NATIONAL JUNIOR COLLEGE
SENIOR HIGH 1 PROMOTIONAL EXAMINATION
Higher 2

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

PHYSICS

Paper 1 Multiple Choice

Additional Materials: Multiple Choice Answer Sheet

9749/01

29 September 2021
1 hour

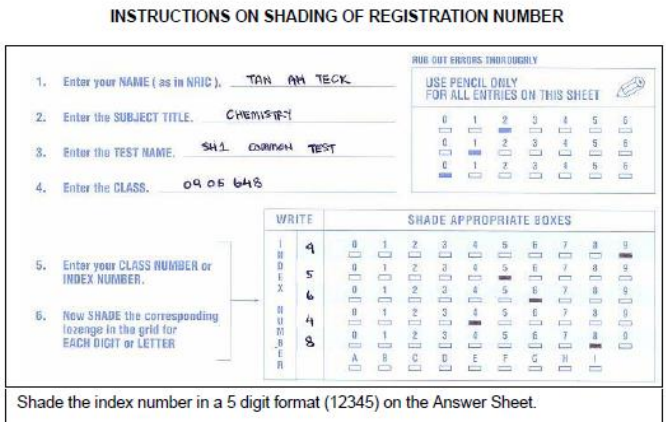
READ THE INSTRUCTION FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, subject class and registration number 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 Optical Mark Sheet.

Read the instructions 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.



Shade the index number in a 5 digit format (12345) on the Answer Sheet.

OAS index number is in 5-digit format.

5 digit format: **2nd digit** and the **last four digits** of the Reg Number.

This document consists of **14** printed pages and **2** blank pages**.**

[Turn over

Data

speed of light in free space	$c = 3.00 \times 10^{8}\,\mathrm{m\,s^{-1}}$
permeability of free space	$\mu_0 = 4\pi \times 10^{-7}\,\mathrm{H\,m^{-1}}$
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\,\mathrm{F\,m^{-1}}$
	$(1/(36\pi)) \times 10^{-9}\,\mathrm{F\,m^{-1}}$
elementary charge	$e = 1.60 \times 10^{-19}\,\mathrm{C}$
the Planck constant	$h = 6.63 \times 10^{-34}\,\mathrm{J\,s}$
unified atomic mass constant	$u = 1.66 \times 10^{-27}\,\mathrm{kg}$
rest mass of electron	$m_e = 9.11 \times 10^{-31}\,\mathrm{kg}$
rest mass of proton	$m_p = 1.67 \times 10^{-27}\,\mathrm{kg}$
molar gas constant	$R = 8.31\,\mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant	$N_A = 6.02 \times 10^{23}\,\mathrm{mol^{-1}}$
the Boltzmann constant	$k = 1.38 \times 10^{-23}\,\mathrm{J\,K^{-1}}$
gravitational constant	$G = 6.67 \times 10^{-11}\,\mathrm{N\,m^{2}\,kg^{-2}}$
acceleration of free fall	$g = 9.81\,\mathrm{m\,s^{-2}}$

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	$\phi = -Gm/r$
temperature	$T/\mathrm{K} = T/^\circ\mathrm{C} + 273.15$
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V} < c^2 >$
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.	$v = v_0 \cos\omega t$ $= \pm\omega\sqrt{x_0^2 - x^2}$
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	$V = \frac{Q}{4\pi\varepsilon_0 r}$
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	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

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1 The table shows the abbreviations for multiples and sub-multiples and their corresponding powers of ten.

Which power of ten is **not** stated correctly?

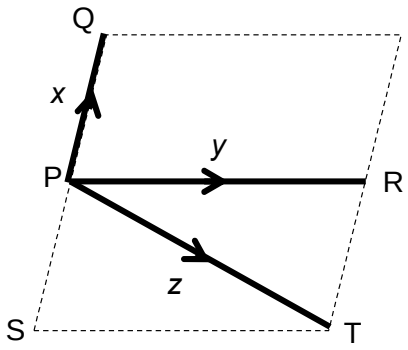
A	pico	10^{-12}
B	nano	10^{-9}
C	mega	10^{6}
D	tera	10^{9}

2 A voltmeter connected across a resistor in a circuit gives readings which have high precision but low accuracy.

Which of the following best describes the likely error in readings taken with this voltmeter?

	random error	systematic error
A	high	high
B	high	low
C	low	high
D	low	low

3 In the diagram, *x* and *y* are two vectors. PS = PQ and ST = PR.



What does vector *z* represent?

