

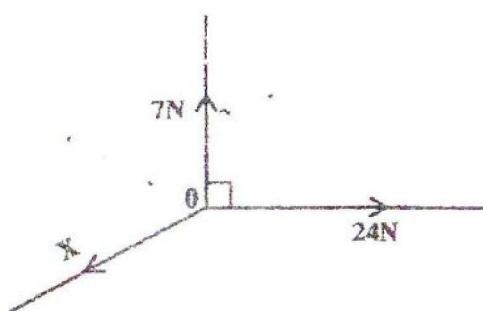
LIST OF PHYSICAL CONSTANTS

Universal gravitational constant	G	=	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Acceleration due to gravity	g	=	9.81 m s^{-2}
Radius of the Earth	R_E	=	6380 km
Mass of the Earth	M_E	=	$5.98 \times 10^{24} \text{ kg}$
Mass of the Moon	M_M	=	$7.35 \times 10^{22} \text{ kg}$
1 Atmosphere	Atm.	=	$1.01 \times 10^5 \text{ N m}^{-2}$
Boltzmann's constant	k	=	$1.38 \times 10^{-23} \text{ J K}^{-1}$
Density of water		=	$1.00 \times 10^3 \text{ kg m}^{-3}$
Specific heat capacity of water		=	$4200 \text{ J kg}^{-1} \text{ K}^{-1}$
Specific latent heat of fusion of ice		=	$3.34 \times 10^5 \text{ J kg}^{-1}$
Specific latent heat of vaporization of water		=	$2.26 \times 10^6 \text{ J kg}^{-1}$
Avogadro's number	N_A	=	$6.02 \times 10^{23} \text{ per mole}$
Molar gas constant	R	=	$8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
Stefan-Boltzmann constant	σ	=	$5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Speed of light in vacuum	c	=	$3.0 \times 10^8 \text{ m s}^{-1}$

Which S.I. unit could be used to express the power of a light bulb?

- (A) $\text{kg} \cdot \text{m}^2 \text{s}^{-2}$
- (B) $\text{kg} \cdot \text{m}^{-1} \text{s}^{-1}$
- (C) $\text{kg} \cdot \text{m}^2 \text{s}^{-3}$
- (D) $\text{kg} \cdot \text{s}^{-2}$

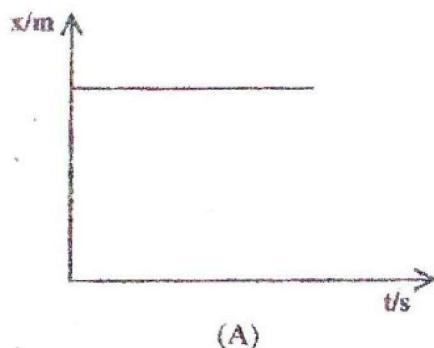
Item 2 refers to the following.



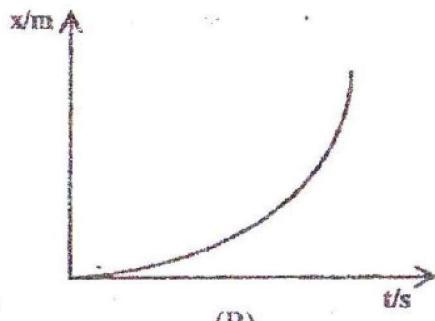
2. Coplanar forces with magnitudes 7 N, 24 N and X are in equilibrium. What is the value of X?

- (A) 17 N
- (B) 24 N
- (C) 25 N
- (D) 31 N

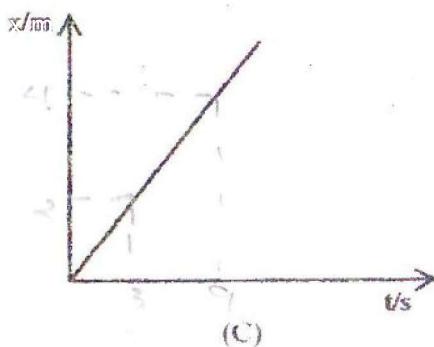
3. Which of the following graphs applies to a body in motion but with zero acceleration?



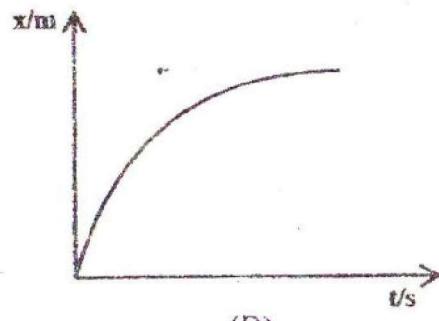
(A)



(B)



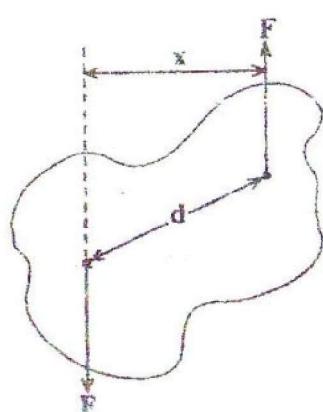
(C)



(D)

4. A body of constant mass will have uniform acceleration if the resultant force acting on it
- decreases uniformly with time
 - increases uniformly with time
 - is constant
 - is proportional to the displacement from a fixed point
5. A body moves in a circle of radius r with centripetal acceleration, a . Its velocity is v , and angular frequency is ω . Which of the following equations for a are correct?
- $a = \frac{v^2}{r}$
 - $a = r^2\omega$
 - $a = rv$
- I, II and III
 - I and II only
 - I and III only
 - II and III only
6. A constant force acts on a mass m , which is initially at rest. The velocity acquired for a given displacement is proportional to
- \sqrt{m}
 - m
 - $\frac{1}{\sqrt{m}}$
 - $\frac{1}{m}$
7. A racing car is moving round a circular track at a constant speed of 60 m s^{-1} . The radius of the track is 500 m . What is the ratio of the centripetal force to the weight of the car?
- 0.02
 - 0.73
 - 1.2
 - 71.0
8. A body of 2.5 kg , initially at rest is acted on by a net force directed along the x -axis which varies as shown in the graph below.
-
- | Time (s) | Force (N) |
|----------|-----------|
| 0 | 0 |
| 2 | 20 |
| 4 | 20 |
| 5 | 0 |
- The magnitude of the momentum obtained would be
- 0 Ns
 - 50 Ns
 - 70 Ns
 - 140 Ns
9. Which velocity-time graph BEST represents the motion of a falling spherical body from rest through glycerine?
- -
 -
 -

10.



Two parallel forces act on a rigid body as shown in the diagram above. The size of the torque on the body by these forces is

- (A) Fd
- (B) Fx
- (C) $2Fd$
- (D) $2Fx$

12.



A stone is thrown from A to D. The stone follows a parabolic path such that the highest point reached is B. C is a point just before it lands at D.

The vertical component of acceleration of the stone is

- (A) the least at B
- (B) the same at C and B
- (C) maximum at A
- (D) greatest at D

13.

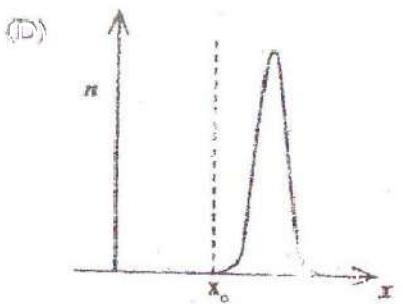
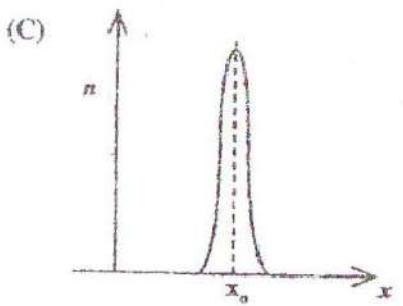
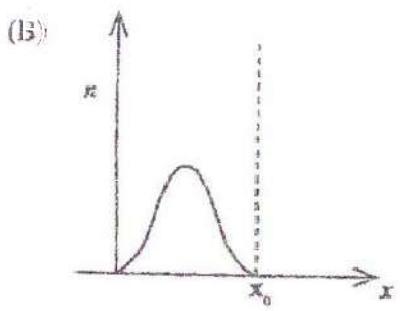
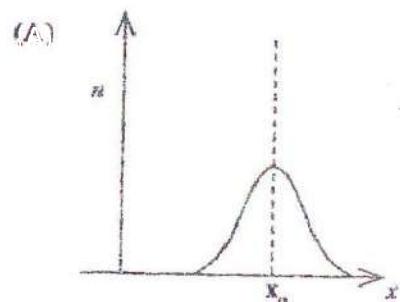
A slingshot is a child's toy that converts the strain energy of the stretched material into the moving energy of the propelled object. A boy pulls on his slingshot with a force of 20 N and it extends by 7 cm. At what velocity does the 20 g stone fly off?

- (A) 8.4 m s^{-1}
- (B) 76 m s^{-1}
- (C) 18.7 m s^{-1}
- (D) 2.6 m s^{-1}

$$\text{Strain energy} = \frac{1}{2} k x^2$$

14. The true value of a quantity is x_0 . This quantity is measured a large number of times and the number n , of particular values of x , is plotted against x .

Which graph below represents measurements of poor accuracy but high precision?



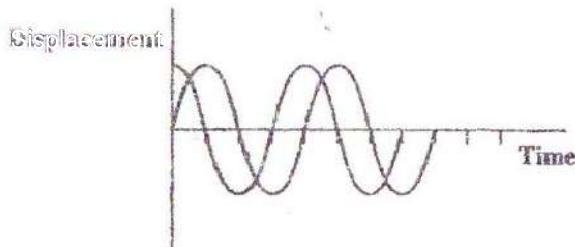
15. Two spheres, one of mass m and the other of mass $\frac{m}{2}$ are moving towards each other with velocity, v .



The spheres have an elastic collision. Which one of the following statements is correct?

- (A) The total kinetic energy after impact is $\frac{1}{2}mv^2$.
(B) The spheres stick together on impact.
(C) The total kinetic energy after impact is zero.
(D) The magnitude of the total momentum before impact is $\frac{1}{2}mv$.

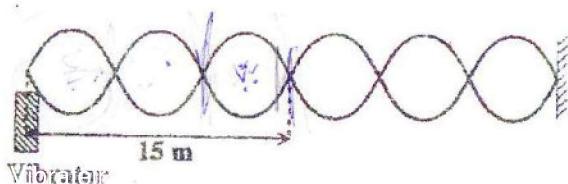
Item 16 refers to the following graph showing two oscillations.



16. What is the phase difference between the oscillations?

- (A) π rad
(B) $\pi/4$ rad
(C) $3\pi/4$ rad
(D) $\pi/2$ rad

Item 17 refers to the vibrator below which produces stationary waves on a stretched cable.



17. The frequency of the vibrator is 50 Hz. What is the speed of the wave?

- (A) 250 m s^{-1}
- (B) 500 m s^{-1}
- (C) 750 m s^{-1}
- (D) 330 m s^{-1}

18. Which of the following observations indicates that sound waves are longitudinal?

- (A) Sound waves are diffracted around corners.
- (B) Sound waves cannot be polarized.
- (C) Sound waves obey the laws of reflection.
- (D) Sound waves are refracted as they pass from cool air to warm air.

19. For a particle oscillating with simple harmonic motion in a vertical plane, which of the following statements is NOT true?

- (A) The velocity of the particle is minimum at the centre of motion of the particle.
- (B) The total energy is constant.
- (C) The acceleration of the particle is directed towards a fixed point.
- (D) The restoring force is maximum at the extremities of the motion.

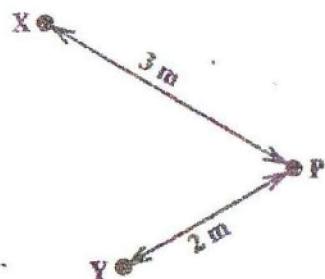
20. A. Young's double-slit experiment was performed with white light incident on the slits. The first bright fringe after the central maximum is a

- (A) green fringe
- (B) orange fringe
- (C) white fringe
- (D) blue fringe

21. Which of the following can correct the condition known as long sight?

- (A) Plane-concave lens
- (B) Cylindrical lens
- (C) Diverging meniscus lens
- (D) Converging meniscus lens

22. Two sources of sound, X and Y, that are in phase are positioned as shown in the diagram. They both produce waves with wavelength 2 m and amplitude A. What would be the amplitude of the sound observed at point P?



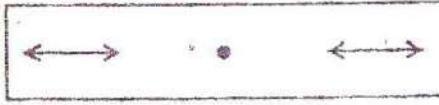
- (A) $\frac{5}{2}A$
- (B) $2A$
- (C) 0
- (D) A

23. A sound wave of intensity I_1 has an amplitude of 30 mm. Another wave of the same frequency but of intensity I_2 has an amplitude of 10 mm. What is the value of

$$\frac{I_1}{I_2}$$

- (A) 3
(B) 9
(C) 15
(D) 81

24. An air column in a tube which is closed at one end vibrates in its fundamental mode. The amplitude of the vibrations of the air can be represented in magnitude and direction at various points by arrows with a dot indicating a very small amplitude. Which diagram BEST represents the oscillation of the air molecules?

- (A) 
- (B) 
- (C) 
- (D) 

25. Which of the following is NOT a condition necessary for two-source destructive interference of sound waves to be observed?

- (A) Sources must be coherent.
(B) Amplitudes of the waves must be similar.
(C) Waves overlapping must have a path difference of one wavelength.
(D) Waves overlapping must be out of phase by π radians.

26. An object is placed 5 cm in front of a diverging lens of focal length 20 cm. The image is

- (A) 4 cm from the lens on the same side as the object
(B) 6.7 cm from the lens on the same side as the object
(C) 4 cm from the lens on the opposite side of the object
(D) 6.7 cm from the lens on the opposite side of the object

27. A motorbike emits an 80 dB noise. The intensity of the sound from the motorbike is

- (A) 10^{-12} Wm^{-2}
(B) 10^{-9} Wm^{-2}
(C) 10^{-4} Wm^{-2}
(D) 10^{-1} Wm^{-2}

18. A particle oscillates so that its displacement x from a fixed point is related to time t by the equation

$$x = 3 \sin 5\pi t$$

If x is measured in cm and t is measured in s, we can deduce that the particle

- I. moves with Simple Harmonic Motion
 - II. has a frequency of 2.5 Hz
 - III. has an amplitude of 1.5 cm
- (A) I and II only
 (B) I, II and III
 (C) II and III only
 (D) III only

19. A pendulum swings freely with a period of 1.5 s on the earth's surface where acceleration due to gravity is g . If the pendulum were to swing in another place where acceleration due to gravity is g' , what would be the value of its new period?

- (A) $\sqrt{g'/g}$
 (B) $\sqrt{g/g'}$
 (C) g/g'
 (D) g'/g

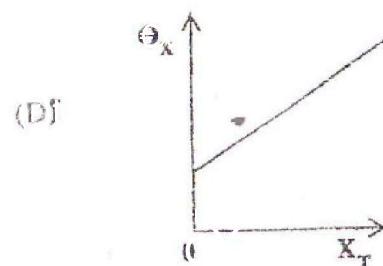
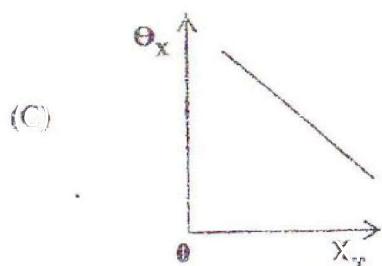
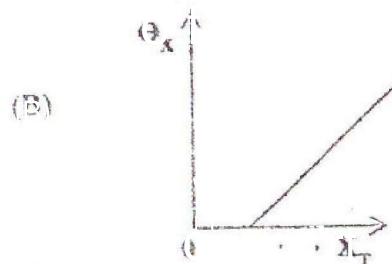
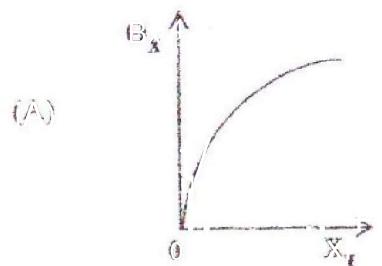
30. Which of the following statements are TRUE about resonance?

- I. It occurs at the highest frequency of the oscillating system.
 - II. It causes a significant increase in the amplitude of oscillation.
 - III. It occurs when the driver frequency is close to the natural frequency of the oscillating system.
- (A) I and II only
 (B) I, II and III
 (C) I and III only
 (D) II and III only

31. X_T is a temperature measuring scale for a substance. X_0 and X_{100} were determined at the ice point and steam point. The temperature on the centigrade scale which corresponds to a value X_T is given by

$$\theta_x = \frac{X_T - X_0}{X_{100} - X_0} \times 100$$

Which of the following graphs BEST describes the relationship between θ_x and X_T ?



32. A spherical blackbody of surface area A is at an absolute temperature T_1 . It is suspended at the centre of a container whose walls are at temperature T_2 .

