

Name

Index Number

Anglo-Chinese School
(Independent)



END-OF-YEAR EXAMINATION 2024
YEAR 5 IB DIPLOMA PROGRAMME

PHYSICS (HIGHER LEVEL)

PAPER 1A

Monday

23 September 2024

2 hours

INSTRUCTIONS TO STUDENTS

Write your index number in the provided OTAS sheet.

Do not open this booklet until you are told to do so.

There are 40 questions. Answer all the questions.

For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

The maximum mark for paper 1A is [40 marks].

The maximum mark for paper 1A and 1B is [60 marks].

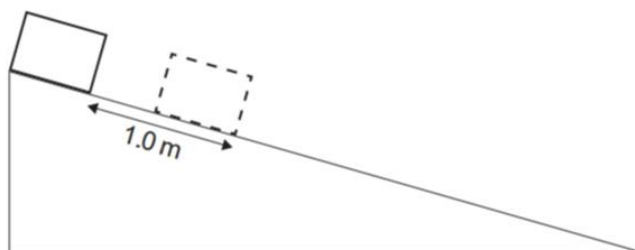
The combined time for both Paper 1A and Paper 1B is 2 hours.

INFORMATION FOR STUDENTS

Data booklet will be provided.

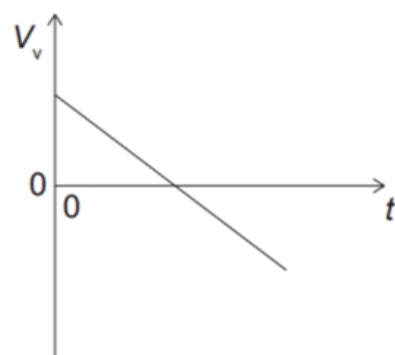
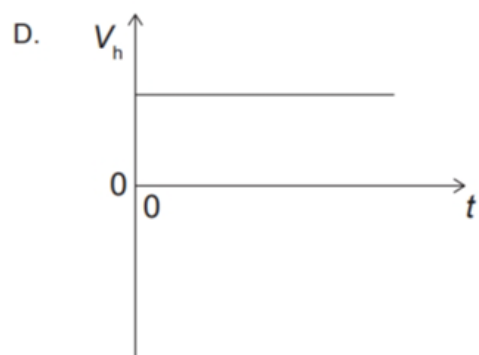
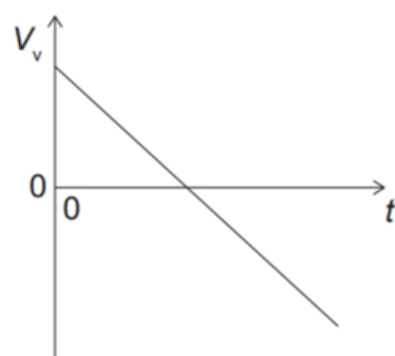
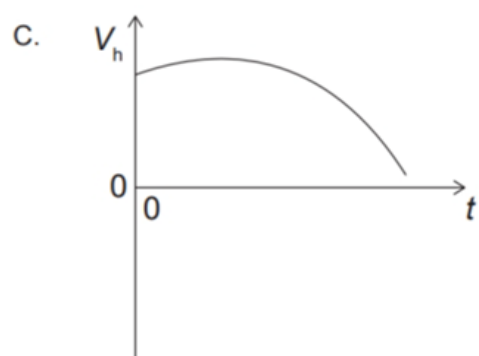
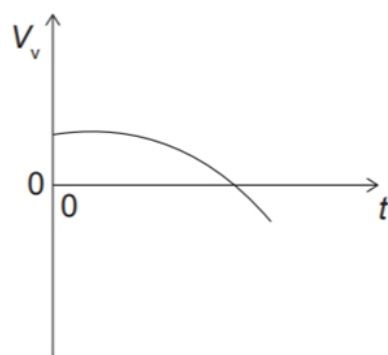
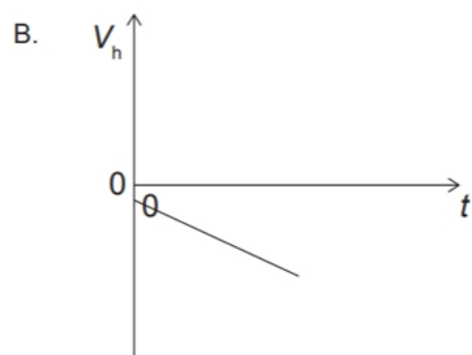
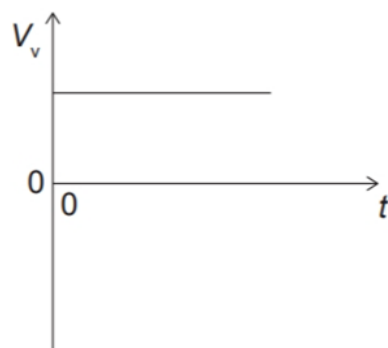
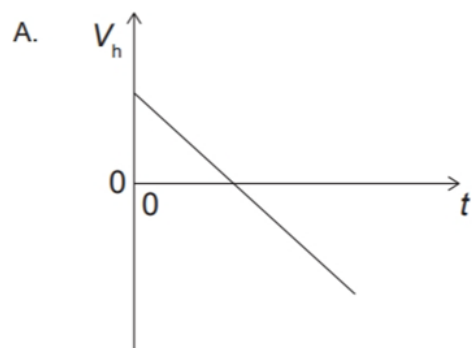
Calculators are allowed for this paper.

