EUNOIA JUNIOR COLLEGE
JC1 Promotional Examination 2020
General Certificate of Education Advanced Level
Higher 2

PHYSICS

Paper 1 Multiple Choice

9749/01

02 October 2020

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 **19** printed pages and **1** blank page.

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, $p = \rho gh$

gravitational potential, $\phi = -\frac{Gm}{r}$

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 $\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

1 Using the concept of relativity, the total energy E of a particle can be expressed using the following equation

$$E^2 = \left(\alpha c^2\right)^2 + \left(\beta c\right)^2$$

where c is the speed of light.

What physical quantities do α and β represents respectively?

	α	β
A	mass	momentum
B	force	momentum
C	mass	force
D	momentum	mass

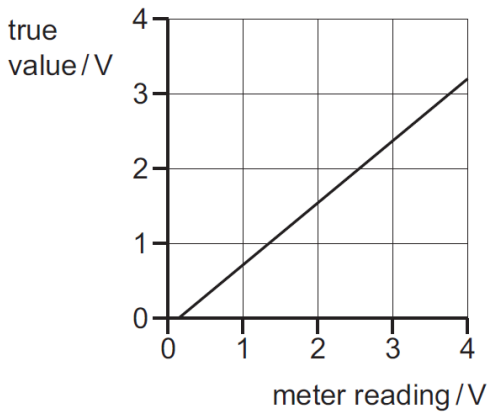
2 The mass, length and breadth of a sheet of aluminium foil when measured is subjected to a percentage uncertainty of 1%, 1% and 2% respectively. The mean thickness of the foil is determined by folding the foil twice to give a stack of 4 sheets which thickness when measured gives a value of (11.2 ± 0.4) mm.

What is the percentage uncertainty of the calculated density?

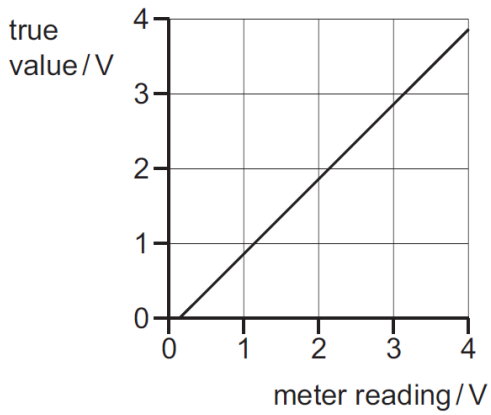
A 4.9% **B** 7.6% **C** 11.1% **D** 18.3%

3 A voltmeter gives readings that are larger than the true values and has a systematic error. Which graph represents the calibration curve for the voltmeter most accurately?

