NEET UG (2024)
Physics
Quiz-10

SECTION-A

1. The speed of a homogeneous solid sphere after rolling down an inclined plane of vertical height h, form rest without sliding, is

(1) $\sqrt{\frac{10}{7}gh}$ (2) $\sqrt{gh}$

(3) $\sqrt{\frac{6}{5}gh}$ (4) $\sqrt{\frac{4}{3}gh}$

2. One quarter of the disc of mass m is removed. If r be the radius of the disc, the new moment of inertia is

(1) $\frac{3}{2}mr^2$ (2) $\frac{mr^2}{2}$

(3) $\frac{3}{8}mr^2$ (4) None of these

3. The radius of gyration of a body about an axis at a distance 6 cm from its centre of mass is 10 cm. Then its radius of gyration about a parallel axis through its centre of mass will be

(1) 80 cm (2) 8 cm

(3) 0.8cm (4) 80 cm

4. A wheel rotates with a constant acceleration of 2.0 radian/sec^2. If the wheel starts from rest the number of revolutions it makes in the first ten seconds will be approximately

(1) 8 (2) 16

(3) 24 (4) 32

5. The ratio of the lengths of two wires A and B of same material is 1 : 2 and the ratio of their diameter is 2 : 1. They are stretched by the same force, then the ratio of increase in length will be

(1) 2 : 1 (2) 1 : 4

(3) 1 : 8 (4) 8 : 1

6. Young's modulus of a wire of length L and radius r is Y N/m^2. If the length and radius are reduced to $L/2$ and $r/2$, then its Young's modulus will be

(1) $Y/2$

(2) Y

(3) $2Y$

(4) $4Y$

7. Calculate the work done, if a wire is loaded by 'Mg' weight and the increase in length is 'l'

(1) Mgl (2) Zero

(3) $Mgl/2$ (4) $2Mgl$

8. A wire is suspended by one end. At the other end a weight equivalent to 20 N force is applied. If the increase in length is 1.0 mm, the increase in energy of the wire will be

(1) 0.01 J (2) 0.02 J

(3) 0.04 J (4) 1.00 J

9. According to the principle of conservation of angular momentum, if moment of inertia of a rotating body decreases, then its angular velocity

(1) decreases

(2) increases

(3) remains constant

(4) becomes zero

10. When a mass is rotating in a plane about a fixed point, its angular momentum is directed along the

(1) radius of orbit

(2) tangent to the orbit

(3) line parallel to plane of rotation

(4) line perpendicular to plane of rotation

11. The motion of a rigid body which is not pivoted or fixed in some way is either a pure ...*A*... or a combination of translation and rotation. The motion of a rigid body which is pivoted or fixed in some way is ...*B*...

Here, A and B refer to

(1) rotation and translation

(2) translation and rotation

(3) translation and the combination of rotation and translation

(4) None of the above

12. The moment of inertia of a circular ring of radius r and mass M about diameter is

(1) Mr^2 (2) $\frac{1}{2}Mr^2$

(3) $\frac{3}{2}Mr^2$ (4) $\frac{1}{4}Mr^2$

13. A disc of moment of inertia $\frac{9.8}{\pi^2}$ kgm^2 is rotating

14. The moment of inertia of a circular ring of mass 1 kg about an axis passing through its centre and perpendicular to its plane is 4 kg-m^2. The diameter of the ring is

(1) 2 m (2) 4 m

(3) 5 m (4) 6 m

15. A sphere of mass m and radius r rolls on a horizontal plane without slipping with the speed u. Now if it u rolls up vertically, the maximum height it would attain will be

(1) $\frac{3u^2}{4g}$ (2) $\frac{5u^2}{2g}$

(3) $\frac{7u^2}{10g}$ (4) $\frac{u^2}{2g}$

16. A particle with position vector $\vec{r}$ has a linear momentum $\vec{p}$. Which of the following statements is true in respect of its angular momentum $\vec{L}$ about the origin

