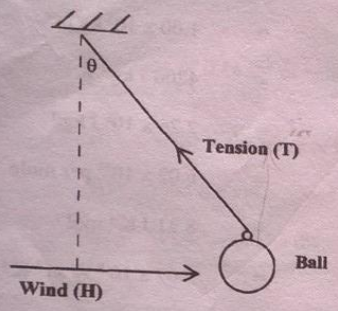
LIST OF PHYSICAL CONSTANTS

Universal gravitational constant	G	=	6.67×10^{-11} N m^2 kg^{-2}
Acceleration due to gravity	g	=	9.81 m s^{-2}
1 Atmosphere	Atm	=	1.00×10^5 N m^{-2}
Boltzmann's constant	k	=	1.38×10^{-23} J K^{-1}
Density of water	ρ	=	1.00×10^3 kg m^{-3}
Specific heat capacity of water	C_w	=	4200 J kg^{-1} K^{-1}
Specific latent heat of vaporization of water	L_V	=	2.26×10^6 J kg^{-1}
Avogadro's number	N_A	=	6.02×10^{23} per mole
Molar gas constant	R	=	8.31 J K^{-1} mol^{-1}
Stefan-Boltzmann constant	σ	=	5.67×10^{-8} W m^{-2} K
Speed of light in vacuum	c	=	3.0×10^8 m s^{-1}

[4 mks]

of two sounds other?

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 θ
(D) T = H/cos θ

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

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

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 $x = 3$ mg and $y = 9$ kg then

(A) $y = 3 \times 10^5 x$
(B) $y = 3 \times 10^3 x$
(C) $y = 3 \times 10^6 x$ X3x10^-3
(D) $y = 3 \times 10^9 x$

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.)

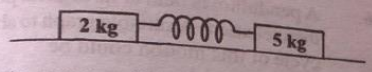
(A) $\frac{16}{27}g$
(B) $\frac{3}{4}g$
(C) $\frac{4}{3}g$
(D) $\frac{9}{4}g$

7. For an object undergoing projectile motion which of the following options BEST describes the vertical and horizontal components of velocity?

	Horizontal V_x	Vertical V_y
(A)	Constant	Changes
(B)	Constant	Constant
(C)	Changes	Constant
(D)	Changes	Changes

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

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

10. An object of mass, m, travelling initially at a velocity, u, is acted upon by a force, F, for a period, t, until it is travelling with a velocity, v. Which of the following equations can be used to determine the impulse of the force?

I. Impulse = Ft

II. Impulse = $mv - mu$

III. Impulse = $\frac{mv - mu}{t}$

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

11. A car with mass, m, moves around a circular road of radius, r, at a constant speed, v. Which of the following statements is/are true?

I. The car's velocity changes and the magnitude of the acceleration is $\frac{v^2}{r}$.

II. There is no resultant force on the car since its speed is constant.

III. The resultant force on the car is outwards from the centre and equals $\frac{mv^2}{r}$.

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

GO ON TO THE NEXT PAGE

12. 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.

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

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

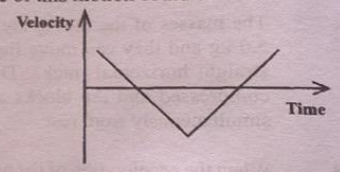
14. A van has mass m. The van's engine has a maximum power output of P. The LEAST time required for the van to be accelerated from rest to a speed, v, is

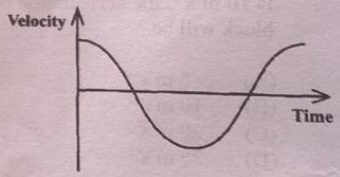
(A) $\frac{mv^2}{2P}$
(B) $\frac{mv}{P}$
(C) $\frac{mP}{v}$
(D) $\frac{2P}{mv^2}$

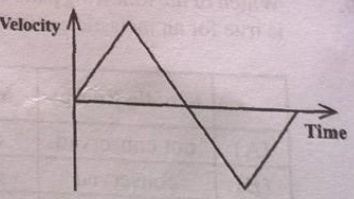
15. A student of weight 500 N is planning a trip to the peak of Blue Mountain. From her starting point, this will involve an increase in altitude of 1800 m. She buys 'high calorie' energy bars which release 1000 kJ of energy when digested. Assuming her body to be 10% efficient, how many bars will she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

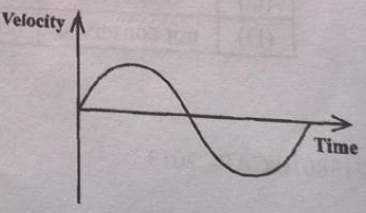
(A) 1
(B) 9
(C) 90
(D) 900

16. A pendulum is held at its highest point and then released. A suitable graph to show one cycle of this motion could be

(A)


(B)


(C)


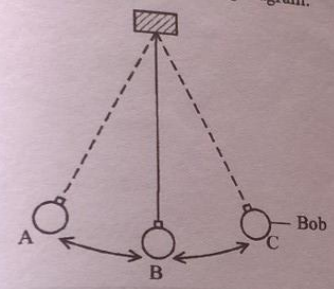
(D)


The displacement of a particle undergoing simple harmonic motion is given by $x = 8 \sin (0.4 \pi t)$ where x is in metres and t in seconds.

The frequency of oscillation of the particle is

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

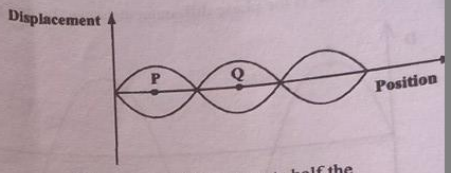
Item 18 refers to the following diagram.



18. A pendulum starts its oscillation from Position A. The kinetic energy of the pendulum bob is MAXIMUM when the bob is

(A) at position A
(B) at position B
(C) at position C
(D) between Positions A and B

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

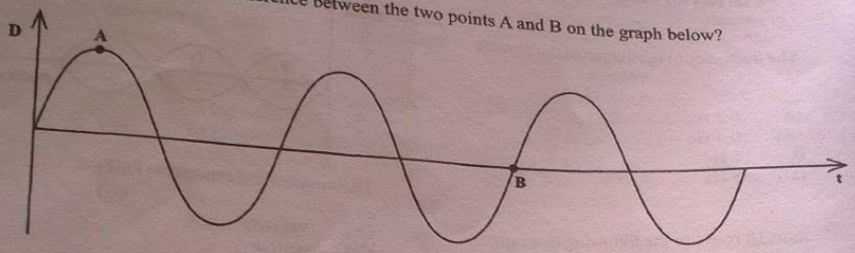


The distance PQ represents half the

(A) velocity
(B) period
(C) wavelength
(D) amplitude

GO ON TO THE NEXT PAG

20. What is the phase difference between the two points A and B on the graph below?



(A) $\frac{7\pi}{4}$ radians

(B) $\frac{13\pi}{4}$ radians

(C) $\frac{7\pi}{2}$ radians

(D) 3π radians

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21. 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

2. 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.

