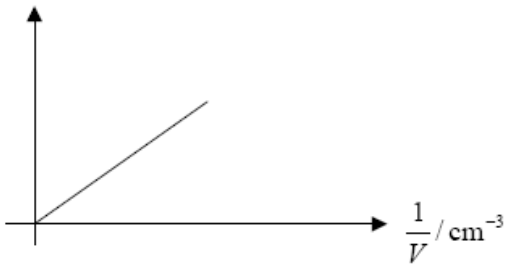
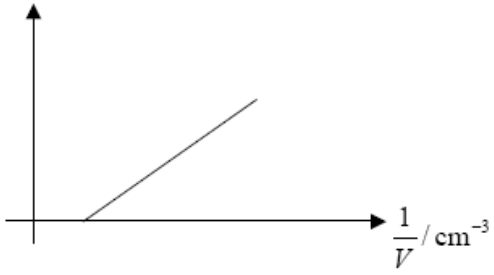
2IB Physics SL+HL. Training May 2008 TM. With argumentation!

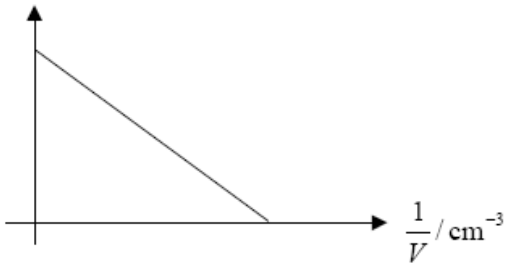
1. N02 S1: 2, H1: 1

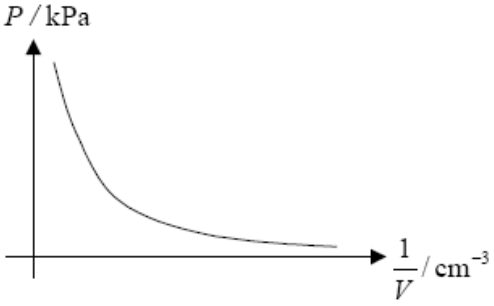
The pressure P, and volume V, of a sample of a gas are measured at constant temperature and a graph of P against $\frac{1}{V}$ is plotted.

Which **one** of the following graphs would be obtained if P is proportional to $\frac{1}{V}$ **and there is a systematic error in the measurement of** ***P***?

A. 

B. 

C. 

D. 

2. N02 H1: 2

The resultant force acting on an object is measured to an accuracy of ± 4 %. The mass of the object is measured to an accuracy of ± 2 %. The acceleration of the object can be calculated to an accuracy of approximately

A. ± 2 %.

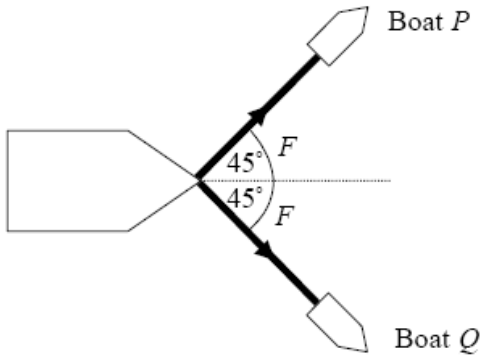
B. ± 4 %.

C. ± 6 %.

D. ± 8 %.

3. N02 S1: 1

Two small identical boats, P and Q, are towing a larger boat which has its engines switched off. The magnitude of the towing force exerted by each small boat is F. The directions of the forces are shown in the diagram below.



The magnitude of the **total** towing force on the large boat is

A. F.

B. $2F$.

C. $\frac{F}{\sqrt{2}}$.

D. $\sqrt{2} \times F$.

4. N02 S1: 5

A car is travelling in a straight line along a horizontal road with speed v. The driver pushes the brake pedal and the maximum braking force is applied. The car travels a distance d in coming to rest. If the car had been travelling at twice the speed, $2v$, the distance travelled in coming to rest would be

A. $4d$.

B. $3d$.

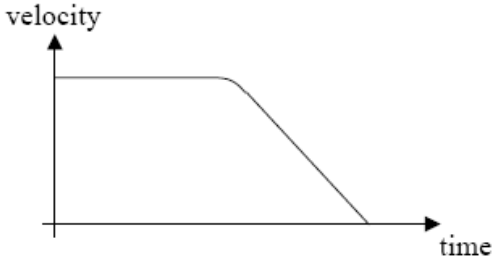
C. $2d$.

D. d

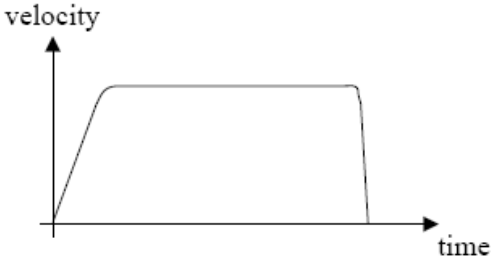
5. N02 S1: 3

A woman parachutist jumps from a plane. After free falling for a short while, she opens her parachute and lands safely on the ground. Which **one** of the following graphs best shows how her velocity varies from the moment that she leaves the plane to the moment she lands on the ground?