- 1 An object is sliding from rest down a frictionless inclined plane. The object slides 1.0 m during the first second. What additional distance will the object slide during the next second?

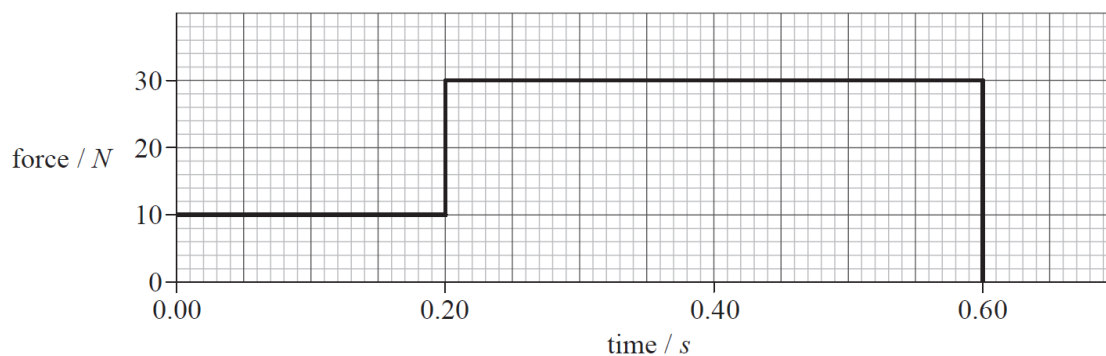


- A 1.0 m
B 2.0 m
C 3.0 m
D 4.9 m
- 2 A ball is thrown horizontally at a speed of 15 m s^{-1} from the top of a cliff that is 80 m above the surface of the sea. Air resistance is negligible. What is the distance from the bottom of the cliff to the point where the ball lands in the sea?
- A 45 m
B 61 m
C 80 m
D 240 m
- 3 A balloon rises at a steady vertical velocity of 10 m s^{-1} . An object is dropped from the balloon at a height of 40 m above the ground. Air resistance is negligible. What is the time taken for the object to hit the ground?
- A 10 s
B 5.1 s
C 4.1 s
D 2.1 s

- 4 A projectile is launched at an angle above the horizontal with a horizontal component of velocity V_h and a vertical component of velocity V_v . Air resistance is negligible. Which graphs show the variation with time of V_h and of V_v ?

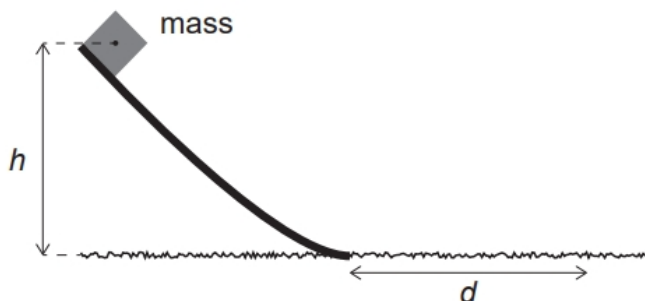


- 5 The graph shows how an external force applied to an object of mass 2.0 kg varies with time. The object is initially at rest.



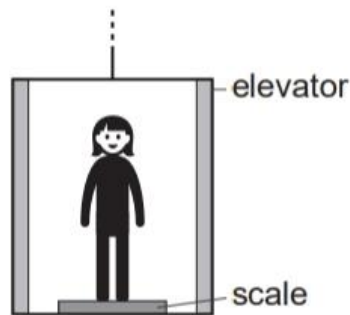
What is the speed of the object after 0.60 s?