The NET rate of loss of heat by radiation from the body is given by

- (A) $P = \sigma AT_1^4$
- (B) $P = \sigma AT_2^4$
- (C) $P = \sigma A(T_1 + T_2)^4$
- (D) $-P = \sigma A(T_1^4 - T_2^4)$

33. What is the unit of heat capacity?

- (A) $\text{J kg}^{-1}\text{K}^2$
- (B) J kg^{-1}
- (C) J K^{-1}
- (D) J

34. $16 \times 10^{-3}\text{m}^3$ of a gas at a pressure of 1750 kPa is contained in a cylinder. The gas is expanded at constant pressure until the volume becomes $140 \times 10^{-3}\text{m}^3$. How much work is done by the gas?

- (A) 217 kJ
- (B) 245 kJ
- (C) 273 kJ
- (D) 347 kJ

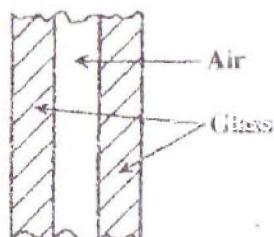
35. An adult at rest has a blood pressure of 130/85. This is measured in mm of mercury. What would this reading be in Pa? (Density of mercury = 13600 kg m^{-3} .)

- (A) $(1.73/1.13) \times 10^5$
- (B) $(1.73/1.13) \times 10^2$
- (C) $(1.73/1.13) \times 10^4$
- (D) $(1.73/1.13) \times 10^6$

36. Which of the following options has the materials CORRECTLY categorized?

	CRYSTALLINE SOLID	AMORPHOUS SOLID
(A)	glass	rubber
(B)	copper	diamond
(C)	diamond	glass
(D)	rubber	copper

37. A double layer glass wall has a layer of air trapped between it as shown in the diagram below.



Which method of heat transfer is SIGNIFICANTLY reduced by the air layer?

- (A) Conduction
- (B) Convection
- (C) Evaporation
- (D) Radiation

38. Which of the following is NOT an assumption used in the Kinetic Theory of gases?

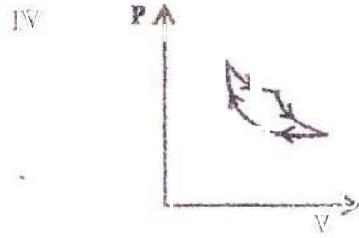
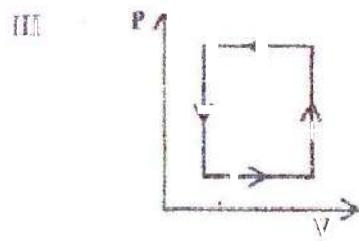
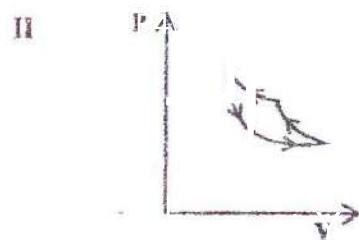
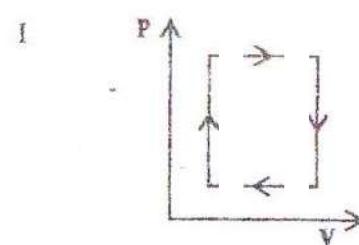
- (A) The volume of the molecules is negligible.
- (B) The attraction between the molecules is negligible.
- (C) The molecules accelerate between collisions.
- (D) The duration of collision between molecules is negligible.

40.

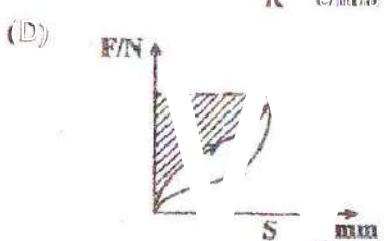
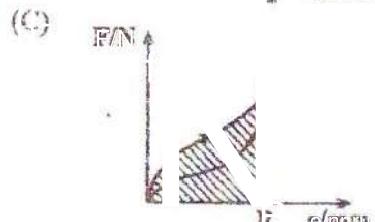
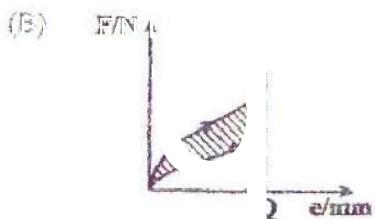
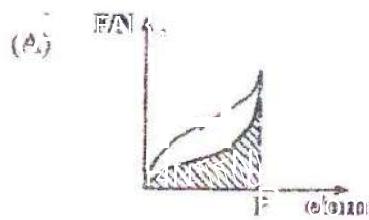
- The average kinetic energy, \bar{E} , of a sample of argon gas is $8 \times 10^{-21} \text{ J}$. What is the temperature of the gas?

- (A) 113 K
- (B) 386 K
- (C) 597 K
- (D) 870 K

41.



39. In which of the following graphs does the shaded area show the energy lost during the loading and unloading process of a polymeric material?



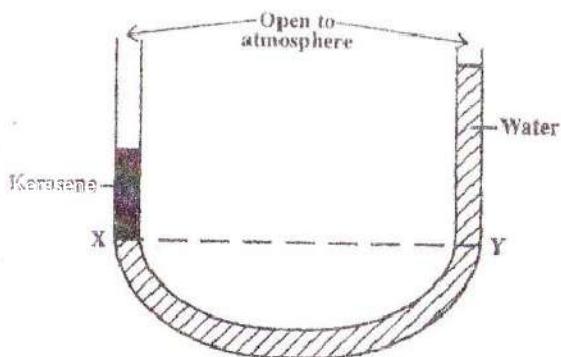
The above P-V diagrams represent ideal gas cycles. Which pair of diagrams corresponds to NET work being done by the gas?

- (A) I and II only
- (B) I and IV only
- (C) II and III only
- (D) II and IV only

Calculate the volume occupied by one atom of copper if it has a molar mass of 0.0635 kg and a density of 8920 kg m^{-3} .

- (A) $1.18 \times 10^{-29} \text{ m}^3$
- (B) $7.12 \times 10^{-29} \text{ m}^3$
- (C) $2.33 \times 10^{-29} \text{ m}^3$
- (D) $9.41 \times 10^{-29} \text{ m}^3$

43.



The diagram above shows a U-tube containing two immiscible liquids. Which statement about the arrangement is TRUE?

- (A) The kerosene exerts a greater pressure at X than the pressure exerted by the water at Y.
- (B) The water exerts a greater pressure at Y than the pressure exerted by the water at X.
- (C) The pressure at X and Y is equal to atmospheric pressure.
- (D) The pressure at X is equal to the pressure at Y.

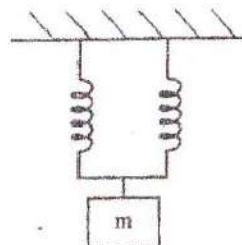
44.

An alloy is made of a mixture of two metals. Metal A has a density of 8900 kg m^{-3} and Metal B has a density of 7800 kg m^{-3} . What is the density of the alloy if Metal A has three times the volume of Metal B?

- (A) 8350 kg m^{-3}
- (B) 8625 kg m^{-3}
- (C) 8075 kg m^{-3}
- (D) 7950 kg m^{-3}

45.

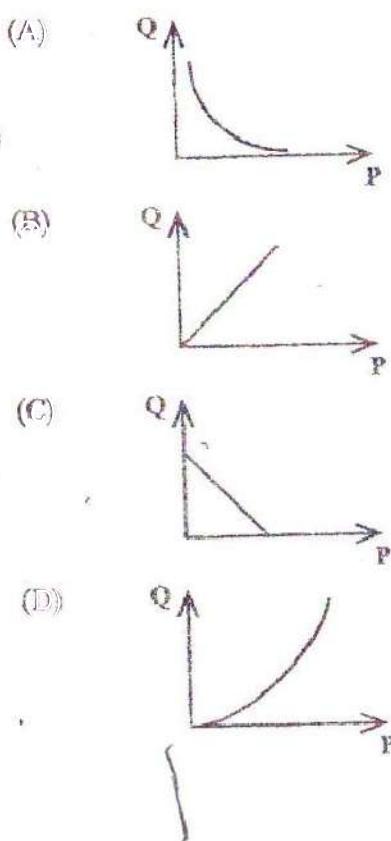
A spring with spring constant k , has an extension x , when a mass m , is attached to it. Another spring, identical to the first is hung parallel to the first and the same mass m is hung across both. Which option gives the correct values of extension and spring constant of the combination?



	Extension	Spring constant
(A)	$x/2$	$k/2$
(B)	$x/2$	$2k$
(C)	$2x$	$k/2$
(D)	$2x$	$2k$

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

1. In the relationship $C = PQ$, C is a constant. Which graph represents the relationship between Q and P?



2. Two velocity vectors of magnitude 20 km h^{-1} and 40 km h^{-1} are to be subtracted. Which of the following is NOT a possible value for the answer?

(A) 10 km h^{-1}
 (B) 20 km h^{-1}
 (C) 30 km h^{-1}
 (D) 40 km h^{-1}

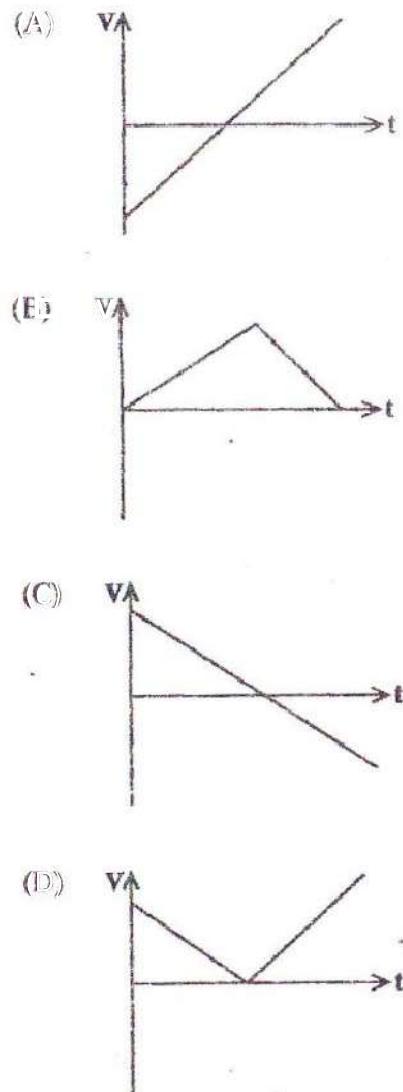
3. The base SI units of specific heat capacity are

(A) $\text{m}^2 \text{s}^{-4} \text{K}^{-1}$
 (B) $\text{kg m}^2 \text{s}^3 \text{K}^{-1}$
 (C) $\text{m}^2 \text{s}^2 \text{K}^{-1}$
 (D) $\text{kg m}^2 \text{K}^{-1}$

4. An object of mass, m, is moving with kinetic energy E. Which of the following has the same base units as its momentum?

(A) \sqrt{mE}
 (B) mE
 (C) mP^2
 (D) $\frac{E}{m}$

5. Taking upwards as positive, which of the following graphs BEST describes a ball that was thrown upwards and then came back down to the same height?



6. A tennis ball is given a horizontal velocity of 8 m s^{-1} when it is hit at a height of 1.8 m above the ground. It is in the air for

- (A) 0.37 s
- (B) 0.61 s
- (C) 2.95 s
- (D) 8.89 s

Item 7 refers to the following diagram.



7. An object of mass M travelling with a velocity u collides with a stationary object of mass $2M$. After collision the two masses stick together and move with a common velocity v . The magnitude of v is equal to

- (A) $3u$
- (B) u
- (C) $u/2$
- (D) $u/3$

8. An object moving at constant speed in a circle of radius r turns through an angle θ (measured in radians) in a time t . The velocity v along the tangent is given by

- (A) $v = 2\pi r\theta/t$
- (B) $v = \frac{r\theta}{2\pi t}$
- (C) $v = \frac{r\theta}{t}$
- (D) $v = \frac{\theta}{rt}$

9. A hammer thrower makes 4 complete revolutions in 3.2 s . The distance between the hammer and the thrower is 1.5 m . What is the centripetal acceleration of the hammer?

- (A) 0.375 m s^{-2}
- (B) 2.9 m s^{-2}
- (C) 5.8 m s^{-2}
- (D) 92.5 m s^{-2}

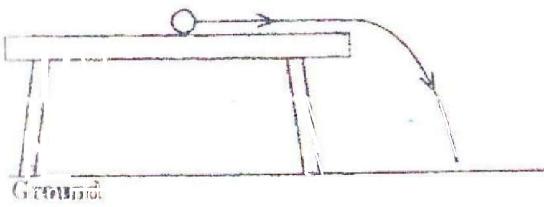
10. Which of the following equations represents the gravitational field strength of a point a distance h from the surface of the Earth where r is the radius of the Earth?

- (A) $g' = \frac{r^2}{(r+h)^2} g$
- (B) $g' = \frac{(r+h)^2}{r^2} g$
- (C) $g' = \frac{r^2}{h^2} g$
- (D) $g' = \frac{r}{(r+h)} g$

11. A hot-air balloon moving upwards has a total weight of 200 N and a volume of 20 m^3 . Assuming the density of the air outside the balloon is 1.2 kg m^{-3} , the NET upward force on the balloon is then approximately

- (A) 24 N
- (B) 40 N
- (C) 176 N
- (D) 240 N

Item 12 refers to the diagram below.

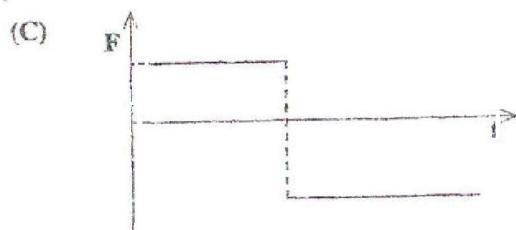
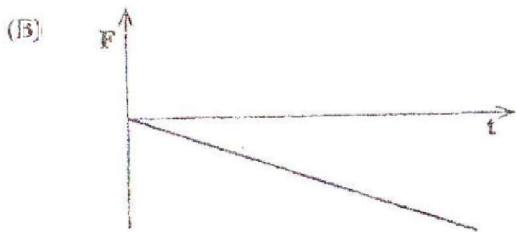
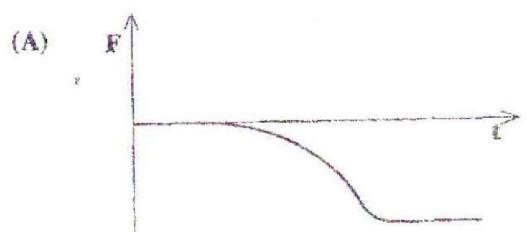


13

A bee is pushed by a wind of constant force from rest for a fixed distance. The kinetic energy acquired by the bee of mass, m is

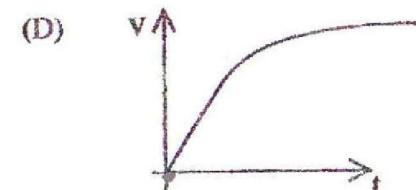
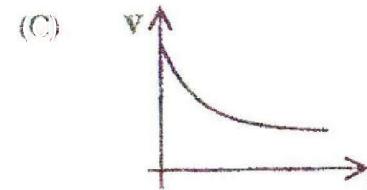
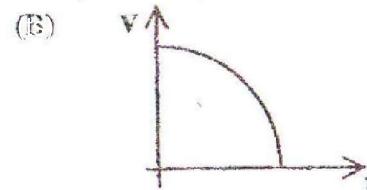
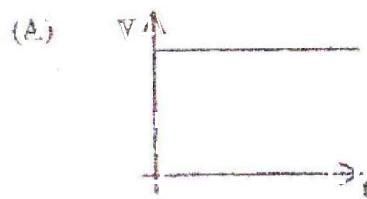
- (A) proportional to \sqrt{m}
- (B) proportional to m .
- (C) proportional to $\frac{1}{m}$
- (D) independent of m

A marble rolls off the horizontal surface of a table and falls to the ground. Which graph shows how the resultant vertical force acting on the marble varies with time before it hits the ground?



14.

Which of the following graphs represents the velocity-time graph of a brass ball-bearing when released in a column of glycerine?



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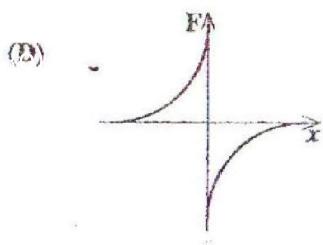
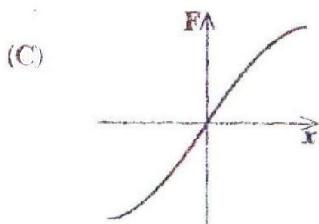
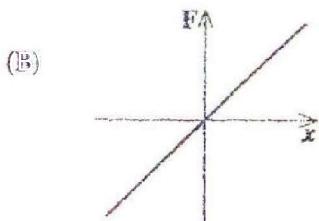
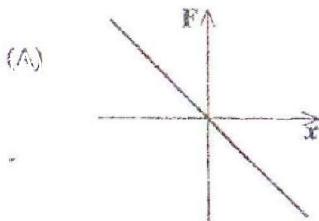
15. A car travelling at a constant velocity is provided with 15 kW of useful power. The driving force on the car is 600 N. What is the velocity of the car?