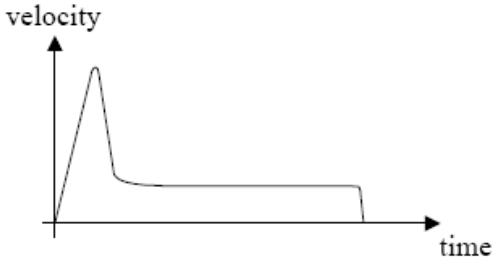
A.



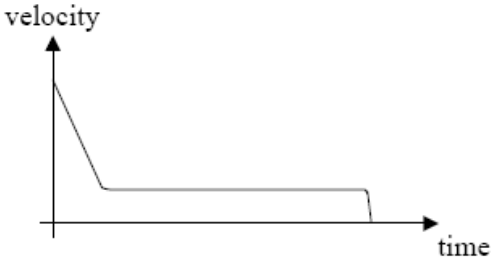
B.



C.



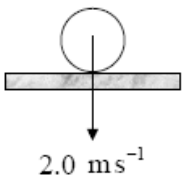
D.



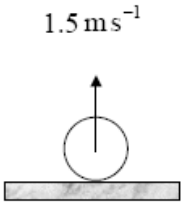
6. N02 S1: 4

A ball is dropped on to a flat horizontal surface. Just before it hits the surface it is moving at a speed of 2.0 ms^{-1}. After bouncing, it leaves the surface at a speed of 1.5 ms^{-1} as shown in the diagrams below.

Just **before** hitting surface



Just **after** leaving surface



If the ball is in contact with the ground for 0.1 s, the magnitude of its average acceleration during contact with the ground is

A. 35 ms^{-2}.

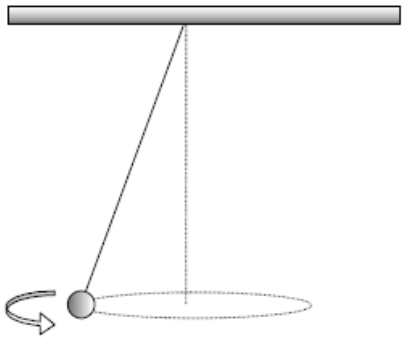
B. 20 ms^{-2}.

C. 15 ms^{-2}.

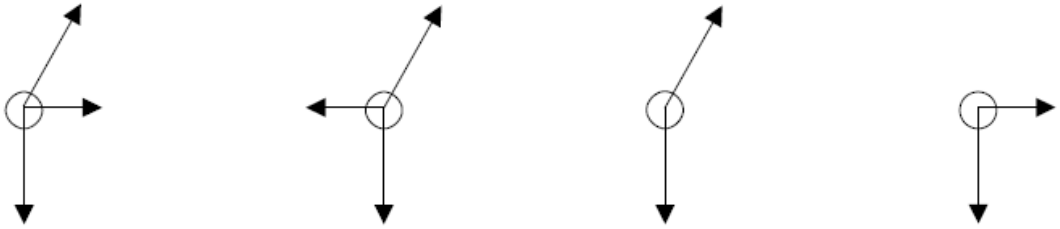
D. 5 ms^{-2}.

7. N02 S1: 6, H1: 3

A ball is swinging in a horizontal circle as shown in the diagram below.



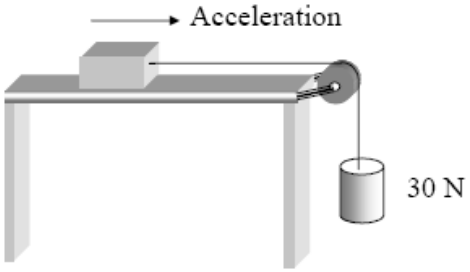
Which **one** of the following diagrams best shows the forces acting on the ball when it is at the position shown above?



A. B. C. D.

8. N02 H1: 4

In the situation below, a 30 N weight is attached to a block. The block accelerates along a horizontal surface. Friction is negligible.



The tension in the string is

A. greater than 30 N.

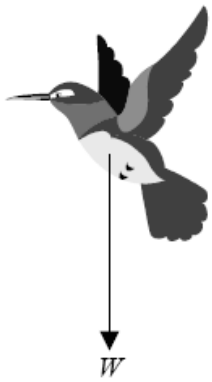
B. 30 N.

C. less than 30 N.

D. zero.

9. N02 S1: 7

Newton's third law identifies **pair**s of forces that are equal in magnitude. One of the forces acting on a bird in flight is the gravitational force *W* downwards (exerted by the Earth) as shown below.