(1) $\vec{L}$ acts along $\vec{p}$

(2) $\vec{L}$ acts along $\vec{r}$

(3) $\vec{L}$ is maximum when $\vec{p}$ and $\vec{r}$ are parallel

(4) $\vec{L}$ is maximum when $\vec{p}$ is perpendicular to $\vec{r}$

17. A solid cylinder on moving with constant speed v_0 reaches the bottom of an incline of 30°. A hollow cylinder of same mass and radius moving with the same constant speed v_0 reaches the bottom of a different incline of θ. There is no slipping and both of them go through the same distance in the same time; θ is then equal to

(1) 37° (2) 30°

(3) 42° (4) 45°

18. According to Hook's law of elasticity, if stress is increased, the ratio of stress to strain

(1) Increases

(2) Decreases

(3) Becomes zero

(4) Remains constant

19. Why the spring is made up of steel in comparison of copper?

(1) Copper is more costly than steel

(2) Copper is more elastic than steel

(3) Steel is more elastic than copper

(4) None of the above

20. The modulus of elasticity is dimensionally equivalent to

(1) Surface tension

(2) Stress

(3) Strain

(4) None of these

21. Match the column.

Column-I		**Column-II**	
(A)	Translational equilibrium	**(1)**	$\Sigma F = 0$
(B)	Moment of inertia of disc	**(2)**	MR^2
(C)	Rotational equilibrium	**(3)**	$\frac{1}{2}I\omega^2$
(D)	Kinetic energy of rolling body	**(4)**	$\frac{1}{2}mv_{cm}^2 + \frac{1}{2}I\omega^2$
(E)	Moment of inertia of ring	**(5)**	$\Sigma\tau = 0$
		(6)	$MR^2/2$

(1) (A) → (1); (B) → (6); (C) → (5); (D) → (4); (E) → (2)

(2) (A) → (4); (B) → (3); (C) → (2); (D) → (1); (E) → (6)

(3) (A) → (6); (B) → (5); (C) → (3); (D) → (4); (E) → (2)

(4) (A) → (1); (B) → (2); (C) → (4); (D) → (5); (E) → (6)

22. Consider the following statements and select the correct statement(s).

I. Angular velocity is a scalar quantity

II. Linear velocity is a vector quantity

III. About a fixed axis, angular velocity has fixed direction

IV. Every point on a rigid rotating body has different angular velocity

(1) I only (2) II only

(3) II and III (4) III and IV

23. **Assertion:** For a system of particles under central force field, the total angular momentum is conserved.

Reason: The torque acting on such a system is zero.

(1) Assertion is correct, reason is correct; reason is a correct explanation for assertion.

(2) Assertion is correct, reason is correct; reason is not a correct explanation for assertion

(3) Assertion is correct, reason is incorrect

(4) Assertion is incorrect, reason is correct.

24. If I_{xy} is the moment of inertia of a ring about a tangent in the plane of the ring and $I_{x'y'}$ is the moment of inertia of a ring about a tangent perpendicular to the plane of the ring then

(1) $I_{xy} = I_{x'y'}$ (2) $I_{xy} = \frac{1}{2} I_{x'y'}$

(3) $I_{x'y'} = \frac{1}{4} I_{xy}$ (4) $I_{xy} = \frac{3}{4} I_{x'y'}$

25. Moment of inertia of a rigid body depends on

(1) Mass of the body
(2) Shape of the body
(3) Size of the body
(4) All of these

26. A swimmer while jumping into water from a height easily forms a loop in the air, if

(1) he pulls his arms and legs in
(2) he spreads his arms and legs
(3) he keeps himself straight
(4) none of the above

27. Which of the following is/are essential condition for mechanical equilibrium of a body?

(1) Total force on the body should be zero
(2) Total torque on the body should be zero
(3) Both (1) and (2)
(4) Total linear momentum should be zero

28. Which of the following is incorrect?

(1) $\vec{v} = \vec{\omega} \times \vec{r}$ (2) $\vec{\tau} = \vec{F} \times \vec{r}$

(3) $\vec{L} = \vec{r} \times \vec{p}$ (4) None of these

29. A 2 *m* long rod of radius 1 *cm* which is fixed from one end is given a twist of 0.8 radians. The shear strain developed will be