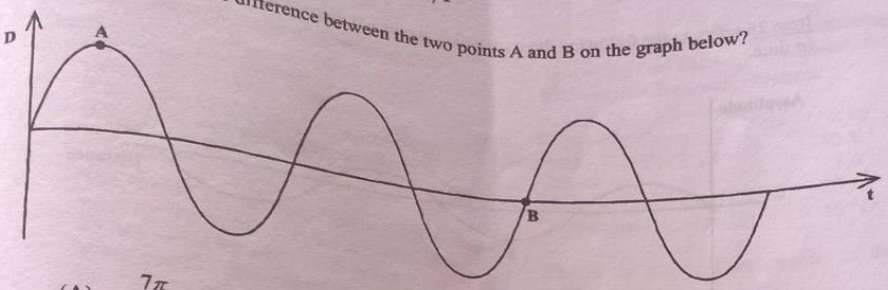
23. Which of the following events is associated with transverse waves but NOT longitudinal waves?

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

24. 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) 1 000 m s^{-1}
(D) 2 000 m s^{-1}

20. What is the phase difference between the two points A and B on the graph below?



(A) $\frac{7\pi}{4}$ radians

(B) $\frac{13\pi}{4}$ radians

(C) $\frac{7\pi}{2}$ radians

(D) 3π radians

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(B) square of the amplitude of the oscillation
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(A) 125 m s^{-1}
(B) 250 m s^{-1}
(C) 1 000 m s^{-1}
(D) 2 000 m s^{-1}

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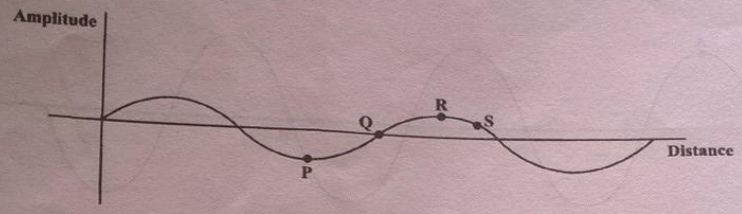
Item 25 refers to the following diagram which shows a stationary wave on a string at one instant in time.



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

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

---

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

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

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. 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

29. In Young's double slit experiment, the separation between the slits is halved and the distance between the slits and screen is doubled. The fringe width is

(A) unchanged
(B) halved
(C) doubled
(D) quadrupled

30. A student's range of hearing is from 4(Hz to 15 kHz. What is the SHORTES wavelength of sound she can hear if th speed of sound in air is 330 m s^{-1}?

(A) 0.022 m
(B) 0.045 m
(C) 8.25 m
(D) 22.0 m

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

(A) The thermocouple
(B) The resistance thermometer
(C) The alcohol-in-glass thermometer
(D) The 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) 88.1 °C
(D) 102.4 °C

33. An immersion heater rated 150 W is fitted into a large block of ice at 0 °C. The specific latent heat of fusion of the ice is 3×10^5 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. 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 the metal?

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

(B) $\frac{2 \times 10 \times 20}{240 \times 3 \times 60}$ J kg^{-1}K^{-1}

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

(D) $\frac{240 \times 3 \times 20}{2 \times 10}$ J kg^{-1}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

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36. 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

37. Metals are generally better thermal conductors than non-metals because

(A) they contain free electrons
(B) they contain more electrons
(C) their molecules are closer together
(D) their molecules are less firmly bonded

38. Which of the following methods of heat transfer occurs as a consequence of a change in density of a substance?

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

39. 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) $(T_2 - T_1)^4$

40. A gas contains N molecules. The speeds of the molecules are $C1$, $C2$..., C_N. Which of the following equations can be used to determine the r.m.s speed of the molecules?

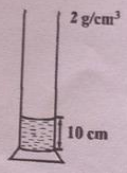
(A) $\sqrt{\frac{C_1 + C_2 + ...C_N}{N}}$

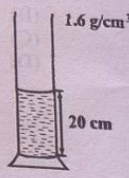
(B) $\sqrt{\frac{C_1^2 + C_2^2 + ... + C_N^2}{N}}$

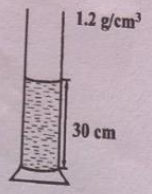
(C) $\sqrt{\frac{(C_1 + C_2 + ...C_N)^2}{N}}$

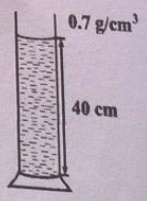
(D) $\sqrt{\frac{(C_1^2 + C_2^2 + ... + C_N^2)^2}{N}}$

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

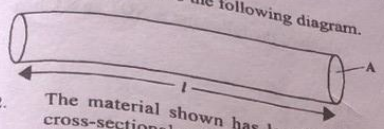
(A)


(B)


(C)


(D)


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 Young's modulus of the material?

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

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

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

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

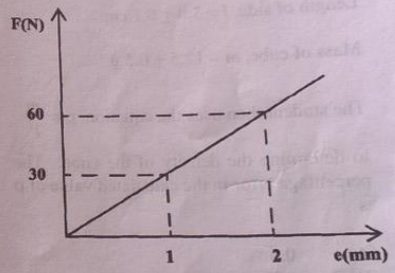
43. Helium gas is kept in a container at a pressure of 1.7×10^5 Pa. If the density of helium is 0.92 kg m^{-3}, calculate the root mean square speed of the helium atoms.

(A) 248 m s^{-1}
(B) 330 m s^{-1}
(C) 430 m s^{-1}
(D) 745 m s^{-1}

44. 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 is negligible compared to their separation.
(D) The duration of a collision is negligible compared with the time between collisions.

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

END OF TEST

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) I and IV only
(C) II and III 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 %

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

P: kg m^{-3}
Q: kg m s^{-2}
R: kg^2 m^{-3} s^{-1}

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

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

4. Which of the following is NOT an S.I. base unit?

(A) g
(B) K
(C) m
(D) s

5. A signal station sounds its horn and flashes a light to warn an approaching ship. The ship hears the sound 10 seconds after the flash is seen. If the speed of sound in air is 340 m s^{-1}, how far away from the signal station is the ship?

