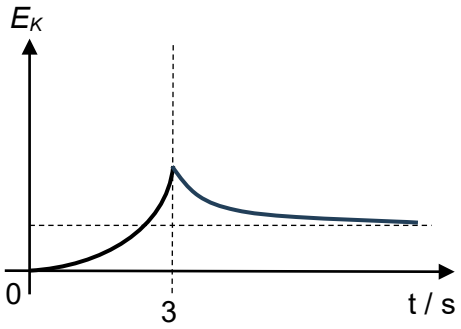
A



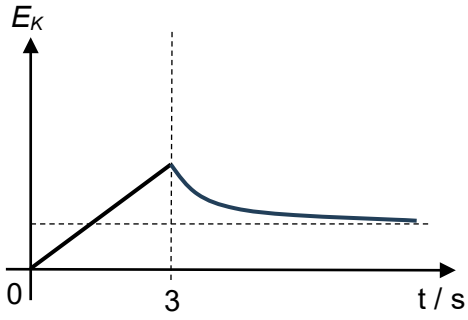
B



C



D



13 A mass m_1 is attached to one end of an elastic string of an unstretched length L. When the mass is rotating with a linear speed v on a smooth table in a horizontal circle, an extension e is obtained.

Which of the following shows the correct expression for mass m_2, attached to the end of the same string, if it is rotated with the same linear speed v but twice the radius as that produced by m_1?

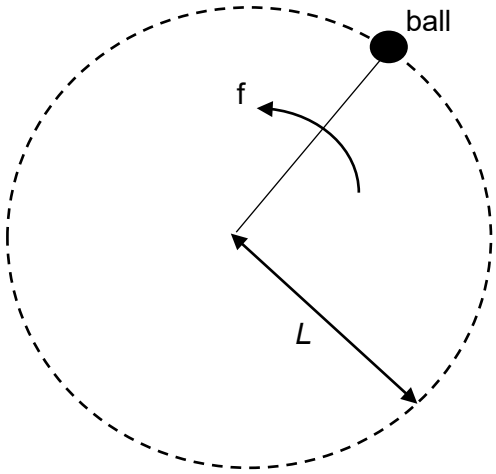
A $m_2 = \dfrac{2m_1(L+2e)}{e}$

B $m_2 = \dfrac{2m_1(L+e)}{e}$

C $m_2 = \dfrac{2m_1(2L+e)}{e}$

D $m_2 = \dfrac{2m_1(2L+2e)}{e}$

14 A ball of mass m is attached to a rope. The ball is rotating in a vertical circle of radius L with a constant frequency f as shown. The acceleration of free fall is g.



What is the maximum variation in the magnitude of the tension in the string during one revolution of the stone?

A 0

B $2mg$

C $2\pi^2 f^2 mL$

D $4\pi^2 f^2 mL$

15 At a point outside the Earth and a distance x from its centre, the Earth's gravitational field strength is about 5 N kg^{-1}. At the Earth's surface, the gravitational field strength is about 10 N kg^{-1}.

Which one of the following gives an approximate value for the radius of the Earth?

A $x\sqrt{2}$ **B** $\frac{x}{2\sqrt{2}}$ **C** $\frac{x}{2}$ **D** $\frac{x}{\sqrt{2}}$

16 A satellite orbits around the earth along the equatorial plane.

Which of the following statements is correct?

A The period of the orbit is always 24 hours.

B A similar satellite orbiting along the equatorial plane with double the orbital radius will have less kinetic energy.

C The period of the orbit changes with mass of the satellite.

D A satellite of larger mass orbiting along the equatorial plane with same orbital radius will have more total energy.

17 Which one of the following is a property of a uniform gravitational field?

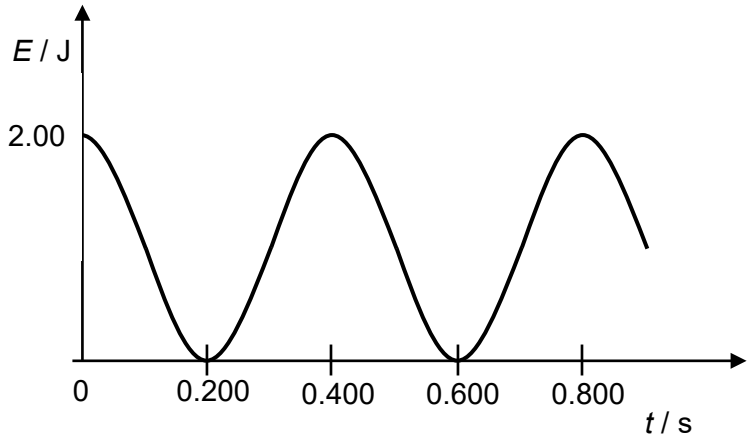
A The gravitational potential has the same value at all points within it.