The Newton's third law force **that pairs with** *W* is the

A. upwards force on the bird (exerted by the air).

B. downwards force on the air (exerted by the bird).

C. upwards force on the Earth (exerted by the bird).

D. downwards force on the Earth (exerted by the air).

10. N02 S1: 8, H1: 5

A ball is thrown vertically upwards into the air. At the highest point, its **acceleration** is

A. zero but about to become upwards.

B. zero but about to become downwards.

C. upwards.

D. downwards.

11. N02 H1: 6

An object accelerates uniformly from rest in a straight line. During the first 10 seconds it travels a total of 25 m. Its velocity **at 10** s is

A. 5.0 ms^{-1}.

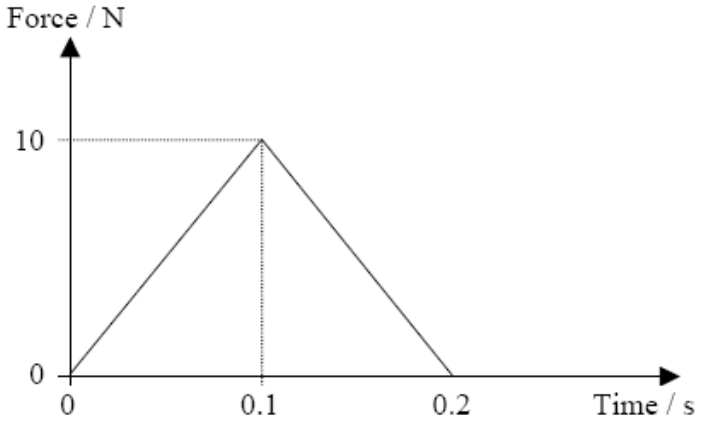
B. 2.5 ms^{-1}.

C. 0.5 ms^{-1}.

D. 0.0 ms^{-1}.

12. N02 S1: 9, H1: 7

A varying force acts upon an object. The graph below shows how the force varies with time.



The impulse received by the object is

A. 100 N s.

B. 10 N s.

C. 2 N s.

D. 1 N s.

13. N02 S1: 10, H1: 8

A car **accelerates uniformly** from rest. It attains a speed v after having travelled a distance d. If air resistance can be ignored, the best estimate for the speed attained after having travelled a distance $2d$ is

A. v.

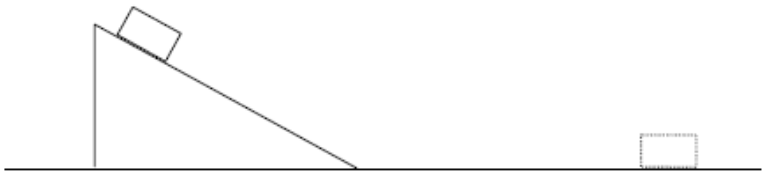
B. $\sqrt{2}\,v$.

C. $2v$.

D. $4v$.

14. N02 S1: 11

A block slides from rest down a smooth slope onto a rough horizontal floor where it comes to rest.



Which of the following best represents the energy changes taking place?

A. Potential → kinetic → potential

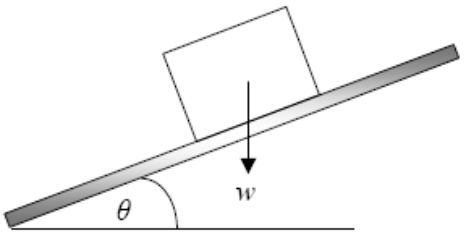
B. Kinetic → potential → thermal

C. Potential → thermal → kinetic

D. Potential → kinetic → thermal

15. N02 H1: 9

A block of weight w is at rest on a slope as shown below.



If the coefficient of static friction is μ and the angle between the slope and the horizontal is θ, then the frictional force between the slope and the block is

A. zero.

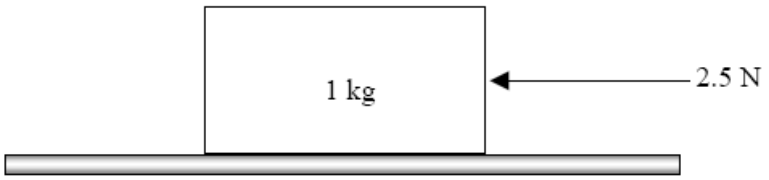
B. $w \cos \theta$.

C. $\mu w \cos \theta$.

D. $\mu w \sin \theta$.

16. N02 H1: 10

A block of mass 1.0 kg is placed on a rough horizontal surface and a horizontal force of 2.5 N is applied to the block as shown below.



The following data is available:

Coefficient of **static** friction = 0.3
Coefficient of **dynamic** friction = 0.2
Acceleration due to gravity = 10 $m s^{-2}$.