(1) 0.002 (2) 0.004
(3) 0.008 (4) 0.016

30. Shearing stress causes change in

(1) Length (2) Breadth
(3) Shape (4) Volume

31. When strain is produced in a body within elastic limit, its internal energy

(1) Remains constant
(2) Decreases
(3) Increases
(4) None of the above

32. A ball falling in a lake of depth 200 *m* shows 0.1% decrease in its volume at the bottom. What is the bulk modulus of the material of the ball

(1) 19.6×10^{8} N/m^2
(2) 19.6×10^{-10} N/m^2
(3) 19.6×10^{10} N/m^2
(4) 19.6×10^{-8} N/m^2

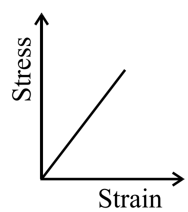
33. The Bulk modulus for an incompressible liquid is

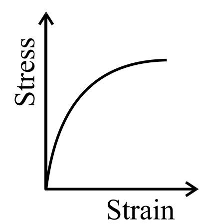
(1) Zero
(2) Unity
(3) Infinity
(4) Between 0 to 1

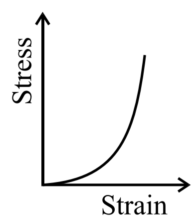
34. The ratio of lengths of two rods *A* and *B* of same material is 1 : 2 and the ratio of their radii is 2 : 1, then the ratio of modulus of rigidity of A and B will be

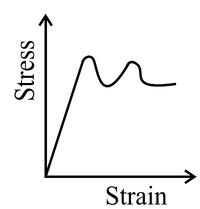
(1) 4 : 1 (2) 16 : 1
(3) 8 : 1 (4) 1 : 1

35. Which of the following is the graph showing stress-strain variation for elastomers?

(1) 

(2) 

(3) 

(4) 

SECTION-B

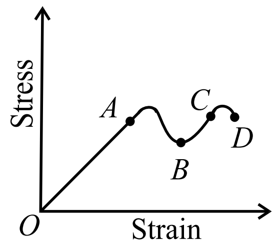
36. A steel wire is stretched with a definite load. If the Young's modulus of the wire is Y. For decreasing the value of Y

(1) Radius is to be decreased
(2) Radius is to be increased
(3) Length is to be increased
(4) None of the above

37. If the density of the material increase, the value of Young's modulus

(1) Increases
(2) Decreases
(3) First increases, then decreases
(4) First decreases, then increases

38. A graph is shown between stress and strain for a metal. The part in which Hooke's law holds good is



(1) OA (2) AB

(3) BC (4) CD

39. The torque of force $\vec{F} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ newton acting at a point $\vec{r} = 3\hat{i} + 2\hat{j} + 3\hat{k}$ metre about origin is:

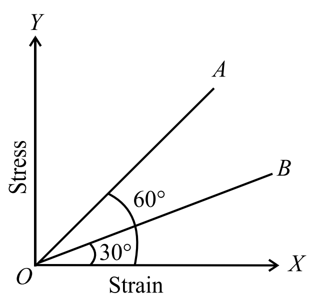
(1) $6\hat{i} - 6\hat{j} + 12\hat{k}$ N-m

(2) $-6\hat{i} + 6\hat{j} - 12\hat{k}$ N-m

(3) $17\hat{i} - 6\hat{j} - 13\hat{k}$ N-m

(4) $-17\hat{i} + 6\hat{j} + 13\hat{k}$ N-m

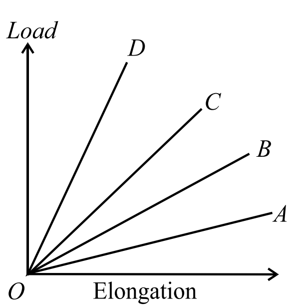
40. The stress versus strain graphs for wires of two materials *A* and *B* are as shown in the figure. If Y_A and Y_B are the Young 's moduli of the materials, then



(1) $Y_B = 2Y_A$ (2) $Y_A = Y_B$

(3) $Y_B = 3Y_A$ (4) $Y_A = 3Y_B$

41. The load versus elongation graph for four wires of the same material is shown in the figure. The thickest wire is represented by the line