- A 7.0 m s⁻¹
 B 14.0 m s⁻¹
 C 18.0 m s⁻¹
 D 28.0 m s⁻¹
- 6 A mass is released from the top of a smooth ramp of height h . After leaving the ramp, the mass slides on a rough horizontal surface. The mass comes to rest in a distance d . What is the coefficient of dynamic friction between the mass and the horizontal surface?



- A $\frac{gd}{h}$
 B $\sqrt{\frac{d}{2gh}}$
 C $\frac{d}{h}$
 D $\frac{h}{d}$

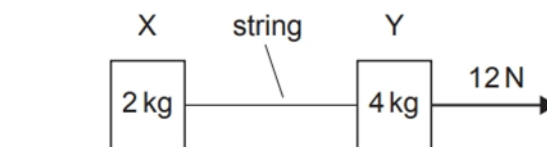
- 7 A person with a weight of 600 N stands on a scale in an elevator. What is the acceleration of the elevator when the scale reads 900 N?



- A 4.9 m s^{-2} downwards
 B 1.5 m s^{-2} downwards
 C 1.5 m s^{-2} upwards
 D 4.9 m s^{-2} upwards
- 8 An object of mass 8.0 kg is falling vertically through the air. The drag force acting on the object is 60 N. What is the best estimate of the acceleration of the object?

- A zero
 B 2.3 m s^{-2}
 C 7.5 m s^{-2}
 D 10 m s^{-2}

- 9 X and Y are two objects on a frictionless table connected by a string. The mass of X is 2 kg and the mass of Y is 4 kg. The mass of the string is negligible. A constant horizontal force of 12 N acts on Y. What are the acceleration of Y and the magnitude of the tension in the string?

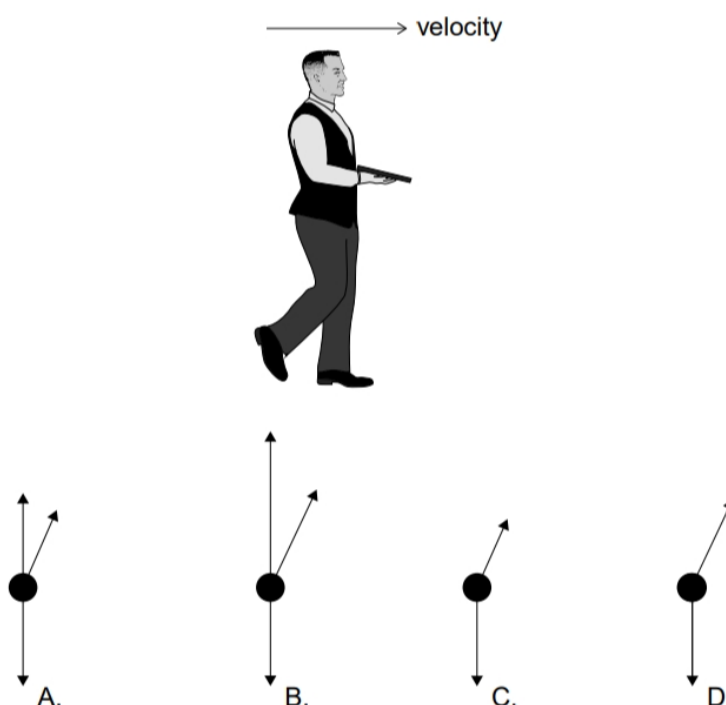


	Acceleration of Y/ m s^{-2}	Tension in the string/ N
A	2	4
B	2	6
C	3	4
D	3	6

- 10 An object of mass $2m$ moving at velocity $3v$ collides with a stationary object of mass $4m$. The objects stick together after the collision. What is the final speed and the change in total kinetic energy immediately after the collision?

	Final speed	Change in total kinetic energy
A	v	$3mv^2$
B	v	$6mv^2$
C	$2v$	$3mv^2$
D	$2v$	$6mv^2$

- 11 A waiter carrying a tray is accelerating to the right as shown in the image. What is the free-body diagram of the forces acting on the tray?