Based on this data, it can be deduced that the block will

A. not move.

B. move at steady speed.

C. move with constant acceleration.

D. move with increasing acceleration.

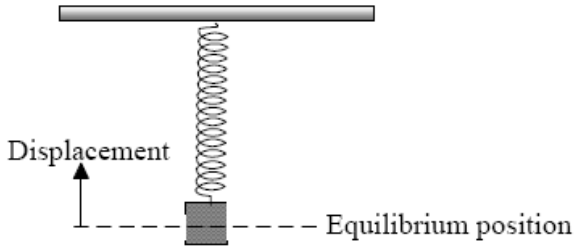
17. N02 S1: 12

A substance changes from a solid to a liquid at **constant temperature.** Which **one** of the following correctly describes the changes in the average interatomic potential energy and the average kinetic energy of the molecules during the process?

	Average interatomic potential energy	**Average kinetic energy**
A.	Increases	Remains constant
B.	Remains constant	Increases
C.	Increases	Increases
D.	Remains constant	Remains constant

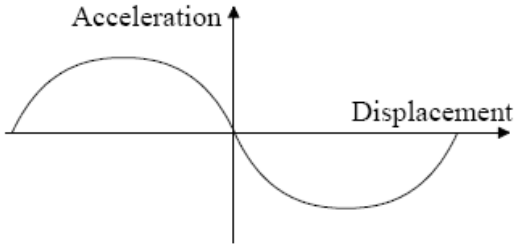
18. N02 H1: 11

A mass on the end of a spring undergoes simple harmonic motion about an equilibrium position as shown below.

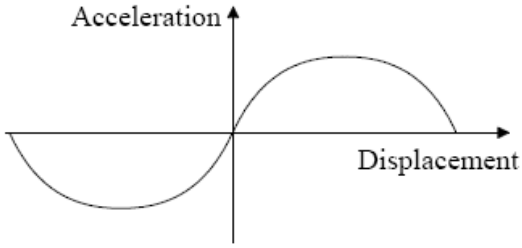


If the upward direction is taken as positive, which graph best represents how the **acceleration** of the mass varies with **displacement** from the equilibrium position?

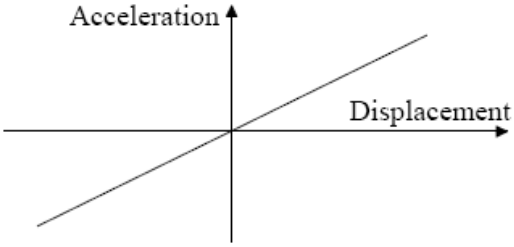
A.



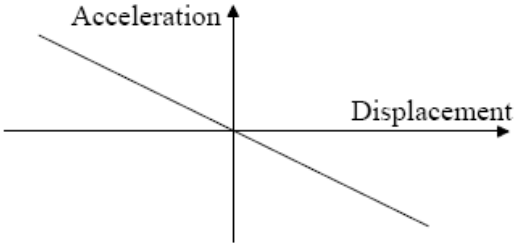
B.



C.



D.



19. N02 S1: 15, H1: 15

When a gas is compressed at constant temperature, the pressure increases. This is because the molecules of the gas

A. repel each other.

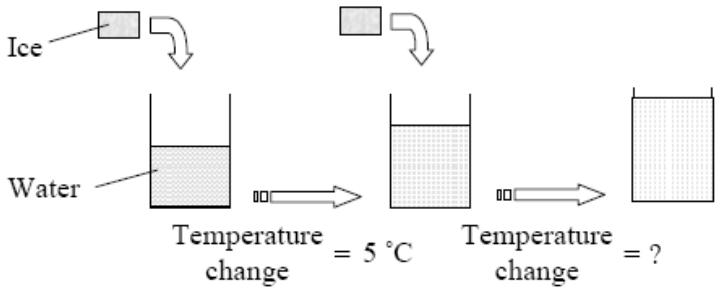
B. are squashed together.

C. hit the walls of the container at a greater average speed.

D. hit the walls of the container more often in a given time.

20. N02 S1: 13, H1: 14

When a lump of ice was added to a beaker of warm water, the resulting water temperature was 5 °C less than the initial temperature of the warm water.



If another identical lump of ice is added to the same beaker, the temperature will

A. go down by another 5 °C.

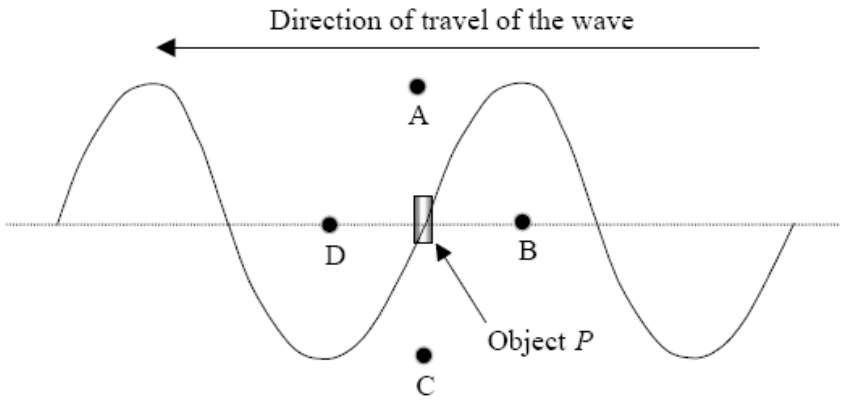
B. not go down at all.