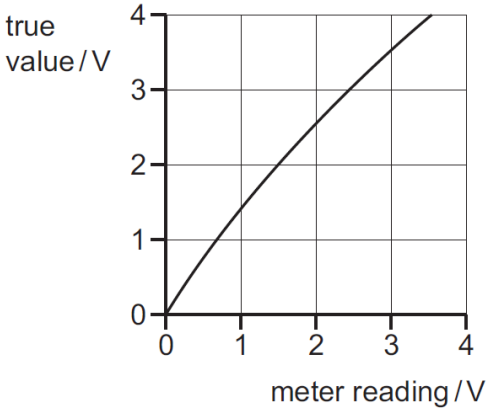
A



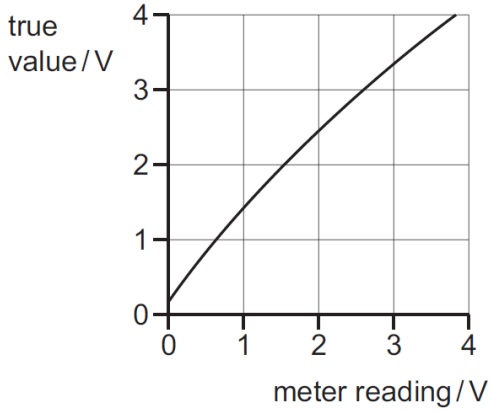
B



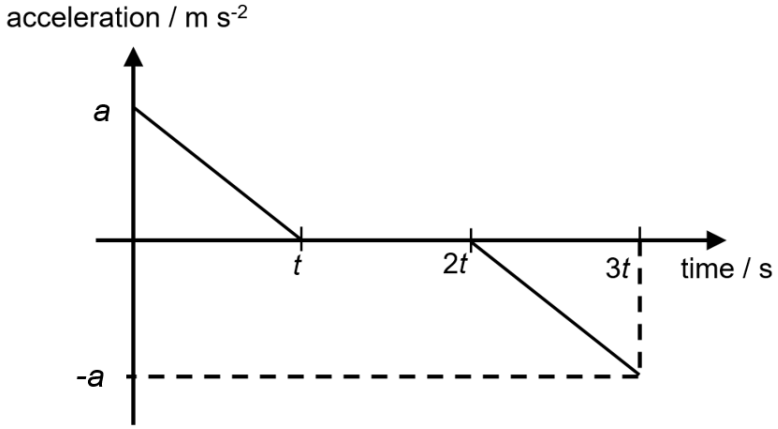
C



D

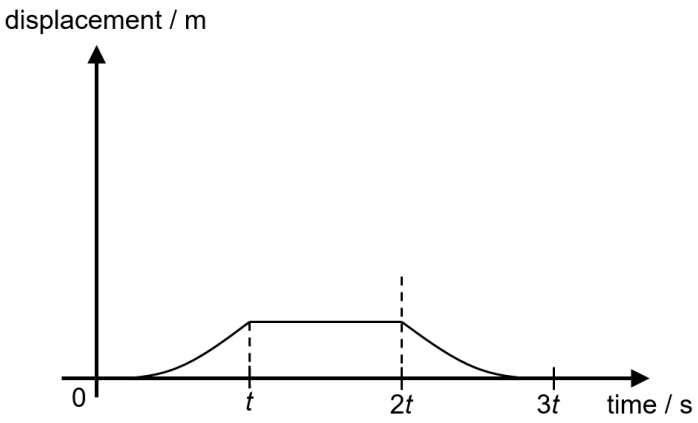


4 A car starts from rest and accelerates along a straight line. The acceleration-time graph of the car is given below.

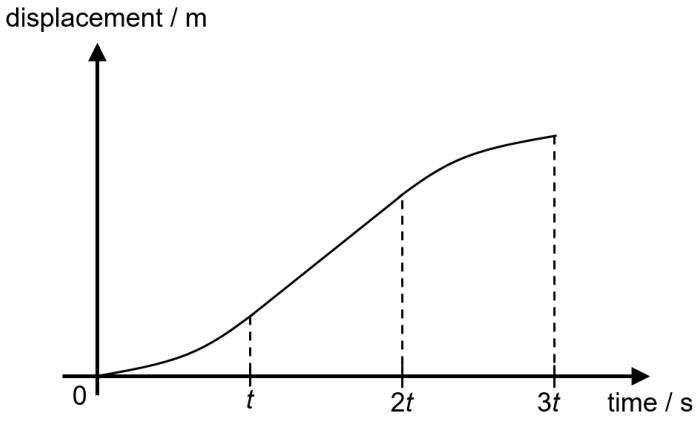


Which of the following options gives the correct displacement-time graph of the car?