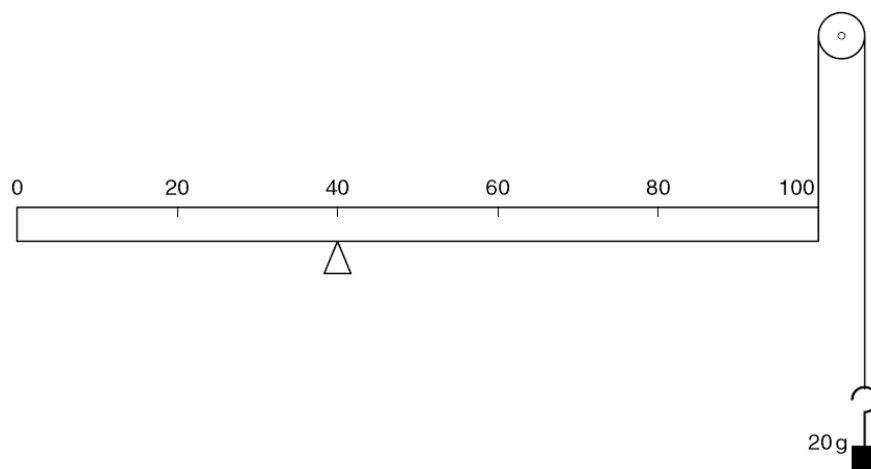


- 12 A force of magnitude F_1 accelerates a body of mass m from rest to a speed v . A force of magnitude F_2 accelerates a body of mass $2m$ from rest to a speed $2v$.

The ratio $\frac{\text{work done by } F_2}{\text{work done by } F_1}$ is

- A 2
B 4
C 8
D 16

- 13 A car takes 20 minutes to climb a hill at constant speed. The mass of the car is 1200 kg and the car gains gravitational potential energy at a rate of 6.0 kW. What is the height of the hill?
- A 0.6 m
B 12 m
C 612 m
D 6100 m
- 14 A cyclist rides up a hill of vertical height 100 m in 500 s at a constant speed. The combined mass of the cyclist and the bicycle is 80 kg. The power developed by the cyclist is 200 W. What is the efficiency of the energy transfer in this system?
- A 8 %
B 28 %
C 58 %
D 78 %
- 15 A bar rotates horizontally about its center, reaching a maximum angular speed in six complete rotations from rest. The bar has a constant angular acceleration of 0.11 rad s^{-2} . What is the final angular speed of the bar?
- A 2.0 rad s^{-1}
B 2.9 rad s^{-1}
C 4.1 rad s^{-1}
D 8.3 rad s^{-1}
- 16 A uniform metre rule of mass 100 g is supported by a knife-edge at the 40 cm mark and a string at the 100 cm mark. The string passes round a frictionless pulley and carries a mass of 20 g as shown in the diagram. At which mark on the rule must a 50 g mass be suspended so that the rule balances?



- A 4 cm B 36 cm C 44 cm D 96 cm

- 17 Two stars X and Y are at different distances from an observer. Star X has a radius twice that of Star Y . The surface temperature of Star X is half of Star Y . Star X is also three times further away from the observer than Star Y .

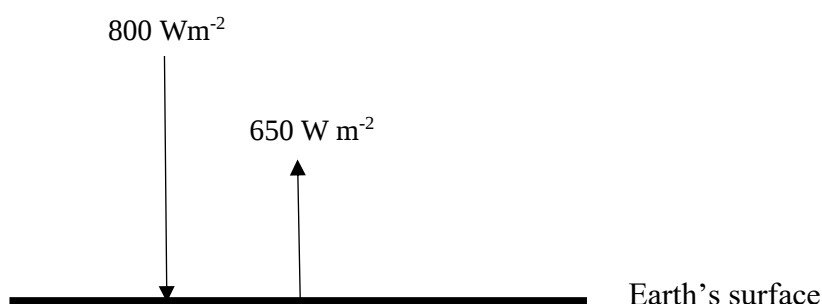
What will be the ratio $\frac{\text{brightness of Star } X}{\text{brightness of Star } Y}$?

- A $\frac{36}{1}$ B $\frac{1}{36}$ C $\frac{6}{1}$ D $\frac{1}{6}$

- 18 A container filled with an ideal gas is at a temperature of 80°C . The average speed of the gas molecules is 350 m s^{-1} . The temperature of the gas is increased to 160°C . What is now the average speed of the gas molecules?

- A 390 m s^{-1} B 430 m s^{-1} C 490 m s^{-1} D 700 m s^{-1}

- 19 The diagram shows the incident and radiated intensities of the solar radiation on a region of the Earth's surface.

