# ENGINEERING MECHANICS

**MULTIPLE CHOICE QUESTIONS (MCQs):**

**UNIT-2: CENTROID, MOMENT OF INERTIA AND FRICTION**

**1. CENTROID OF LINES AND AREAS:**

01. The centre of gravity of an equilateral triangle with each side (a) is _____ from any of the three sides [ ]

a) $a\sqrt{3}/2$ b) $a\sqrt{2}/3$ c) $a/2\sqrt{3}$ d) $a/3\sqrt{2}$

02. A circular hole of radius (r) is cut out from a circular disc of radius (2r) in such a way that the diagonal of the hole is the radius of the disc. The centre of gravity of the section lies at [ ]

a) centre of a disc b) centre of the hole
c) somewhere in the disc d) somewhere in the hole

03. The centre of gravity of a body is the point through which the weight of the body passes, when it is kept in the [ ]

a) horizontal position b) vertical position
c) inclined position d) any position

04. The centroid of a quadrant of a circle lies along its central radius at a distance of [ ]

a) 0.2R b) 0.3R c) 0.4R d) 0.6R

05. For a quarter circle of 50mm radius lying in the first quadrant with the origin as the centre, the centroidal distance is found to be [ ]

a) 21.22 mm & 21.22 mm b) 31.83 mm & 31.83 mm
c) 21.22 mm & 31.83 mm d) None of the above

06. A slender homogeneous wire AB of semicircular shape is suspended from one end A. Determine the inclination that the diameter AB would make with the vertical. [ ]

a) $23.8^0$ b) $30.8^0$ c) $32.5^0$ d) $61.2^0$

07. A prismatic rod is bent up in the L shape so that AB= 80mm, BC=30mm. It is freely hanging with the help of a string attached at end A. Find the angle made by AB with vertical. [ ]

a) $28.77^0$ b) $38.77^0$ c) $39.77^0$ d) None of these

08. Find the X centroid of the plane lamina which is made by joining points one by one. Starting with point A (0,3), B (4,2) C (4,0), D (0, -4), F (-4,3). [ ]

a) +0.33m b) -0.33 m c) +0.659 m d) -0.982 m

09. Centroid of wire bend in the form of arc of a circle with radius R, subtending angle 2α and having x axis as axis of symmetry is given by. [ ]

a) 2 R/α b) R tan α/π c) R cos α/π d) R sin α/α

10. A semicircular plate of radius r mm is freely suspended at one end. Find angle made by its diameter with vertical. [ ]

a) $22.3^0$ b) $23^0$ c) $42.3^0$ d) $12.48^0$

11. The centroid of an equilateral triangle of side a with one side parallel to the x axis [ ]

a) $\left(\frac{a}{2}, \frac{a}{\sqrt{6}}\right)$ b) $\left(\frac{a}{2}, \frac{a}{\sqrt{12}}\right)$ c) $\left(\frac{a}{2}, \frac{a}{\sqrt{24}}\right)$ d) $\left(\frac{a}{2}, \frac{a}{3}\right)$

12. Centroid of lamina in the form of a sector of circle of radius R and subtending an angle 2α and have x axis as axis of symmetry is given by [ ]

a) 2R cos α/3$\pi$ b) 2R sin α/3$\alpha$ c) 2R cos α/2$\pi$ d) 2R cos α/2$\alpha$

13. An equilateral triangular lamina is suspended at its one of vertices. Its edge makes an angle of ------- with vertical. [ ]

a) $30^0$ b) $60^0$ c) $90^0$ d) $12^0$

14. The centroid of arc of a radius R and symmetric about the X- axis with subtended angle 2α is…. [ ]

a) $\frac{2R}{\alpha}$ b) $\frac{R\tan\alpha}{\alpha}$ c) $\frac{R\cos\alpha}{\alpha}$ d) $\frac{R\sin\alpha}{\alpha}$

15. The centre of gravity of a 10 x 15 x 5cm T section from its bottom is…… [ ]

a) 7.5 cm b) 5.0 cm c) 8.75 cm d) 7.85 cm

16. The centroid of a plane lamina will not be at its geometrical centre if it is a… [ ]

a) circle
b) equilateral triangle
c) rectangle
d) right angled triangle

17. The centre of gravity of a 10 x 15 x 5cm T section from its bottom is…… [ ]

a) 7.5 cm b) 5.0 cm c) 8.75 cm d) 7.85 cm

18. The centroid of isosceles triangle with base b and sides L is at distance……from its base. [ ]

a) b) c) d)

19. An isosceles triangle of base Lb and height ‘d’ is subtracted from triangle of base B and height 0. The centroidal distance from the……. [ ]

a) b) c) d)