- (A) 2 m s^{-1}
(B) 5 m s^{-1}
(C) 10 m s^{-1}
(D) 25 m s^{-1}

16. In a simple harmonic motion with amplitude A and period T, the maximum velocity is

- (A) A/T
(B) $A/2\pi T$
(C) $2\pi A/T$
(D) $2\pi A/T$

17. A particle moves with simple harmonic motion in a straight line. Which of the following graphs BEST represents the way in which the force F acting on the particle depends on the displacement x?



18. A mass of 250 g hanging at the end of a spring of spring constant, k , makes 21 oscillations in 11 seconds. What would be the period if the system were taken to a planet where gravity was $\frac{1}{4}$ of that on Earth?

- (A) $\frac{1}{4}$ s
 (B) $\frac{1}{4} \left(\frac{21}{11} \right)$ s
 (C) $\frac{11}{21}$ s
 (D) $4 \left(\frac{11}{21} \right)$ s

19. A child's swing of mass 10 kg is oscillating with simple harmonic motion where the maximum height reached is 0.5 m above the equilibrium position. The following table shows pairs of energy values during the oscillation. Which pair is NOT possible?

PE/J	KE/J
0	49
18	31
38	13
49	0

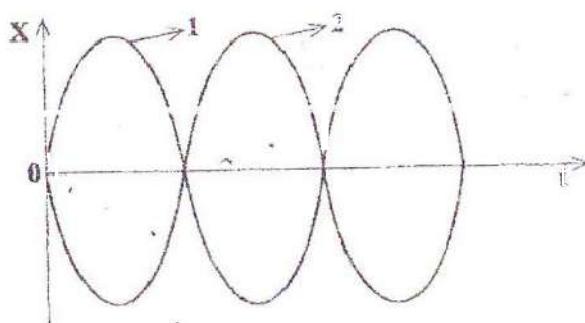
20. Elastic waves in a solid are

- (A) transverse
 (B) longitudinal
 (C) either transverse or longitudinal
 (D) neither transverse nor longitudinal

21. The refractive index of water is 1.33. What will be the speed of light in water?

- (A) 3.0×10^8 m s^{-1}
 (B) 2.26×10^8 m s^{-1}
 (C) 4.0×10^8 m s^{-1}
 (D) 1.33×10^8 m s^{-1}

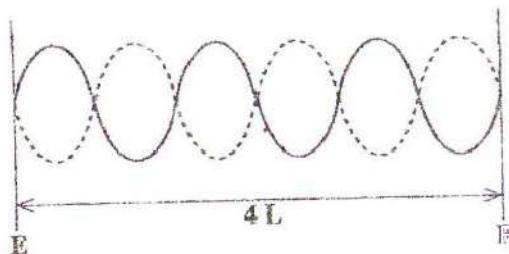
Item 22 refers to the following diagram.



22. What is the phase difference between Waves 1 and 2?

- (A) $\frac{3\pi}{2}$ radians
 (B) $\frac{\pi}{2}$ radians
 (C) $\frac{\pi}{4}$ radians
 (D) π radians

Item 23 refers to the following diagram.

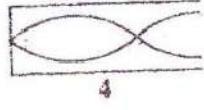
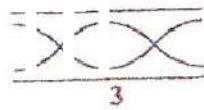
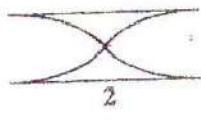


23. Give the wavelength of the stationary wave in terms of L if the distance between points E & F is 4L.

- (A) 4L
 (B) 2L
 (C) $\frac{4}{3}L$
 (D) $\frac{1}{3}L$

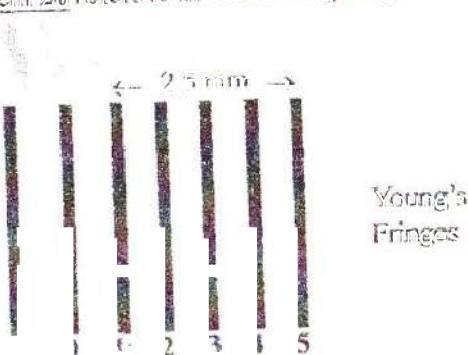
24. The distance between a node and a neighbouring antinode of a stationary wave is equal to
(A) the wavelength
(B) one quarter of wavelength
(C) twice the wavelength
(D) half of the wavelength

Item 25 refers to the following vibrations of four air columns of equal length.



25. The ratio of the frequencies $f_1 : f_2 : f_3 : f_4$ is
(A) 12 : 6 : 3 : 4
(B) 1 : 2 : 4 : 3
(C) 4 : 2 : 3 : 1
(D) 1 : 2 : 3 : 4

Item 26 refers to the following diagram.



26. In a Young's two-slit experiment, the separation between the first and fifth bright fringe is 2.5 mm when the wavelength used is 6.2×10^{-7} m. The distance from the slits to the screen is 0.8 m, then the separation of the two slits is

- (A) 0.2 mm
(B) 0.5 mm
(C) 0.8 mm
(D) 1.0 mm

27. When monochromatic light of wavelength 6.0×10^{-7} m is incident normally on a plane diffraction grating, the angle between the two second order diffraction lines formed is 40° .

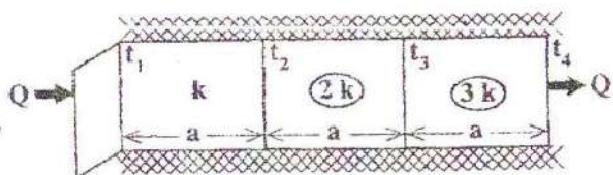
What is the number of lines per millimetre of the grating?

- (A) 187
(B) 285
(C) 350
(D) 536

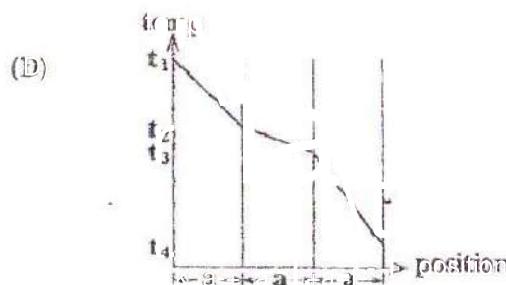
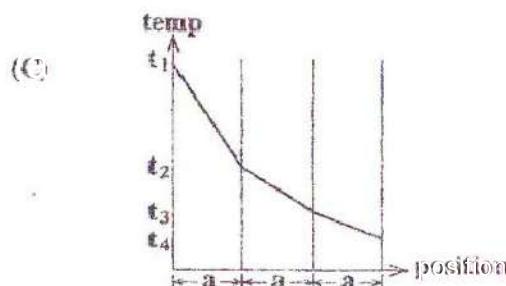
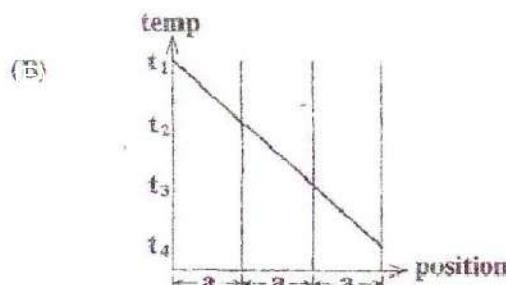
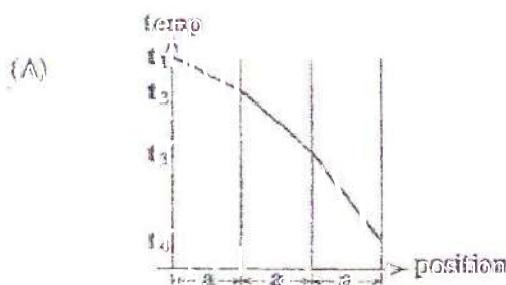
28. Two sound waves have intensities 0.1 W m^{-2} and 5 W m^{-2} . What is the difference in their intensity levels?

- (A) 1.7 dB
(B) 5 dB
(C) 17 dB
(D) 50 dB

36. A composite bar of 3 materials of thermal conductivities k , $2k$ and $3k$. The sides of the bar are lagged and heat is transferred from left to right as shown in the diagram below.



Each layer has thickness a and the temperature distribution is $t_1 > t_2 > t_3 > t_4$. Which of the following diagrams BEST describes the temperature gradient of the composite wall?



37. Which statement BEST explains the occurrence of convection currents?

- (A) Hot molecules exert greater forces than cold ones.
 (B) Brownian motion causes fluids to be in constant motion.
 (C) Heat decreases the density of fluids through expansion so they must rise.
 (D) The movement of bubbles due to the process of boiling.

38. A container of fixed volume contains 5.0 mol of gas at a pressure of 3.5×10^5 Pa. An extra 4.0 mol of gas is pumped into the container and the container is allowed to return to its original temperature. What is the final pressure of the gas?

- (A) 3.5×10^5 Pa
 (B) 4.4×10^5 Pa
 (C) 6.3×10^5 Pa
 (D) 14×10^5 Pa

39. Which of the following equations represents the TOTAL kinetic energy of one mole of a monatomic gas?

- (A) $E_k = \frac{2}{3}RT$
 (B) $E_k = \frac{5}{2}RT$
 (C) $E_k = \frac{1}{2}kT$
 (D) $E_k = \frac{2T}{3R}$

29. Two sound waves of the same frequency having amplitudes of 3 cm and 1 cm respectively are moving towards each other in the same straight line. The resultant wave produced will vary in loudness. The ratio of the maximum to minimum intensity is
- (A) 4/1
(B) 9/2
(C) 6/1
(D) 9/1
30. The inability of the eye to focus clearly on near objects is called
- (A) presbyopia
(B) astigmatism
(C) myopia
(D) hypermetropia
31. A geologist needs to know how the temperature of the soil 20 m below the earth's surface changes throughout the day. The thermometer he selects for this job is the
- (A) liquid in glass
(B) constant volume gas
(C) resistance
(D) thermocouple
32. The readings on a resistance thermometer are as follows
- ice point $27.5\ \Omega$
steam point $73.8\ \Omega$
unknown point $41.2\ \Omega$
- On the scale of the resistance thermometer the unknown temperature is
- (A) 29.6°C
(B) 42.0°C
(C) 55.8°C
(D) 89.0°C
33. What is the name given to the amount of heat energy needed to raise the temperature of 1 kg of substance through 1 degree or 1 kelvin?
- (A) Heat capacity
(B) Latent heat
(C) Specific heat capacity
(D) Specific latent heat
34. A solar furnace has a concave mirror of collecting area 0.80 m^2 and the average thermal radiation from the sun reaching the earth is about 750 W m^{-2} . A small object with heat capacity of 1000 J K^{-1} is heated by the furnace from 10°C to 40°C . The time taken for the heating is
- (A) 30 s
(B) 50 s
(C) 60 s
(D) 100 s
- Item 35 refers to the diagram below showing the change in temperature of substance Q with time.
-
35. What section of the graph represents the change from liquid to solid?
- (A) A
(B) B
(C) C
(D) D

40. A boiler contains water at atmospheric pressure. Use the data below to calculate the work done by the system in producing 1 kg of steam (water vapour) at atmospheric pressure.

Data: 1 kg of water at 100 °C occupies $1.0 \times 10^{-3} \text{ m}^3$

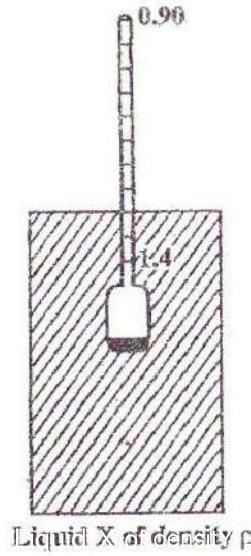
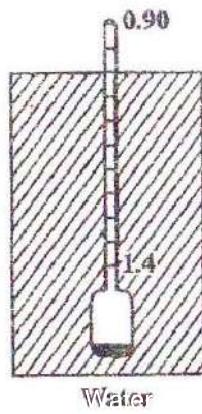
1 kg of steam at 100 °C and at atmospheric pressure occupies 1.7 m^3

- (A) 6 J
- (B) 1600 J
- (C) $100 \times 10^9 \text{ J}$
- (D) $1.7 \times 10^5 \text{ J}$

41. Which of the following statements about an isothermal process in an ideal gas are true?

- I. The energy added by heating, Q , is zero
 - II. The change in internal energy, ΔU , is zero
 - III. The work done by the gas, W , equals the change in internal energy.
- (A) I only
 - (B) II only
 - (C) I and III only
 - (D) II and III only

Item 42 refers to the diagram above showing a hydrometer, a device that measures relative density.



42. What is the density, ρ , of liquid X?

- (A) 1.3 kg m^{-3}
- (B) 300 kg m^{-3}
- (C) 1000 kg m^{-3}
- (D) 1300 kg m^{-3}

43. A child drinks orange juice of density, ρ , using a straw held vertically. The atmospheric pressure is P_0 and the child can lower the pressure at the top of the straw by 20%.

The MAXIMUM length of straw that would allow the child to drink the juice is

(A) $\frac{2P_0}{\rho g}$

(B) $\frac{P_0}{2\rho g}$

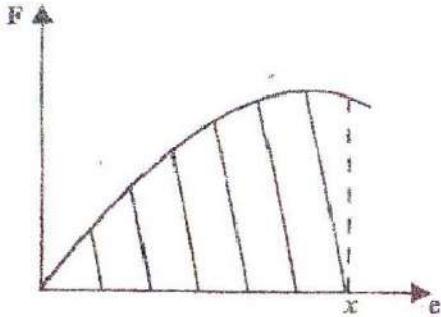
(C) $\frac{P_0}{5\rho g}$

(D) $\frac{P_0}{\rho g}$

45. Which one of the statements about deformation of solids is NOT true?

- (A) A solid behaves elastically if no permanent deformation takes place after the force has been removed.
 (B) Stress is the extension per unit length of the material. It has no units.
 (C) All solids are elastic when small forces are attached to them.
 (D) In stretching a material, the work done is stored as strain energy, once Hooke's Law applies.

Item 44 refers to the following diagram.

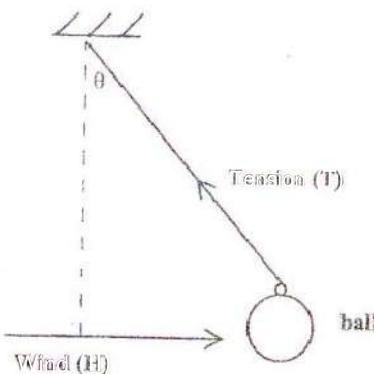


44. The diagram shows the force extension graph for an elastic material. What does the shaded region under the graph represent?

- (A) The Young's modulus of the material
 (B) The tensile stress of the material
 (C) The tensile strain of the material
 (D) The strain energy of the material

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

1. A rubber ball of weight, W , is suspended from a support and is being displaced laterally at an angle, θ° , from the vertical by a wind of constant force (H). The ball is in equilibrium and the tension in the string is T .



Which of the following equations is correct?

- (A) $T = W$
- (B) $T = H$
- (C) $T = W/\cos \theta$
- (D) $T = H/\cos \theta$

2. In determining the density of a cube, a student records the following measurements:

Length of side, $l = 3.0 \pm 0.1 \text{ cm}$

Mass of cube, $m = 12.5 \pm 0.5 \text{ g}$

The student then uses the equation $\rho = \frac{m}{l^3}$

to determine the density of the cube. The percentage error in the calculated value of ρ is

- (A) 0.6%
- (B) 7%
- (C) 14%
- (D) 40%

3. Which of the choices below gives the dimensions of the universal gravitational constant G ?

- (A) $\text{kg}^{-1} \text{ m}^3 \text{ s}^2$
- (B) m s^{-2}
- (C) $\text{kg m}^{-2} \text{ s}^{-1}$
- (D) $\text{kg}^{-1} \text{ m}^{-1} \text{ s}^{-1}$

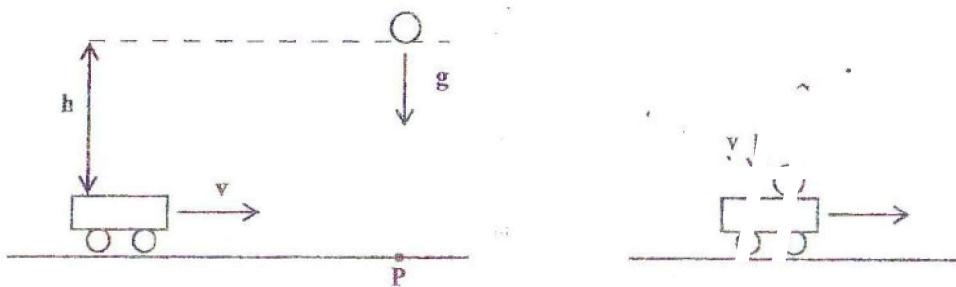
4. The number of moles of carbon -12 atoms in 0.060 kg is

- (A) 0.5
- (B) 5
- (C) 6
- (D) 12

5. If $x = 3 \text{ mg}$ and $y = 9 \text{ kg}$ then

- (A) $y = 3 \times 10^6 x$
- (B) $y = 3 \times 10^3 x$
- (C) $y = 3 \times 10^5 x$
- (D) $y = 3 \times 10^9 x$

Item 6 refers to the diagram and information below.