B Its direction is opposite to the direction of motion of a test mass released in it.

C Its field strength is the same at all points within it.

D Its magnitude is the same in all directions.

18 The graph below represents the variation of kinetic energy E with time t of a 0.5 kg mass undergoing simple harmonic motion. Its acceleration is a, displacement is x and velocity is v.



Which of the following equations correctly corresponds to the simple harmonic motion represented above?

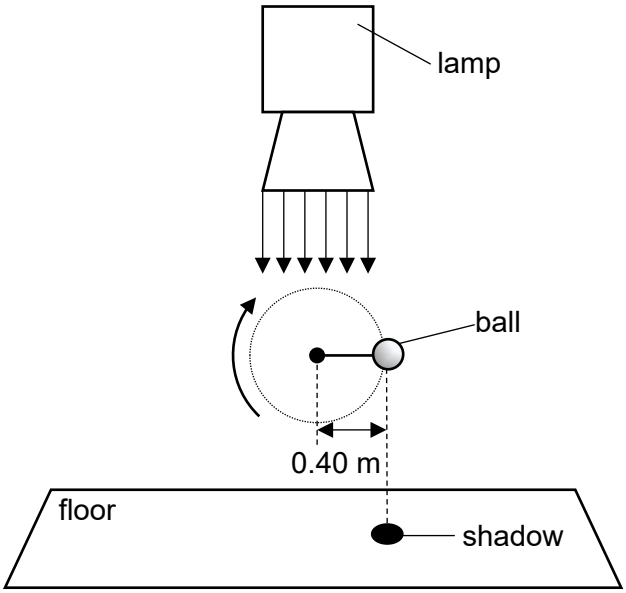
A $v = 2.83 \sin (15.7\, t)$

B $v = 2.83 \cos (7.85\, t)$

C $x = 0.36 \cos (15.7\, t)$

D $a = -0.36 \sin (7.85\, t)$

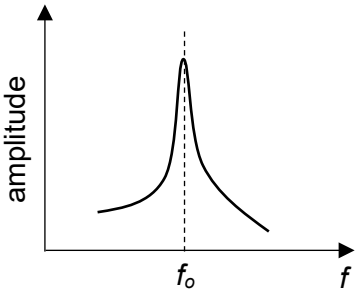
19 A ball is in uniform circular motion vertically with linear speed of 2.0 m s^{-1}. The radius of the motion is 0.40 m. A lamp shines from above and projects a shadow of the ball on the floor. The diagram below shows the position of the shadow at time t = 0 s.



What is the distance travelled by the shadow from t = 0 s to t = 0.40 s?

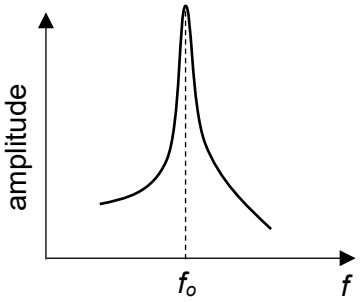
A 0.17 m **B** 0.57 m **C** 0.75 m **D** 0.97 m

20 A pendulum is constructed from a fixed length of light thread and a spherical, low density, polystyrene bob. It is forced to oscillate at different frequencies *f* in air, and the response is shown in the graph below.

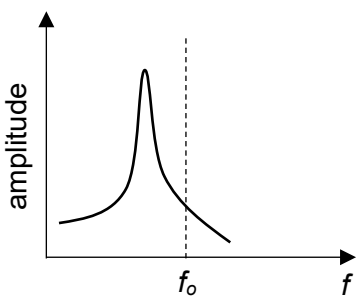


Which one of the following graphs best represents the results if the experiment were to be repeated in a vacuum?

