GOVERNMENT ZIRTIRI RESIDENTIAL SCIENCE COLLEGE

Subject : Mathematics
Paper Name : Mechanics
Paper No : XI
Semester : VI Semester

A. Multiple choice questions

1. Forces 3, 2, 4, 5kg(force) act respectively along the sides $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$ and $\overrightarrow{DA}$ of a square. The magnitude of their resultant is

(a) $\sqrt{8}$kg
(b) $\sqrt{5}$kg
(c) $\sqrt{3}$ kg
(d) $\sqrt{10}$kg

2. A uniform ladder rests in equilibrium with its lower end on a rough horizontal plane and its upper end against a smooth vertical wall. If θ be the inclination of the ladder to the vertical and μ is the coefficient of friction, then

(a) $\tan\theta = 2\mu$
(b) $2\tan\theta = \mu$
(c) $\tan 2\theta = \mu$
(d) none of the above

3. The least force P required to pull a body up on an inclined plane inclined at an angle α to the horizontal is

(a) $P = W \cos(\alpha+\lambda)$
(b) $P = W \cos(\alpha-\lambda)$
(c) $P = W \sin(\alpha+\lambda)$
(d) $P = W \cos\alpha$

4. Suppose that a system of forces acts at different points of a rigid body is in equilibrium, then

(a) The couple G must vanish
(b) The resultant R must vanish
(c) The moments of all the forces is zero
(d) The resultant R and the couple G must separately vanish.

5. The equation of the resultant of any number of coplanar forces acting on a rigid body is given by

(a) $xR_y - yR_x = G$
(b) $xR_x - yR_y = G$
(c) $xR_x + yR_y = G$
(d) $xR_y + yR_x = G$

6. The centre of gravity of the rod of mass M and its length *a* is at
   - (a) $\frac{1}{2}a$
   - (b) $\frac{1}{3}a$
   - (c) $\frac{1}{4}a$
   - (d) 2s

7. The C.G of a triangle formed by three rods is
   - (a) The incenter of the triangle
   - (b) the orthocenter of the triangle
   - (c) at one side of a triangle
   - (d) the centroid of a triangle

8. The moment of inertia of a plane distribution with respect to any normal axis
   - (a) is equal to its moment of inertia
   - (b) is equal to the sum of moment of inertia
   - (c) is equal tp product of inertia
   - (d) cannot be determined.

9. The moment of inertia of a uniform thin rod of length *2a* and of mass M about an axis through the midpoint at perpendicular to the rod is
   - (a) $2Ma^2/3$
   - (b) Ma^2
   - (c) $Ma^2/3$
   - (d) $Ma^2/4$

10. A square hole is taken out from a circular lamina, the diagonal of the square being a radius of the circle. Then the distance of the C.G of the remainder from the centre of the circle, where a being the diameter of the circle, is
   - (a) $\frac{a}{8\pi-4}$
   - (b) $\frac{1}{8\pi-4}$
   - (c) $\frac{a}{8\pi}$
   - (d) none of the above

11. If the magnitudes of tangential and normal accelerations of a particle moving in a plane curve are equal, then
   - a) the velocity of the particle is constant
   - b) the velocities varies as ψ
   - c) the velocities varies as e^{ψ}
   - d) the velocities varies as ρ

12. For a particle executing SHM of period $\frac{\pi}{5}$ sec and amplitude 10 cm, the maximum velocity attained is

a) 50 cm/sec
b) 100 cm/sec
c) 5 cm/sec
d) 15 cm/sec

13. The maximum velocity of a body moving with SHM is 2 cm/sec and its period is $\frac{1}{5}$ sec. Then its amplitude is

a) $\frac{1}{5\pi}$ cm
b) $\frac{\pi}{5}$ cm
c) $\frac{2}{5\pi}$ cm
d) $\frac{2\pi}{5}$ cm

14. The position of a moving body at time t is given by $x = a\cos\omega t$, $y = a\sin\omega t$. Its speed

a) varies as time
b) varies as the distance travelled
c) is constant
d) varies jointly as time and as the distance travelled

15. The equation of SHM of period T of a particle is

a) $\ddot{x} = -T^2 x$
b) $\ddot{x} = -\frac{4\pi^2}{T^2} x$
c) $\ddot{x} = -\frac{1}{T^2} x$
d) $\ddot{x} = -\frac{T^2}{4\pi^2} x$