A trolley is travelling at a uniform velocity, v , along a horizontal path. A lump of plasticine is released from a point directly above a point P on its path.

6. The plasticine travels a vertical distance, h , and acquires a speed v (equal to that of the trolley) before it lands directly on top of the trolley and sticks on it.

What is the distance of the trolley from the point P when the plasticine begins to fall?

(A)

$$zh$$

$$h = ut + \frac{1}{2}gt^2$$

(B)

$$\sqrt{2h}$$

$$2h = g^2t^2$$

(C)

$$h$$

$$t = \sqrt{\frac{2h}{g}}$$

(D)

$$\frac{h}{\sqrt{2}}$$

$$d = vt \quad v = u + at \text{ but } u=0 \\ = gt$$

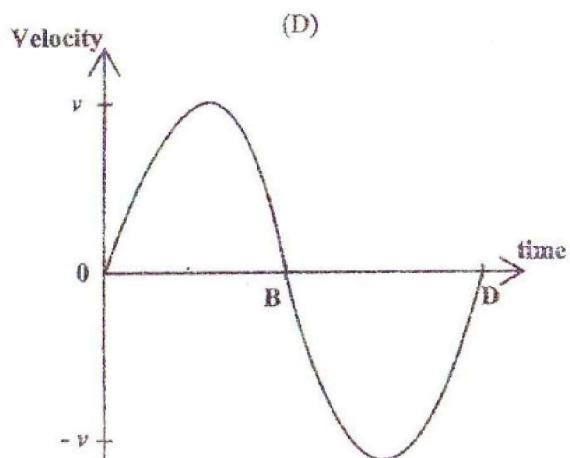
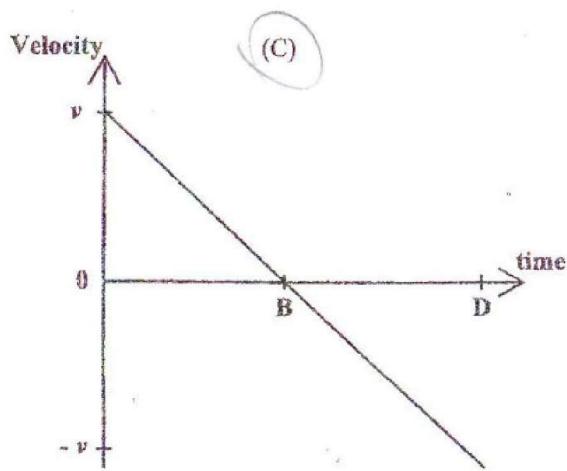
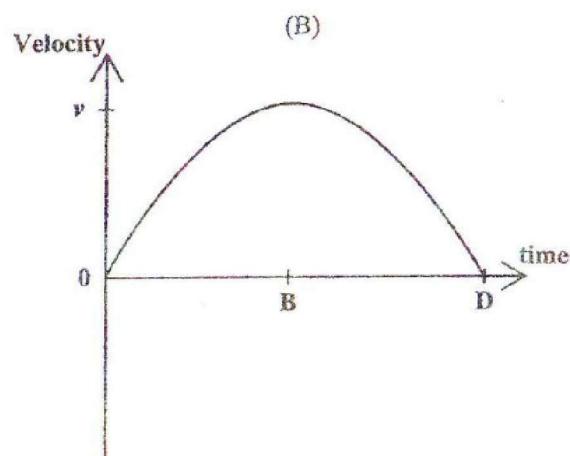
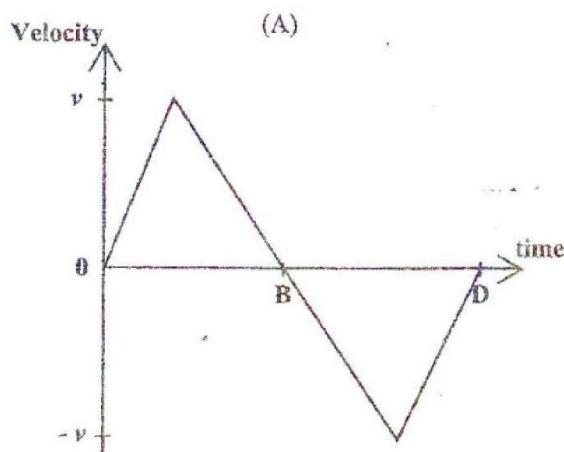
$$d = gt^2$$

$$= 2h$$

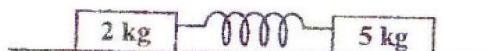
Q7

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7. A man throws a ball with velocity, v , through the air towards his friend who is 60 m away. Which of the following graphs represents the vertical component of the velocity of the ball whilst it is in motion?



8. A light spring is permanently connected between two blocks of wood on a frictionless surface as in the diagram below.



The masses of the blocks are 2.0 kg and 5.0 kg and they can move freely along a straight horizontal track. The spring is compressed and the blocks are released simultaneously from rest.

When the acceleration of the heavier block is 10 m s^{-2} , the acceleration of the lighter block will be

- (A) 5 m s^{-2}
 (B) 10 m s^{-2}
 (C) 20 m s^{-2}
 (D) 25 m s^{-2}

9. The following statements refer to an INELASTIC COLLISION:

- I. The total amount of momentum is NOT conserved.
- II. The total amount of kinetic energy is NOT conserved.
- III. The total amount of momentum is conserved.

Which of the above statements is/are TRUE for an INELASTIC COLLISION?

- (A) I only
 (B) III only
 (C) I and III only
 (D) II and III only

10. Two satellites S_1 and S_2 are orbiting around a planet of radius R . S_1 moves just above the surface and S_2 is an orbit of radius $4R$. The value of the ratio

$$\frac{\text{Orbital speed of } S_1}{\text{Orbital speed of } S_2} \text{ is}$$

$$(A) \frac{1}{4} \frac{V_1^2}{V_2^2} = \frac{4V}{V}$$

$$(B) \frac{1}{2} \frac{V_1}{V_2} = \frac{2V}{V}$$

$$(C) \frac{2}{2} \frac{V_1}{V_2} = \frac{V}{V}$$

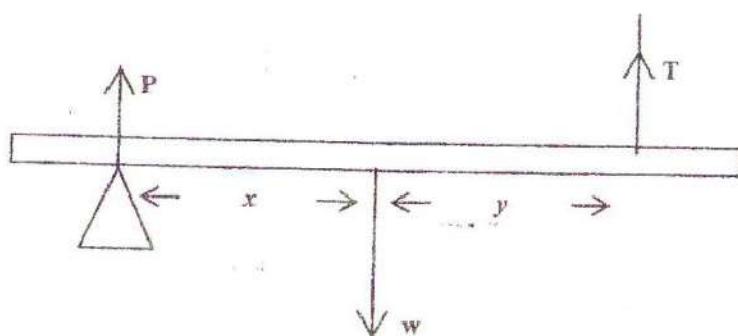
$$(D) 4$$

11. Which of the statements below BEST describes the motion of a geostationary satellite?

- (A) It moves with the same velocity as the earth.
 (B) Its geographical location changes as the earth rotates.
 (C) Its acceleration is zero.
 (D) Its angular velocity is equal to that of the earth.

9c

12. The plank shown below is in equilibrium when acted on by the forces shown

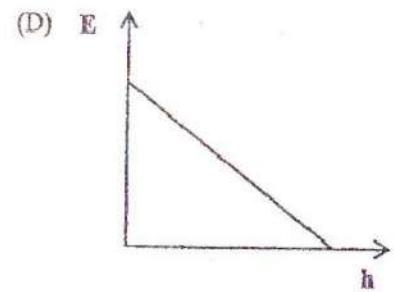
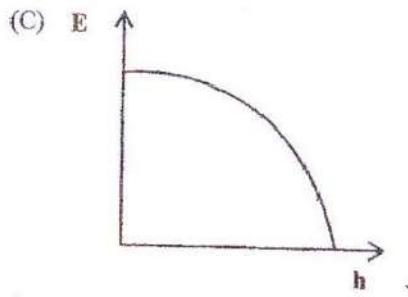
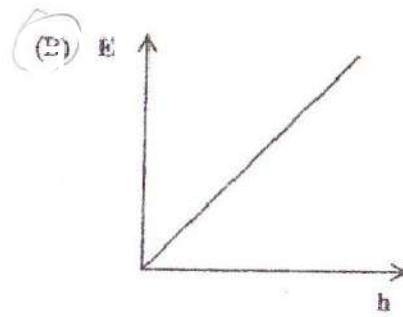
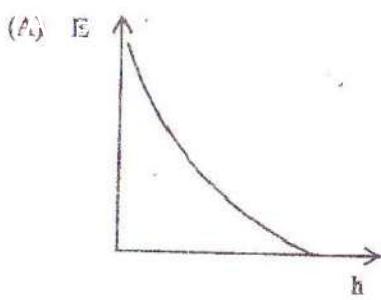


Which statements is/are true?

- I. $T + P = W$
- II. $P(x+y) = Wy$
- III. $Px = Ty$

- (A) I only
 (B) I and II only
 (C) II and III only
 (D) I, II and III

13. A rock is thrown vertically upwards from the ground. Neglecting air resistance, the graph that BEST shows the relationship between the kinetic energy, E , of the rock and its height, h , is:



14. A van has mass m . The van's engine has a maximum power output of P . The LEAST time for the van to be accelerated from rest to a speed, v is

(A) $\frac{mv}{P}$

(B) $\frac{mv^2}{2P}$

(C) $\frac{mv^2}{P}$

(D) $\frac{2P}{mv^2}$

15. A student of weight 500 N is planning a trip to the peak of Blue Mountain. From her starting point, this will involve an increase in altitude of 1 800 m. She buys "high calorie" energy bars which release 1 000 kJ of energy when digested. Assuming her body to be 10% efficient, how many bars will she need to eat for the necessary gain in altitude?

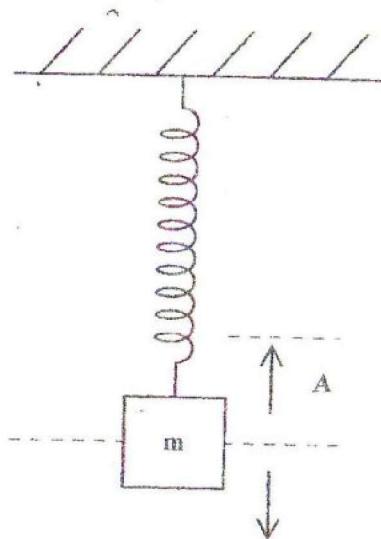
(A) 1

(B) 9

(C) 90

(D) 900

16. A mass hanging from a spring with force constant k oscillates vertically with an amplitude A .



The MAXIMUM velocity on the mass during this simple harmonic motion is

(A) $\frac{k}{m} A$

(B) $\frac{m}{k} A$

(C) $\sqrt{\frac{m}{k}} A$

(D) $\sqrt{\frac{k}{m}} A$

17. The displacement of a particle undergoing simple harmonic motion is given by

$$x = 8 \sin 0.4 \pi t$$

The frequency of oscillation of the particle is

(A) 0.2 Hz

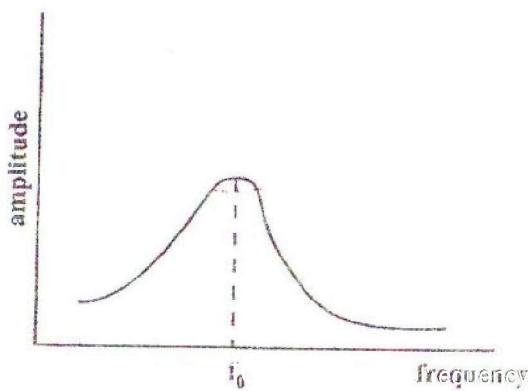
(B) 0.4 Hz

(C) 5 Hz

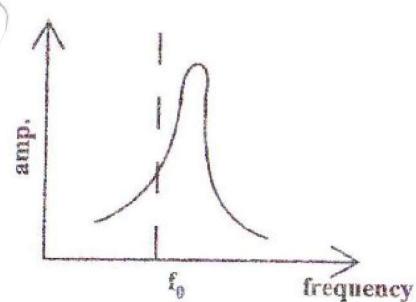
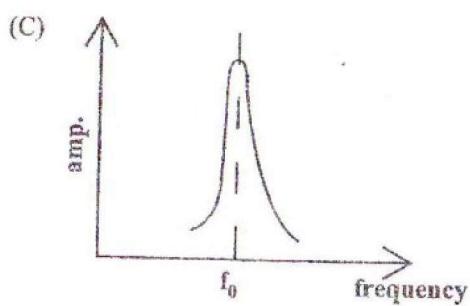
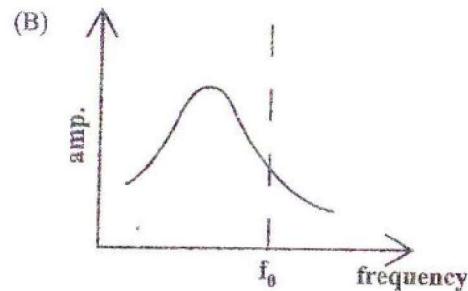
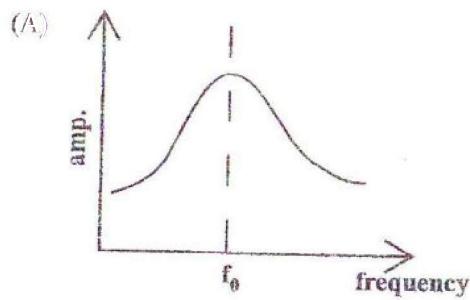
(D) 8 Hz

Q3

18. A system made up of a light helical spring to which a small mass is attached, is forced to oscillate at different frequencies, f , in air. The response is shown in the diagram below.



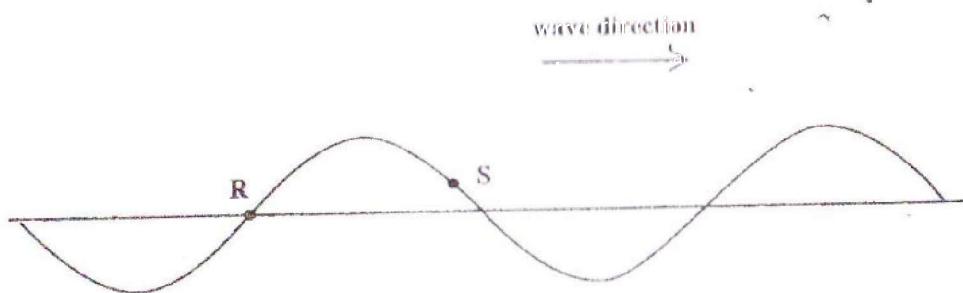
If the experiment were done in an evacuated chamber, which graph BEST represents the result?



19. Stationary waves are produced by superimposing progressive waves of frequency 500 Hz. Successive nodes are separated by a distance of 2 m. What is the speed of the progressive waves?

- (A) 125 m s^{-1}
- (B) 250 m s^{-1}
- (C) 1000 m s^{-1}
- (D) 2000 m s^{-1}

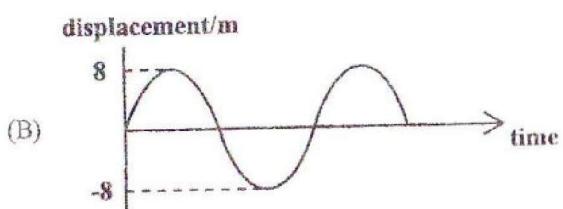
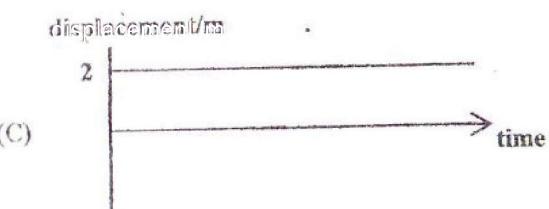
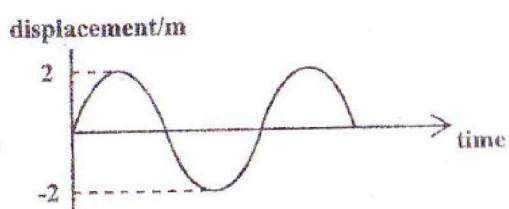
20. The diagram below shows an instantaneous position of a transverse wave travelling from left to right along a string.



Which of the following correctly describes the subsequent motion, if any, of the points R and S on the string?