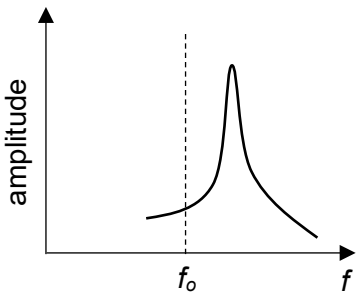
A



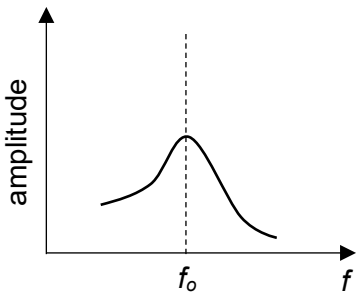
B



C

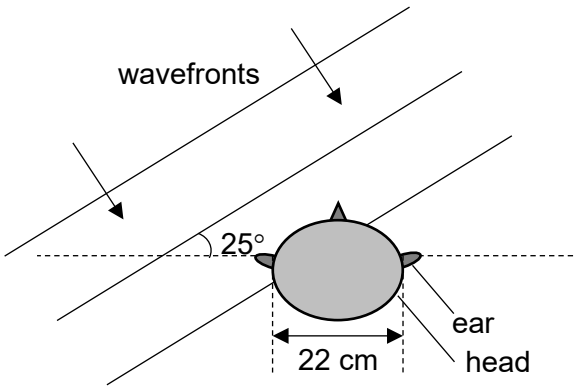


D



21 Humans are able to detect the general direction of a sound source because sound from the source reaches the ears at slightly different times.

The figure below shows a human head with the ears 22 cm apart. Sound waves of wavelength 1.7 m from a distant source reach the head at an angle of 25°.

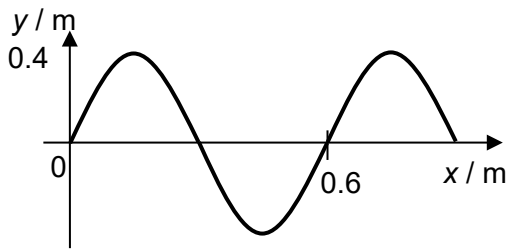


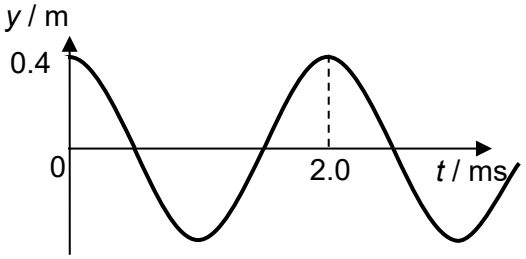
Top view
(figure not to scale)

What is the phase difference between the waves reaching the left and right ear?

A 0.17 rad **B** 0.34 rad **C** 0.74 rad **D** 0.81 rad

22 The displacement-position (y–x) graph of a travelling wave at an instant of time and the displacement-time (y–t) graph of a particle on the wave are as shown below.

