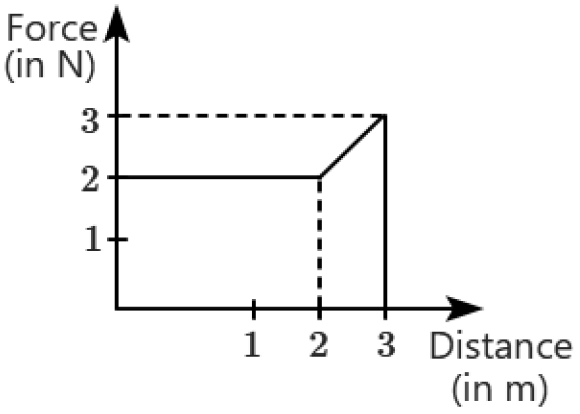
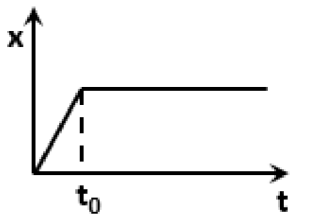
SECTION A

1 A particle moves in one dimension from rest under the influence of a force that varies with the distance travelled by the particle as shown in the figure. The kinetic energy of the particle after it has travelled 3 m is:



1. 2.5 J
2. 6.5 J
3. 4 J
4. 5 J

2 The figure given below shows the displacement and time, $(x - t)$ graph of a particle moving along a straight line:



The correct statement, about the motion of the particle, is:

1.	the particle moves at a constant velocity up to a time t_0 and then stops.
2.	the particle is accelerated throughout its motion.
3.	the particle is accelerated continuously for time t_0 then moves with constant velocity.
4.	the particle is at rest.

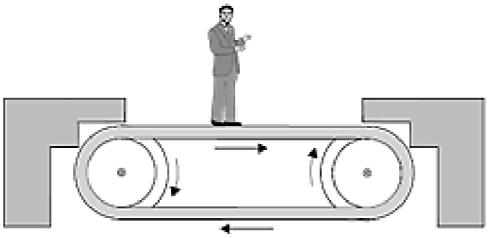
3 A man of mass m, standing at the bottom of the staircase, of height L, climbs it and stands at its top.

a.	work done by all forces on man is equal to the rise in energy mgL.
b.	work done by all forces on man is zero.
c.	work done by the gravitational force on man is mgL.
d.	the reaction force from a step does not do work because the point of the application of the force does not move while the force exists.

Choose the correct option:
1. (a, d)
2. (a, c)
3. (b, d)
4. (a, b, c)

4 The work done by the external forces on a system equals the change in:
1. total energy
2. kinetic energy
3. potential energy
4. none of these

5 The figure shows a man of mass 65 kg standing stationary with respect to a horizontal conveyor belt that is accelerating with 1 ms^{-2}. If the coefficient of static friction between the man's shoes and the belt is 0.2, up to what acceleration of the belt can the man continue to be stationary relative to the belt? (Take $g = 10$ m/s^2)



1. 2 ms^{-2}
2. 3 ms^{-2}
3. 1 ms^{-2}
4. 9.8 ms^{-2}

6 How many 2.5 kg bricks can a man carry up a staircase 3.6 m high in one hour if he works at the average rate of 9.8 watts?
1. 800
2. 200
3. 600
4. 400

7 The component of a vector $\vec{r}$ along the X-axis will have maximum value if:

1.	$\vec{r}$ is along the positive Y-axis.
2.	$\vec{r}$ is along the positive X-axis.
3.	$\vec{r}$ makes an angle of 45° with the X-axis.
4.	$\vec{r}$ is along the negative Y-axis.

8 Two springs A and B $(k_A = 2k_B)$ are stretched by applying forces of equal magnitudes at the four ends. If the energy stored in A is E, that in B is:
1. $E/2$
2. $2E$
3. E
4. $E/4$

9 A block of mass M lies at rest on a horizontal table.

Statement-I:	(Newton's 3rd Law) To every action, there is an equal and opposite reaction. Action and reaction forces act on different bodies and in opposite directions.
Statement-II:	The normal reaction is the reaction force, while the weight is the action.