A $x + y$ **B** $x - y$ **C** $-x - y$ **D** $y - x$

4 An elevator is moving downwards with an acceleration of 5.8 m s^{-2}. A ball, held 2.0 m above the floor of the elevator and at rest with respect to the elevator, is released.

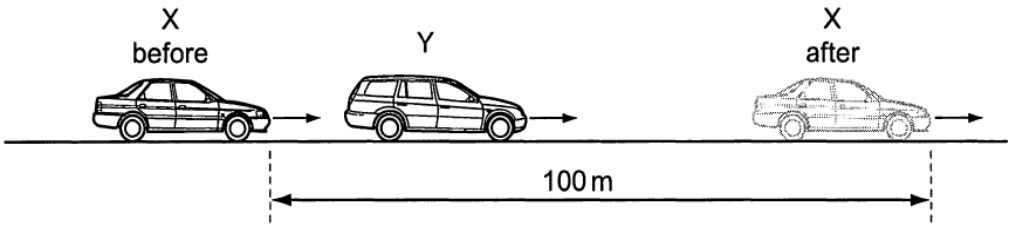
How long does it take for the ball to reach the floor of the elevator?

A 0.51 s **B** 0.64 s **C** 0.83 s **D** 1.00 s

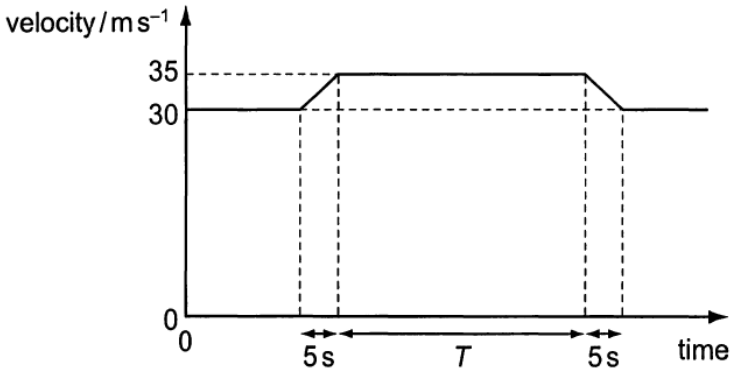
5 Two cars X and Y are initially travelling at 30 m s^{-1} on a straight motorway.

X overtakes Y by accelerating for 5.0 s to 35 m s^{-1}, remaining at 35 m s^{-1} for a time *T* and then decelerating for 5.0 s to 30 m s^{-1}.

X advances by 100 m relative to Y during overtaking.



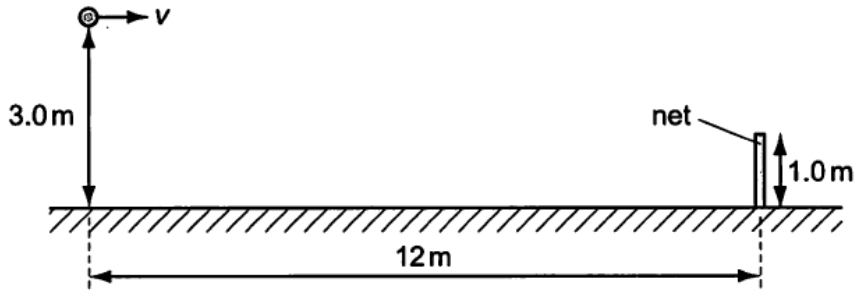
The diagram shows the velocity-time graph for X.



What is time *T* ?

A 10 s **B** 15 s **C** 20 s **D** 25 s

6 In a tennis match, a ball is hit horizontally with a speed *v*, as shown in the diagram.



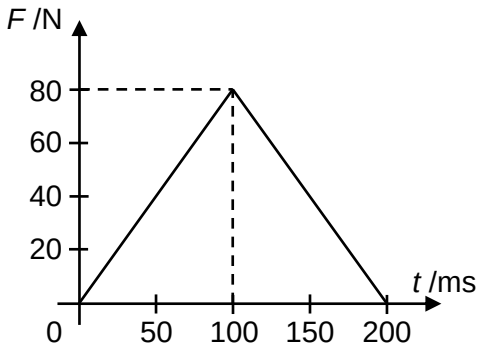
The bottom of the ball is initially 3.0 m above the ground and a horizontal distance of 12 m from the net.

The ball just clears the net, which is 1.0 m high.

What is the value of *v* ? (Neglect the effects of air resistance.)