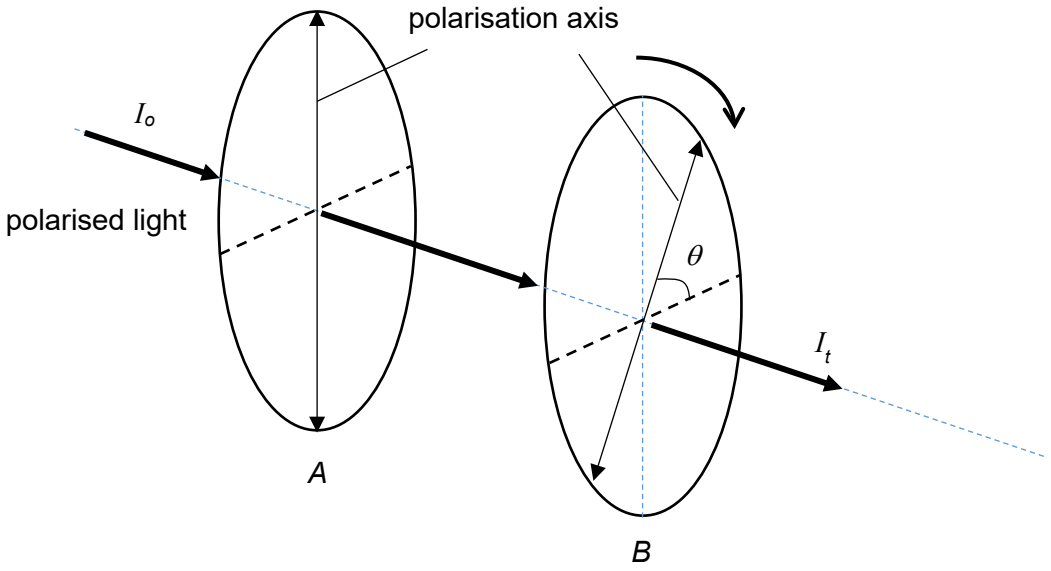




The speed of the wave is

A 0.2 m s^{-1} **B** 0.3 m s^{-1} **C** 200 m s^{-1} **D** 300 m s^{-1}

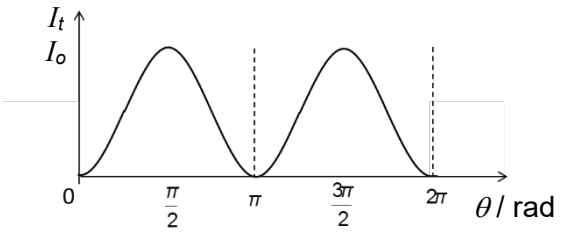
23 The figure below shows two ideal polarisers *A* and *B* where their polarisation axes are initially parallel to each other.



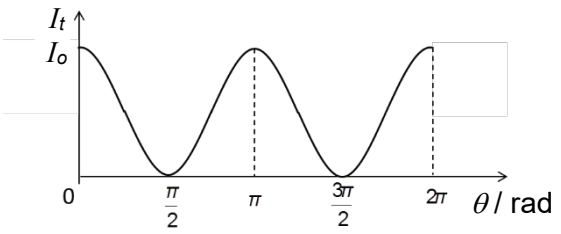
Polarised light of intensity I_0 is incident on *A* with its plane of polarisation parallel to the polarisation axis. Polariser *B* is then rotated so that its polarisation axis makes an angle *θ*, as shown in the figure above.

Which of the following graphs shows how the intensity of the transmitted light I_t varies with the angle *θ*?