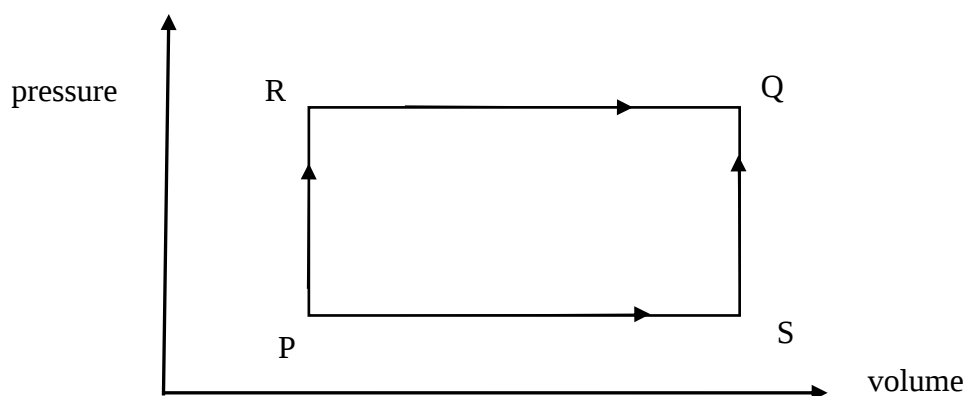


What is the albedo of the region?

- A 0.82 B 0.23 C 0.19 D 1
- 20 The average intensity of the solar radiation incident at right angle to the surface of a planet is 360 W m^{-2} . The emissivity of the planet is 0.60. What is the surface temperature of the planet?
- A 355 K B 321 K C 282 K D 169 K
- 21 An ideal gas has an internal energy U at 0°C . The gas is heated to 273°C . What is the internal energy of the gas at 273°C ?

- A $\sqrt{2} U$ B $2 U$ C $4 U$ D $273 U$

- 22 One mole of an ideal gas at atmospheric pressure 1.0×10^5 Pa and temperature 300 K occupies a volume of 0.025 m^3 . The pressure and temperature of the gas are raised to 5.0×10^5 Pa and 600 K. What is the volume that the gas occupies?
- A 0.010 m^3 B 0.025 m^3 C 0.050 m^3 D 0.063 m^3
- 23 A positive amount of thermal energy Q is transferred to an ideal gas from its surroundings. The internal energy of the gas increases and the gas does a positive amount of work W on its surroundings. The change of state of the gas is
- A isochoric (isovolumetric),
B isobaric.
C isothermal.
D adiabatic.
- 24 A fixed mass of gas undergoes changes of pressure and volume as shown.



When the gas is taken from state P to state Q by the stages PR and RQ, 3 J of work is done by it and there is a thermal transfer of 8 J of energy into it. When the same resultant change is achieved by stages PS and SQ, 1 J of work is done by the gas.

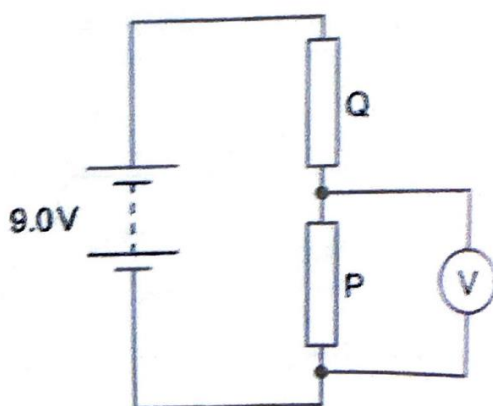
In this case, what is the thermal transfer of energy?

- A 4 J out of the gas
B 6 J into the gas
C 8 J into the gas
D 10 J into the gas

- 25 A beaker contains water at a higher temperature than its surroundings. Which of the following correctly describes the entropy change in the water and in the surroundings as the water cools?

	entropy of the water	entropy of the surroundings
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

- 26 Two resistors, P and Q are connected in series to a 9.0 V battery with negligible internal resistance.



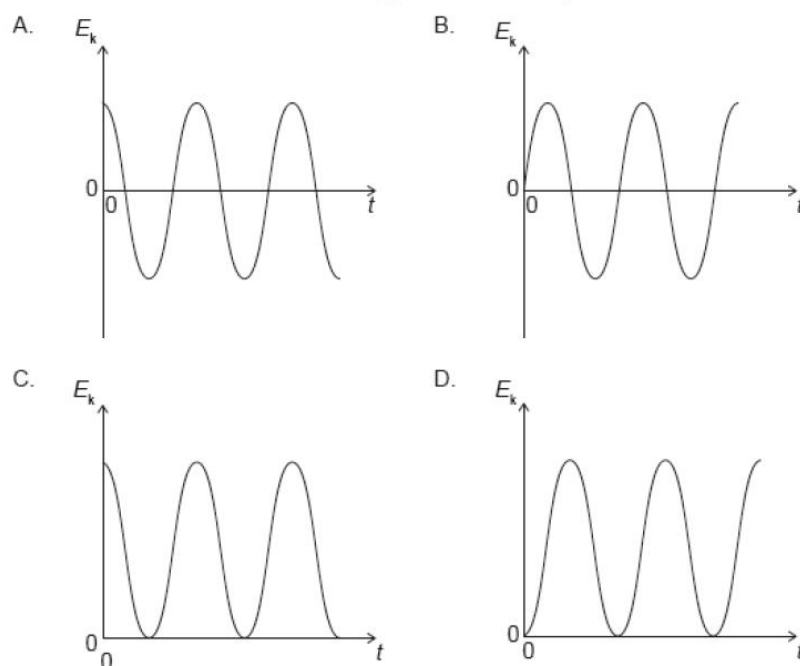
The resistance of the voltmeter is equal to the resistance of P. The reading on the voltmeter is 6.0 V.