A 16 m s^{-1} **B** 19 m s^{-1} **C** 30 m s^{-1} **D** 38 m s^{-1}

7 A body of mass 2 kg is traveling at a velocity of 15 m s^{-1} at time $t = 0$. A force F acts in the direction of motion. The variation of the force F with time t is shown in the graph below.



What is the velocity of the body at $t = 100$ ms?

A 17 m s^{-1} **B** 19 m s^{-1} **C** 2000 m s^{-1} **D** 4000 m s^{-1}

8 Two identical spheres, each of mass m and traveling with speed v, are moving towards each other.

The two spheres have a head-on elastic collision.

Which statement is correct?

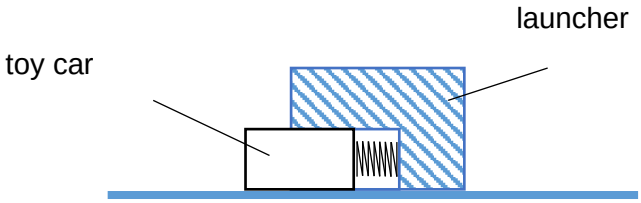
A The sum of the momenta before the impact is $2mv$.

B The total kinetic energy before the impact is zero.

C The total kinetic energy after the impact is mv^2.

D The spheres stick and move together after impact.

9 A toy car can be launched from its launcher remotely. The mass of the car is m while the launcher's mass is $4m$. The toy is placed stationary on a smooth surface as shown. The toy car is launched with an initial kinetic energy of K.



What is the kinetic energy of the launcher immediate after the toy car is launched?

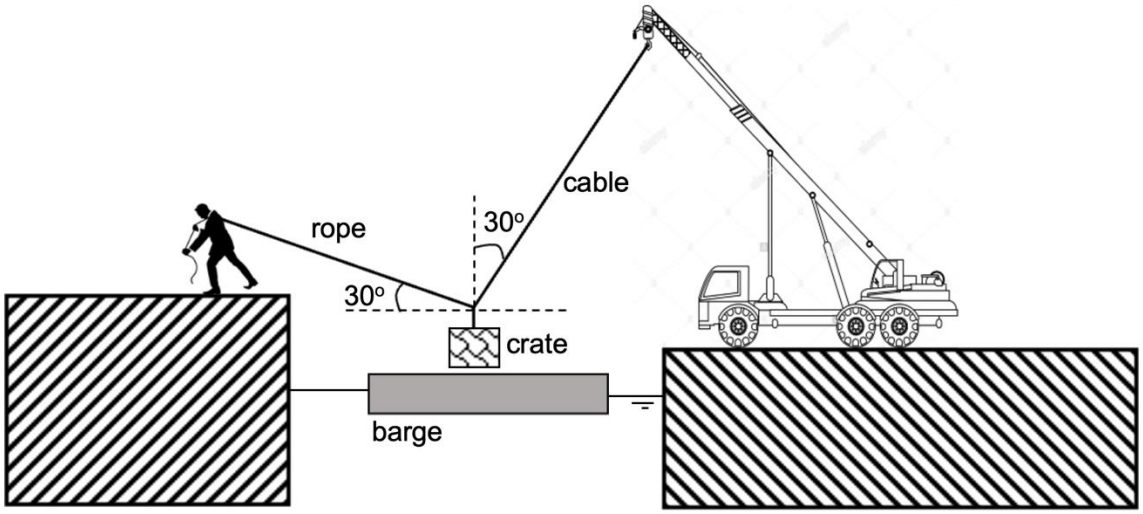
A $\frac{1}{5}K$ **B** $\frac{1}{4}K$ **C** $\frac{1}{16}K$ **D** $\frac{1}{25}K$

10 A General-Purpose Machine Gun shoots bullets at a rate of 750 rounds per minute. Each bullet weighs 5.6 g and its average velocity in its effective range is taken to be 840 m s^{-1}.

What is the force experienced by a target board, if the all the bullet is assumed to hit the target and embedded in the board?

A 35 N **B** 59 N **C** 3.5 kN **D** 59 kN

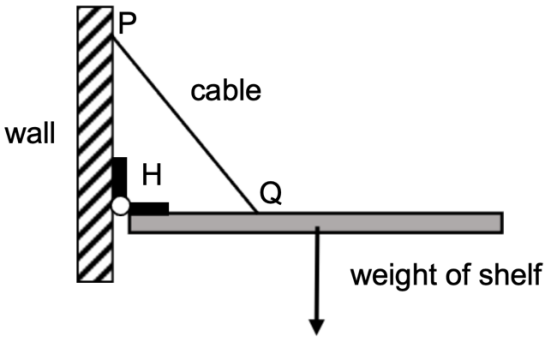
11 A small crane is used to load a crate weighing 600 N onto a barge. The man uses a rope and applies a force of 300 N to the rope.