(1) OD (2) OC

(3) OB (4) OA

42. Which of the following is not an expression for kinetic energy?

(1) $K = \frac{1}{2}MR^2\omega^2$

(2) $K = \frac{1}{2}I\omega^2$

(3) $K = \frac{1}{2}mv^2$

(4) None of these

43. Match the column.

Column-I		**Column-II**	
(A)	Rolling motion	**(1)**	Torque
(B)	Rate of change of angular momentum	**(2)**	Rotatory motion
(C)	Hollow cylinder about axis	**(3)**	$I_z + Ma^2$
(D)	Theorem of parallel axes	**(4)**	MR^2

(1) (A) → (1); (B) → (3); (C) → (4); (D) → (2)

(2) (A) → (3); (B) → (2); (C) → (4); (D) → (1)

(3) (A) → (2); (B) → (1); (C) → (4); (D) → (3)

(4) (A) → (3); (B) → (1); (C) → (2); (D) → (4)

44. **Assertion:** A particle is moving on a straight line with a uniform velocity, its angular momentum is always zero.

Reason: The linear momentum is not zero when particle moves with a uniform velocity.

(1) Assertion is correct, reason is correct; reason is a correct explanation for assertion.

(2) Assertion is correct, reason is correct; reason is not a correct explanation for assertion

(3) Assertion is correct, reason is incorrect

(4) Assertion is incorrect, reason is correct.

45. The moment of inertia of two spheres of equal masses about their diameters are equal. If one of them is solid and other is hollow, the ratio of their radii is

(1) $\sqrt{3} : \sqrt{5}$ (2) 3 : 5

(3) $\sqrt{5} : \sqrt{3}$ (4) 5 : 3

46. A particle undergoes uniform circular motion. About which point on the plane of the circle, will the angular momentum of the particle remain conserved

(1) Centre of the circle

(2) On the circumference of the circle

(3) Inside the circle

(4) Outside the circle

47. The moment of inertia about an axis of a body which is rotating with angular velocity 1 rads^{-1} is numerically equal to

(1) One-fourth of its rotational kinetic energy

(2) Half of the rotational kinetic energy

(3) Rotational kinetic energy

(4) Twice the rotational kinetic energy

48. The Young's modulus of the material of a wire is 6×10^{12} N/m^2 and there is no transverse strain in it, then its modulus of rigidity will be

(1) $3 \times 10^{12}\ N/m^2$

(2) $2 \times 10^{12}\ N/m^2$

(3) $10^{12}\ N/m^2$

(4) None of the above

49. The elastic energy stored in a wire of Young's modulus Y is

(1) $Y \times \frac{\text{Strain}^2}{\text{Volume}}$

(2) Stress × Strain × Volume

(3) $\frac{\text{Stress}^2 \times \text{Volume}}{2Y}$

(4) $\frac{1}{2}\ Y \times \text{Stress} \times \text{Strain} \times \text{Volume}$

50. The ratio of Young's modulus of the material of two wires is 2 : 3. If the same stress is applied on both, then the ratio of elastic energy per unit volume will be

(1) 3 : 2 (2) 2 : 3

(3) 3 : 4 (4) 4 : 3

Solution

1. **(1)**

$$v = \sqrt{\frac{2gh}{1+\frac{K^2}{R^2}}} = \sqrt{\frac{2gh}{1+\frac{2}{5}}} = \sqrt{\frac{10}{7}gh}$$

2. **(3)**

Moment of inertia of whole disc about an axis through centre of disc and perpendicular to its plane is $I = \frac{1}{2}mr^2$

As one quarter of disc is removed, new mass,

$$m' = \frac{3}{4}m$$

$$\therefore \quad I' = \frac{1}{2}\left(\frac{3}{4}m\right)r^2 = \frac{3}{8}mr^2$$

3. **(2)**

From the theorem of parallel axis, the moment of inertia I is equal to

$I = I_{CM} + Ma^2$

where I_{CM} is moment of inertia about centre of mass and a the distance of axis from centre.