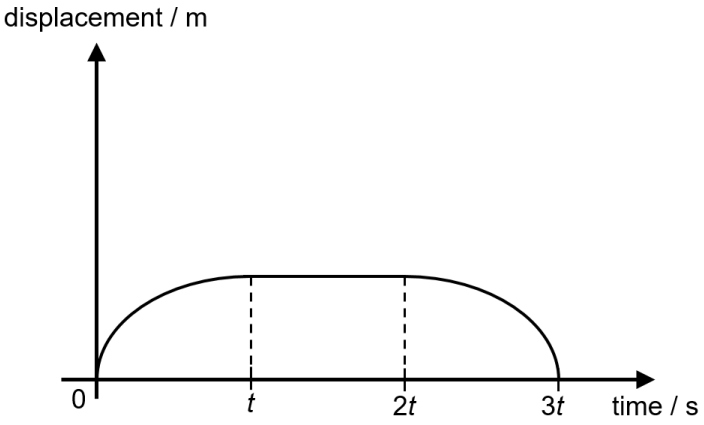
A



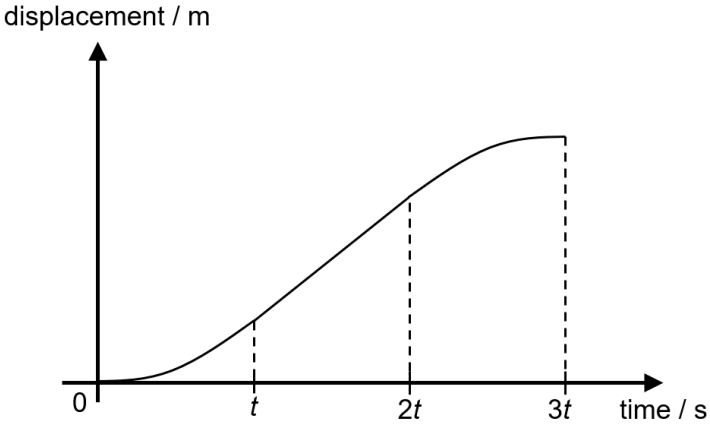
B



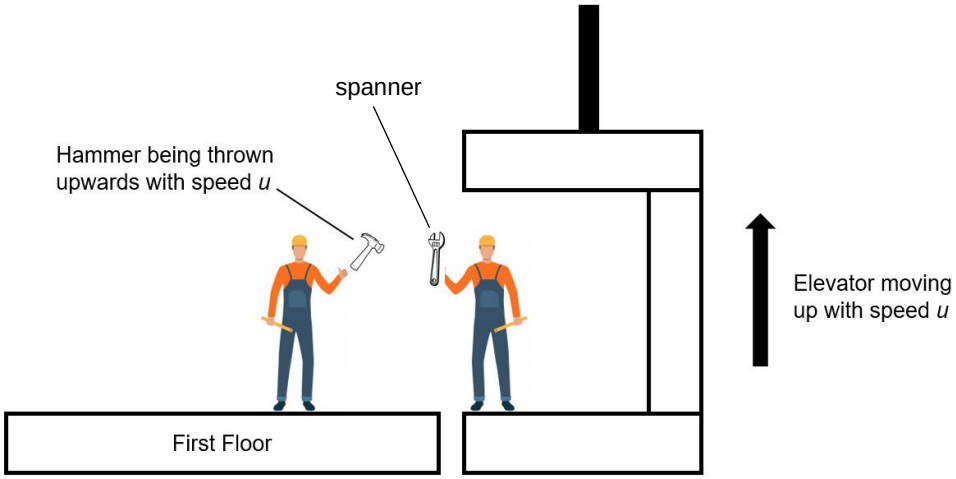
C



D



5 At a construction site, a workman is in an elevator moving upwards at a constant speed u. When the elevator is level with the first floor, he lets go of a spanner. At the same instant, a second workman standing on the first floor throws a hammer upwards with initial speed u.



Which of the following statement correctly describes the motion of the hammer and the spanner as seen by the workman on the first floor assuming that both the spanner and hammer will hit the first floor?

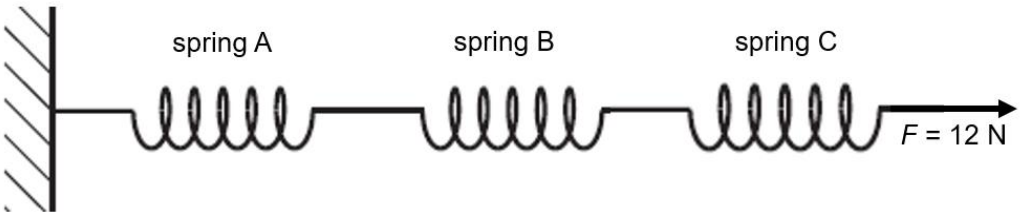
A The spanner lands on the first floor before the hammer does.

B Both the spanner and hammer lands on the first floor at the same time.

C The spanner travels a longer distance than the hammer before landing on the first floor.

D The spanner and the hammer both move upwards, but the spanner rises more slowly than the hammer.

6 3 springs A, B and C with spring constants k_A = 2 N m^{-1}, k_B = 3 N m^{-1}and k_C = 6 N m^{-1} are connected in series as shown below.



What is the ratio of the extensions x_A : x_B : x_C when the spring is being subjected to a force of 12 N?

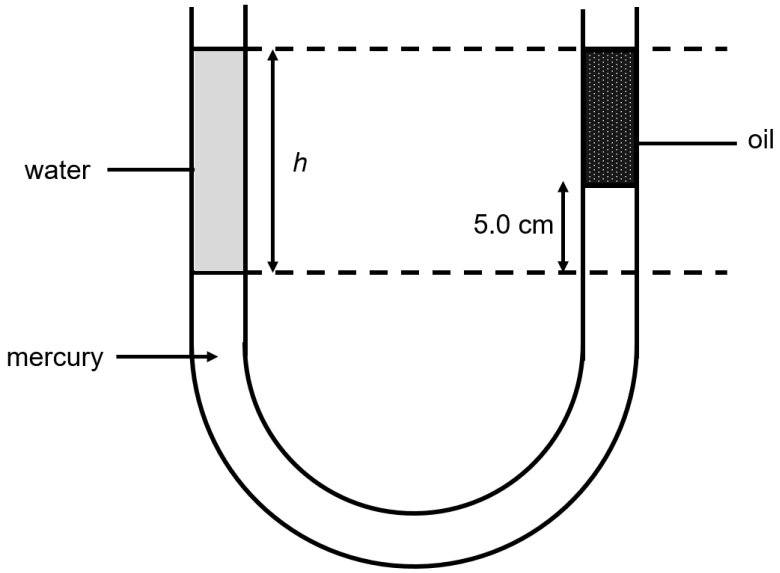
A 1 : 2 : 3

B 2 : 3 : 6

C 3 : 2 : 1

D 6 : 3 : 2

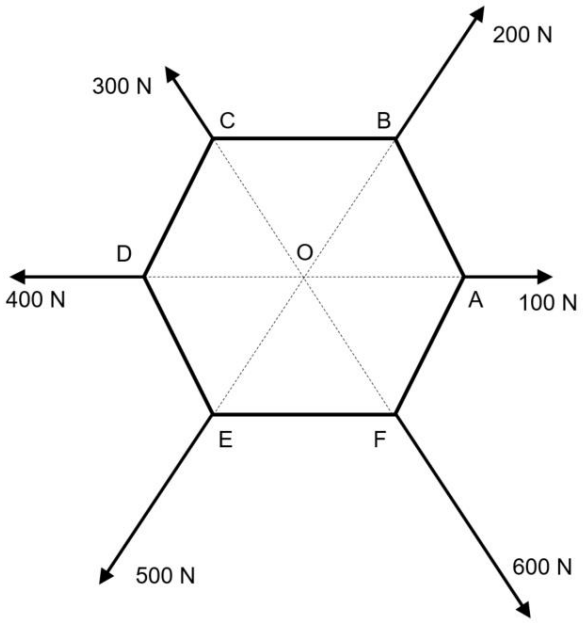
7 A manometer is filled with mercury, water and oil as shown below.