C. go down by more than 5 °C.

D. go down by less than 5 °C.

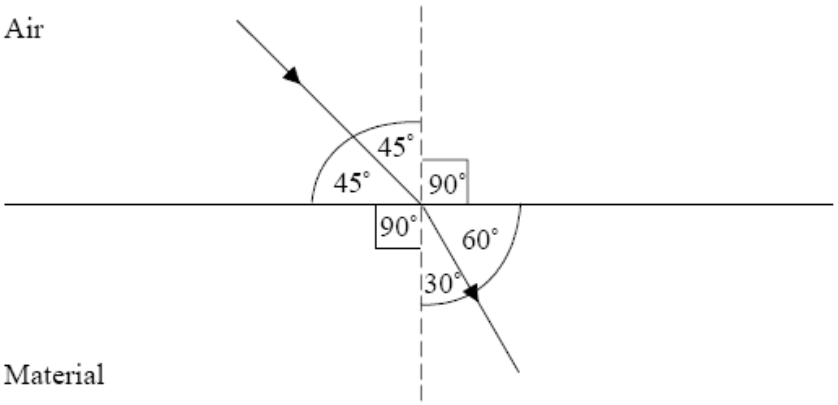
21. N02 S1: 16, H1: 19

The diagram below shows ripples on the surface of water at one instant of time. The ripples are moving **right to left** and a small object, *P*, is floating in the water. After a **quarter** of a time period, which letter correctly shows the position of the floating object?



22. N02 S1: 17, H1: 20

Light is refracted at the interface between air and a material as shown below.



The table below lists the value for the sine of various angles.

Angle	0°	30°	45°	60°	90°
Sin (angle)	0.00	0.50	0.71	0.87	1.00

Which **one** of the following is the best estimate for the refractive index of the material?

A. 0.8

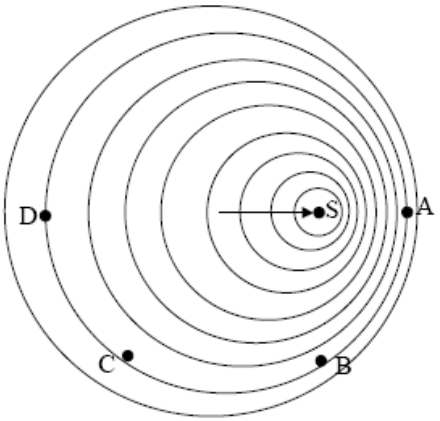
B. 1.2

C. 1.4

D. 1.7

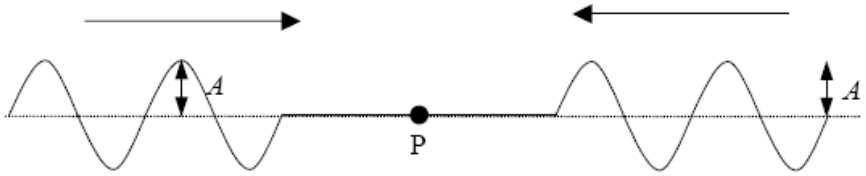
23. N02 H1: 24

The diagram below represents the wavefronts spreading out from a moving source of sound S. The positions of four observers are also shown. If the frequency of the source is *f*, which observer hears a sound closest in value to this frequency when the source is at the position shown?



24. N02 S1: 18

Two waves of equal frequency, wavelength and amplitude, A, are travelling along a string towards the same point P as shown below.



If the waves arrive at P at the same time, which of the following best describes the subsequent motion of the string at point P?

A. It will not move.

B. It will oscillate with amplitude A.

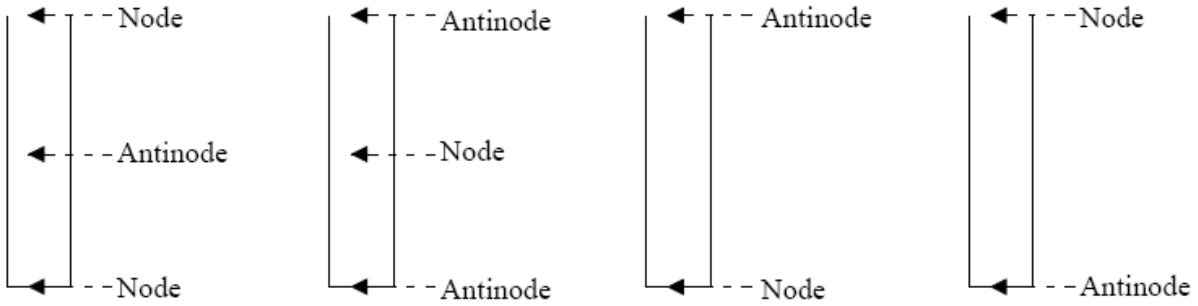
C. It will oscillate with amplitude $2A$.