1.	Statement I is true, Statement II is true and Statement I is the correct reason for Statement II.
2.	Statement I is true, Statement II is true, Statement I is not the correct reason for Statement II.
3.	Statement I is true, Statement II is false.
4.	Statement I is false, Statement II is true.

10 The coordinates of a moving particle at any time t are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time t is given by:
1. $\sqrt{\alpha^2 + \beta^2}$
2. $3t\sqrt{\alpha^2 + \beta^2}$
3. $3t^2\sqrt{\alpha^2 + \beta^2}$
4. $t^2\sqrt{\alpha^2 + \beta^2}$

11 A ball is projected with a velocity of 10 ms^{-1} at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be:
1. 10 ms^{-1}
2. zero
3. $5\sqrt{3}$ ms^{-1}
4. 5 ms^{-1}

12 Rain is falling vertically downwards with a speed of 4 kmh^{-1}. A girl moves a straight road with a velocity of 3 kmh^{-1} . The apparent velocity of rain with respect to the girl is:
1. 3 kmh^{-1}
2. 4 kmh^{-1}
3. 5 kmh^{-1}
4. 7 kmh^{-1}

13 When a horse pulls a cart, the force that helps the horse to move forward is the force exerted by:
1. the cart on the horse
2. the ground on the horse
3. the ground on the cart
4. the horse on the ground

14 The temperatures of two bodies measured by a thermometer are $t_1 = 20^{\circ}C \pm 0.5^{\circ}C$ and $t_2 = 50^{\circ}C \pm 0.5^{\circ}C$. The temperature difference with permissible error is:
1. $31^{\circ}C \pm 0.5^{\circ}C$
2. $30^{\circ}C \pm 1.0^{\circ}C$
3. $30^{\circ}C \pm 0.0^{\circ}C$
4. $30^{\circ}C \pm 1.5^{\circ}C$

15 A rope of length 8 m and linear density 0.5 kg/m is lying lengthwise on a horizontal smooth floor. It is pulled by a force of 12 N. The tension at the mid-point would be:
1. 12 N
2. 8 N
3. 6 N
4. 4 N

16 A dimensionless quantity,
1. never has a unit
2. always has a unit
3. may have a unit
4. does not exist

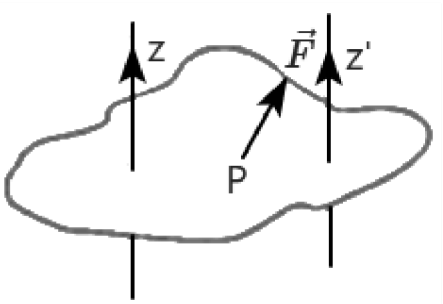
17 If $|\vec{A}| = 2$ and $|\vec{B}| = 4$, then match the relations in column-I with the angle θ between $\vec{A}$ and $\vec{B}$ in column-II.

	Column-I		Column-II
(a)	$\vec{A}.\vec{B} = 0$	**(i)**	$\theta = 0^\circ$
(b)	$\vec{A}.\vec{B} = 8$	**(ii)**	$\theta = 90^\circ$
(c)	$\vec{A}.\vec{B} = 4$	**(iii)**	$\theta = 180^\circ$
(d)	$\vec{A}.\vec{B} = -8$	**(iv)**	$\theta = 60^\circ$

Choose the correct answer from the options given below:

1.	(a)–(iii), (b)-(ii), (c)-(i), (d)-(iv)
2.	(a)–(ii), (b)-(i), (c)-(iv), (d)-(iii)
3.	(a)–(ii), (b)-(iv), (c)-(iii), (d)-(i)
4.	(a)–(iii), (b)-(i), (c)-(ii), (d)-(iv)

18 The figure shows a lamina in XY-plane. Two axes z and z' pass perpendicular to its plane. A force $\vec{F}$ acts in the plane of the lamina at point P as shown. (The point P is closer to the z'-axis than the z-axis.)