Given that the density of mercury, water and oil is 13600 kg m^{-3}, 1000 kg m^{-3} and 800 kg m^{-3} respectively, what is the value of height *h*?

A 8.0 cm **B** 18.0 cm **C** 68.0 cm **D** 320.0 cm

8 6 teams A, B, C, D, E and F are playing a game of tug of war concurrently by pulling at the ropes connected to a regular hexagon with centre O as shown below. The magnitude of the forces exerted by the teams are shown in the diagram.



What is the magnitude and direction of the resultant force acting on the hexagon ring?

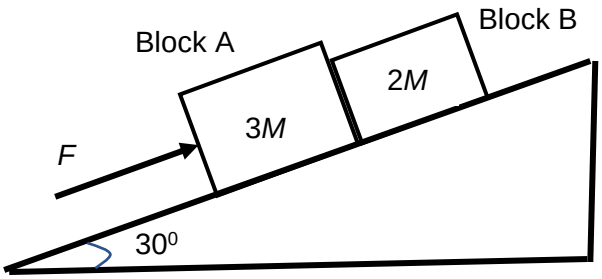
A 600 N along OE

B 600 N along OB

C 900 N along OE

D 900 N along OB

9 Two blocks A and B with masses 3*M* and 2*M* respectively are pushed up a smooth slope by a force *F* applied along the slope as shown.



What is the magnitude of the force that B exerts on A?

A $\frac{1}{2}F$

B $\frac{2}{5}F$

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

D F

10 A helicopter with blades of diameter 5.0 m is hovering above the ground at a particular instant in time. Its blades are rotating in such a way that they are pushing air downwards at a speed of 18 m s^{-1}. The density of the surrounding air can be taken as 1.02 kg m^{-3}.

What is the upward force acting on the blades?

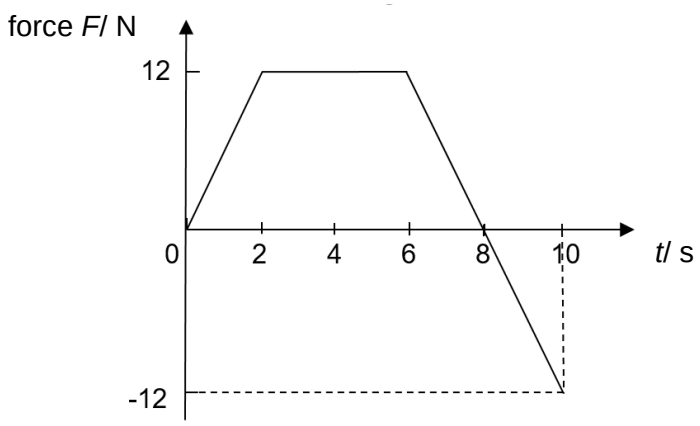
A 360 N

B 1400 N

C 6500 N

D 26000 N

11 A body of mass 3.0 kg is acted on by a force F which varies with time t as shown in the diagram below.



Given that the velocity of the body at t = 4 s is 12 m s^{-1}, what is the velocity of the body at t = 8 s?

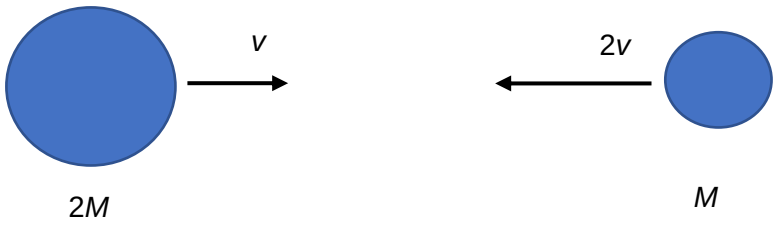
A 0 m s^{-1}

B 20 m s^{-1}

C 24 m s^{-1}

D 36 m s^{-1}

12 An object of mass 2M travelling to the right with speed v collides elastically with another object of mass M travelling to the left with speed 2v.



What is the total momentum and total kinetic energy of the two objects after collision?

	Total momentum	Total kinetic energy
A	0	0
B	4Mv	0
C	0	3Mv^2
D	4Mv	3Mv^2

13 A lady applies a horizontal force to a crate and the crate accelerates uniformly in the direction of the force.

Which statement is correct?

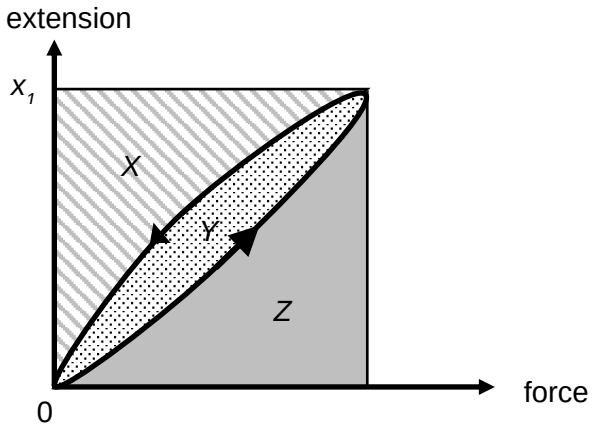
A The force applied by the lady on the crate is greater than the force applied by the crate on the lady.