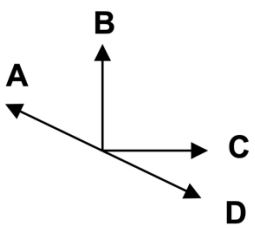
What is the tension in the cable from the crane?

A 690 N **B** 600 N **C** 520 N **D** 300 N

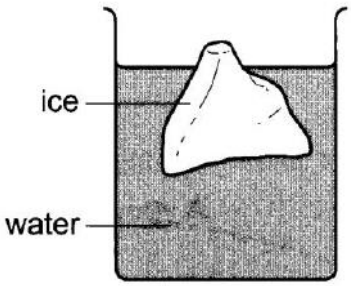
12 A hinged shelf is held horizontally against a wall by a cable PQ. The forces acting on the shelf are its weight, the force exerted by the cable and the force exerted by the hinge H.



Which arrow could represent the direction of the force the hinge exerts on the wall?



13 A lump of ice floats in water as shown.



Which statement correctly explains why it floats?

A The lump of ice floats because the area of its surface is larger than the area of its upper surface.

B The pressure acting upwards on the lower surface of the ice is always larger than the pressure acting downwards on its upper surface.

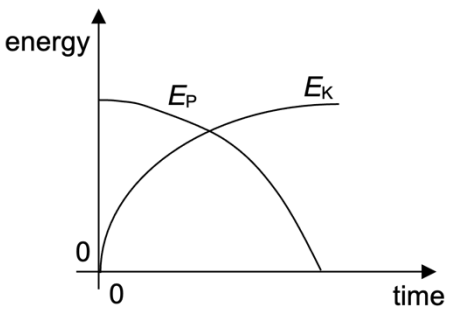
C The mass of water displaced is equal to the upthrust.

D The pressure difference between the lower and upper surfaces of the lump of ice gives rise to an upthrust equal in magnitude to its weight.

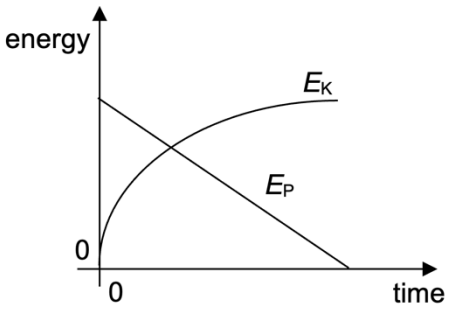
14 A steel ball is released at rest from the surface of oil in a tall cylinder so that it falls to the bottom of the cylinder.

Which graph shows the variation with time of the gravitational potential energy, E_P and the kinetic energy E_K of the ball?

A



B



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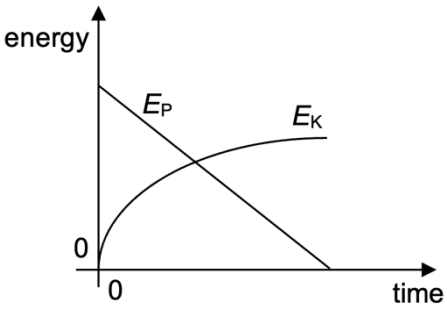
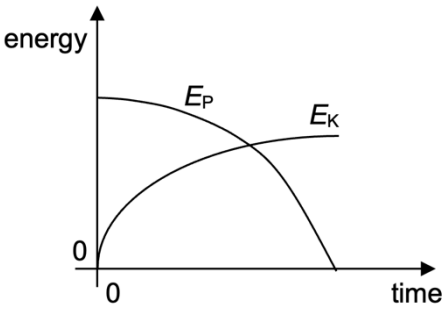


D



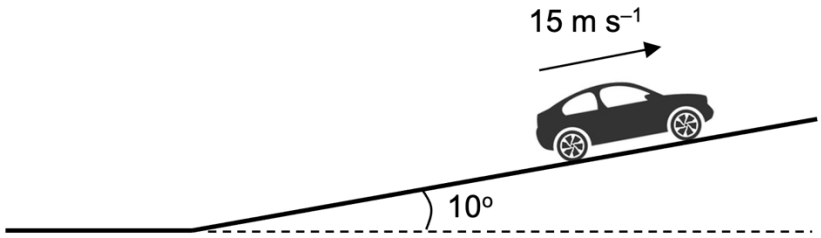
15 In a hydroelectric power station, water is supplied from a reservoir 80 m above the power station. The water passes through its turbines at a rate of 6.0 $m^3\ s^{-1}$.