a.	torque $\vec{\tau}$ caused by $\vec{F}$ about z-axis is along $\hat{k}$
b.	torque $\vec{\tau}'$ caused by $\vec{F}$ about z'-axis is along $\hat{k}$
c.	torque caused by $\vec{F}$ about the z-axis is greater in magnitude than that about the z'-axis
d.	total torque is given by $\vec{\tau}_{net} = \vec{\tau} + \vec{\tau}'$

Choose the correct option:
1. (c, d)
2. (a, c)
3. (b, c)
4. (a, b)

19 Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$ respectively. The centre of mass of this system has a position vector:
1. $-2\hat{i} + 2\hat{k}$
2. $-2\hat{i} - \hat{j} + \hat{k}$
3. $2\hat{i} - \hat{j} - 2\hat{k}$
4. $-\hat{i} + \hat{j} + \hat{k}$

20 If the potential energy of a gas molecule is $U = \frac{M}{r^6} - \frac{N}{r^{12}}$, M and N being positive constants, then the potential energy at equilibrium must be:
1. zero
2. $M^2/4N$
3. $N^2/4M$
4. $MN^2/4$

21 Four point masses, each of value m, are placed at the corners, of a square $ABCD$ of side l. The moment of inertia of this system about an axis passing through A and parallel to BD is:
1. $2ml^2$
2. $\sqrt{3}ml^2$
3. $3ml^2$
4. ml^2

22 When a disc rotates with uniform angular velocity, which of the following is not true?

1.	the sense of rotation remains the same.
2.	the orientation of the axis of rotation remains the same.
3.	the speed of rotation is non-zero and remains the same.
4.	the angular acceleration is non-zero and remains the same.

23 What would be the torque about the origin when a force $3\hat{j}$ N acts on a particle whose position vector is $2\hat{k}$ m?
1. $6\hat{j}$ N-m
2. $-6\hat{i}$ N-m
3. $6\hat{k}$ N-m
4. $6\hat{i}$ N-m

24 Given below are two statements:

Assertion (A):	The centre of mass of a two-particle system lies on the line joining the two particles, being closer to the heavier particle.
Reason (R):	The product of the mass of one particle and its distance from the centre of mass is numerically equal to the product of the mass of another particle and its distance from the centre of mass.

1.	Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
2.	Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.
3.	**(A)** is true but **(R)** is false.
4.	Both **(A)** and **(R)** are false.

25 A solid sphere of mass m and radius R is rotating about its diameter. A solid cylinder of the same mass and same radius is also rotating about its geometrical axis with an angular speed twice that of the sphere. The ratio of their kinetic energies of rotation (sphere/cylinder) will be:

1. $2:3$
2. $1:5$
3. $1:4$
4. $3:1$

26 Given below are two statements:

Assertion (A):	Absolute zero temperature is also the zero energy temperature of gas molecules.
Reason (R):	At absolute zero temperature, the molecules of gas come to rest, hence possess no energy of any form.

1.	Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
2.	Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.
3.	**(A)** is true but **(R)** is false.
4.	Both **(A)** and **(R)** are false.

27 Water is flowing in streamlined motion through a horizontal tube. The pressure at a point in the tube is p where the velocity of flow is v. At another point, where the pressure is $p/2$, the velocity of flow is (density of water = ρ):

1. $\sqrt{v^2+\frac{p}{\rho}}$
2. $\sqrt{v^2-\frac{p}{\rho}}$
3. $\sqrt{v^2+\frac{2p}{\rho}}$
4. $\sqrt{v^2-\frac{2p}{\rho}}$

28 Equal mass of three liquids are kept in three identical cylindrical vessels A, B and C. The densities are ρ_A, ρ_B, ρ_C with $\rho_A < \rho_B < \rho_C$. The force on the base will be:

1. maximum in vessel A
2. maximum in vessel B
3. maximum in vessel C
4. equal in all the vessels

29 If ΔU and ΔW represent the increase in internal energy and work done by the system respectively in a thermodynamical process, which of the following is true?