B The force applied by the lady on the crate equals the force applied by the crate on the lady.

C The forces acting on the crate are in equilibrium.

D The total frictional force acting on the crate equals the force applied by the lady on the crate.

14 An elastic material has a loading and unloading path as shown when an external force stretches the material to an extension x_1.



Which of the shaded area(s) represents the elastic potential energy stored in the spring?

A *X*

B *Z*

C *X* + *Y*

D *Y* + *Z*

15 An electric motor is required to haul a cage of mass 400 kg up an uncompleted building at a constant speed through a vertical height of 1200 m in 2.0 minutes.

What is the total power wasted if the overall efficiency of the motor is 80%?

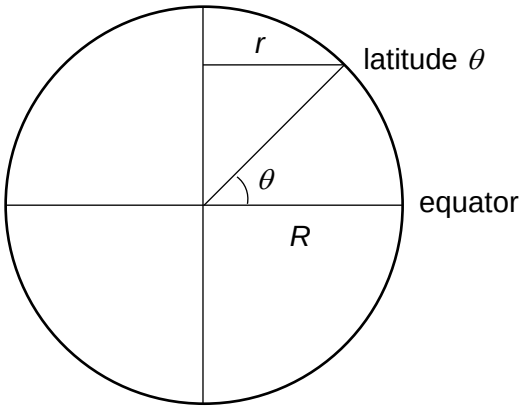
A 7.8 kW

B 9.8 kW

C 39 kW

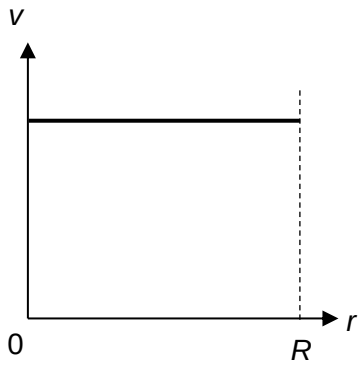
D 49 k

16 A student on Earth moves in a circular path of radius r with velocity v because of the Earth's rotation about its axis. At the equator, r is equal to the radius R of the Earth. r is smaller than R when the student is at a different latitude of θ degrees on Earth as shown.

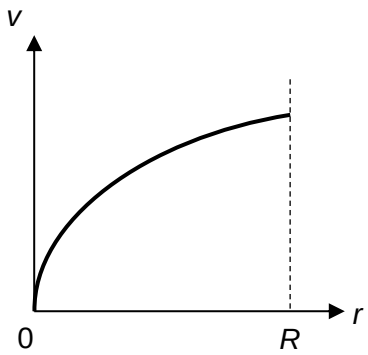


Which of the following graphs best represents the relation between v and r?

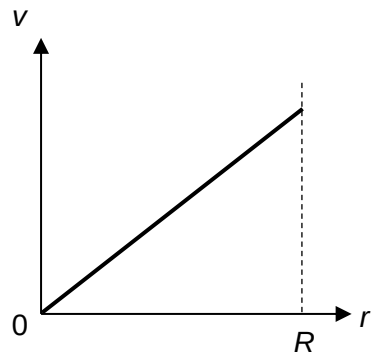
A



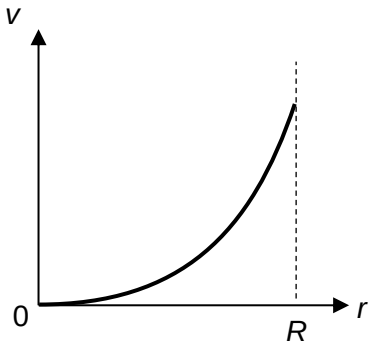
B



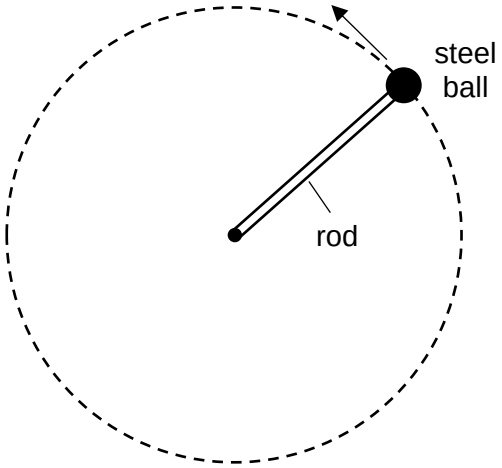
C



D



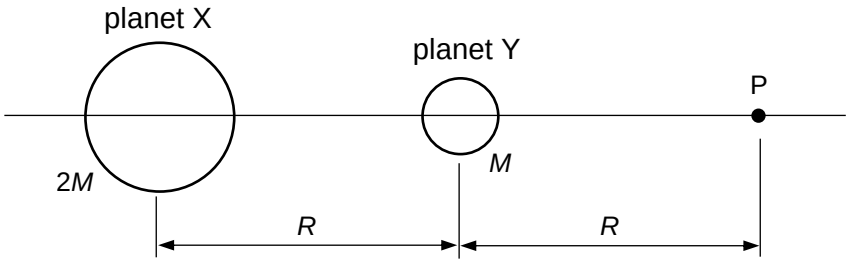
17 A steel ball fixed to one end of a light rod rotates in a vertical circle with a constant speed.