(A) 34 m
(B) 340 m
(C) 3 400 m
(D) 34 000 m

6. Which of the following is NOT an equation for uniformly accelerated motion?

(A) $v^2 = u^2 + 2at$
(B) $v = u + at$
(C) $s = ut + \frac{1}{2} at^2$
(D) $s = \frac{1}{2} (u + v) t$

7. 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

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 force of 200 N acts on a trolley of mass 2 kg causing it to move off from rest and reach a speed of 14 m s^{-1}. The rate of change of momentum of the trolley is

(A) 28 kg m s^{-2}
(B) 100 kg m s^{-2}
(C) 200 kg m s^{-2}
(D) 2 800 kg m s^{-2}

11. A car with mass, m, moves round a circular road of radius, r, at a constant speed, v. Which of the following statements is/are true?

I. Its velocity changes and the magnitude of the acceleration is $\frac{v^2}{r}$.
II. There is no resultant force on the car since its speed is constant.
III. The resultant force on the car is outwards from the centre and equals $\frac{mv^2}{r}$.

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

12. When a small steel ball bearing falls through glycerine it quickly reaches a terminal velocity. This happens because the

(A) viscous drag reduces to zero
(B) upthrust on the ball bearing equals the viscous drag
(C) weight of the ball bearing equals the upthrust acting on it
(D) viscous drag increases as the velocity of the ball bearing increases

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 N kg^{-1}]

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

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

(C) $\frac{mP}{v}$

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

15. 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) $\sqrt{2mE}$

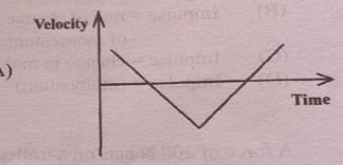
16. The displacement of a particle undergoing simple harmonic motion is given by

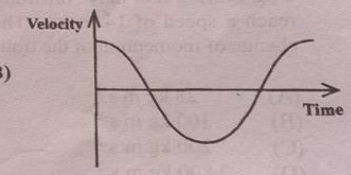
$x = 8 \sin 0.4 \pi t$

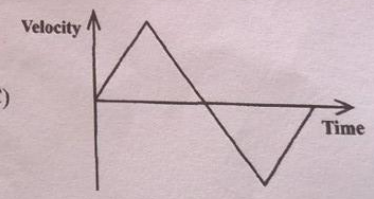
The frequency of oscillation of the particle is

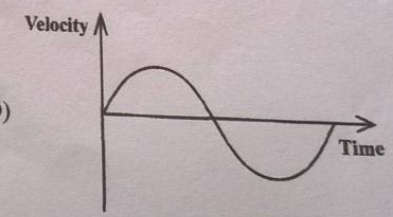
(A) 0.2 Hz
(B) 0.4 Hz
(C) 5 Hz
(D) 8 Hz

17. A pendulum is held at its highest point and then released. A suitable graph to show one cycle of this motion is

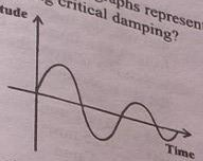
(A)


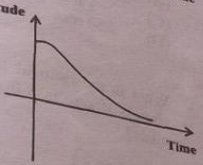
(B)


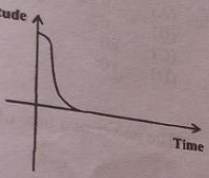
(C)


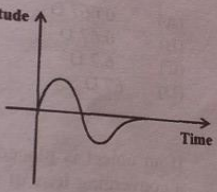
(D)


18. Which of the following graphs represents a body undergoing critical damping?

(A)


(B)


(C)


(D)


19. 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.

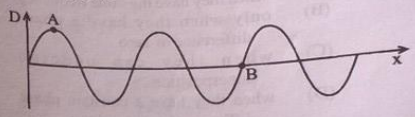
(C) Sound waves in air are transverse and light waves are longitudinal.

(D) Sound waves in air are longitudinal and light waves are transverse.

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

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

21. What is the phase difference between the two points labelled A and B on the graph below?



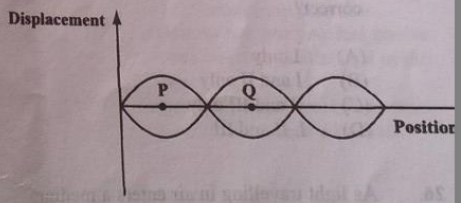
(A) $\frac{3\pi}{4}$ radians

(B) $\frac{3\pi}{2}$ radians

(C) $\frac{7\pi}{4}$ radians

(D) 3π radians

Item 22 refers to the following displacement-position graph which represents a stationary wave at two different instants of time.



22. What does the distance PQ represent?

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

23. The intensity of sound is directly proportional to the

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

24. Two sources are said to be coherent

(A) when they have the same frequency
(B) only when they have a phase difference of zero
(C) when they can undergo superposition
(D) when they have a constant phase difference between them

25. After investigating the refraction of water waves in a ripple tank, a student draws the following conclusions.

I. When refraction occurs, the wave length of the waves changes.
II. Refraction is caused by a change in the speed of the wave.
III. When the waves are incident along the normal, a change of frequency occurs.

Which of the above conclusions is/are correct?

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

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

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

27. In a double slit experiment using a monochromatic light source of wavelength 400 nm, the distance between the bright fringes was found to be 8.0 mm. If the screen is 5 m from the double slit, what is the slit separation?

(A) 0.001 mm
(B) 0.25 mm
(C) 1 mm
(D) 250 mm

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

(A) 0.63
(B) 6.3
(C) 80
(D) 10^8

29. The power of a lens of focal length 15 cm is

(A) 0.067 D
(B) 0.67 D
(C) 6.7 D
(D) 67 D

30. If an object is placed 10 cm in front of a converging lens of focal length 30 cm, where is the image formed?

(A) 10 cm behind the lens
(B) 30 cm in front of the lens
(C) Between 10 cm and 30 cm behind the lens
(D) Between 10 cm and 30 cm in front of the lens

31. Which of the thermometers listed below could possibly measure temperatures between 73 K and 1473 K?

(A) Thermocouple
(B) Alcohol-in-glass
(C) Mercury-in-glass
(D) Constant volume oxygen thermometer

32. Temperatures on the empirical centigrade scale are determined by the formula,

$$\theta = \frac{x_\theta - x_0}{x_{100} - x_0} \times 100\ ^\circ C$$

where x is a physical property that varies with temperature. What is x for a thermocouple?