$\therefore \quad I = MK^2 + M \times (6)^2$

$MK_1^2 = MK^2 + 36M$

$K_1^2 = K^2 + 36$

$\Rightarrow \quad (10)^2 = K^2 + 36$

$\Rightarrow \quad K^2 = 100 - 36 = 64 \quad \Rightarrow \quad K = 8$ cm

4. **(2)**

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2 \qquad \Rightarrow \quad \theta = 100$ rad

$\therefore$ Number of revolution $= \frac{100}{2\pi} = 16$ (approx.)

5. **(3)**

Here, $l_1 = \frac{FL_1}{\pi r_1^2 Y}$ and $l_2 = \frac{FL_2}{\pi r_2^2 Y}$

Therefore, $\frac{l_1}{l_2} = \frac{L_1}{L_2} \times \left(\frac{r_2}{r_1}\right)^2$

Given that, $L_2 = 2L_1$ and $r_2 = \frac{r_1}{2}$

Thus, $\frac{l_1}{l_2} = \frac{1}{2} \times \frac{1}{(2)^2} = \frac{1}{8}$.

6. **(2)**

Young's modulus does not depend upon the dimensions of wire. It is constant for a given material of wire.

7. **(3)**

Work done $= \frac{1}{2}Fl = \frac{Mgl}{2}$

8. **(1)**

Increase in energy

$= \frac{1}{2} \times F \times \Delta l = \frac{1}{2} \times 20 \times 1 \times 10^{-3} = 0.01$ J

9. **(2)**

As $L = I\omega$ = constant, therefore, when I decreases, ω will increase.

10. **(4)**

As angular momentum, $\vec{L} = \vec{r} \times \vec{p}$, therefore, direction of $\vec{L}$ is along a line perpendicular to the plane of rotation.

11. **(2)**

The motion of a rigid body which is not pivoted or fixed in some way is cither a pure **translation** or a combination of translation and rotation. The motion of a rigid body which is pivoted or fixed in some way is rotation.

12. **(2)**

Moment of inertia of a circular ring about a diameter

$$I = \frac{1}{2}Mr^2$$

13. **(1)**

Work done = decrease in rotational kinetic energy

$= \frac{1}{2}I \times (\omega_1^2 - \omega_2^2) = \frac{1}{2}I \times 4\pi^2(n_1^2 - n_2^2)$

$= \frac{1}{2} \times \frac{9.8}{\pi^2} \times 4\pi^2(10^2 - 5^2) = 9.8 \times 2 \times 75$

= 1470 J

14. **(2)**

Moment of inertia of circular ring about an axis passing through its centre of mass and perpendicular to its plane

$I = MR^2$

Here, $I = 4$ kgm^2, $m = 1$ kg

$R^2 = \frac{4}{1} = 4$

$R = 2$m

Therefore, diameter of ring = 4 m.

15. **(3)**

The rolling sphere has rotational as well as translational kinetic energy

$\therefore$ Kinetic energy $= \frac{1}{2}mu^2 + \frac{1}{2}I\omega^2$

$$= \frac{1}{2}mu^2 + \frac{1}{2}\left(\frac{2}{5}mr^2\right)\omega^2 = \frac{1}{2}mu^2 + \frac{mu^2}{5}$$

$$= \frac{7}{10}mu^2$$

Potential energy = kinetic energy

$$\therefore \quad mgh = \frac{7}{10}mu^2 \quad \Rightarrow \quad h = \frac{7u^2}{10g}$$

16. **(4)**

Angular momentum L is given as

$L = \vec{r} \times \vec{p} = rp\sin\theta$

$\vec{r}$ = position vector of the particle w. r. t. origin,

$\vec{p}$ = its linear momentum

$\vec{r} \times \vec{p}$ is maximum when p is perpendicular to r

i.e. $\theta = 90°$

17. **(3)**

For solid cylinder, $\theta = 30°$, $K^2 = \frac{1}{2}R^2$

For hollow cylinder, θ = ?, $K^2 = R^2$

Using we find, $\frac{\left(1+\frac{1}{2}\right)}{\sin 30°} = \frac{1+1}{\sin\theta}$

$\therefore \quad \sin\theta = \frac{2}{3} = 0.6667$

$\theta = 42°$

18. **(4)**

The ratio of stress to strain is always constant. If stress is increased, strain will also increase so that their ratio remains constant.