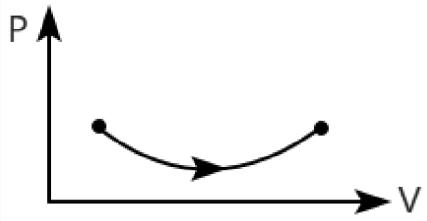
1.	$\Delta U = -\Delta W$, in an adiabatic process
2.	$\Delta U = \Delta W$, in an isothermal process
3.	$\Delta U = \Delta W$, in an adiabatic process
4.	$\Delta U = -\Delta W$, in an isothermal process

30 The Young's modulus of brass and steel are respectively 1×10^{10} N/m^2 and 2×10^{10} N/m^2. A brass wire and a steel wire of the same length are extended by 1 mm under the same force; the radii of brass and steel wires are R_B and R_S respectively. Then,

1. $R_S = \sqrt{2} R_B$
2. $R_S = \frac{R_B}{\sqrt{2}}$
3. $R_S = 4R_B$
4. $R_S = \frac{R_B}{4}$

31 A cube of metal is subjected to a hydrostatic pressure of 4 GPa. The percentage change in the volume of the cube is: (Given bulk modulus of metal, $B = 8 \times 10^{10}$ Pa)
1. 2.5
2. 5
3. 7.5
4. 10

32 Consider the process on a system shown in the figure. During the process, the work done by the system:

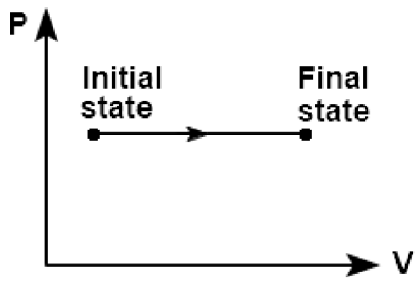


1.	continuously increases
2.	continuously decreases
3.	first increases then decreases
4.	first decreases then increases

33 Excess pressure inside a bubble is $2P_0$ where P_0 is the atmospheric pressure. Then the pressure inside the bubble is:
1. P_0
2. $2P_0$
3. $3P_0$
4. $4P_0$

34 Assume that a space shuttle flies in a circular orbit very close to the earth's surface. Taking the radius of the space shuttle's orbit to be equal to the radius of the earth (R) and the acceleration due to gravity to be g, the time period of one revolution of the space shuttle is (nearly):
1. $\sqrt{\frac{2R}{g}}$
2. $\sqrt{\frac{\pi R}{g}}$
3. $\sqrt{\frac{2\pi R}{g}}$
4. $\sqrt{\frac{4\pi^2 R}{g}}$

35 The (P-V) diagram for an ideal gas in a piston-cylinder assembly undergoing a thermodynamic process is shown in the figure. The process is:



1. adiabatic
2. isochoric
3. isobaric
4. isothermal

SECTION B

36 A Carnot engine, having an efficiency of $\eta = \frac{1}{10}$ as a heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at a lower temperature is:
1. 100 J
2. 99 J
3. 90 J
4. 1 J

37 An increase in the temperature of a gas-filled in a container would lead to:

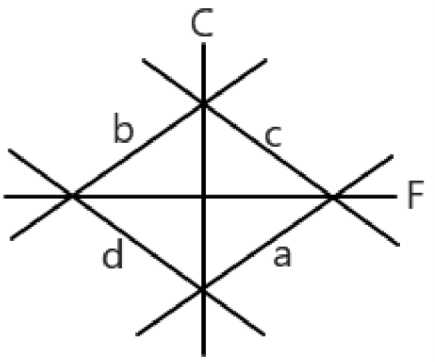
1.	decrease in intermolecular distance.
2.	increase in its mass.
3.	increase in its kinetic energy.
4.	decrease in its pressure.