Assume the density of water is 1000 kg m^{-3}.

If the efficiency of the power station is 60%, what is the electrical power output?

A 4.7 MW **B** 2.8 MW **C** 1.9 MW **D** 0.29 MW

16 A car of mass 1100 kg is travelling at a constant speed of 15 m s^{-1} up a slope inclined at 10° to the horizontal. The combined frictional forces acting on the car are directed down the slope and are equal to $\frac{W}{5}$, where W is the weight of the car.



What is the useful output power of the car's engine?

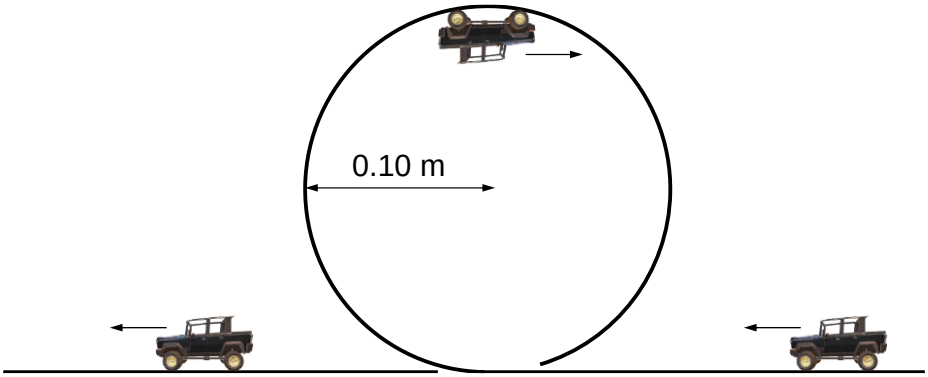
A 190 kW **B** 60 kW **C** 32 kW **D** 28 kW

17 An object travels at constant speed around a circle of radius 1.0 m in 1.0 s.

What is the magnitude of its acceleration?

A zero **B** 1.0 m s^{-2} **C** 2π m s^{-2} **D** $4\pi^2$ m s^{-2}

18 A toy car travels along a track which contains a vertical circular loop of radius 0.10 m as shown.



What is the minimum speed of the car required at the top of the circular loop to prevent it from falling off the track?

A 10 m s^{-1} **B** 1.4 m s^{-1} **C** 1.0 m s^{-1} **D** 0.30 m s^{-1}

19 A small object of mass 0.10 kg is released from rest at the rim of a semi-spherical bowl of radius 20 cm. Take g = 10 m s^{-2}.

The normal reaction force on the object when it passes the bottom of the bowl is

A 3.0 N **B** 2.5 N **C** 2.0 N **D** 1.0 N

20 Values of the acceleration a of a particle moving in simple harmonic motion as a function of its displacement x are given in the table below.

a / mm s^{-2}	16	8	0	–8	–16
x / mm	–4	–2	0	2	4

The period of the motion is

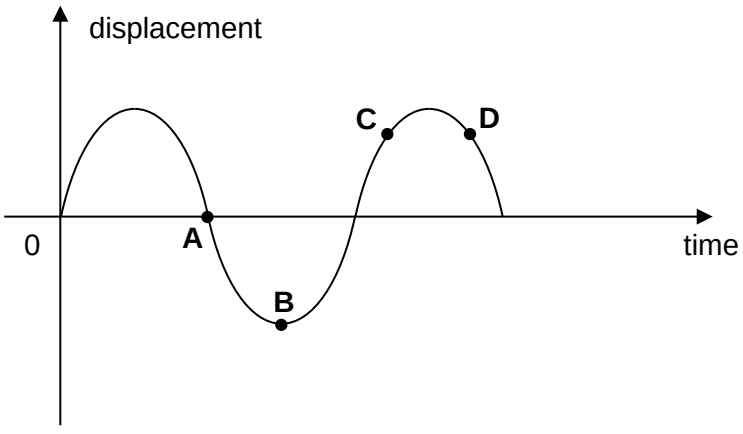
A $\frac{1}{\pi}$ s **B** $\frac{2}{\pi}$ s **C** 2 s **D** π s

21 A small mass executes simple harmonic motion about a point P with amplitude a and period T. Its displacement from P at time $\frac{T}{8}$ after passing through P is

A $\frac{a}{8}$ **B** $\frac{a}{\sqrt{2}}$ **C** $\frac{a}{2\sqrt{2}}$ **D** $\frac{a}{2}$

22 The diagram shows the graph of displacement against time for a body performing simple harmonic motion.

At which point are the velocity and acceleration in opposite directions?