How do the linear momentum and total mechanical energy of the ball at its highest position compare with the linear momentum and total mechanical energy of the ball at its lowest position?

	linear momentum	total mechanical energy
A	the same	the same
B	the same	higher
C	different	the same
D	different	higher

18 Two planets X and Y have masses $2M$ and M respectively. The centres of the planets are separated by a distance R. Point P is on the straight line joining the centres of the two planets and is at a distance R from the centre of planet Y as shown.

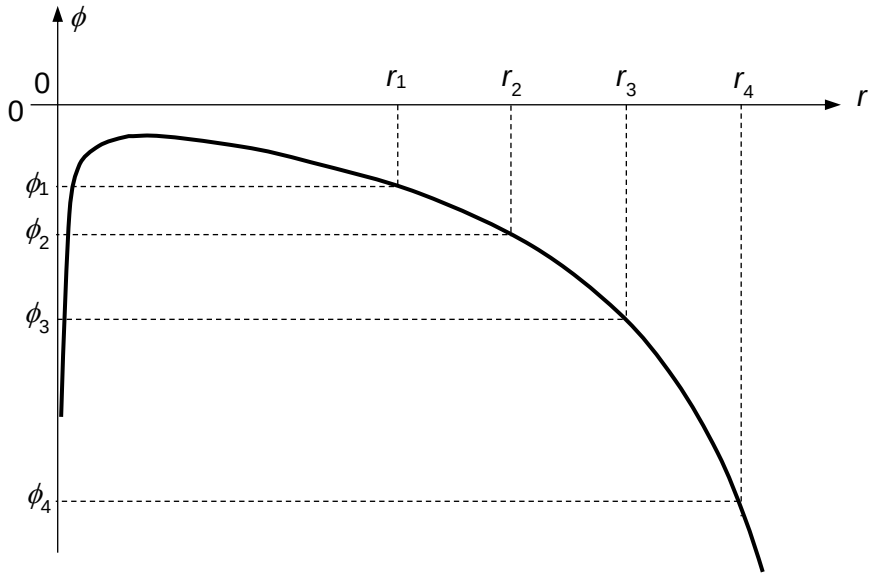


What is the magnitude of the gravitational field strength at the point P due to the two planets?

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

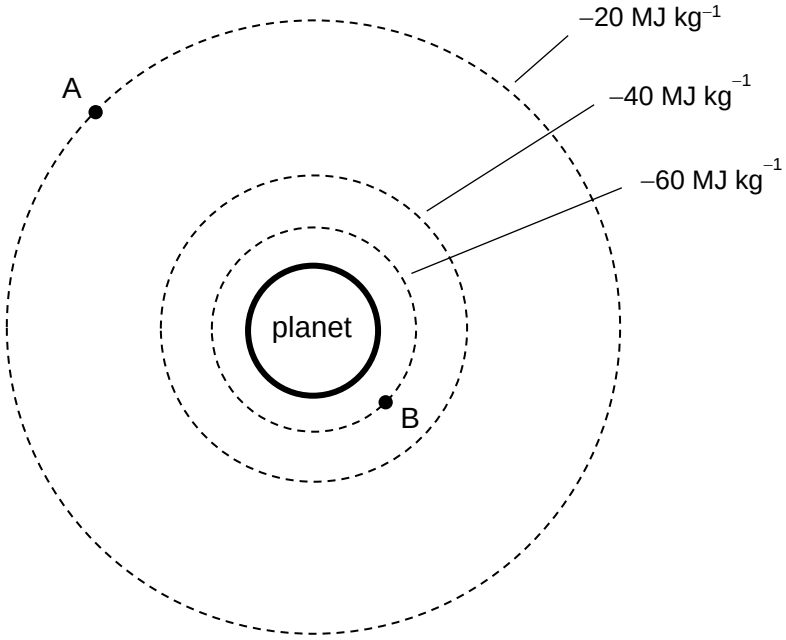
19 The gravitational potential ϕ along the line joining the centres of a planet and its moon varies with the distance r from the centre of the moon as shown.

What is best estimate of the gravitational force acting on a 1 kg mass at r_2?



A $\frac{\phi_1 - \phi_2}{r_2 - r_1}$ **B** $-\frac{\phi_2}{r_2}$ **C** $\frac{\phi_1 - \phi_3}{r_3 - r_1}$ **D** $\frac{\phi_2 - \phi_3}{r_3 - r_2}$

20 The diagram shows the equipotential surfaces near a planet.



What is the work done by an external force to move a mass of 10 kg from point A to point B without a change in kinetic energy?

A –400 MJ **B** –40 MJ **C** 40 MJ **D** 400 MJ

21 Which of the following quantities is not necessarily the same for satellites that are in geostationary orbits around the Earth?