What is the value of the ratio $\frac{\text{resistance of the voltmeter}}{\text{resistance of } Q}$?

- A** $\frac{1}{2}$ **B** $\frac{1}{4}$ **C** 2 **D** 4
- 27 Two heating elements X and Y of a domestic fan heater are made of wire of the same resistivity and length. They are connected in parallel to a power supply. Element X transfers energy at a rate of 1.0 kW and element Y transfers energy at a rate of 1.5 kW. The diameters of the wire of the heating elements are d_x and d_y . What is the value of the ratio $\frac{d_x}{d_y}$?
- A** 0.67 **B** 0.82 **C** 1.2 **D** 1.5
- 28 Which group below do all three quantities remain constant when a particle moves in simple harmonic motion?

A	acceleration	force	total energy
B	maximum amplitude	force	total energy
C	acceleration	force	angular frequency
D	maximum amplitude	total energy	angular frequency

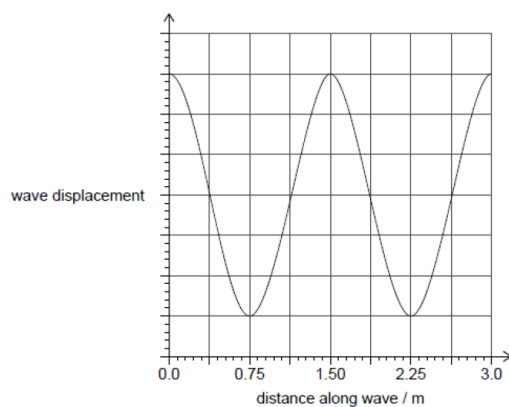
- 29 A particle is displaced to maximum amplitude and released at time $t = 0$. It performs simple harmonic motion (SHM). Which graph shows the variation of time with kinetic energy E_k of the particle?



- 30 A simple mass-spring system of mass m and spring constant k undergoes simple harmonic motion (SHM) oscillates with time period T and angular frequency ω . The mass is increased to $2m$ and spring constant is reduced to $\frac{1}{2}k$. Which of the following gives the new value of angular frequency?

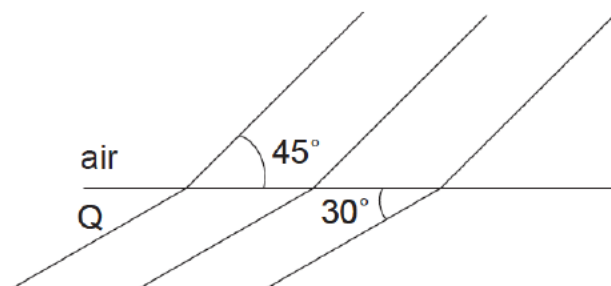
- A 2ω
- B 4ω
- C $\frac{1}{2}\omega$
- D $\frac{1}{4}\omega$

- 31 The graph shows the variation of the displacement of a wave with distance along the wave. The wave speed is 0.50 m s^{-1}



What is the period of the wave?

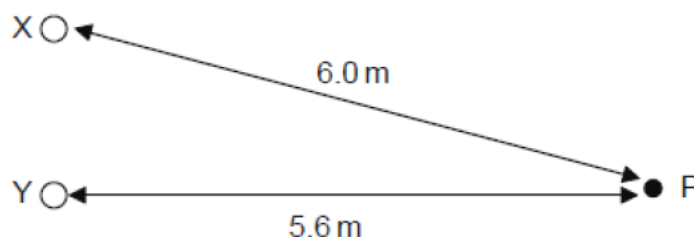
- A 0.33 s
 - B 1.5 s
 - C 3.0 s
 - D 6.0 s
- 32 Wavefronts travel from air to medium Q as shown.



What is refractive index of medium Q?