	Point R	Point S
(A)	stationary	downwards
(B)	downwards	upwards
(C)	downwards	stationary
(D)	upwards	downwards

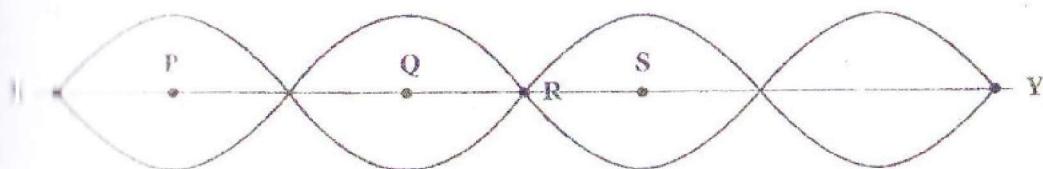
21. Two sources of water waves X and Y generate waves which are out of phase by 180° . If the waves from X are of amplitude 5 m and the waves from Y are of amplitude 3 m, which of the following graphs correctly describes the oscillation of a particle which is equidistant from BOTH X and Y?



11) The intensity of sound is directly proportional to the

- (A) amplitude of the oscillation
- (B) square of the amplitude of the oscillation
- (C) wavelength of the oscillation
- (D) square of the wavelength of oscillation

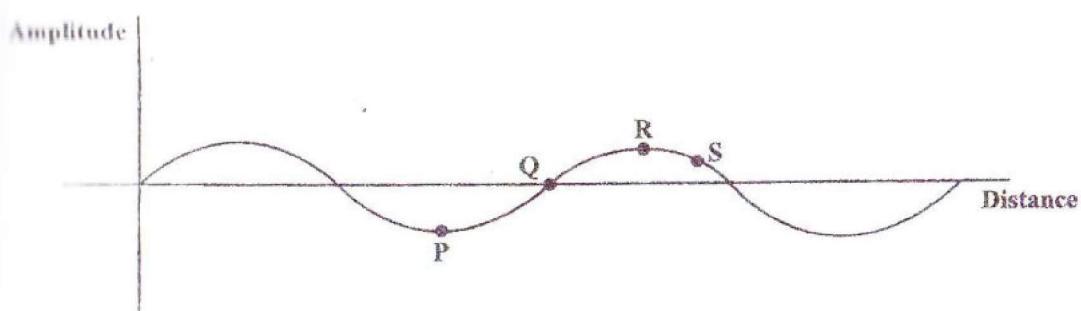
12) A standing wave is set up on a stretched string XY as shown in the diagram below.



Which of the following statements is correct?

- (A) Oscillations of Points P and Q are out of phase with each other.
- (B) Particle at X arrives at Point R one period later.
- (C) Oscillations at Points X and Q are exactly in phase with each other.
- (D) Oscillations at Points Q and S are exactly in phase with each other.

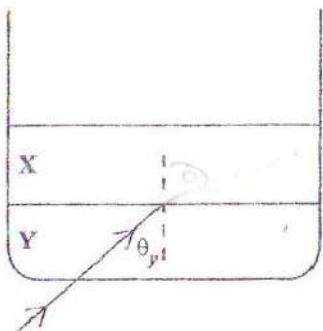
Item 13 refers to the following diagram which shows a stationary wave on a string at one instant in time.



13) Where on this stationary wave does an antinode exist?

- (A) P only
- (B) Q only
- (C) S only
- (D) P and R only

25. A liquid X floats in a container on top of another liquid Y . Light whose velocity is V_y strikes the boundary with an angle of incidence θ_y . In Liquid X the angle of refraction is θ_x and the velocity is V_x .



- Which pair of statements is TRUE if the wavelength DECREASES as the light crosses the boundary?

- (A) $\theta_y > \theta_x$ $V_y > V_x$
 (B) $\theta_y > \theta_x$ $V_x > V_y$
 (C) $\theta_x > \theta_y$ $V_y > V_x$
 (D) $\theta_x > \theta_y$ $V_x > V_y$

26. In a Young's two-slit experiment, light of wavelength 500 nm produces fringes 2 mm apart on a screen. If light of wavelength 250 nm is used and the slit separation is doubled, how far apart would the fringes be?

- (A) 4 mm
 (B) 6.5 mm
 (C) 1 mm
 (D) 2 mm

27. X-rays differ from microwaves in that they

- (A) cannot be refracted
 (B) are deviated by an electric field.
 (C) have a shorter wavelength
 (D) cannot be polarized

28. What is the ratio of the intensity of two sounds if one is 8.0 dB louder than the other?

- (A) 0.63
 (E) 12
 (C) 80
 (D) 10⁸

$$I = 10 \log \frac{I}{I_0}$$

29. Accommodation in the human eye refers to

- (A) the dilation of the pupil to allow more light to enter the eye
 (B) the adjustment of the lens to focus on objects according to their distance
 (C) changing the shape of the eye so that the image fits on the retina
 (D) the use of lenses to correct defects in vision

30. The near point of a defective eye is 30 cm from the eye. If the normal near point is 25 cm from the eye, the focal length of lens needed to correct this defect is

- (A) 5 cm
 (B) 25 cm
 (C) 30 cm
 (D) 150 cm

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

31. Which of the following types of thermometers has the WIDEST temperature measuring range?

- (A) Platinum resistance
 (B) Mercury in glass
 (C) Constant volume gas
 (D) Alcohol in glass

45

GO ON TO THE NEXT PAGE

32. The length of the liquid column in a mercury thermometer at ice point is 15 mm and at the steam point is 220 mm. When placed in a cup of tea the length of the mercury column is 195 mm. What is the temperature of the tea, as measured on the centigrade scale of this thermometer?

(A) 76.6°C
 (B) 87.8°C
 (C) 88.1°C
 (D) 102.4°C

33. An immersion heater rated at 150 W is fitted into a large block of ice at 0°C . The specific latent heat of fusion of the ice is $3 \times 10^5 \text{ J kg}^{-1}$. How long does it take to melt 10 g of ice?

(A) 2 s
 (B) 5 s
 (C) 20 s
 (D) 150 s

34. Which of the following statements is/are TRUE?

- I. Whilst a substance is melting its temperature remains constant.
- II. The triple point of a substance has a constant value.
- III. The boiling point of a liquid does not depend on the pressure of the surroundings.

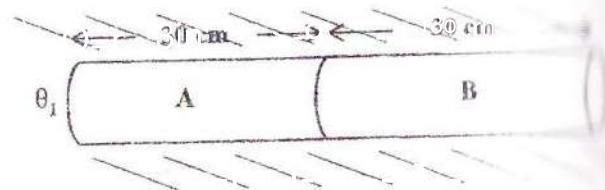
(A) I only
 (B) I and II only
 (C) II and III only
 (D) I, II and III

35. Water falls from a height of 500 m. What is the rise in temperature of the water at the bottom if all the energy gained is converted to internal energy in the water?

(A) 0.19 K
 (B) 0.24 K
 (C) 0.49 K
 (D) 1.17 K

36.

An insulated composite metal rod consists of 30 cm of Metal A with a conductivity of $300 \text{ W m}^{-1} \text{ K}$ and 30 cm of Metal B with a conductivity of $200 \text{ W m}^{-1} \text{ K}$.



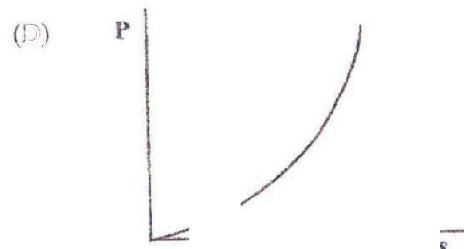
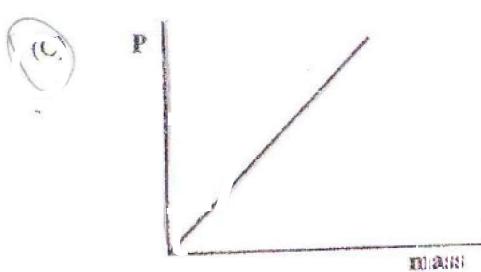
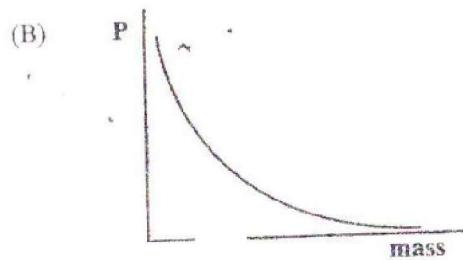
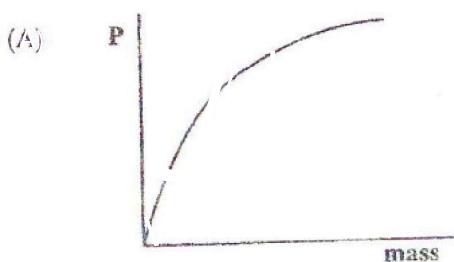
An insulated rod of Metal A of length L conducts heat at the same rate as the composite bar when it has the same temperatures θ_1 and θ_2 at its ends. L is equal to

(A) 40 cm
 (B) 50 cm
 (C) 60 cm
 (D) 75 cm

37. A large metal cube has dimensions 1.2 m \times 1.2 m \times 1.2 m. It is heated in a furnace until the blackened cube is at a temperature of 780°C . What is the rate of energy transfer from the surface?

(A) 36.3 kW
 (B) 120 kW
 (C) 183 kW
 (D) 600 kW

38. Which graph BEST represents pressure 'P' of a gas as a function of its mass when the gas is pumped into a container of fixed volume and the temperature remains constant?



39. Which of the following statements is NOT one of the basic assumptions of the kinetic theory of gases?

- (A) The attractive forces between the gas molecules are negligible.
 (B) The collisions between the gas molecules are inelastic.
(C) The size of the gas molecules are negligible compared to their separation.
(D) The duration of a collision is negligible compared with the time between collisions.

40. What is the pressure of a gas of density 0.09 kg m^{-3} and root-mean-square velocity of 1900 m s^{-1} ?

- (A) 1.31 Pa
(B) 57.0 Pa
(C) $1.08 \times 10^5 \text{ Pa}$
 (D) $1.2 \times 10^6 \text{ Pa}$

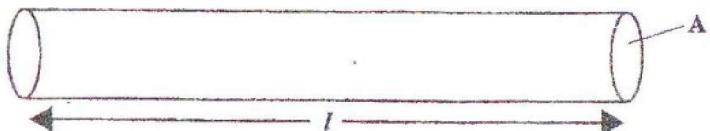
41. The first law of thermodynamics may be written as $\Delta U = Q + W$.

For an isothermal process this equation becomes

- (A) $\Delta U = Q$
(B) $\Delta U = W$
(C) $Q = W - \Delta U$
 (D) $Q = -W$

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Item 42 refers to the following diagram.



42. The material shown has length, l , and cross sectional area A . When a force, F , is applied to the material it causes an extension, e , in the material. Which of the following expressions can be used to determine the Young modulus of the material?

(A) $\frac{F^2}{Ae}$

(B) $\frac{Fa}{el}$

(C) $\frac{Ae}{Fl}$

(D) $\frac{el}{Fa}$

43. Which of the following statements about the molecular model of liquids are TRUE?

- I. Their molecules are packed closely together.
- II. Neighbouring molecules cluster together and there is a constant transfer of molecules between clusters.
- III. The forces between molecules are very strong.
- IV. The pattern of molecules is NOT fixed.

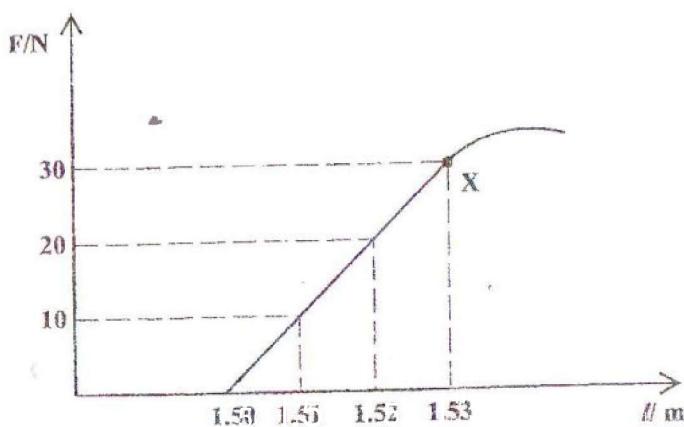
(A) II and IV only

(B) III and IV only

(C) I, II and III only

(D) I, II and IV only

44. The graph below was obtained by applying various forces, F , to a piece of wire and measuring its length, L .

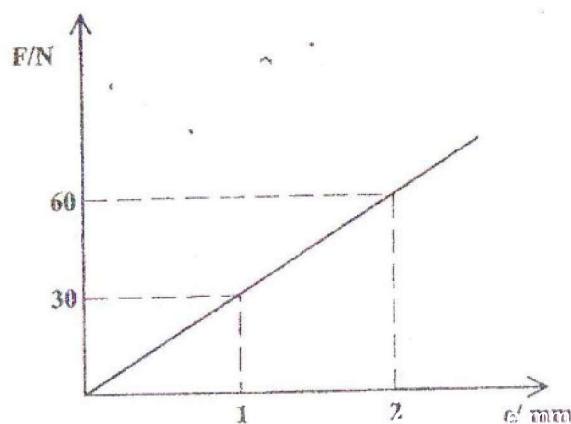


What information can be inferred from the graph?

- The force constant of the material is 1000 Nm^{-1} .
- The ultimate tensile stress of the material is about 35 N.
- The strain at X is 3%.
- The material obeyed Hooke's Law up to 30 N.

- (A) I and IV only
 (B) II and III only
 (C) II and IV only
 (D) III and IV only

- Item 45 refers to the following diagram which shows the force-extension graph of a wire.



How much work is done in stretching the wire from an extension of 1 mm to 2 mm?

- (A) 0.015 J
 (B) 0.030 J
 (C) 0.045 J
 (D) 0.060 J

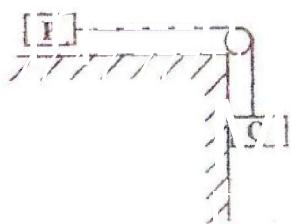
IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

1. Which of the quantities below are dimensionless?
- I. Relative density
II. Force
III. Length
IV. Refractive index
- (A) I and II only
(B) II and III only
(C) I and IV only
(D) II and IV only
2. In determining the density of a cube a student records the following measurements:

Length of side, $l = 3.0 \pm 0.1$ cm
Mass of cube, $m = 12.5 \pm 0.5$ g

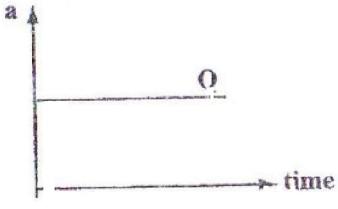
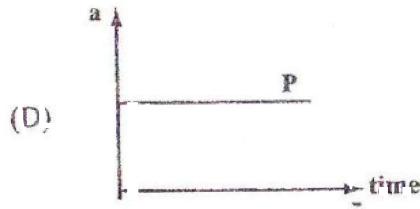
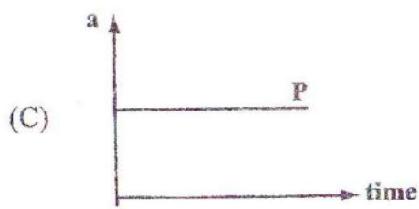
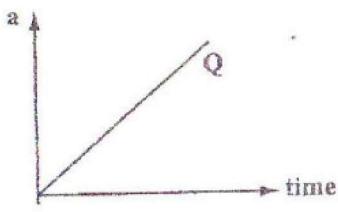
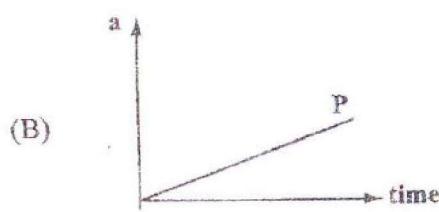
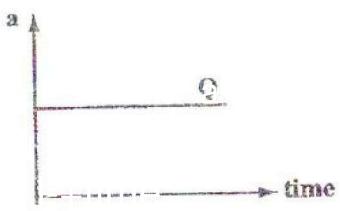
The student then uses the equation $\rho = \frac{m}{l^3}$ to determine the density of the cube. The percentage error in the calculated value of ρ is
- (A) 0.6%
(B) 7%
(C) 14%
(D) 40%
3. Given that the following quantities have the base units shown
- P: kg m³
Q: kg m s⁻²
R: kg² m² s⁻¹
- What quantity does $\frac{PQ}{R}$ represent?
- (A) Distance
(B) Speed
(C) Acceleration
(D) Force
4. The molar mass of aluminium is 27 g and its density is 2700 kg m⁻³. The number of aluminium atoms in a piece of aluminium with a volume of 1.0 m³ is approximately
- (A) 6×10^{25}
(B) 6×10^{26}
(C) 6×10^{27}
(D) 6×10^{28}
5. If the average velocity of a particle is zero, then the distance it has travelled
- (A) must be zero
(B) cannot be zero
(C) is negative
(D) may or may not be zero
6. A tennis ball is given a horizontal velocity of 8 m/s when it is hit at a height 1.8 m above the ground. It is in the air for
- (A) 0.37 s
(B) 0.61 s
(C) 2.98 s
(D) 8.89 s

Item 7 refers to the following information. Two identical masses are attached by a string, which passes over a frictionless pulley.