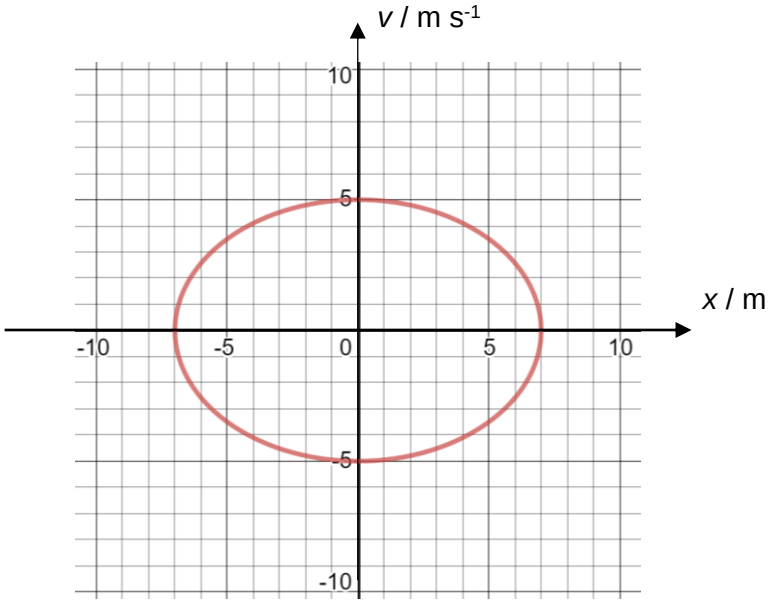
A angular velocity

B centripetal acceleration

C orbital radius

D gravitational potential energy

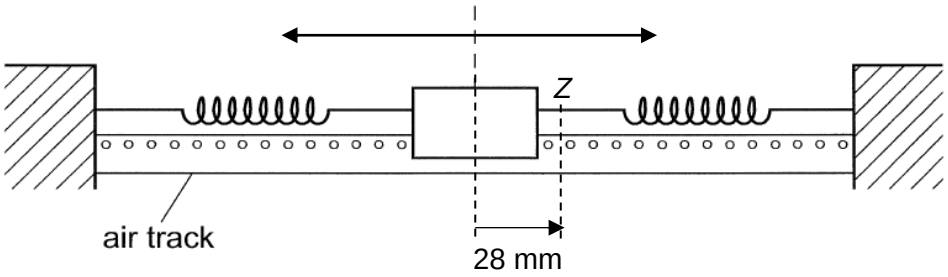
22 The graph below shows how the velocity of an oscillator varies with its displacement.



What is the period of the oscillator?

A 1.4 s **B** 0.71 s **C** 7.4 s **D** 8.8 s

23 A linear air track vehicle is held centrally on an air track by two springs. It was displaced to the right by 50 mm and released, causing it to undergo simple harmonic oscillation. The period of its oscillation is 3.0 s.

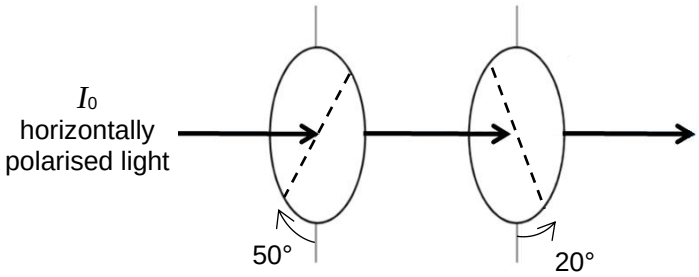


During the oscillation, the linear air track vehicle passes a point *Z*, which is 28 mm to the right of the equilibrium position.

What is the time interval between the point of release and the time when the air track vehicle passes point *Z* the **second** time?

A 0.47 s **B** 0.53 s **C** 2.5 s **D** 2.7 s

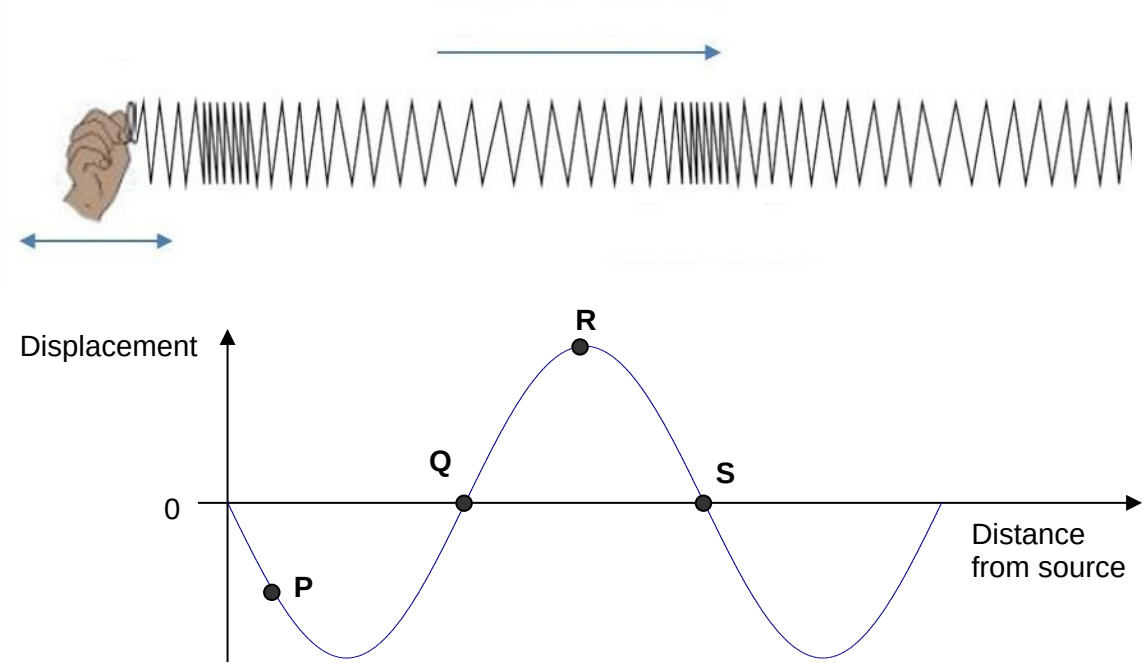
24 A beam of horizontally polarised light with intensity I_0 was shone on a series of two polarising filters as shown in the diagram below. The angles of their polarising axes to the vertical is 50° and 20° respectively.