(A) e.m.f.
(B) Volume
(C) Length
(D) Resistance

33. Which of the following statements is/are true about temperature?

I. Whilst a substance is melting its temperature remains constant.
II. The temperature at 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

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 is supplied	200 s
Temperature rise of metal	10 K

What is the specific heat capacity of the metal?

(A) $\frac{240 \times 3 \times 6}{2 \times 10 \times 200}\ Jkg^{-1}K^{-1}$

(B) $\frac{2 \times 10 \times 200}{240 \times 3 \times 60}\ Jkg^{-1}K^{-1}$

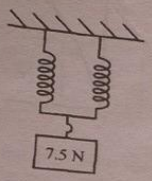
(C) $\frac{2 \times 10 \times 200}{240 \times 3}\ Jkg^{-1}K^{-1}$

(D) $\frac{240 \times 3 \times 200}{2 \times 10}\ Jkg^{-1}K^{-1}$

35. On a hot day, you feel cool when you perspire because the

(A) perspiration is wet and you feel cooler when you get wet
(B) molecules in the air absorb the perspiration from your skin
(C) day is so hot that you feel cooler when compared to the heat of the day
(D) perspiration takes heat energy from your skin to help it evaporate

42. Two identical springs hang side by side (in parallel) and are connected to a load of 7.5 N. They each experience an extension of 2.5 cm. What is the force constant of ONE of the springs?

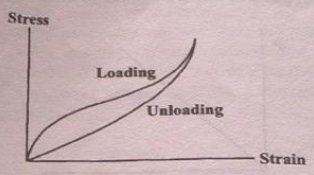


(A) 1.5 Nm^{-1}
(B) 30 Nm^{-1}
(C) 150 Nm^{-1}
(D) 300 Nm^{-1}

43. A 5 kg mass hangs from a uniform steel wire and the resulting stress in the wire is σ. Hanging a 10 kg mass from a steel wire of twice the diameter would result in a stress of

(A) $\sigma/2$
(B) σ
(C) 2σ
(D) 4σ

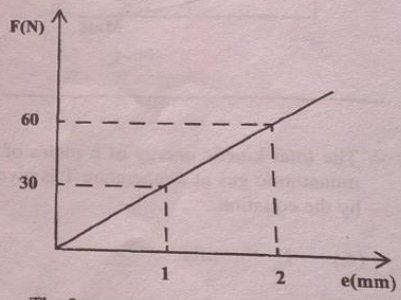
Item 44 refers to the following graph.



44. The graph above is MOST likely to apply to

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

Item 45 refers to the following diagram.



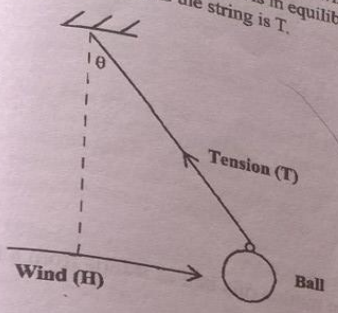
45. The figure above shows the force-extension graph of a wire. How much work is done in stretching the wire from an extension of 1 mm to 2 mm?

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

END OF TEST

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 kg $\pm$ 1kg. She next lifts her suitcase and the mass changes to 104 kg $\pm$ 1kg. What is the mass of her suitcase?

(A) 49 kg $\pm$ 1 kg
(B) 49 kg $\pm$ 2 kg
(C) 50 kg $\pm$ 1 kg
(D) 51 kg $\pm$ 2 kg

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

P: kg m^{-3}
Q: kg m s^{-2}
R: kg^2 m^{-3} 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 0.060 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.)

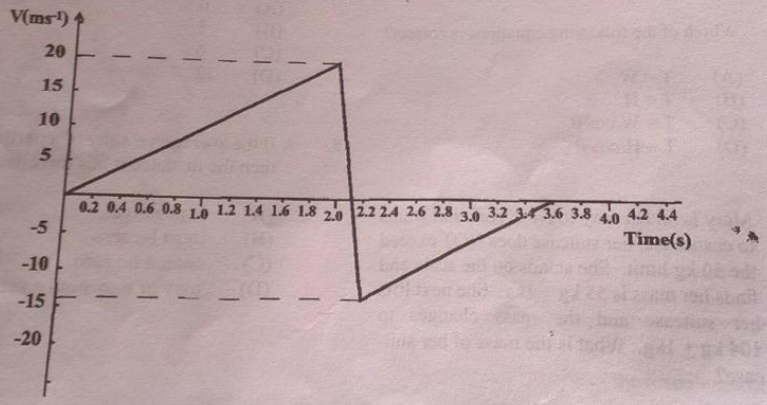
(A) $\frac{16}{27}g$

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

(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.

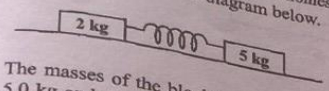


What is the height from which the ball was released?

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

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}

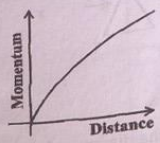
9. A rocket in gravity-free space is burning 5.0×10^2 kg of fuel per second. The exhaust gases are expelled at 8.0×10^3 m s^{-1} relative to the rocket, whose mass is 2.0×10^5 kg at that time. What is its acceleration?

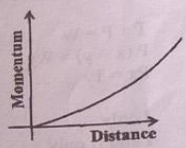
(A) 10 m s^{-2}
(B) 20 m s^{-2}
(C) 400 m s^{-2}
(D) 2500 m s^{-2}

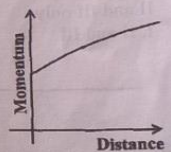
10. Which of the following statements is NOT true about an object floating in a fluid?

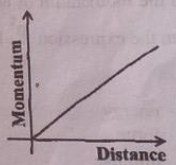
(A) The resultant force on the object is zero.
(B) The weight of the object is equal to the weight of the fluid displaced.
(C) The upthrust is equal to the weight of the fluid displaced.
(D) The upthrust is greater than the weight of the object.

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?

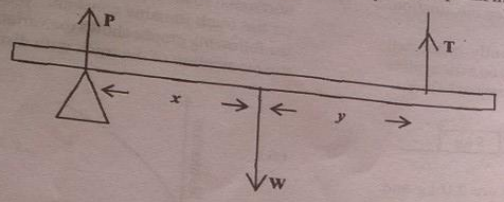
(A)


(B)


(C)


(D)


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

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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) $2\sqrt{m}E$

(C) $\sqrt{m}E$

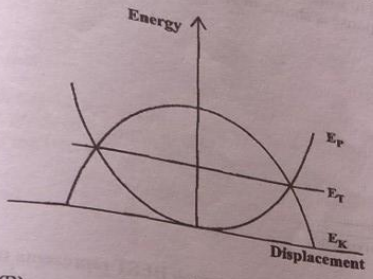
(D) $\sqrt{2mE}$

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?