23 Which of the following statements about damped oscillations is true?

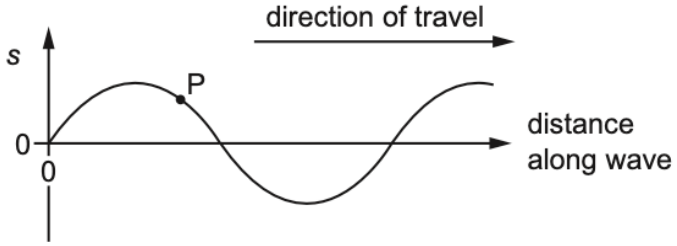
A During light damping, the amplitude of the oscillation decreases exponentially with time while the period of the oscillation stays constant.

B During light damping, the amplitude of the oscillation remains constant while the period of the oscillation increases.

C During critical damping, the amplitude of the oscillation decreases exponentially while the period of the oscillation increases.

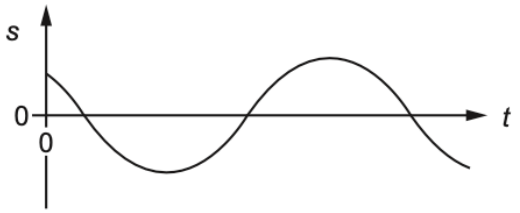
D During critical damping, the amplitude of the oscillation remains constant while the period of the oscillation increases.

24 A wave moves along the surface of water. The diagram shows the variation of displacement *s* with distance along the wave at time *t* = 0.

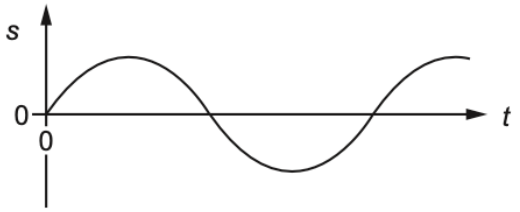


Which graph best shows the variation with time *t* of the displacement *s* of the point P on the wave?

A



B



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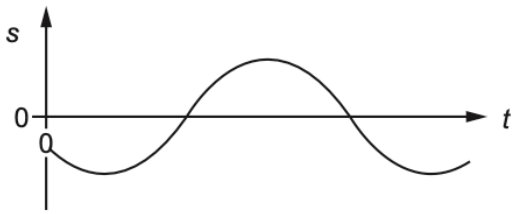

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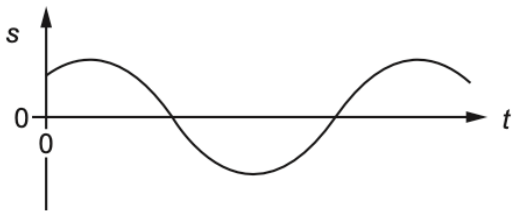
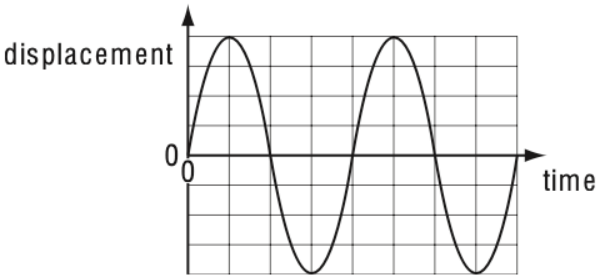


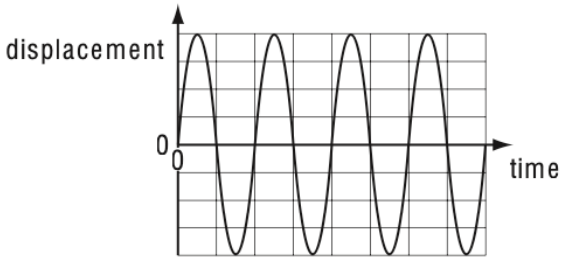
25 The diagram shows a graph of displacement against time for a sound wave.



The intensity of the sound is halved.

Which graph shows the displacement of this sound wave?