16. The maximum range of projectile with a velocity u projected from the ground under the gravity is

a) 2 u / g
b) 2 u^2
c) u^2 / g
d) $4u^2$ / g

17. The terminal velocity of a particle falling under a medium with $\ddot{x}$ = g – 4kx as the equation of motion is

a) g / k
b) g^2 / k^2
c) 2g / k
d) g / 4k

18. If R_1, R_2 are the horizontal ranges of two projectiles projected with the same velocity u from the same point making angles 30^0 and 60^0 respectively with the horizontal, then

a) $R_1 = R_2$
b) $R_1 = 2R_2$
c) $2R_1 = R_2$
d) None of the above

19. If a particle moves along the x-axis under an attraction towards the origin O, varying inversely as the square of the distance from it, then the equation of motion is
a) $x = \mu/x^2$
b) $x = -\mu/x^2$
c) $x = -\mu x^2$
d) $x = \mu x^2$

20. If the equation of motion of a body falling under gravity in a resisting medium is $v\frac{dv}{dx} = g-kv^2$, then the terminal velocity is
a) the greatest velocity attained
b) the least velocity attained
c) the initial velocity
d) the velocity when the acceleration is greatest

21. If e be the coefficient of restitution of collision of two inelastic bodies, then
a) e = 1
b) e = 0
c) e = ½
d) e = -1

22. A smooth sphere impinges directly with velocity u on another smooth sphere of equal mass at rest. If the spheres are perfectly elastic, the velocity of second sphere after collision will be
a) u
b) 0
c) u/2
d) None of the above

23.A smooth ball falling vertically from a height x impinges on a horizontal fixed plane. If e is the coefficient of restitution, them the ball rebounds to a height
a) e^2x
b) ex
c) e / x
d) x / e

24. A sphere falling vertically from a height h impinges on a horizontal fixed table and rebounds to a height h_1. If e is the coefficient of restitution between the sphere and the plane, then
a) $h_1 = e^2h$
b) $h_1 = 2e^2h$
c) $h_1 = \sqrt{eh}$
d) None of the above

25. If e be the coefficient of restitution of collision of two inelastic bodies, then
    a) e = 1
    b) e = -1
    c) e = ½
    d) e = 0

B. Fill in the blanks:

1. If $\mu = \tan\lambda$, then the body is _______________.

2. The value of least force required to pull down a body of 30kg on an inclined plane under its own weight, is ________.

3. The least force P required to pull down an inclined plane inclined at an angle α to the horizontal is attained, when (where λ is the angle of friction and θ is the angle made by the force P to the inclined plane) ________.

4. The moment of inertia if a uniform solid sphere a radius a , mass m about a diameter is _______.

5. The centre of gravity of a circular arc of radius 4cm subtending at an angle $\pi/2$ lies on the axis of symmetry at a distance of ________.

6. The center of mass G of a circular arc of radius r subtending an angle 2α radian at the center is ______.

7. If a particle moves so that its tangential acceleration is always zero, then its acceleration varies as ___.

8. A particle is executing SHM such that its period of oscillation is $\pi\ seconds$. If its maximum acceleration is 8 ft/sec^2, then its amplitude is ______.

9. The position of a particle moving along the x-axis is given by $x = a\cos\omega t + b\sin\omega t$ at time t, then the acceleration varies as ________.

10. The equation of motion of a particle of mass m falling from a point under gravity and resistance equal to mk(velocity)^2 is ___.

11. The least velocity with which a body can be projected to have a horizontal; range R is ____.

12. A particle of mass m is let fall from a height h in a medium whose resistance is mk (velocity)^2. The terminal velocity of the particle is given by ___.

13. A smooth sphere of mass m strikes a plane normally and is rebounded. If e be the coefficient of restitution, then the loss of its kinetic energy is ___.

14. The energy of an agent is its capacity to do ___.

15. Two equal and perfectly elastic spheres ___ their velocities after impact.

Answer key:

A.

1. (d)	**2. (a)**	**3. (c)**	**4. (b)**	**5. (a)**
6. (a)	**7. (d)**	**8. (b)**	**9. (c)**	**10. (a)**
11. (d)	**12. (b)**	**13. (a)**	**14. (c)**	**15. (b)**
16. (c)	**17. (d)**	**18. (a)**	**19. (b)**	**20. (a)**
21. (b)	**22. (a)**	**23. (a)**	**24. (a)**	**25. (d)**

B.

1. limiting equilibrium	**2.** $P=30\sin(\lambda-\alpha)$	**3.** $\theta = \pi - \lambda$
4. $2ma^2/5$	**5.** $\frac{8\sqrt{2}}{\pi}$ **or** $\frac{16\sin\frac{\pi}{4}}{\pi}$	**6.** $\left(\frac{r\sin\alpha}{\alpha}, 0\right)$
7. $\frac{1}{\rho}$	**8. 2 ft**	**9. Displacement**
10. $\ddot{x} = g+kv^2$	**11.** $\sqrt{g/R}$	**12.** $\sqrt{g/k}$
13. $1/2m(1-e^2)u^2$	**14. work**	**15. interchange**