D. It will oscillate with varying amplitude.

25. N02 S1: 19, H1: 21

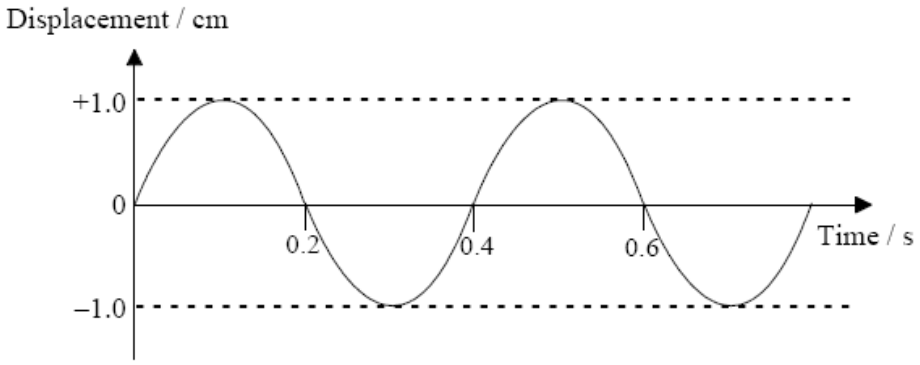
An organ pipe is closed at one end and open at the other as shown below.

Which **one** of the following diagrams correctly shows the positions of the displacement nodes and antinodes when the **fundamental** standing wave is formed in the tube?



26. N02 H1: 22

A longitudinal wave travels down a spring. The graph below shows the variation of **displacement with time** for one piece of the spring.



Which **one** of the following quantities **cannot** be determined from the graph?

A. The amplitude of the wave

B. The time period of the oscillations

C. The speed of the wave

D. The frequency of the wave

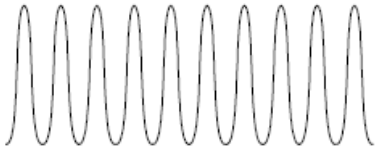
27. M02 S1: 17

Light is incident from air onto on a glass block. What happens to the frequency and wavelength of the light on entering the glass?

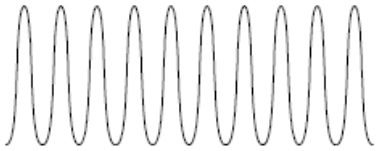
	Frequency	**Wavelength**
A.	changes	changes
B.	changes	unchanged
C.	unchanged	changes
D.	unchanged	unchanged

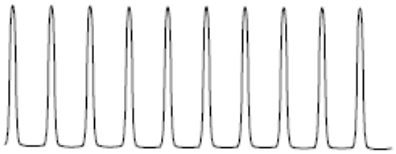
28. M02 S1: 18, H1: 21

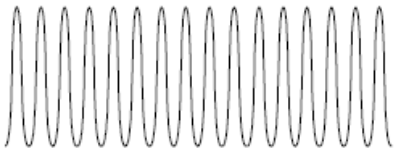
Monochromatic light incident on two narrow parallel slits produces a fringe pattern on a screen, with the intensity distribution shown below.

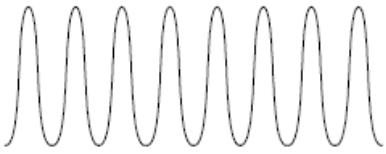


If the same slits were spaced **further apart**, which of the following diagrams best shows the intensity distribution pattern that would result?

A. 

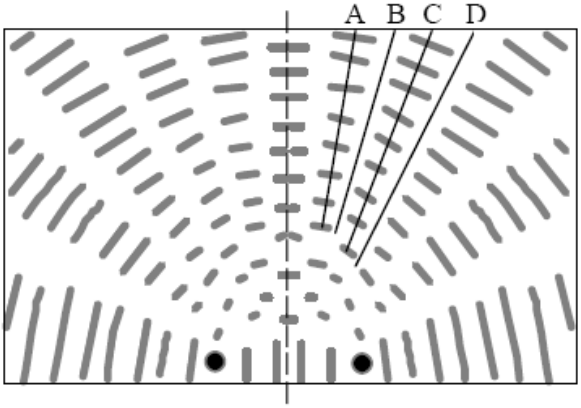
B. 

C. 

D. 

29. M02 H1: 20

Two identical sources dipping in phase into water in a ripple tank generate the wave pattern shown below.



Along which of the labelled lines is the difference in path length from the two sources equal to **two** wavelengths?