A



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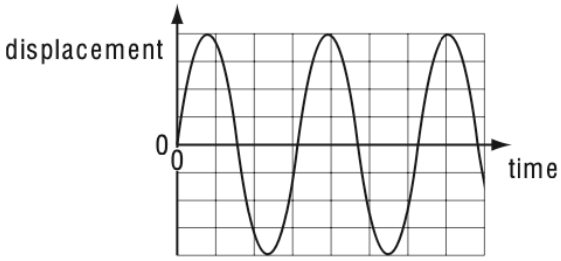

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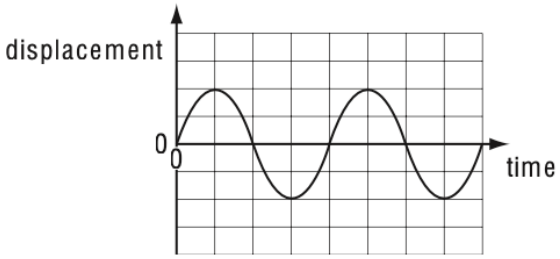
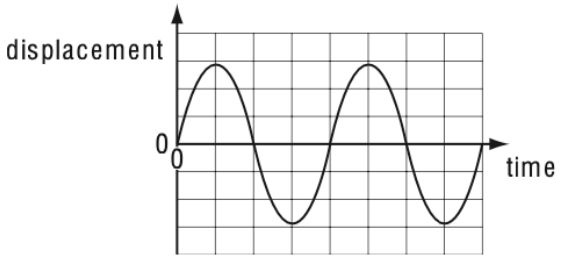


D



26 A point source of sound emits energy equally in all directions at a constant rate and a person 8.0 m form the source listens. After a while, the power of the source is halved. If the person wishes the sound to seem as loud as before, how far should he be now from the source?

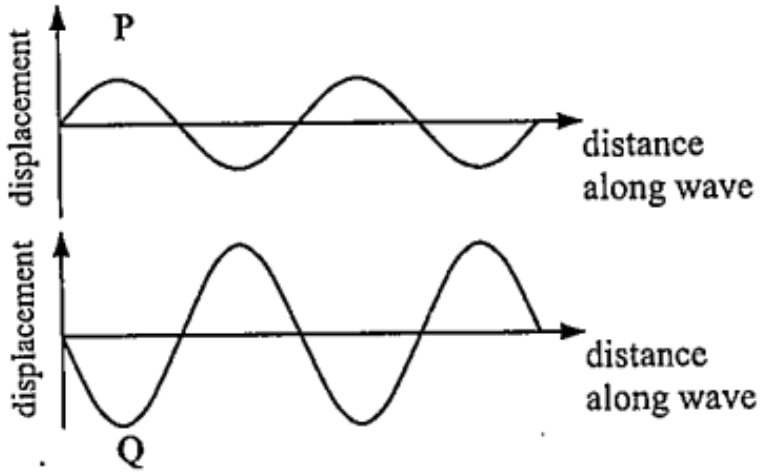
A 2.0 m **B** 2.8 m **C** 4.0 m **D** 5.7 m

27 A vertically polarised beam of light of intensity I_0 enters a polarising filter whose plane of polarisation is at 45° to the vertical.

What is the intensity of the transmitted beam?

A zero **B** $I_0/\sqrt{2}$ **C** $I_0/2$ **D** I_0

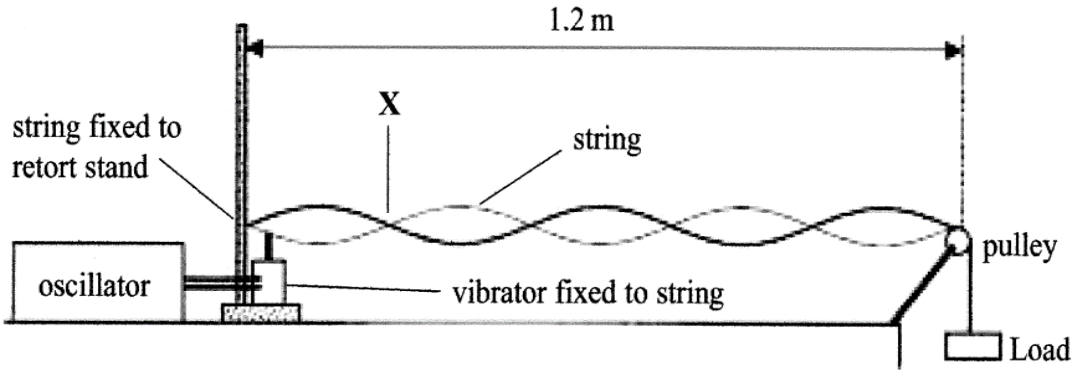
28 Two waves **P** and **Q**, of same frequency, have amplitude Y and $3Y$ respectively.