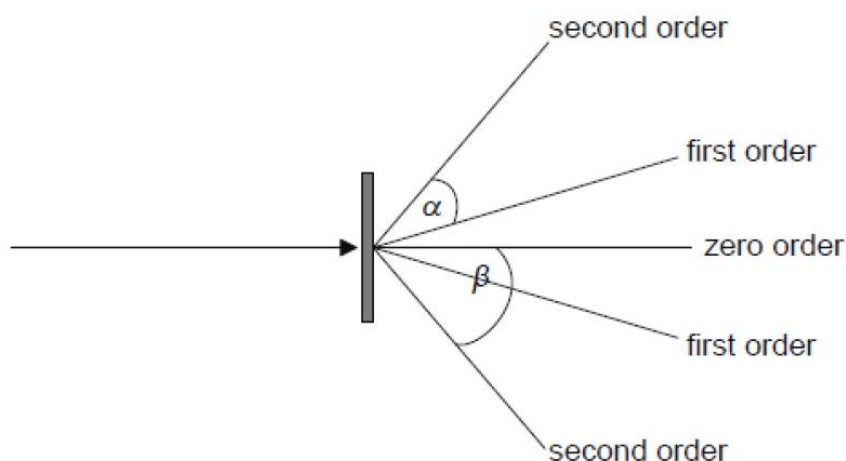
- A $\frac{\sin 30^\circ}{\sin 45^\circ}$
- B $\frac{\sin 45^\circ}{\sin 30^\circ}$
- C $\frac{\sin 45^\circ}{\sin 60^\circ}$
- D $\frac{\sin 60^\circ}{\sin 45^\circ}$

- 33 X and Y are two coherent sources of light. The phase difference between X and Y is zero. The intensity at P due to X and Y separately is I . The wavelength of each wave is 0.20 m.



What is the resultant intensity at P?

- A 0
 B I
 C $2I$
 D $4I$
- 34 A beam of monochromatic light is incident normally on a diffraction grating. The grating space is d . The angles between the different orders are shown on the diagram.



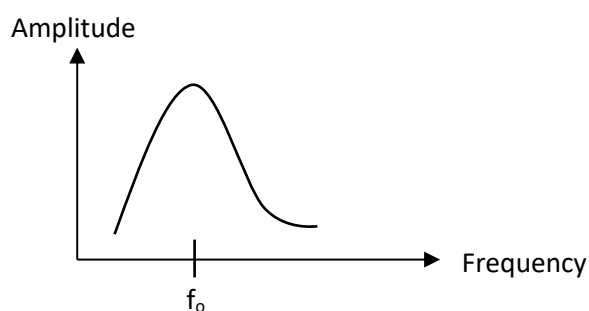
What is the expression for wavelength of light used?

- A $\frac{d \sin \alpha}{2}$ B $\frac{d \sin \beta}{2}$ C $d \sin \alpha$ D $d \sin \beta$
- 35 A tall vertical cylinder is filled with water and a tuning fork vibrating at 300 Hz is held over its open top. The water is slowly run out and the first resonance of the air column is heard when the water level is 0.16 m below the top of the cylinder. Neglecting end corrections, how far from the top will the water level be when the next resonance is heard?
- A 0.24 m B 0.32 m C 0.48 m D 0.64 m