19. **(3)**

Steel is more elastic than copper. Due to this reason that springs are made of steel not copper

20. **(2)**

Hookes law establishes the relationship between stress and strain

Stress : The force per unit area

Strain : The elongation or contraction per unit length (dimensionless)

The ratio of stress to strain is known as the elastic modulus of the material

Elastic Modulus = $\frac{\text{Stress}}{\text{Strain}}$ Hence, the modulus of elasticity is dimensionally equivalent to the stress.

21. **(1)**

(A)→(1);(B)→(6);(C)→(5);(D)→(4);(E)→(2);

For translational equilibrium, total ext force =0

$\Sigma F = 0$

Moment of inertia of disc = $\frac{MR^2}{2}$

For rotational equilibrium, net external torque =0

$\Sigma\tau = 0$

Kinetic energy of rolling body = K.E. of translation + K.E. of rotation.

$$K = \frac{1}{2}mv_{cm}^2 + \frac{1}{2}I\omega^2$$

Moment of inertia of a ring = MR^2

22. **(3)**

Linear velocity has magnitude and direction both therefore it is a vector quantity, Angular velocity has a fixed direction when a body rotates about a fixed axis.

23. **(1)**

Both the assertion and reason arc true.

For central forces,

$$\tau = \frac{dL}{dt} = 0$$

$\therefore$ L = constant

24. **(4)**

I_{xy}, moment of inertia of a ring about its tangent in the plane of ring $I_{xy} = \frac{3}{2}MR^2$

Moment of inertia about a tangent perpendicular to the plane of ring $I_{x'y'} = 2MR^2$

$$\therefore \quad I_{xy} = \frac{3}{4}(2MR^2) = \frac{3}{2}MR^2$$

or $\quad I_{xy} = \frac{3}{4}I_{x'y'}$

25. **(4)**

From $I = MR^2$, moment of inertia depends on the mass and size of the body. It also depends on the distribution of mass, thus it depends on the shape of the body as well.

26. **(1)**

He decreases his Moment of inertia by this act and therefore increases his angular velocity.

27. **(3)**

A rigid body is in mechanical equilibrium if

(i) it is in translational equilibrium and

(ii) it is in rotational equilibrium.

28. **(2)**

Torque $\vec{\tau} = \vec{r} \times \vec{F}$

29. **(2)**

Given : L = 2m

r = 1 cm = 10^{-2} m

twist = θ = 0.8 rad

Angle of shear = ϕ = $(r\theta / L)$

= $\{(10^{-2} \times 0.8) / 2\}$

= 0.4×10^{-2}

i.e. shear strain = 0.004

30. **(3)**

Shearing stress causes change in shape.

31. **(3)**

Due to increase in intermolecular distance

32. **(1)**

$$B = \frac{\rho gh}{\Delta v / v}$$

$$= \frac{1000 \times 200 \times 9.8}{\frac{0.1}{100}}$$

= 19.6×10^8 N/m^2.

33. **(3)**

We know that, Bulk modulus

$$B = \frac{-dP}{\frac{dV}{V}}$$

As liquid is incompressible, dV = 0

$$\Rightarrow \quad \beta = \frac{-dP}{0} = \infty$$

So, Bulk modulus for an incompressible liquid is infinity.

34. **(4)**

Since, modulus of rigidity is property of the material therefore it will remain uneffected.

35. **(3)**

Elastomer:- The elastic body is called elastomer. e.g eraser

We can see major strain by applying small stress.

36. **(4)**

It is the specific property of a particular metal at a given temperature which can be changed only by temperature variations.

37. **(1)**

If density of the material increases then more force (stress) is required for same deformation i.e. the value of young's modulus increases.

38. **(1)**

In the region OA, stress proportional to strain i.e. Hooke's law holds good.