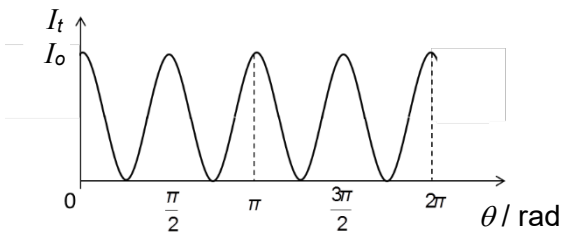
A



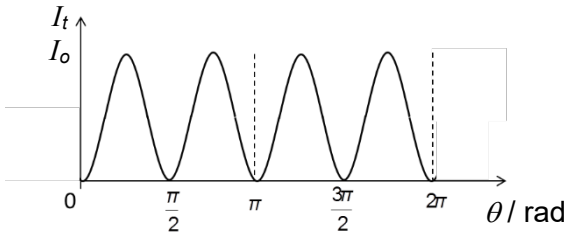
B



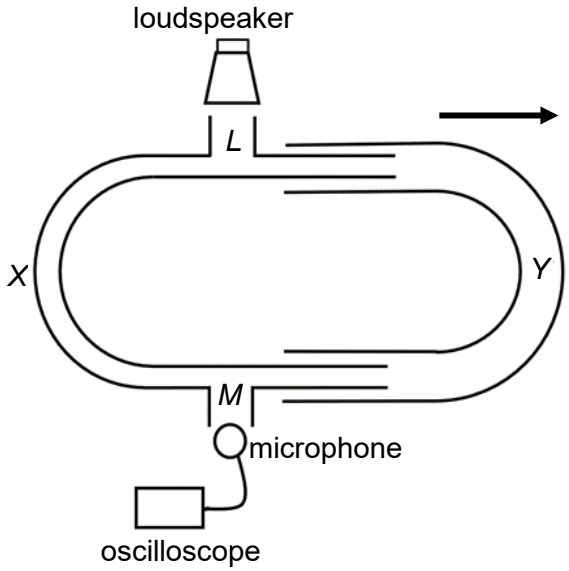
C



D



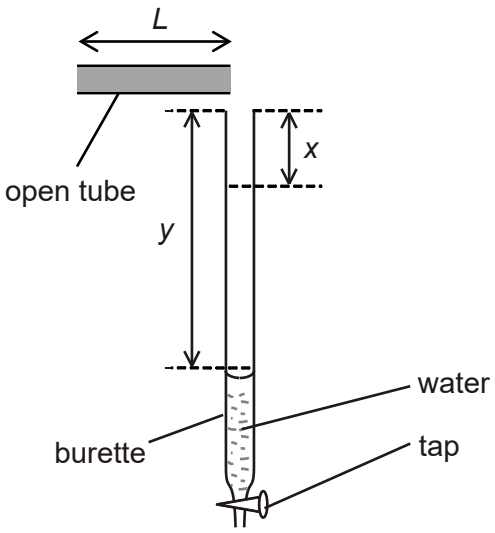
24 A loudspeaker and a microphone connected to an oscilloscope is set up as shown in the diagram below. The left-tube *LXM* is fixed in a position while the right-tube *LYM* is a sliding section capable of sliding horizontally. The length of path *LXM* and *LYM* are initially equal, and the oscilloscope produces a signal of large amplitude when the loudspeaker produces a sound of wavelength 8.4 cm.



What is the least distance the sliding section must move to the right for the microphone to produce a signal of large amplitude on the oscilloscope again?

A 2.1 cm **B** 4.2 cm **C** 8.4 cm **D** 16.8 cm

25 Sound wave is produced from a simple open-tube instrument of length *L* at its fundamental frequency. A burette filled with water is held below it.

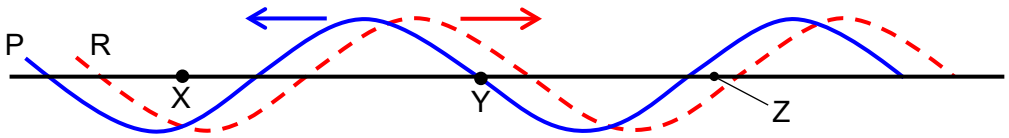


The tap at the base of the burette is opened. As the water runs out, a loud sound is first heard when the water level is a distance *x* below the top of the tube. A second loud sound is heard when the water level is a distance *y* below the top.

Which one of the following is a correct relationship between *L*, *x* and *y*?

A $L = x$ **B** $L = y / 3$ **C** $L = (y - x) / 2$ **D** $L = y - x$

26 Two progressive water waves P and R have identical amplitudes, frequencies and speeds. They are travelling in opposite directions and overlapped as shown.



What will be the resultant wave that is formed due to the supposition of the two waves?

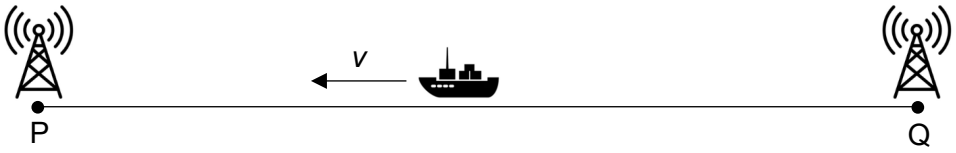
A No resultant wave will be formed as waves P and R add up destructively at some points.

B A stationary wave will be formed with an antinode at X.

C A stationary wave will be formed with a node at Y.

D A stationary wave will be formed with an antinode at Z.

27 A ship moves at a constant speed in a straight line between two radio transmitters P and Q. Both transmitters operate on the same wavelength and radiate signals of equal amplitude.



The speed of the ship in km h^{-1} is v. It detects f maxima of intensity of the radio waves per second.

What is the wavelength of the radio waves in metres?

A $\frac{5v}{18f}$ **B** $\frac{5v}{9f}$ **C** $\frac{v}{f}$ **D** $\frac{2v}{f}$

28 A parallel beam of light of wavelength 450 nm falls normally on a diffraction grating which has 300 lines / mm.

What is the total number of bright spots seen on the screen?

A 7 **B** 8 **C** 14 **D** 15

29 Two monochromatic radiations X and Y are incident normally on a diffraction grating. The second order intensity maximum for X coincides with the third order intensity maximum for Y.

What is the ratio $\frac{\text{wavelength of X}}{\text{wavelength of Y}}$?

A $\frac{1}{2}$ **B** $\frac{2}{3}$ **C** $\frac{3}{2}$ **D** $\frac{2}{1}$

30 The two headlights of an approaching automobile are 1.4 m apart. At what maximum distance will the eye resolve them?

Assume that the pupil diameter is 5.0 mm.

A 13 m **B** 130 m **C** 13 km **D** 130 km