A. A

B. B

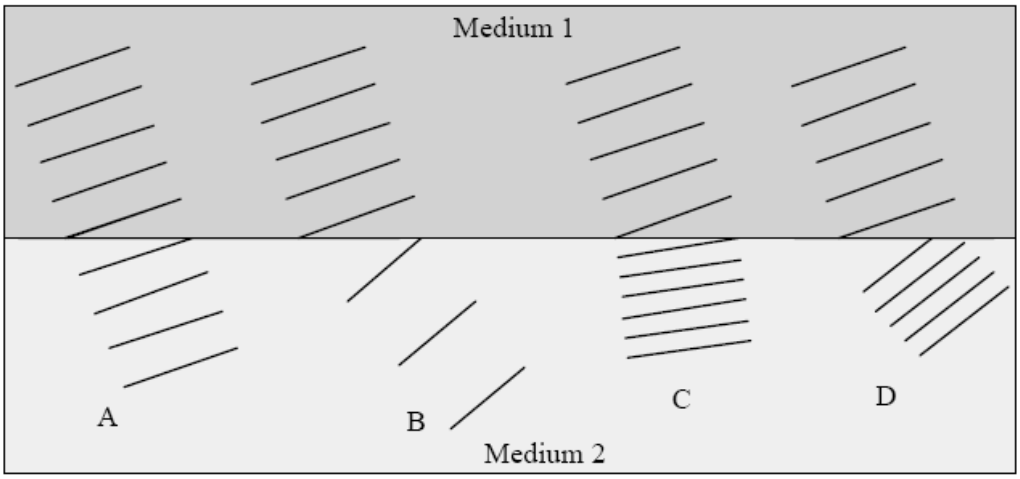
C. C

D. D

30. M02 H1: 22

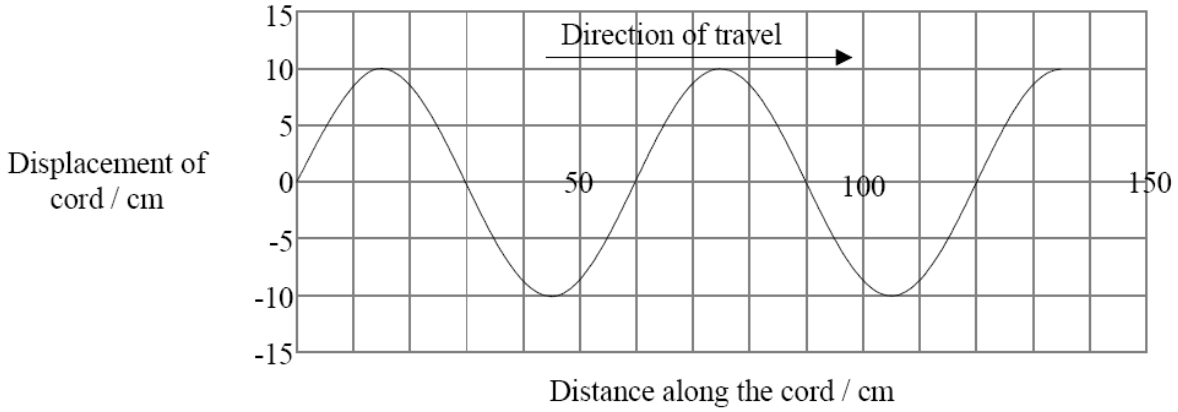
Plane wavefronts approach an interface between two media at an angle.

If the speed of the waves in medium 2 is **greater** than in medium 1, which of the labelled sets below best shows the wavefronts in medium 2?



31. M02 S2: B3p1

The diagram below shows part of a rubber cord along which a wave is travelling.



(a) For this wave determine

(i) its amplitude. *[1]*

(ii) its wavelength. *[1]*

(b) The period of the wave is 0.2 s. What is the speed of the wave? *[2]*

(c) If the above diagram shows the displacement of the cord at time $t = 0$, sketch on the same diagram the displacement of the rubber cord at time 0.1 s later. Explain your sketch. *[3]*

(d) The rubber cord is now stretched between two fixed points 2.5 m apart. If a wave is set up in the cord it travels with a speed of 10 m s^{-1}.

(i) On the diagram below sketch the shape of the standing (stationary) wave pattern produced when the cord is set to vibrate at its fundamental frequency. *[1]*

Undisturbed cord

(ii) Calculate the fundamental frequency of vibration. *[3]*

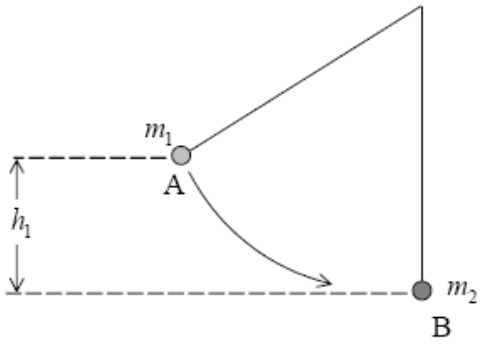
(iii) What is the frequency of vibration of the first harmonic of the stretched cord? *[1]*

32. N02 S2: B1p2, H2: B1p2

Part 2 Pendulum collision

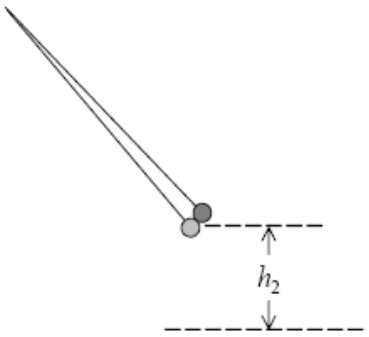
Two balls A and B, of masses m_1 and m_2 respectively, are suspended from a common point by strings of equal length. Ball A is pulled aside to the left, rising a height h_1, as shown in diagram 1 and is then released.