All the graphs below are drawn to the same scale.

7. Which pair of graphs below represents the acceleration of Body P and the acceleration of Body Q?



8. Which of the following pairs of conditions is true for an inelastic collision?

	Kinetic Energy	Momentum
(A)	conserved	conserved
(B)	not conserved	conserved
(C)	conserved	not conserved
(D)	not conserved	not conserved

9. Which of the following equations gives the correct relationship between impulse and momentum?

- (A) Impulse = momentum
- (B) Impulse = rate of change of momentum
- (C) Impulse = change in momentum
- (D) Impulse = (momentum)²

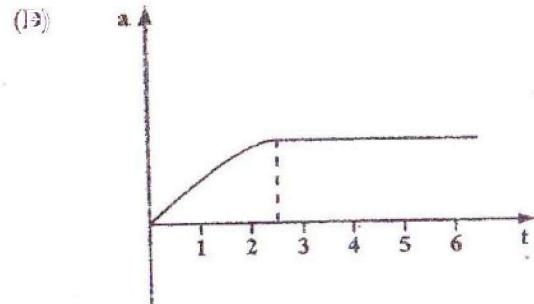
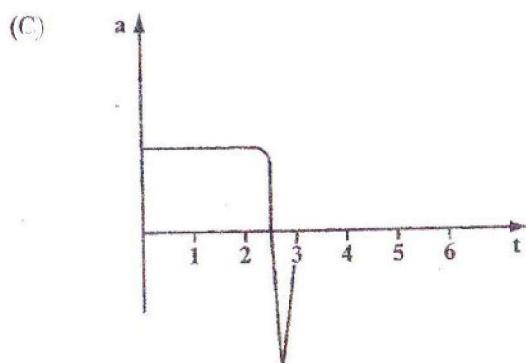
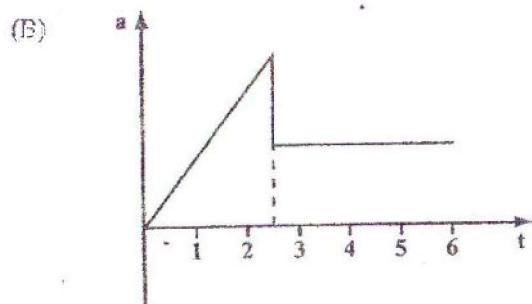
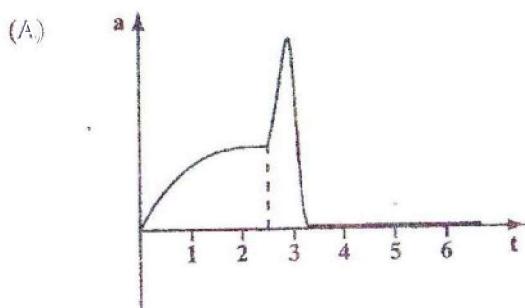
10. A man of mass 50 kg stands on a bathroom scale (balance) in an elevator. If the elevator accelerates upwards to 2 m s^{-2} . What is the reading on the scale?

- (A) 100 N
- (B) 390 N
- (C) 490 N
- (D) 590 N

11. Which of the statements below BEST describes the motion of a geostationary satellite?

- (A) It moves with the same velocity as the earth.
- (B) Its geographical location changes as the earth rotates.
- (C) Its acceleration is zero.
- (D) Its angular velocity is equal to that of the earth.

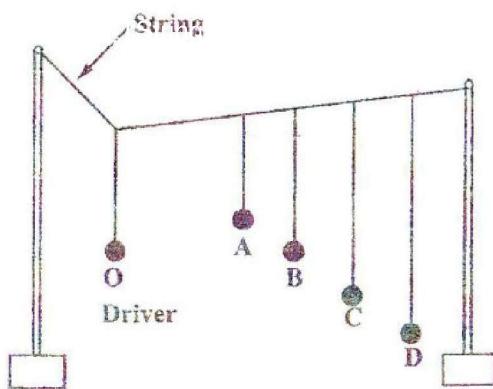
12. A man with a parachute jumps from a plane. He opens his parachute after 2.5 seconds. Which of the graphs below BEST represents how his vertical acceleration a , could vary with time t , during the first 6 seconds of his fall?



Q 5

13. A body falls from a cliff 80 m above the ground. If it loses 25% of its energy overcoming friction, what is its velocity on impact with the ground? [$g = 9.8 \text{ N kg}^{-2}$]
- (A) 19.8 m s^{-1}
(B) 28.0 m s^{-1}
(C) 34.3 m s^{-1}
(D) 39.6 m s^{-1}
14. If m is the mass of an object and E is kinetic energy, then its linear momentum is
- (A) $m\sqrt{E}$
(B) $2\sqrt{mE}$
(C) \sqrt{mE}
(D) $\sqrt{2mE}$
15. A student of weight 500 N is planning a trip up to the peak of Blue Mountain. From her starting point, this will involve an increase in altitude of 1800 m. She buys "high calorie" energy bars which contain 1000 kJ of energy. Assuming her body to be 10% efficient, how many bars will she need to eat for the necessary gain in altitude?
- (A) 1
(B) 9
(C) 90
(D) 900
16. When a particle oscillates in a straight line with simple harmonic motion, the period of the oscillation is
- (A) directly proportional to the displacement of the particle from the origin
(B) directly proportional to the acceleration of the particle
(C) independent of the frequency of oscillation
(D) independent of the amplitude of oscillation
17. The displacement of a particle undergoing simple harmonic motion is given by
- $$x = 8 \sin 0.4\pi t$$
- The frequency of oscillation of the particle is
- (A) 0.2 Hz
(B) 0.4 Hz
(C) 5 Hz
(D) 8 Hz

Item 18 refers to the following diagram.



18. The diagram shows a Barton pendulum system used to demonstrate resonance. Which pendulum would swing with the GREATEST amplitude when the driver O is pulled aside and released?

Item 19 refers to the diagram below which shows a snapshot of a rope as a transverse wave passes along it from left to right.



19. Which of the following correctly shows the directions of the motion of points X, Y and Z on the rope?

- | X | Y | Z |
|-----------|---|---|
| (A) ↓ → ↑ | | |
| (B) ↓ ↑ ↓ | | |
| (C) ↑ ↑ ↑ | | |
| (D) → ← → | | |

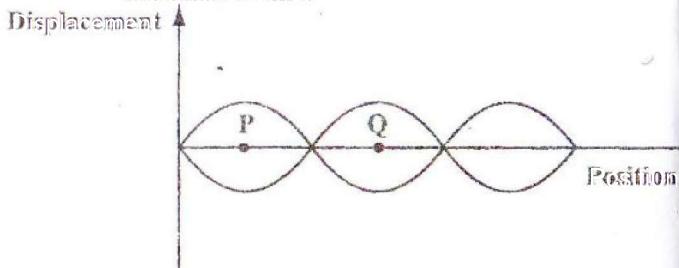
20. Which of the following events is associated with transverse waves but NOT longitudinal waves?

- (A) Interference
- (B) Polarisation
- (C) Reflection
- (D) Refraction

21. Sound waves with a frequency of 200 Hz travel through a medium with a speed of 400 m s⁻¹. What is the phase difference between two points which are 3 m apart in the direction of the wave?

- (A) $\frac{\pi}{4}$ rads
- (B) $\frac{\pi}{2}$ rads
- (C) $\frac{2}{3}\pi$ rads
- (D) π rads

22. The following displacement-position graph represents a stationary wave at two different instants of time.



What does the distance PQ represent?

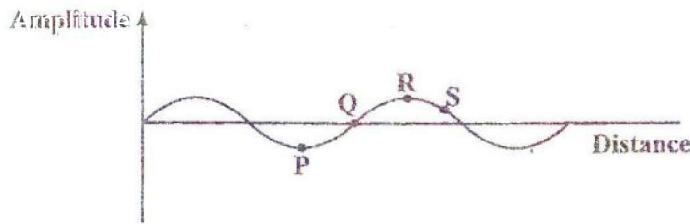
- (A) Half the velocity
- (B) Half the period
- (C) Half the wavelength
- (D) Half the amplitude

23. A wave of amplitude 10 cm has intensity I_1 . Another similar wave has an amplitude of 5 cm and intensity I_2 . What is the value of

$$\frac{I_1}{I_2}?$$

- (A) 2
(B) 4
(C) 20
(D) 50

Item 24 refers to the following graph which shows a stationary wave on a string.



24. Where on this stationary wave does an antinode exist?

- (A) P only
(B) Q only
(C) S only
(D) P and R only

25. Two light sources are said to be coherent. The waves from them must therefore have

- (A) the same frequency and a constant phase difference
(B) the same amplitude and a constant phase difference
(C) the same wavelength and no phase difference
(D) the same velocity and a constant path difference

26. As light travelling in air enters a medium its speed changes to $2.4 \times 10^8 \text{ m s}^{-1}$. The refractive index of the medium is

- (A) 0.60
(B) 0.80
(C) 1.25
(D) 1.50

27. For a double slit interference pattern using light, the separation of fringes will increase if:

- I. Blue light is used instead of red.
II. The screen is moved away from the slits.
III. The slits are brought closer together.
- (A) I only
(B) I and II only
(C) II and III only
(D) I, II and III

28. An object is placed 3 cm in front of a diverging lens of focal length 5 cm. Where will the image be found?

- (A) About 2 cm in front of the lens
(B) About 2 cm behind the lens
(C) About $\frac{1}{2}$ cm in front of the lens
(D) About $\frac{1}{2}$ cm behind the lens

34. In an electrical method for determining the specific heat capacity of a metal, the following readings were obtained

mass of metal	2 kg
supply voltage	240 V
current	3 A
time for which heat supplied	20 s
temperature rise of metal	10 °C

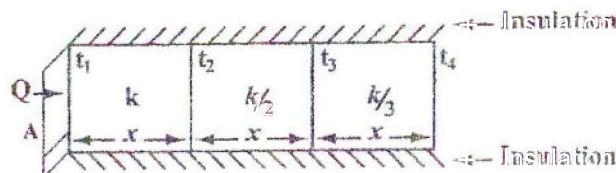
What is the specific heat capacity of metal?

- (A) $\frac{240 \times 3 \times 6}{2 \times 10 \times 20} \text{ J kg}^{-1} \text{ K}^{-1}$
- (B) $\frac{2 \times 10 \times 20}{240 \times 3 \times 6} \text{ J kg}^{-1} \text{ K}^{-1}$
- (C) $\frac{2 \times 10 \times 20}{240 \times 3} \text{ J kg}^{-1} \text{ K}^{-1}$
- (D) $\frac{240 \times 3 \times 20}{2 \times 10} \text{ J kg}^{-1} \text{ K}^{-1}$

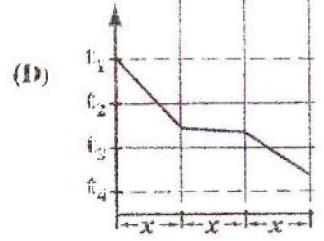
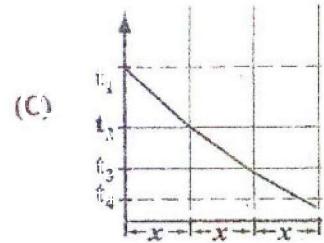
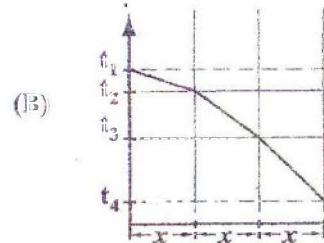
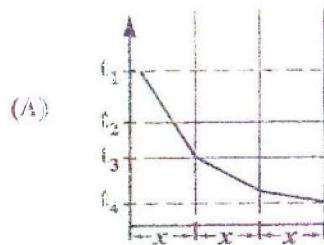
35. Water falls from a height of 500 m. What is the rise in temperature of water at the bottom if all of the energy gained is converted to internal energy in the water?

- (A) 1.17 K
 (E) 0.19 K
 (C) 0.24 K
 (D) 0.49 K

36. A composite conductor with materials of thermal conductivities k , $k/2$, $k/3$ has insulated sides. Heat is transferred through it from left to right as shown in the diagram below.



Each material has the same thickness. Which of the following diagrams BEST describes the temperature gradient of the composite wall?



37. A contractor builds an office window of height 150 cm and width 200 cm with a glass pane of thickness 0.5 cm. The temperature difference across the glass is 15 K and the thermal conductivity of the glass is $0.65 \text{ W m}^{-1} \text{ K}^{-1}$. Calculate the heat energy per second conducted through the window.

(A) 1.63 kW
 (B) 5.85 kW
 (C) 163 kW
 (D) 585 kW

38. A small black sphere has an absolute temperature T_1 . It is hung in the centre of an enclosure whose walls are at a higher absolute temperature T_2 . The net rate of gain of thermal energy by the sphere is proportional to

(A) $(T_1)^4$
 (B) $(T_2)^4$
 (C) $(T_2)^4 - (T_1)^4$
 (D) $(T_2 - T_1)^4$

39. Avogadro's number is the number of molecules in

(A) one litre of gas at N.T.P.
 (B) one mole of a gas
 (C) one gram of a gas
 (D) one kilogram of a gas

40. A gas contains N molecules. The speeds of the molecules are C_1, C_2, \dots, C_N . Which of the following equations can be used to determine the r.m.s speed of the molecules?

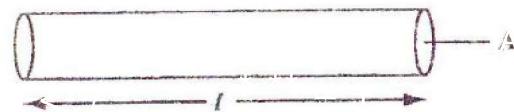
$$\begin{aligned} (A) & \sqrt{\frac{C_1 + C_2 + \dots + C_N}{N}} \\ (B) & \sqrt{\frac{C_1^2 + C_2^2 + \dots + C_N^2}{N}} \\ (C) & \sqrt{\frac{(C_1 + C_2 + \dots + C_N)^2}{N}} \\ (D) & \sqrt{\frac{(C_1^2 + C_2^2 + \dots + C_N^2)^2}{N}} \end{aligned}$$

41. What is the total pressure on the base of a container of cross-sectional area 5.0 m^2 , if it is filled with ethylene glycol of density 1120 kg m^{-3} up to a depth of 3.0 m ?

[Atm. press = $1.0 \times 10^5 \text{ Pa}$]

(A) $3.3 \times 10^4 \text{ Pa}$
 (B) $6.7 \times 10^4 \text{ Pa}$
 (C) $1.0 \times 10^5 \text{ Pa}$
 (D) $1.33 \times 10^5 \text{ Pa}$

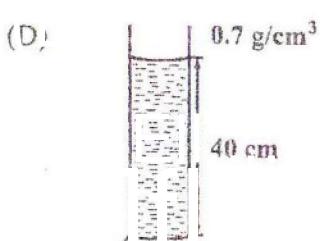
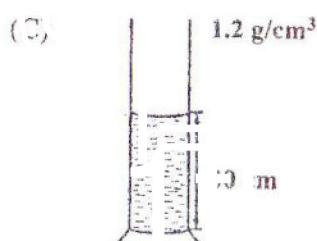
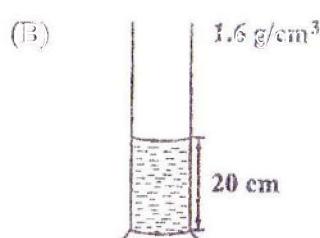
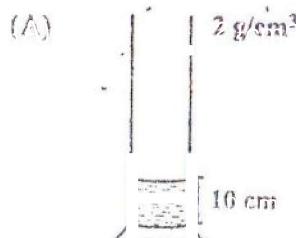
Item 42 refers to the following diagram.



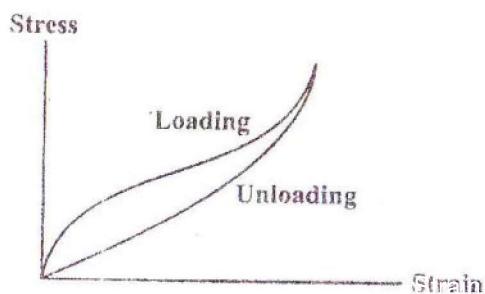
42. The material shown has length, l , and cross-sectional area A . When a force F is applied to the material it causes an extension ϵ , in the material. Which of the following expressions can be used to determine the Young modulus of the material?

$$\begin{aligned} (A) & \frac{Fl}{A\epsilon} \\ (B) & \frac{FA}{el} \\ (C) & \frac{A\epsilon}{Fl} \\ (D) & \frac{el}{FA} \end{aligned}$$

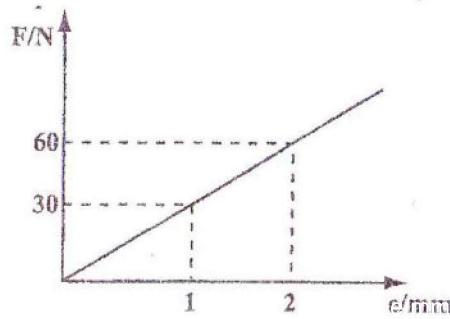
43. Four different liquids are poured into identical measuring cylinders. The diagrams show the heights of the liquids and their densities. Which liquid exerts the LARGEST pressure on the base of its measuring cylinder?