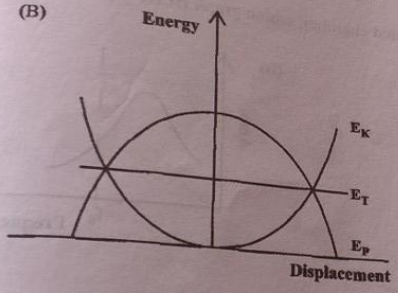
(A) 1
(B) 9
(C) 90
(D) 900

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?

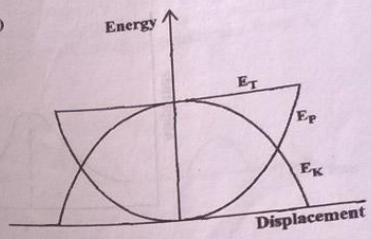
(A)



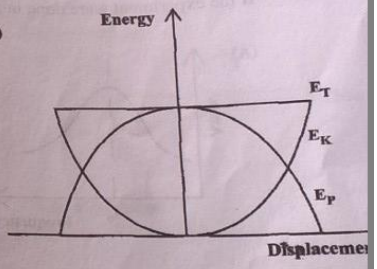
(B)



(C)



(D)



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

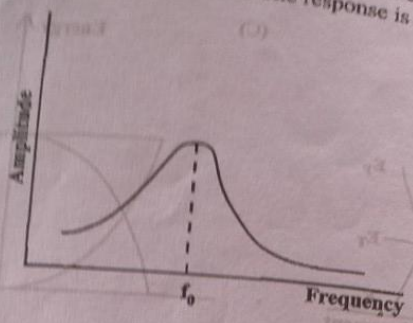
$x = 8 \sin (0.4 \pi t)$ where x is in metres and t in seconds.

The frequency of oscillation of the particle is

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

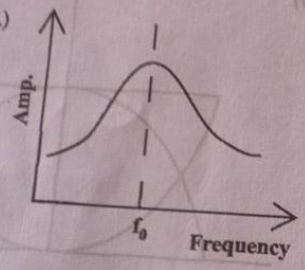
Item 18 refers to the following information.

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.

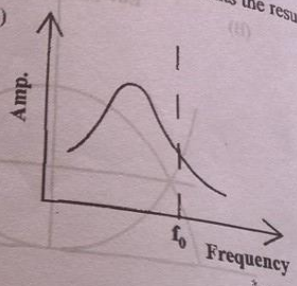


If the experiment were done in an evacuated chamber, which graph BEST represents the result?

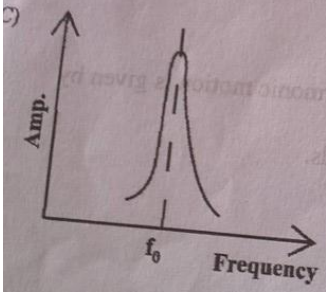
(A)



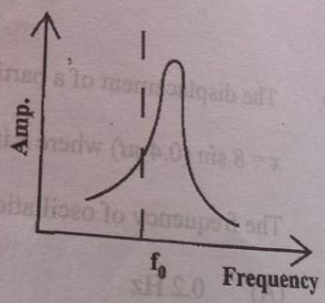
(B)



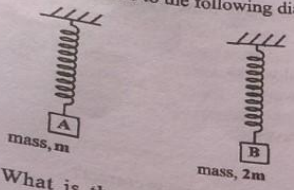
(C)



(D)



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?

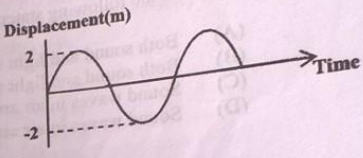
(A) $T_A = \frac{1}{2} T_B$

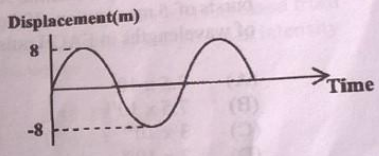
(B) $T_A = \frac{1}{\sqrt{2}} T_B$

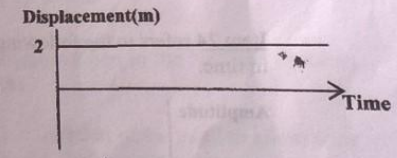
(C) $T_A = \sqrt{2}\, T_B$

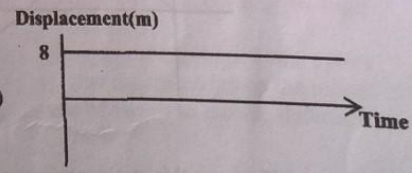
(D) $T_A = 2T_B$

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 ?

(A)


(B)


(C)


(D)


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

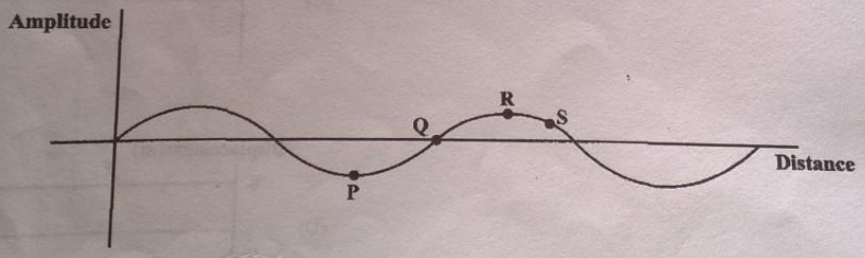
22. Which of the following statements concerning sound and light waves is correct?

(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 i bursts of 5 ms duration. If the wavelength of the electromagnetic waves is 2×10^{-6} m, the numbe 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}

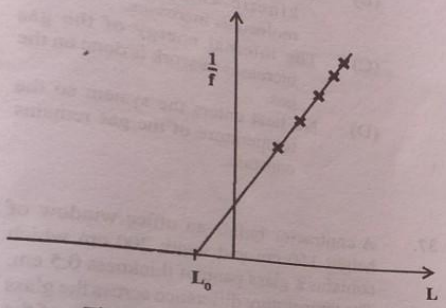
Item 24 refers to the following diagram which shows a stationary wave on a string at one inst in time.



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

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

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 $\frac{1}{frequency}$.



The value of the intercept, L_o, 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 5 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 their 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) 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 3×10^5 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) J kg^{-1}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?