Which list correctly shows the amplitude of the resultant wave and the phase difference the resultant wave and wave **P**?

	amplitude of resultant wave	phase difference between resultant wave and wave **P** / radians
A	$2Y$	0
B	$2Y$	π
C	$4Y$	0
D	$4Y$	π

29 The figure below shows an arrangement to investigate stationary (standing) waves on a stretched string. The stationary wave appears as shown below when the frequency of the oscillator is set at 75 Hz.

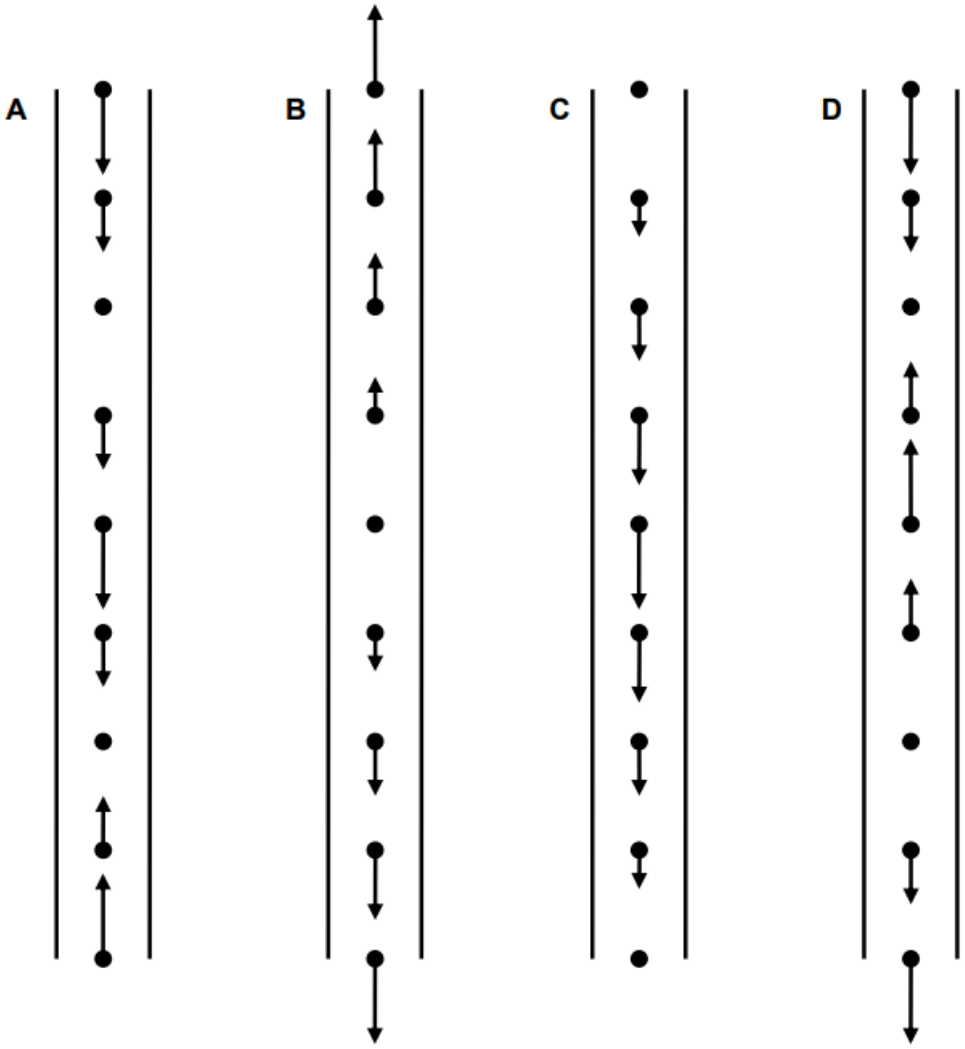


What is the frequency that would produce a stationary wave with two loops on this string?

A 15 Hz **B** 30 Hz **C** 60 Hz **D** 75 Hz

30 The arrows on the diagrams represent the movement of air molecules in a pipe which a stationary longitudinal wave has been set up. The length of each arrow represents the amplitude of the motion, and the arrow head shows the direction of motion at a particular instant.

Which diagram shows a possible stationary wave in which there are two displacement nodes and three displacement antinodes?



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