Item 44 refers to the following graph.



Item 45 refers to the following diagram.



44. This graph is MOST likely to apply to

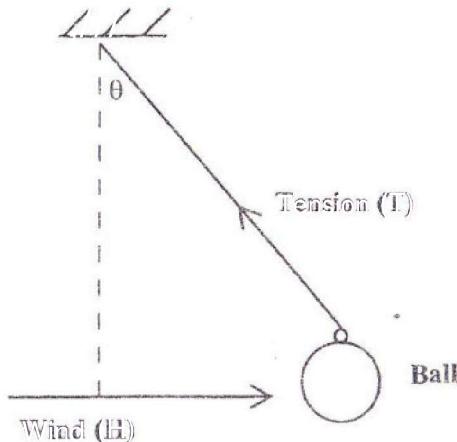
- (A) steel
- (B) glass fibre
- (C) an elastic band
- (D) polythene sheet

45. The figure above shows the force-extension graph of a wire. How much work is done in stretching the wire from an extension of 1 mm to 2 mm?

- (A) 0.015 J
- (B) 0.030 J
- (C) 0.045 J
- (D) 0.060 J

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

1. A rubber ball of weight, W , is suspended from a support and is being displaced laterally at an angle, θ° , from the vertical by a wind of constant force, H . The ball is in equilibrium and the tension in the string is T .



Which of the following equations is correct?

- (A) $T = W$
(B) $T = H$
(C) $T = W/\cos \theta$
(D) $T = H/\cos \theta$
2. Mary is on her way to New York and wants to ensure that her suitcase does NOT exceed the 50 kg limit. She stands on the scale and finds her mass is $55 \text{ kg} \pm 1 \text{ kg}$. She next lifts her suitcase and the mass changes to $104 \text{ kg} \pm 1 \text{ kg}$. What is the mass of her suitcase?

- (A) $49 \text{ kg} \pm 1 \text{ kg}$
(B) $49 \text{ kg} \pm 2 \text{ kg}$
(C) $50 \text{ kg} \pm 1 \text{ kg}$
(D) $51 \text{ kg} \pm 2 \text{ kg}$

Item 3 refers to the following quantities with their base units.

$$P: \text{kg m}^{-3}$$

$$Q: \text{kg m s}^{-2}$$

$$R: \text{kg}^2 \text{m}^3 \text{s}^{-1}$$

3. What quantity does $\frac{PQ}{R}$ represent?

- (A) Speed
(B) Force
(C) Distance
(D) Acceleration

4. The number of moles of carbon-12 atoms in 0.660 kg is

- (A) 0.5
(B) 5
(C) 6
(D) 12

5. If the average velocity of a particle is zero, then the distance it has travelled

- (A) is negative
(B) must be zero
(C) cannot be zero
(D) may or may not be zero

6. What is the gravitational field strength of a planet whose mass is one-third that of the Earth's and whose radius is one-half that of the Earth's? (The gravitational field strength of Earth is g .)

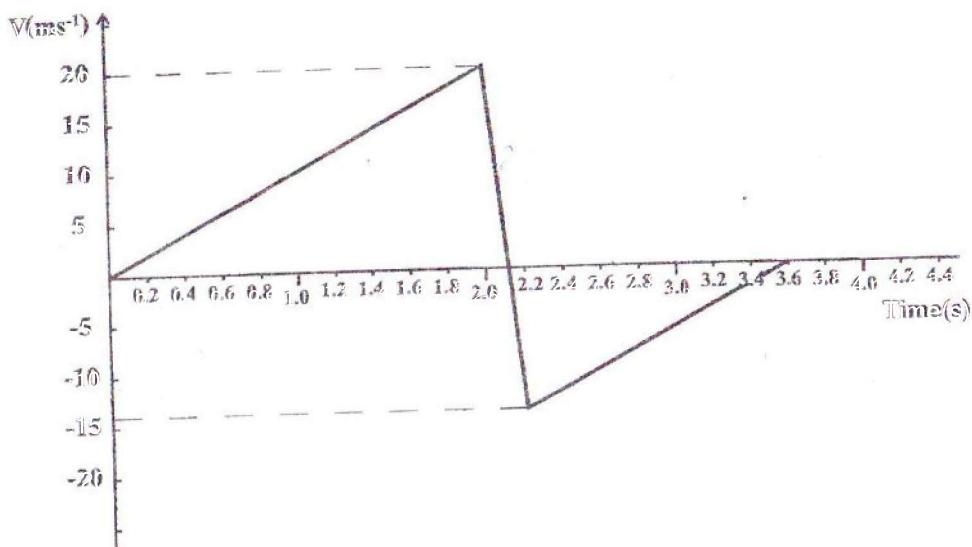
(A) $\frac{16}{27} g$

(B) $\frac{2}{4} g$

(C) $\frac{4}{3} g$

(D) $\frac{9}{4} g$

Item 7 refers to the following graph which shows the motion of a ball as it falls from a height h , and bounces once.



7. What is the height from which the ball was released?

- (A) 10 m
 (B) 20 m
 (C) 21 m
 (D) 40 m

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Item 8 refers to the following information.

A light spring is permanently connected between two blocks of wood on a frictionless surface as shown in the diagram below.



The masses of the blocks are 2.0 kg and 5.0 kg and they can move freely along a straight horizontal track. The spring is compressed and the blocks are released simultaneously from rest.

8. When the acceleration of the heavier block is 10 m s^{-2} , the acceleration of the lighter block will be

(A) 5 m s^{-2}
(B) 10 m s^{-2}
(C) 20 m s^{-2}
(D) 25 m s^{-2}

9. A rocket in gravity-free space is burning $5.0 \times 10^2 \text{ kg}$ of fuel per second. The exhaust gases are expelled at $8.0 \times 10^3 \text{ m s}^{-1}$ relative to the rocket, whose mass is $2.0 \times 10^5 \text{ kg}$ at that time. What is its acceleration?

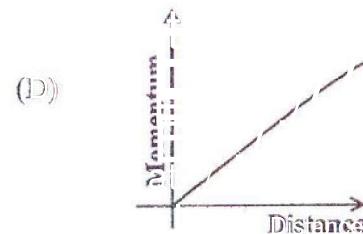
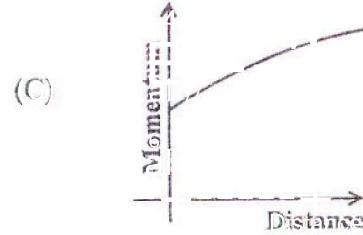
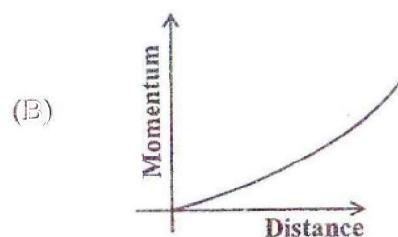
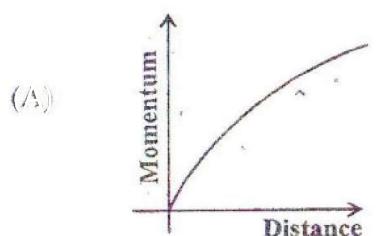
(A) 10 m s^{-2}
(B) 20 m s^{-2}
(C) 400 m s^{-2}
(D) 2500 m s^{-2}

10. Which of the following statements is NOT true about an object floating in a fluid?

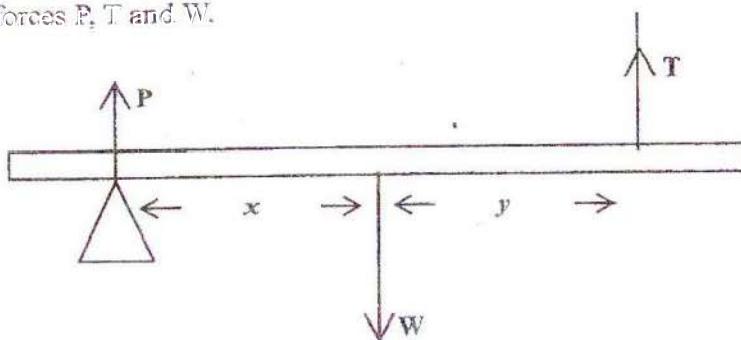
(A) The resultant force on the object is zero.
(B) The weight of the object is equal to the weight of the fluid displaced.
(C) The upthrust is equal to the weight of the fluid displaced.
(D) The upthrust is greater than the weight of the object.

11.

A truck moves off from rest on a straight horizontal road. The resultant force acting on the truck remains constant. Which of the following graphs shows the variation of the momentum of the truck with distance?



Item 12 refers to the following diagram which shows a plank in equilibrium when acted on by the forces P, T and W.



12. From the diagram above which of the following statements is/are true?

- I. $T + P = W$
- II. $P(x + y) = Wy$
- III. $Px = Ty$

- (A) I only
 - (B) I and III only
 - (C) II and III only
 - (D) I, II and III
-

13. If p is the momentum of an object of mass, m , then the expression $\frac{p^2}{m}$ has the same unit as:

- (A) energy
- (B) force
- (C) impulse
- (D) acceleration

14. If m is the mass of an object and E its kinetic energy, then its linear momentum is:

- (A) $m\sqrt{E}$
- (B) $2\sqrt{mE}$
- (C) \sqrt{mE}
- (D) \sqrt{mE}

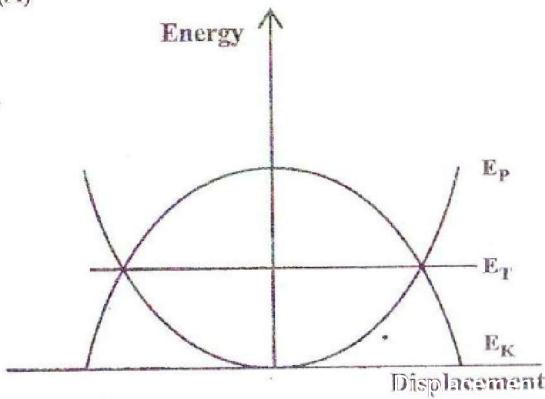
15. A student of weight 500 N is planning a trip to the peak of Blue Mountain. From her starting point, this will involve an increase in altitude of 1800 m. She buys "high calorie" energy bars which release 1000 kJ of energy when digested. Assuming her body to be 10% efficient, how many bars will she need to eat for the necessary gain in altitude?

- (A) 1
- (B) 9
- (C) 90
- (D) 900

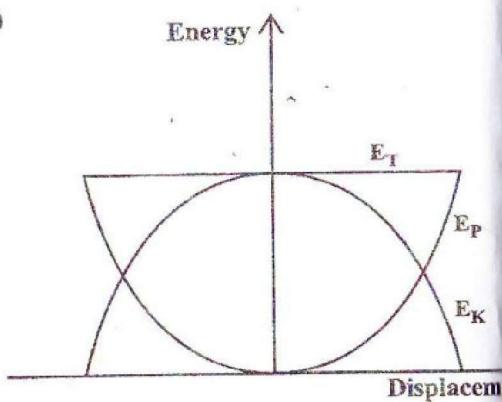
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16. Which of the following graphs BEST represents the relationship between total energy, E_T , potential energy, E_p , kinetic energy, E_K , and displacement of a particle moving in a straight line with simple harmonic motion?

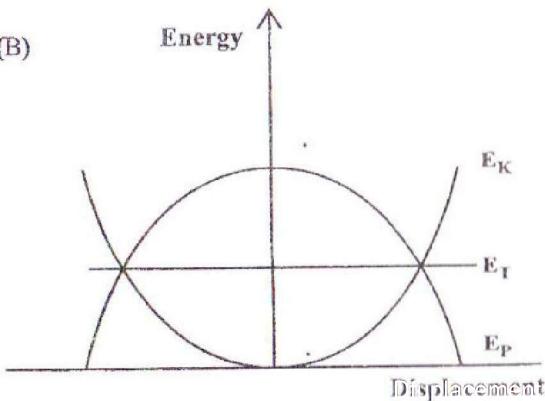
(A)



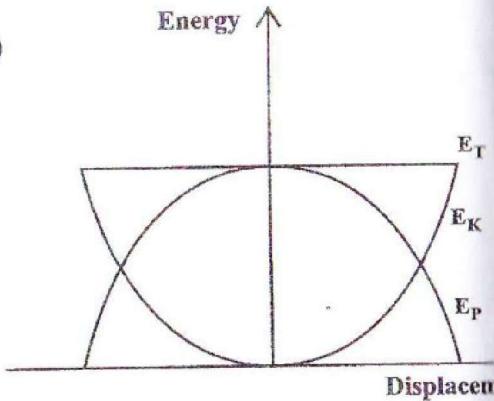
(C)



(B)



(D)



17. The displacement of a particle undergoing simple harmonic motion is given by

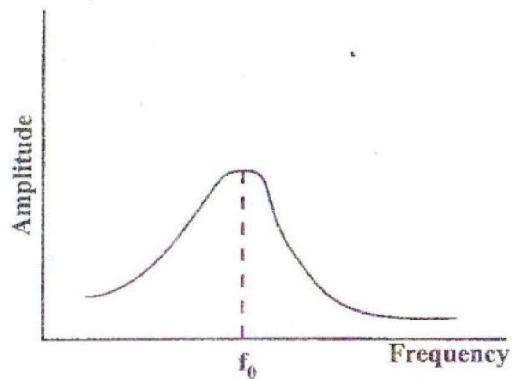
$$x = 8 \sin(0.4\pi t) \text{ where } x \text{ is in metres and } t \text{ in seconds.}$$

The frequency of oscillation of the particle is

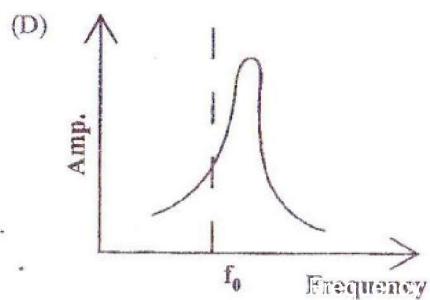
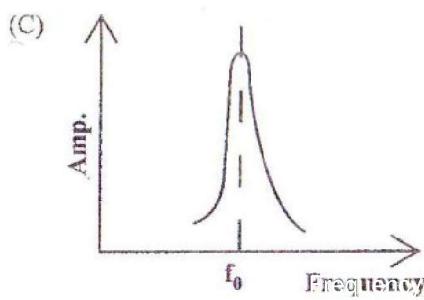
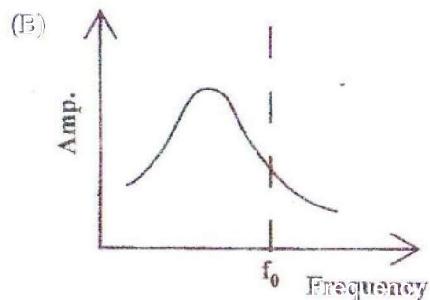
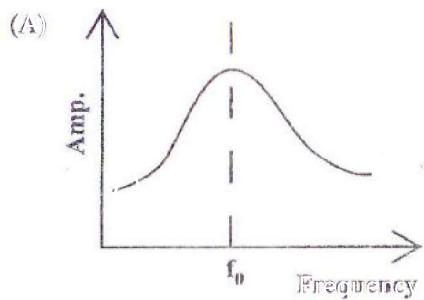
- (A) 0.2 Hz
- (B) 0.4 Hz
- (C) 5 Hz
- (D) 8 Hz

Item 18 refers to the following information.

A system made up of a light helical spring to which a small mass is attached, is forced to oscillate at different frequencies, f , in air. The response is shown in the diagram below.



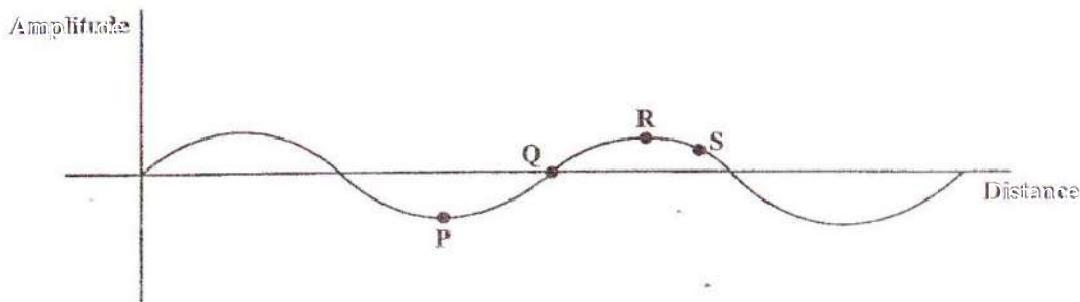
If the experiment were done in an evacuated chamber, which graph BEST represents the result?