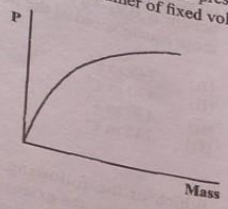
(A) The temperature of the gas decreases as work is done by the gas.
(B) Work is done by the gas so the kinetic energy of the gas molecules increases.
(C) The internal energy of the gas increases as work is done on the gas.
(D) No heat enters the system so the temperature of the gas remains constant.

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 Wm^{-1}K^{-1}. Calculate the heat energy per second conducted through the window.

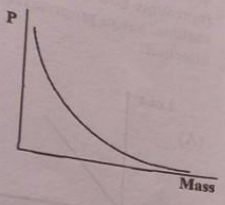
(A) 5.85 J
(B) 585 J
(C) 5.85 kJ
(D) 585 kJ

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?

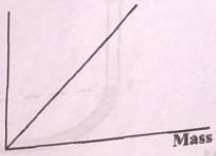
(A)



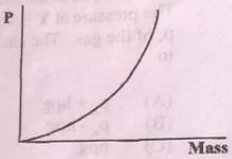
(B)



(C)



(D)



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..., C_N. Which of the following equations can be used to determine the r.m.s speed of the molecules?

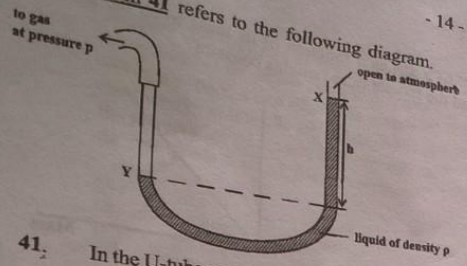
(A) $\sqrt{\frac{C_1 + C_2 + ...C_N}{N}}$

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

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

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

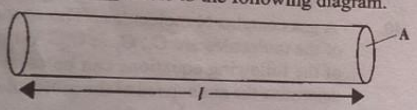
Item 41 refers to the following diagram.



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) $\frac{FA}{el}$

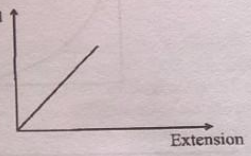
(C) $\frac{Ae}{Fl}$

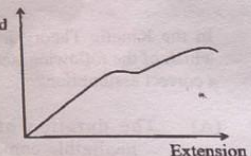
(D) $\frac{el}{FA}$

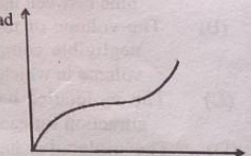
43. Helium gas is kept in a container at a pressure of 1.7×10^5 Pa. If the density of helium is 0.92 kg m^{-3}, calculate the root mean square speed of the helium atoms.

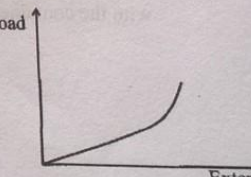
(A) 248 m s^{-1}
(B) 330 m s^{-1}
(C) 430 m s^{-1}
(D) 745 m s^{-1}

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

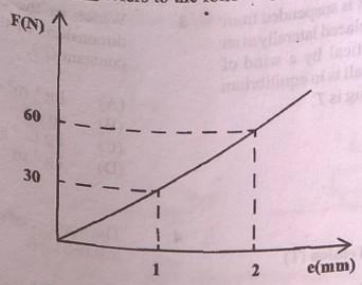
(A)


(B)


(C)


(D)


Item 45 refers to the following diagram.

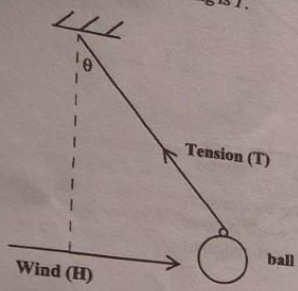


45. The figure above shows the force-extension graph of a wire. How much work is done in stretching the wire from an extension of 1 mm to 2 mm?

(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.

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, $l = 3.0 \pm 0.1$ 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. Which of the choices below gives the dimensions of the universal gravitational constant G ?.

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

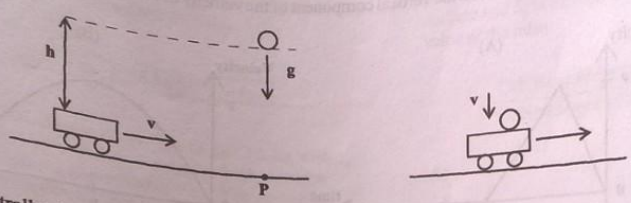
4. The number of moles of carbon –12 atoms in 0.060 kg is

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

5. If $x = 3$ mg and $y = 9$ kg then

(A) $y = 3 \times 10^5 x$
(B) $y = 3 \times 10^3 x$
(C) $y = 3 \times 10^6 x$
(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) $2h$

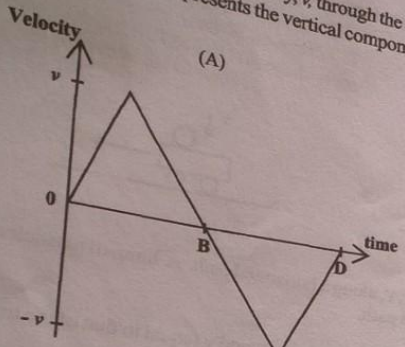
(B) $\sqrt{2h}$

(C) h

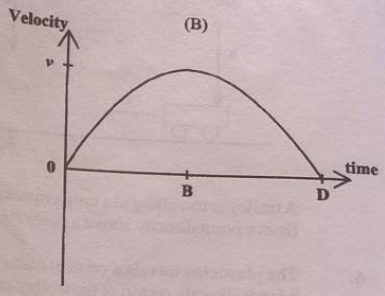
(D) $\frac{h}{\sqrt{2}}$

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?