38 The ratio of the weights of a body on the Earth's surface to that on the surface of a planet is 9 : 4. The mass of the planet is $\frac{1}{9}^{\text{th}}$ that of the Earth. If R is the radius of the Earth, what is the radius of the planet? (Take the planets to have the same mass density)
1. $\frac{R}{9}$
2. $\frac{R}{2}$
3. $\frac{R}{3}$
4. $\frac{R}{4}$

39 Two raindrops reach the earth with different terminal velocities having a ratio $9:4$. Then the ratio of their volumes is:
1. $3:2$
2. $4:9$
3. $9:4$
4. $27:8$

40 A child stands at the centre of a turntable with his arms outstretched. The turntable is set to rotate with an angular speed of 40 rev/min. How much is the angular speed of the child if he folds his hands back and thereby reduces his moment of inertia to $\frac{2}{5}$ times the initial value?
1. 160 rev/min
2. 150 rev/min
3. 100 rev/min
4. 120 rev/min

41 Which of the curves in the figure represents the relation between Celsius and Fahrenheit temperatures?



1. a
2. b
3. c
4. d

42 A body cools from $62^{\circ}C$ to $50^{\circ}C$ in 10 minutes and to $42^{\circ}C$ in the next 10 minutes. The temperature of the surrounding is:
1. $16^{\circ}C$
2. $26^{\circ}C$
3. $36^{\circ}C$
4. $21^{\circ}C$

43 A transverse wave travels along the Z-axis. The particles of the medium must move:
1. along the Z-axis
2. along the X-axis
3. along the Y-axis
4. in the X-Y plane

44 The displacement of a particle along x-axis is given by $x = asin2\omega t$. The motion of the particle corresponds to:

1.	simple harmonic motion of frequency ω/π
2.	simple harmonic motion of frequency $3\omega/2\pi$
3.	non-simple harmonic motion
4.	simple harmonic motion of frequency $\omega/2\pi$

45 If the temperature is raised by 1 K from 300 K, then the percentage change in the speed of sound in the gaseous mixture is: ($R = 8.31$ J/mol-K)
1. $0.167\ \%$
2. $2\ \%$
3. $1\ \%$
4. $0.334\ \%$

46 The displacement of a particle in simple harmonic motion in one time period is:
1. A
2. $2A$
3. $4A$
4. zero

47 A rocket is moving at a speed of 200 ms^{-1} towards a stationary target. While moving, it emits a wave of frequency 1000 Hz. Some of the sound reaching the target gets reflected back to the rocket as an echo. The frequency of the sound as detected by the target and the frequency of the echo as detected by the rocket respectively are: (speed of sound = 330 m/s)
1. 4080 Hz and 2540 Hz
2. 1000 Hz and 1000 Hz
3. 2540 Hz and 4080 Hz
4. 2540 Hz and 2540 Hz

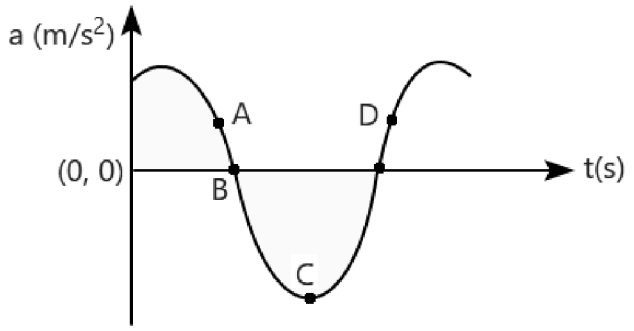
48 The equation of vibration of a taut string, fixed at both ends, is given by:

$$y = (3\text{ mm})\cos\left(\frac{\pi x}{10\text{ cm}}\right)\sin(800\pi\text{ s}^{-1}\text{ t})$$

The speed of waves on the string is:

1. 20 m/s
2. 40 m/s
3. 80 m/s
4. 160 m/s

49 Acceleration-time $(a-t)$ graph for a particle performing S.H.M. is shown in the figure. Select the incorrect statement.



1.	displacement of a particle at A is negative.
2.	the potential energy of the particle at C is minimum.
3.	the velocity of the particle at B is positive.
4.	speed of particle at D is decreasing.

50 If a spring balance having frequency f is taken on the moon (having $g' = g/6$), it will have a frequency of:

1. $6f$
2. $f/\sqrt{6}$
3. $\sqrt{6}f$
4. f

Fill OMR Sheet*

*If above link doesn't work, please go to test link from where you got the pdf and fill OMR from there. After filling the OMR, you would get answers and explanations for the questions in the test.