Diagram 1



Ball A swings down, **sticks** to ball B, and the two balls **together** swing up to the right to a height h_2 as shown in diagram 2.

Diagram 2



(a) Deduce an expression for

(i) the speed of m_1 immediately before it collides with m_2. *[2]*

(ii) the speed of m_1 and m_2 immediately after collision. *[4]*

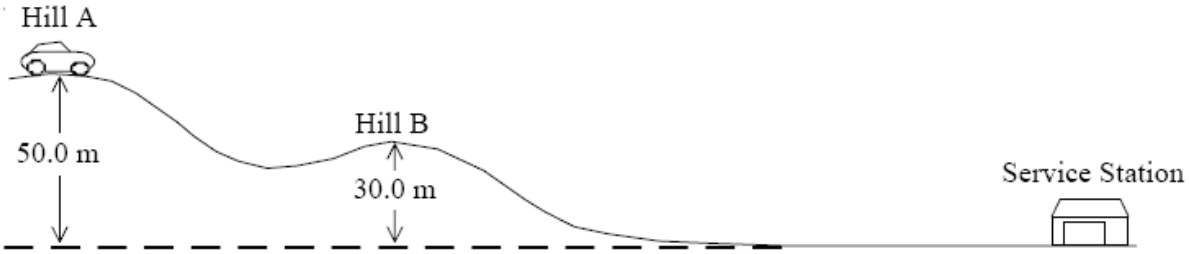
(b) If the expression for the speed of m_1 and m_2 immediately after collision is known, state the name of the principle (law) of physics that enables an expression for the height h_2 to be found in terms of h_1, m_1, m_2 and g. *[1]*

(c) Explain why the height h_2 will always be less than the height h_1. *[1]*

33. N02 S2: B2p2

Part 2 A car rolling down a hill

A car runs out of fuel at the top of hill A. The driver hopes to get to the service station by letting the car roll downhill with its engine switched off. There is a small hill, B, in between as shown. The distance from hill A to hill B along the road is 0.2 km and from hill B to the service station is 0.4 km.



The top of hill A is 50.0 m above the service station and the top of hill B is 30.0 m above the service station.

(a) When the car reaches hill B its speed is $5.0\,m\,s^{-1}$. Assuming that the car starts from rest at hill A, show that the average frictional force acting on the car is 750 N. The mass of the car is 800 kg. *[5]*

(b) Assuming that the frictional force remains constant throughout, determine whether or not the car reaches the service station. *[3]*

(c) Besides friction in the wheels and tyres, name another source of frictional resistance for the moving car, and explain why it will not in fact remain constant during the motion. *[2]*

34. M02 S2: B2

(a) Explain in terms of the microscopic (kinetic) model of an ideal gas

(i) the difference between the temperature of an ideal gas and its internal energy. *[4]*

(ii) why the temperature of a gas, contained in a cylinder fitted with a moveable piston, rises when it is compressed rapidly. *[2]*

(b) An ideal gas is contained in a cylinder fitted with a fixed piston.

The pressure is 1.0×10^5 Pa.

Diagram 1 shows five of the molecules of the gas and their associated velocity vectors.

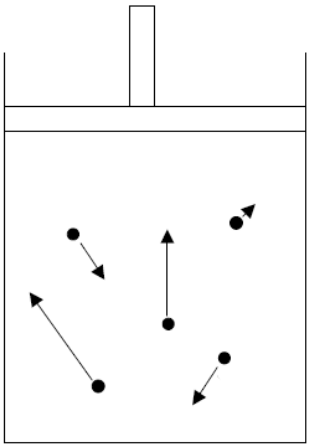


Diagram 1

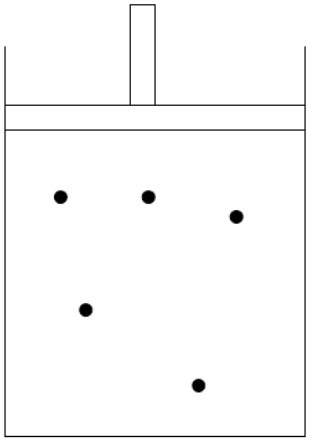


Diagram 2

The gas is now heated at constant volume until its pressure becomes 2.0×10^5 Pa.

(i) Add velocity vectors to the molecules in Diagram 2 opposite to show how you think that, on average, the velocities of the molecules will have changed from the velocities shown in Diagram 1. *[2]*