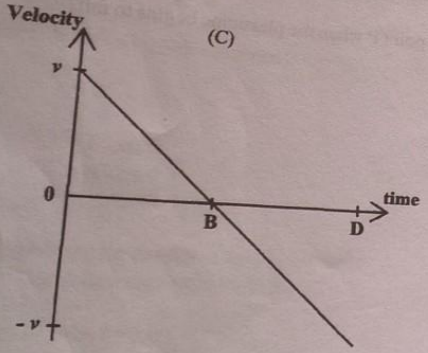
(A)



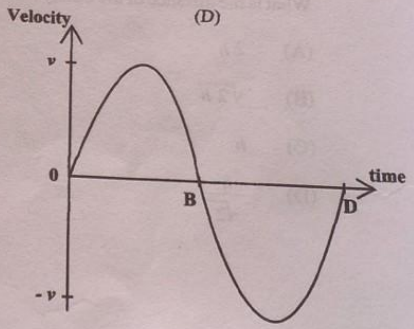
(B)



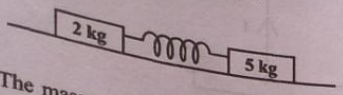
(C)



(D)



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 a 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

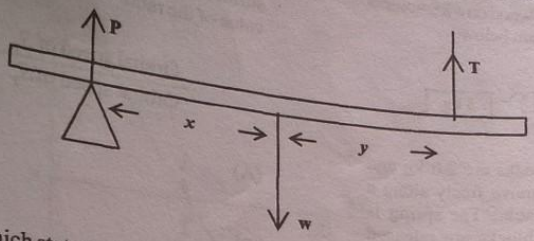
$$\frac{\text{Orbital speed of } S_1}{\text{Orbital speed of } S_2} \text{ is}$$

(A) $\frac{1}{4}$
(B) $\frac{1}{2}$
(C) 2
(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.

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

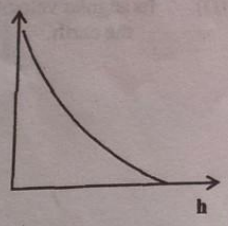


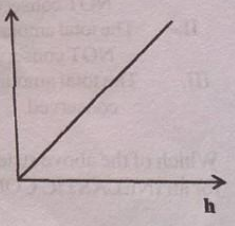
Which statements is/are true?

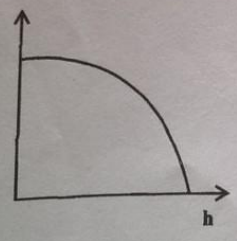
I. $T + P = W$
II. $P(x + y) = Wy$
III. $Px = Ty$

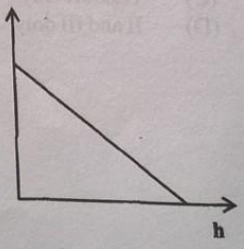
(A) I only
(B) I and II only
(C) II and III only
(D) I, II and III

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:

(A) 

(B) 

(C) 

(D) 

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

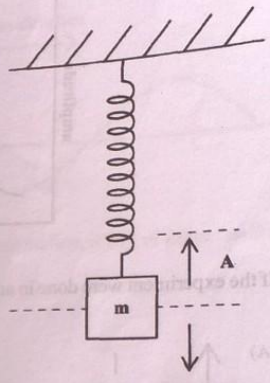
(C) $\frac{mP}{v}$

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

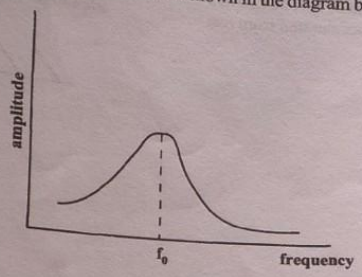
17. The displacement of a particle undergoing simple harmonic motion is given by

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

The frequency of oscillation of the particle is

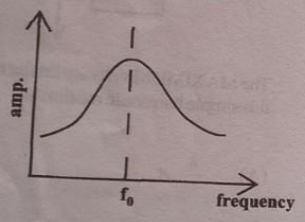
(A) 0.2 Hz
(B) 0.4 Hz
(C) 5 Hz
(D) 8 Hz

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.

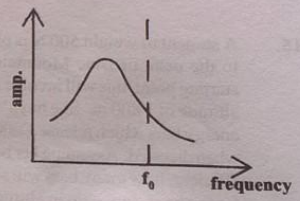


If the experiment were done in an evacuated chamber, which graph BEST represents the result?

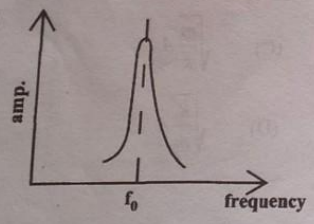
(A)



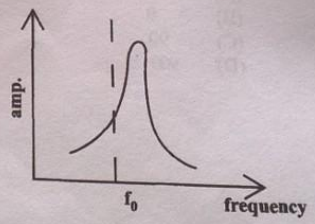
(B)



(C)



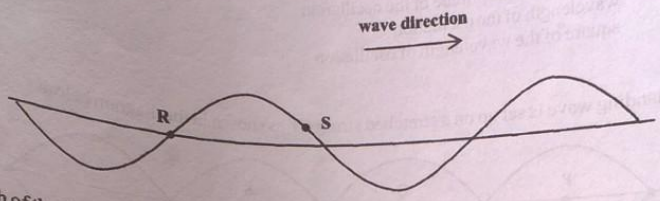
(D)



. 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) 1 000 m s^{-1}
(D) 2 000 m s^{-1}

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

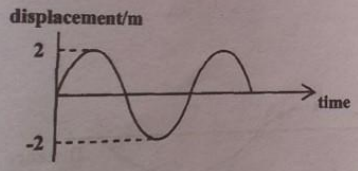


Which of the following correctly describes the subsequent motion, if any, of the points *R* and *S* on the string?

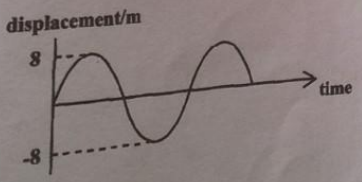
	Point *R*	Point *S*
(A)	stationary	downwards
(B)	downwards	upwards
(C)	downwards	stationary
(D)	upwards	downwards

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*?

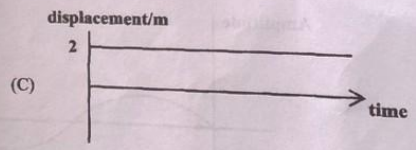
(A)



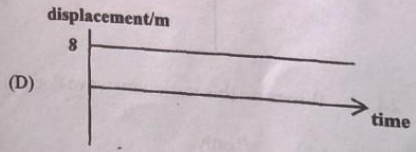
(B)



(C)



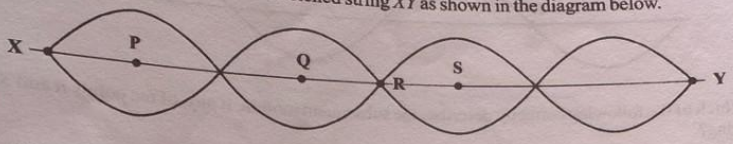
(D)



22. 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

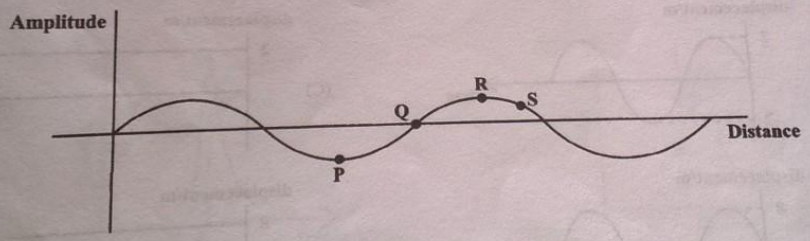
23. A standing wave is set up on a stretched string XY as shown in the diagram below.