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21. The principle of superposition of waves states that when two or more waves meet at a point, the resultant displacement is the
- (A) difference of the displacements of the individual waves
(B) product of the displacements of the individual waves
(C) sum of the displacements of the individual waves
(D) square of the displacements of the individual waves
22. Which of the following statements concerning sound and light waves is correct?
- (A) Both sound and light waves in air are longitudinal.
(B) Both sound and light waves in air are transverse.
(C) Sound waves in air are transverse and light waves are longitudinal.
(D) Sound waves in air are longitudinal and light waves are transverse.
23. A communications satellite sends information to Earth in the form of electromagnetic waves in bursts of 5 ms duration. If the wavelength of the electromagnetic waves is 2×10^6 m, the number of wavelengths in EACH pulse is approximately
- (A) 7.5×10^8
(B) 7.5×10^{11}
(C) 3×10^{16}
(D) 3×10^{19}

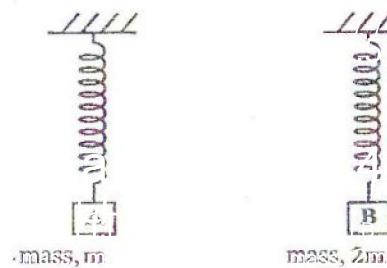
Item 24 refers to the following diagram which shows a stationary wave on a string at one instant in time.



24. Where on this stationary wave does an antinode exist?
- (A) P only
(B) Q only
(C) S only
(D) P and R only

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Item 19 refers to the following diagram.



19. What is the relationship between the periods of A and B, T_A and T_B respectively, if the two springs are similar?

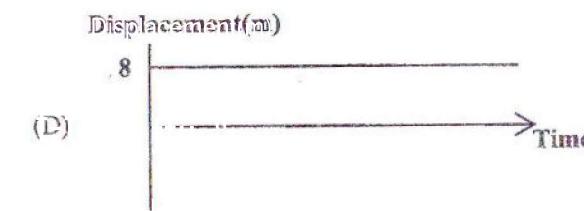
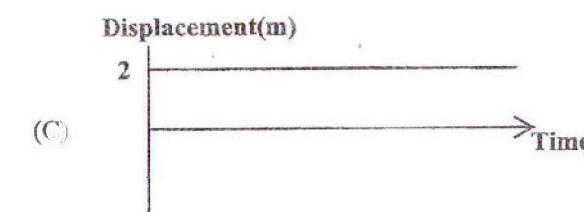
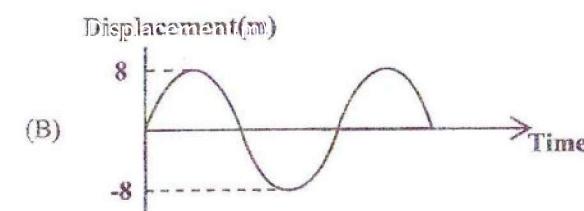
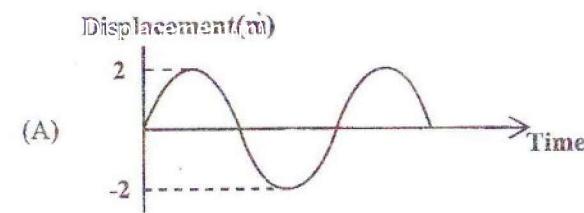
(A) $T_A = \frac{1}{2} T_B$

(B) $T_A = \frac{1}{\sqrt{2}} T_B$

(C) $T_A = \sqrt{2} T_B$

(D) $T_A = 2 T_B$

20. Two sources of water waves, X and Y, generate waves which are out of phase by 180° . If the waves from X are of amplitude 5 m and the waves from Y are of amplitude 3 m, which of the following graphs correctly describes the oscillation of a particle which is equidistant from X and Y?



19. Which of the following statements regarding lenses is/are correct?

- I. A converging lens always forms an image bigger than the object.
- II. An object placed in front of a converging lens can form a virtual image.
- III. A diverging lens can form a real image of an object placed in front of it.

- (A) I only
- (B) II only
- (C) I and III only
- (D) II and III only

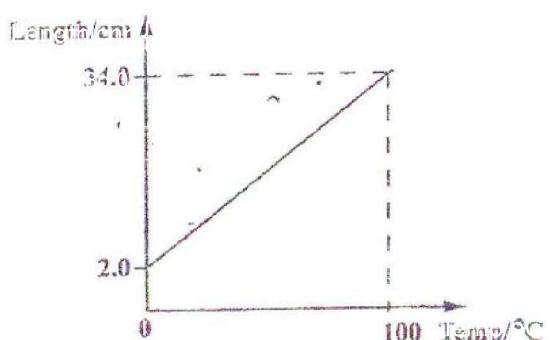
30. The near point of a defective eye is 30 cm from the eye. The normal near point is 25 cm from the eye. The focal length of the lens needed to correct this defect is

- (A) 5 cm
- (B) 25 cm
- (C) 30 cm
- (D) 150 cm

31. Which instrument is MOST suitable for measuring rapidly changing temperature?

- (A) The resistance thermometer
- (B) The mercury-in-glass thermometer
- (C) The thermocouple
- (D) The alcohol-in-glass thermometer

Item 32 refers to the following graph.



32. The graph shows how the length of the mercury in a thermometer changes with temperature. The temperature which corresponds to a length of 10.0 cm is

- (A) 15 °C
- (B) 20 °C
- (C) 25 °C
- (D) 30 °C

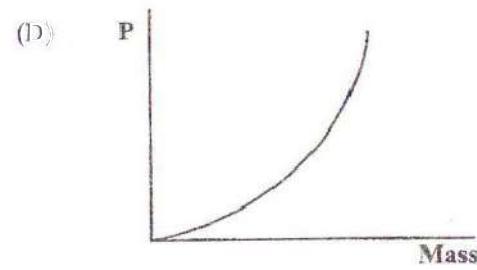
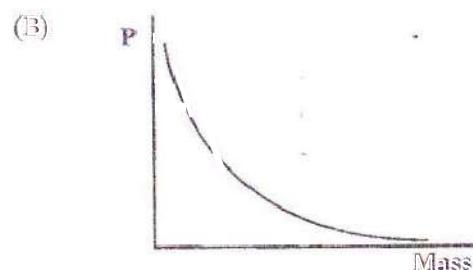
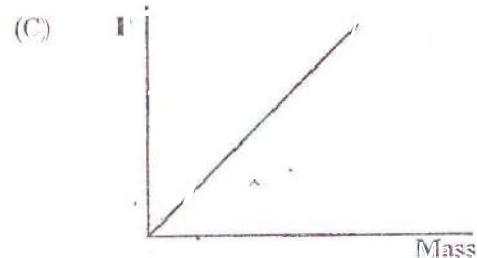
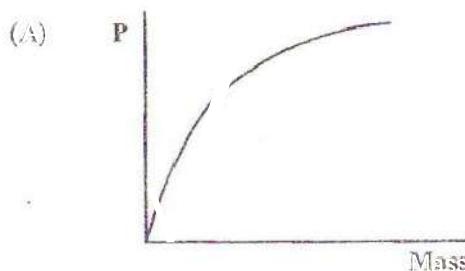
33. What is the name given to the amount of heat energy needed to change 1 kg of water at 100 °C into steam at 100 °C?

- (A) Molar heat capacity
- (B) Specific latent heat of fusion
- (C) Specific heat capacity
- (D) Specific latent heat of vaporisation

25. When measuring the speed of sound in air, different vibrating tuning forks are held over the open end of a resonance tube and the length of air column lowered until the first loud note is heard. The following graph shows how the resonant length varies with $\frac{1}{f}$.
-
- The value of the intercept, L_0 , on the L-axis indicates the
- (A) end correction of the tube
 - (B) amplitude of the sound
 - (C) wavelength of the sound
 - (D) shortest resonant length of the tube
26. A ship sends down a pulse of sound to measure the depth of the sea. The echo is detected 0.1s later. Assuming that sound travels five times faster in sea-water than in the air, how deep is the sea at this point?
- (Speed of sound in air = 330 m s^{-1})
- (A) 25 m
 - (B) 83 m
 - (C) 248 m
 - (D) 1650 m
27. X-rays differ from microwaves in that they
- (A) cannot be refracted
 - (B) are deviated by an electric field
 - (C) have a shorter wavelength
 - (D) cannot be polarized
28. Standing waves are produced in a 10 m long stretched string. If the string vibrates in segments and wave velocity is 20 m s^{-1} , the frequency is
- (A) 2 Hz
 - (B) 4 Hz
 - (C) 5 Hz
 - (D) 10 Hz
29. The amplitude of a wave is increased from 4 m to 6 m. What is the change in intensity of the wave?
- (A) 0.35 dB
 - (B) 1.76 dB
 - (C) 2.0 dB
 - (D) 3.5 dB
30. Accommodation in the human eye refers to the
- (A) dilation of the pupil to allow more light to enter the eye
 - (B) adjustment of the lens to focus on objects according to the distance
 - (C) changing of the shape of the eye so that the image fits on the retina
 - (D) use of lenses to correct defects in vision.
31. Which instrument is MOST suitable for measuring a rapidly changing temperature?
- (A) Thermocouple
 - (B) Resistance thermometer
 - (C) Alcohol-in-glass thermometer
 - (D) Mercury-in-glass thermometer

32. The length of the liquid column in a mercury thermometer at the ice point is 15 mm and at the steam point is 220 mm. When placed in a cup of tea the length of the mercury column is 195 mm. What is the temperature of the tea, as measured on the centigrade scale of this thermometer?
- (A) 76.6 °C
(B) 87.8 °C
(C) 89.1 °C
(D) 102.4 °C
33. An immersion heater rated at 150 W is fitted into a large block of ice at 0 °C. The specific latent heat of fusion of the ice is $3 \times 10^5 \text{ J kg}^{-1}$. How long does it take to melt 10 g of ice?
- (A) 2 s
(B) 5 s
(C) 20 s
(D) 150 s
34. The SI unit for heat capacity is
- (A) J kg^{-1}
(B) $\text{J kg}^{-1}\text{K}^{-1}$
(C) J K^{-1}
(D) J kg K^{-1}
35. Water falls from a height of 500 m. What is the rise in temperature of the water at the bottom, if all the energy gained is converted to internal energy in the water?
- (A) 0.19 K
(B) 0.24 K
(C) 0.49 K
(D) 1.17 K
36. Gas in an enclosed system is allowed to expand with no thermal energy entering or leaving the system. Which of the following statements is true?
- (A) The temperature of the gas decreases as work is done by the gas.
(B) Work is done by the gas so the kinetic energy of the gas molecules increases.
(C) The internal energy of the gas increases as work is done on the gas.
(D) No heat enters the system so the temperature of the gas remains constant.
37. A contractor builds an office window of height 150 cm and width 200 cm which contains a glass pane of thickness 0.5 cm. The temperature difference across the glass is 15 K and the thermal conductivity of the glass is $0.65 \text{ W m}^{-1}\text{K}^{-1}$. Calculate the heat energy per second conducted through the window.
- (A) 5.85 J
(B) 585 J
(C) 5.85 kJ
(D) 585 kJ

38. Which graph BEST represents pressure 'P' of a gas as a function of its mass when the gas is pumped into a container of fixed volume and the temperature remains constant?



39. In the Kinetic Theory for an ideal gas, which of the following statements is NOT a correct assumption?

- (A) The duration of collision is negligible compared with the time between the collisions.
- (B) The volume of the molecules is negligible compared with the volume in which they move.
- (C) The molecules have negligible attraction for each other.
- (D) The molecules have negligible momentum change on collision with the container walls.

40. A gas contains N molecules. The speeds of the molecules are C_1, C_2, \dots, C_N . Which of the following equations can be used to determine the r.m.s speed of the molecules?

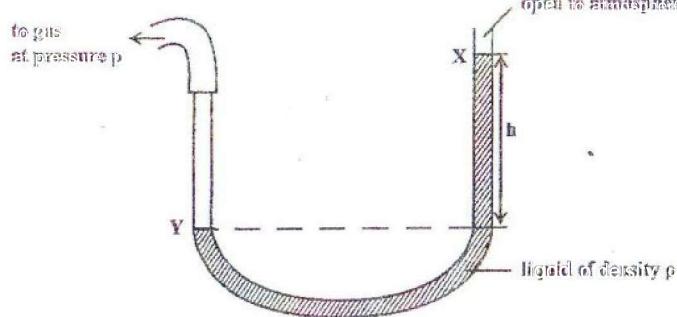
$$(A) \sqrt{\frac{C_1 + C_2 + \dots + C_N}{N}}$$

$$(B) \sqrt{\frac{C_1^2 + C_2^2 + \dots + C_N^2}{N}}$$

$$(C) \sqrt{\frac{(C_1 + C_2 + \dots + C_N)^2}{N}}$$

$$(D) \sqrt{\frac{(C_1^2 + C_2^2 + \dots + C_N^2)^2}{N}}$$

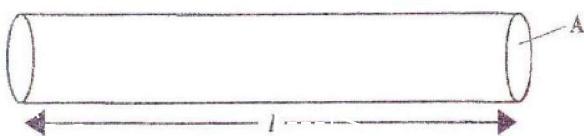
Item 41 refers to the following diagram.



41. In the U-tube manometer shown above, the pressure at X is atmospheric pressure (p_A) and the liquid in the tube has a density of ρ . The pressure at Y is equal to the pressure, p , of the gas. The gas pressure p is equal to

- (A) $p_A + h\rho g$
 (B) $p_A - h\rho g$
 (C) $h\rho g$
 (D) p_A

Item 42 refers to the following diagram.



42. The material shown has length, l , and cross-sectional area, A . When a force, F , is applied to the material it causes an extension, e , in the material. Which of the following expressions can be used to determine the Young modulus of the material?

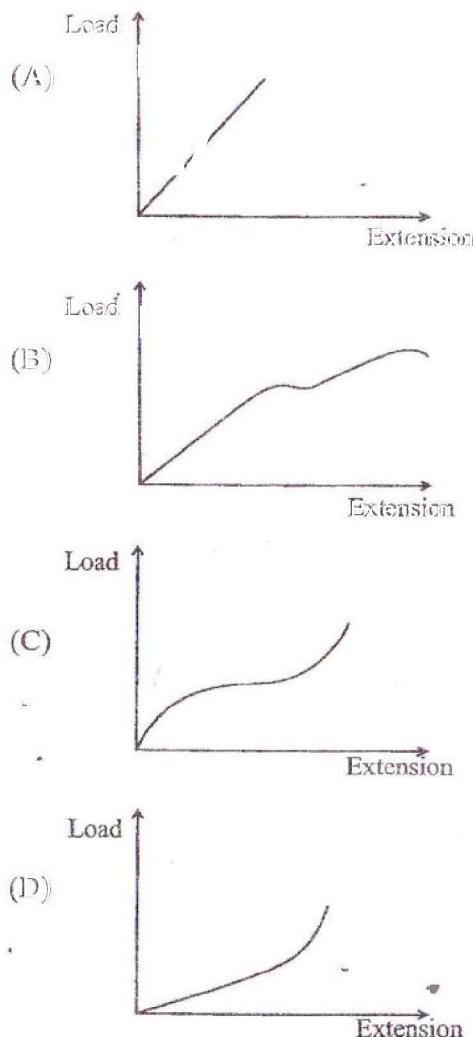
- (A) $\frac{Fl}{Ae}$
 (B) $\frac{FA}{el}$
 (C) $\frac{Ae}{Fl}$
 (D) $\frac{el}{FA}$

43.

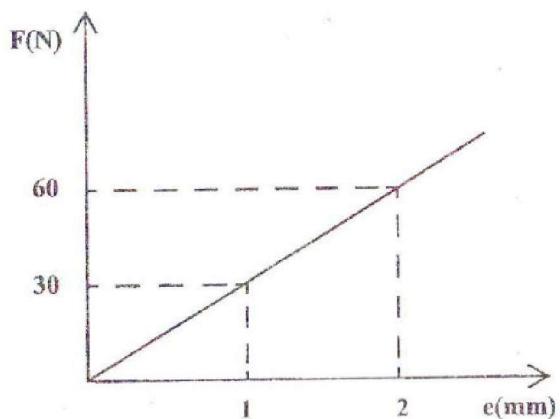
Helium gas is kept in a container at a pressure of 1.7×10^5 Pa. If the density of helium is 0.92 kg m^{-3} , calculate the root mean square speed of the helium atoms.

- (A) 243 m s^{-1}
 (B) 330 m s^{-1}
 (C) 430 m s^{-1}
 (D) 745 m s^{-1}

44. Which of the following graphs BEST represents how the extension of a ductile material varies progressively with the load attached?



Item 45 refers to the following diagram.



45. The figure above shows the force-extension graph of a wire. How much work is done in stretching the wire from an extension of 1 mm to 2 mm?
- (A) 0.015 J
(B) 0.030 J
(C) 0.045 J
(D) 0.060 J

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.