What is the intensity of the emergent light, as a fraction of its initial intensity I_0?

A 0.0310 **B** 0.0483 **C** 0.0585 **D** 0.0686

25 The diagram below shows the displacement-distance graph of a longitudinal wave propagating to the right. A displacement to the right is considered as positive.



P, **Q**, **R**, **S** are particles on the spring.

Which statement correctly describes the motion of the particles on the spring at the instant shown?

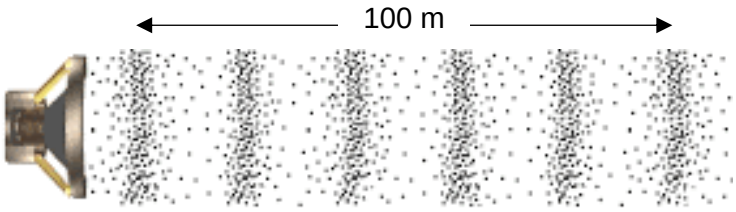
A The point P is moving to the right at maximum speed.

B The point Q is moving to the left at maximum speed.

C The point R is moving to the left with maximum acceleration.

D The point S is moving to the right with maximum acceleration.

26 The diagram illustrates the relative positions of particles in a medium as a sound wave propagates through it, the distance the sound wave travels. The speed of the wave is 1200 m s^{-1}.

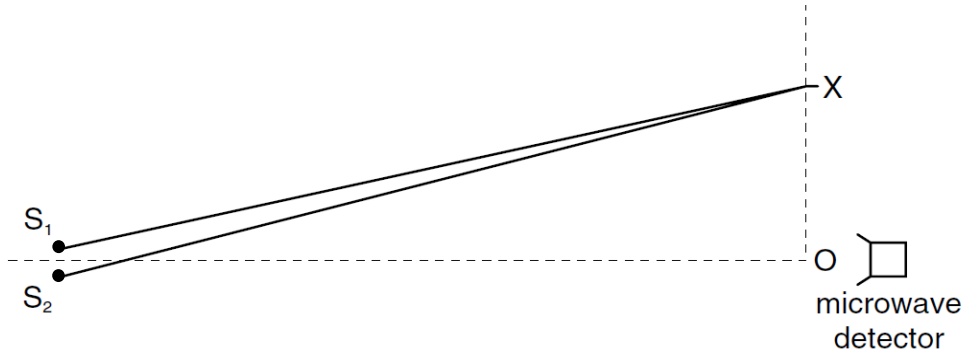


What is the frequency of the wave?

A 12 Hz **B** 30 Hz **C** 60 Hz **D** 72 Hz

27 The diagram shows an experiment which has been set up to demonstrate two-source interference, using microwaves of wavelength λ.

At O, the detector detects a low signal. As it moves towards X, it detects 2 high signals before reaching at X with a low signal.



What is the path difference $S_2X - S_1X$?

A λ **B** $3\lambda/2$ **C** 2λ **D** $5\lambda/2$

28 A double slit experiment, using light of wavelength 600 nm, results in fringes being produced on a screen. The fringe separation is found to be 1.0 mm.

When the distance between the double slits and the viewing screen is increased **by** 2.0 m, the fringe separation increases **to** 3.0 mm.

What is the separation of the double slits producing the fringes?

A 0.4 mm **B** 0.6 mm **C** 0.9 mm **D** 1.2 mm

29 Under bright conditions, a person's normal pupil diameter is around 3.0 mm. Two objects are 2.0 m away from each other on a sunny day.

What is the ~~minimum~~ maximum distance between the person and the objects such that the person sees them as separate images?

A 6 km **B** 12 km **C** 24 km **D** 36 km

30 Monochromatic light of wavelength 5.30×10^{-7} m is incident normally on a diffraction grating. The first order maximum is observed at an angle of 15.4° to the direction of the incident light.

What is the angle between the first and second order diffraction maxima?

A 7.7° **B** 15.4° **C** 16.7° **D** 32.1°

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