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.

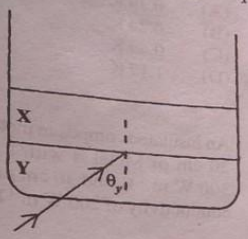
Item 24 refers to the following diagram which shows a stationary wave on a string at one instant in time.



4. 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) 0.5 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
(B) 6.3
(C) 80
(D) 10^8

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

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

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 3×10^5 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?

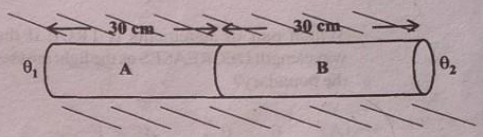
I. Whilst a substance is melting its temperature remains constant.
II. The triple point of a substance has a constant value.
III. The boiling point of a liquid does not depend on the pressure of the surroundings.

(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 W m^{-1} K and 30 cm of Metal *B* with a conductivity of 200 W m^{-1} 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

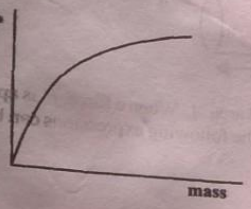
(A) 40 cm
(B) 50 cm
(C) 60 cm
(D) 75 cm

37. A large metal cube has dimensions 1.2 m X 1.2 m X 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?

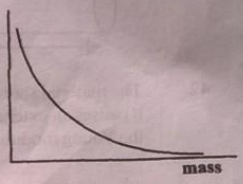
(A) 36.3 kW
(B) 120 kW
(C) 181 kW
(D) 602 kW

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?

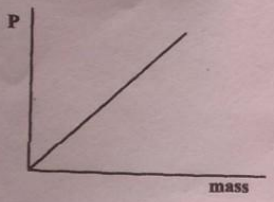
(A)



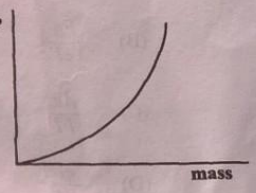
(B)



(C)



(D)



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 1 900 m s^{-1}?

(A) 1.31 Pa
(B) 57.0 Pa
(C) 1.08×10^5 Pa
(D) 1.2×10^6 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) $Q = -W$

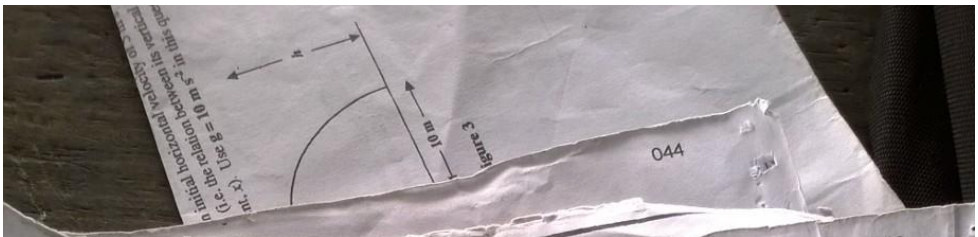
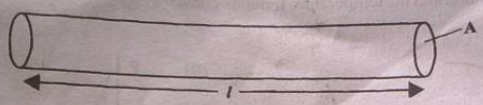


Figure 2

044

046

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) $\frac{Ae}{Fl}$

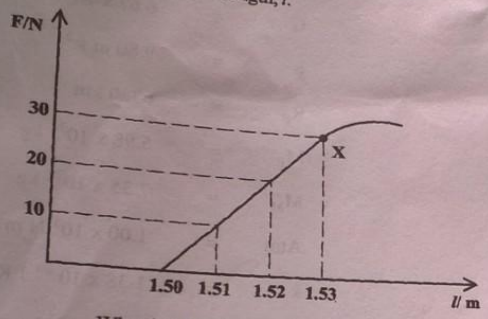
(D) $\frac{el}{FA}$

43. 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.

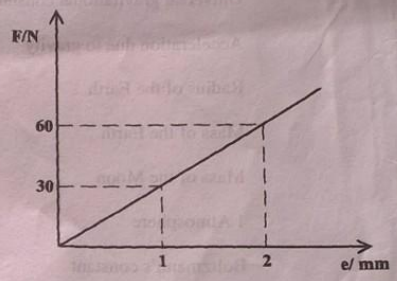


What information can be inferred from the graph?

I. The force constant of the material is 1000 Nm^{-1}.
II. The ultimate tensile stress of the material is about 35 N.
III. The strain at X is 3 %.
IV. 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.



45. 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.

046

048

LIST OF PHYSICAL CONSTANTS

Universal gravitational constant	G	=	6.67×10^{-11} N m^2 kg^{-2}
Acceleration due to gravity	g	=	9.80 m s^{-2}
Radius of the Earth	R_E	=	6380 km
Mass of the Earth	M_E	=	5.98×10^{24} kg
Mass of the Moon	M_M	=	7.35×10^{22} kg
1 Atmosphere	Atm	=	1.00×10^5 N m^{-2}
Boltzmann's constant	k	=	1.38×10^{-23} J K^{-1}
Density of water		=	1.00×10^3 kg m^{-3}
Thermal conductivity of copper		=	400 W m^{-1} K^{-1}
Specific heat capacity of aluminium		=	910 J kg^{-1} K^{-1}
Specific heat capacity of copper		=	387 J kg^{-1} K^{-1}
Specific heat capacity of water		=	4200 J kg^{-1} K^{-1}
Specific latent heat of fusion of ice		=	3.34×10^5 J kg^{-1}
Specific latent heat of vaporization of water		=	2.26×10^6 J kg^{-1}
Avogadro's constant	N_A	=	6.02×10^{23} per mole
Molar gas constant	R	=	8.31 J K^{-1} mol^{-1}
Stefan-Boltzmann's constant	σ	=	5.67×10^{-8} W m^{-2} K^{-4}
Speed of light in vacuum	c	=	3.0×10^8 m s^{-1}