39. **(3)**

$$\vec{F} = 2\vec{i} - 3\vec{j} + 4\vec{k}$$

$$\vec{r} = 3\vec{i} + 2\vec{j} + 3\vec{k}$$

$$\tau = \vec{r} \times \vec{F} \times = \begin{vmatrix} i & j & k \\ 3 & 2 & 3 \\ 2 & -3 & 4 \end{vmatrix}$$

$$= i(8+9) - j(12-6) + k(-9-4)$$

$$= 17\hat{i} - 6\hat{j} - 13\hat{k}$$

40. **(4)**

Young’s modulus is defined as

$$Y = \frac{Stress}{Strain}$$

$\therefore$ Young’s modulus is slope of stress strain curve.

$$\frac{Y_A}{Y_B} = \frac{\tan\theta_A}{\tan\theta_B} = \frac{\tan 60^o}{\tan 30^o} = 3$$

$Y_A = 3Y_B$

41. **(1)**

According to the given diagram, we will get one important factor that " even after applying load to a maximum extent in all wire, extension of "OD" is less as compared to other wires. Therefore we can conclude that thickest wire is represented by "OD" only

42. **(4)**

$$K.E. = \frac{1}{2}mv^2$$

Since $v = \omega r$

$$\therefore \quad K.E. = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2 r^2$$

$$= \frac{1}{2}I\omega^2 \qquad (\because mr^2 = I)$$

43. **(3)**

(A)→(2); (B)→(1); (C)→(4); (D)→(3)

Rolling motion → Combination of translatory and rotatory motion

Rate of change of angular momentum → torque

$$\frac{dL}{dt} = \tau$$

Moment of inertia of a hollow cylinder about axis $= MR^2$

Theorem of parallel axis $I_Z^1 = I_Z + Ma^2$

44. **(4)**

When particle moves with constant velocity $\vec{v}$ then its linear momentum has some finite value $(\vec{P} = m\vec{v})$. Angular momentum (L) = Linear momentum (P) × Perpendicular distance of line of action of linear momentum form the point of rotation (d)

So if $d \neq 0$ then $L \neq 0$, but if $d = 0$ then L may be zero. So we can conclude that angular momentum of a particle moving with constant velocity is not always zero.

45. **(3)**

$$I_s = \frac{2}{5}MR_s^2,\ I_h = \frac{2}{3}MR_h^2$$

As, $I_s = I_h$

$$\therefore \quad \frac{2}{5}MR_s^2 = \frac{2}{3}MR_h^2 \qquad \therefore \quad \frac{R_s}{R_h} = \frac{\sqrt{5}}{\sqrt{3}}$$

46. **(1)**

Force does not produce any torque because it passes through the centre (Point of rotation) and we know that if $\tau = 0$ then L = constant

47. **(4)**

Rotational kinetic energy,

$$KE = \frac{1}{2}I\omega^2$$

Here, $\omega = 1\ \text{rads}^{-1}$

$$\therefore \quad KE = \frac{1}{2}I \times I \qquad \text{or} \qquad I = 2\,KE$$

i.e., moment of inertia about an axis of a body is twice the rotational kinetic energy.

48. **(1)**

Relation between young’s modulus and transverse strain is as follows:

$Y = 2\eta(1 + \sigma)$

Where, η is modulus of rigidity

And σ is transverse strain

For no transverse strain ($\sigma = 0$)

$$Y = 2\eta \Rightarrow \eta = \frac{Y}{2} = 3 \times 10^{12}\ \text{N/m}^2$$

49. **(3)**

$$U = \frac{1}{2} \times \text{Stress} \times \text{Strain} \times \text{Volume}$$

$$= \frac{(\text{Stress})^2 \times \text{Volume} \times \text{Strain}}{2 \times \text{Stress}}$$

$$= \frac{1}{2} \times \frac{(\text{Stress})^2 \times \text{Volume}}{Y}$$

50. **(1)**

$$\text{Energy per unit volume} = \frac{(Stress)^2}{2Y}$$

$$\frac{E_1}{E_2} = \frac{Y_2}{Y_1} \text{ (Stress is constant)}$$

$$\therefore \quad \frac{E_1}{E_2} = \frac{3}{2}$$