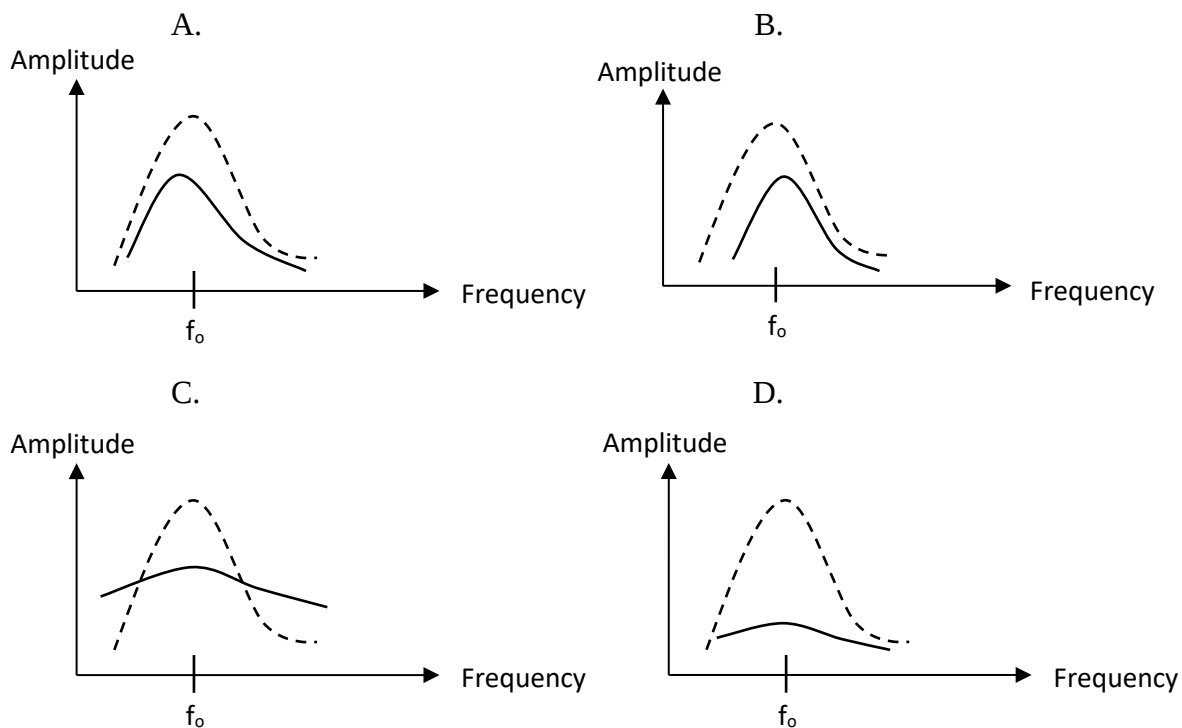
- 36** A string instrument vibrates with fundamental frequency f and the wavelength of the sound produced is λ . Which of the following correctly gives the frequency of vibration of the 8th harmonic of the string and the wavelength of the sound in air?

	Frequency	Wavelength
A	$\frac{f}{4}$	$\frac{\lambda}{8}$
B	$8f$	8λ
C	$\frac{f}{4}$	8λ
D	$8f$	$\frac{\lambda}{8}$

- 37 A certain object is set to oscillate. The graph below shows the variation in frequency of the amplitude of oscillation of a certain mass.



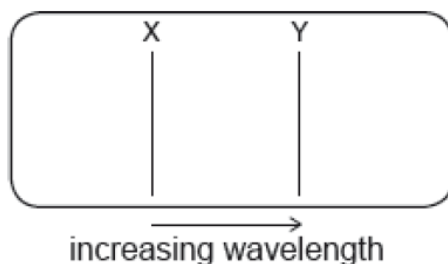
The oscillation of the object is now lightly damped. Which of the following graphs best describes how the amplitude of oscillation will now vary with frequency?



- 38 An ambulance siren emits a sound of frequency 1200 Hz . The speed of sound in air is 330 m s^{-1} . The ambulance moves towards a stationary observer at a constant speed of 40 m s^{-1} . What is the frequency heard by the observer?

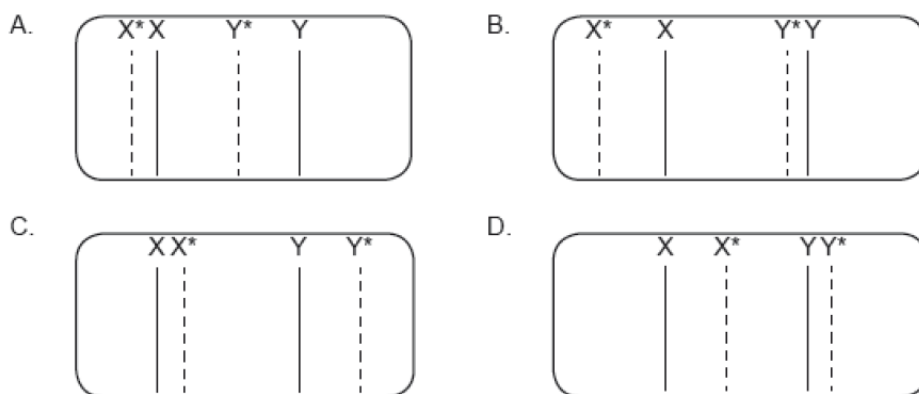
A $\frac{1200 \times 330}{370}$
B $\frac{1200 \times 290}{330}$
C $\frac{1200 \times 370}{330}$
D $\frac{1200 \times 330}{290}$

- 39 Two lines X and Y in the emission spectrum of hydrogen gas are measured by an observer stationary with respect to the gas sample.



The emission spectrum is then measured by an observer moving away from the gas sample.

What are the correct shifts X^* and Y^* for spectral lines X and Y?



- 40 A point source is moving at a constant speed in a straight line towards the right and emits sound waves of constant frequency. The speed of the source is less than the speed of sound.

Which of the diagrams correctly shows the wavefronts emitted by the source?