20. A quarter circular plate of uniform thickness is freely suspended with the help of a string attached at the end of the circular arc. Then the angle made by the radius with vertical in the position of equilibrium is... …… [ ]

a) 13° b) 20.78° c) 33° d) 43º

21. A triangular plate ABC with AB = 80mm, BC = 60mm, AC = 100mm is hanging freely with the help of a string attached at vertex A. Then the angle made by side AB with vertical in the position of equilibrium is [ ]

a) 10.55° b) 15.55° c) 20.55° d) 25.55°

22. A uniform bar 500mm long is bent at ifs midpoint at an angle of 90°. Determine its centroid using the sides as axes. [ ]

a) 83.5 mm & 83.5 mm b) 32.5 mm & 32.5 mm
c) 62.5 mm & 62.5 mm d) none of these

23. Where must a circular hole of radius 1 m, be punched out of a circular disc, so that the centroid of the remainder may be m from the centre of the disc, i.e. 0 [ ]

a) at 0.5m from b) at 1.33 m from 0 c) at 1 m from 0 d) none of these

**ANSWERS**:

| | | | | | | |
|---|---|---|---|---|---|---|
| 01. c | 02. c | 03.d | 04. d | 05. a | 06. c | 07. d |
| 08. a | 09. d | 10. b | 11. b | 12. b | 13. a | 14. d |
| 15. c | 16. d | 17. | 18. | 19. | 20. | 21. |
| 22. c | 23. | | | | | |

01. The centre of gravity of an equilateral triangle with each side (a) is __ from any of the three sides [ ]

a) a√3/2 b) a√2/3 c) a/2√3 d) a/3√2

02. A circular hole of radius (r) is cut out from a circular disc of radius (2r) in such a way that the diagonal of the hole is the radius of the disc. The centre of gravity of the section lies at [ ]

a) centre of a disc b) centre of the hole
c) somewhere in the disc d) somewhere in the hole

03. The centre of gravity of a body is the point through which the weight of the body passes, when it is kept in the [ ]

a) horizontal position b) vertical position
c) inclined position d) any position

04. Two equal forces of magnitude P act at an angle θ, then their resultant will be [ ]

a) Pcosθ/2 b) 2Psinθ/2 c) Ptanθ/2 d) 2Pcosθ/2

05. Two forces act at an angle of $120^0$. If the greater force is 50N and their resultant is perpendicular to the smaller force. The smaller force is [ ]

a) 20N b) 25N c) 30N d) 35N

06. The resultant of two forces acting at right angles is √34 N and acting at $60^0$ is 70N. The forces are [ ]

a) 1N and 4N b) 2N and 3N c) √3N and 5N d) 3N and 5N

07. If two like parallel forces acting on member then their resultant will lie [ ]

a) between the two forces b) outside the two forces

c) at the centre of two forces d) in collinear with any of the force

08. For a quarter circle of 50mm radius lying in the first quadrant with the origin as the centre, the centroidal distance is found to be [ ]

a) 21.23 & 21.23 mm b) 50 & 50 mm

c) 30 & 30 mm d) None of the above

09. A slender homogeneous wire AB of semicircular shape is suspended from one end A. Determine the inclination that the diameter AB would make with the vertical. [ ]

a) $23.8^0$ b) $30.8^0$ c) $32.5^0$ d) $61.2^0$

10. The centroid of an arc of a circle of radius R and symmetric about the x axis with subtended angle 2 α is… [ ]

a) $\frac{R \sin x}{x}$ b) $\frac{2R}{x}$ c) $\frac{R \tan \alpha}{a}$ d) $\frac{R \cos x}{x}$

11. Centroid of wire bend in the form of arc of a circle with radius R, subtending angle 2α and having x axis as axis of symmetry is given by. [ ]

a) 2 R/α b) R tan α/π c) R cos α/π d) R sin α/α

12. A semicircular plate of radius r mm is freely suspended at one end. Find angle made by its diameter with vertical. [ ]

a) $22.3^0$ b) $23^0$ c) $42.3^0$ d) $12.48^0$

13. The centroid of an equilateral triangle of side a with one side parallel to the x axis [ ]

a) $\left(\frac{a}{2}, \frac{a}{\sqrt{6}}\right)$ b) $\left(\frac{a}{2}, \frac{a}{\sqrt{12}}\right)$ c) $\left(\frac{a}{2}, \frac{a}{\sqrt{24}}\right)$ d) $\left(\frac{a}{2}, \frac{a}{3}\right)$

14. Centroid of lamina in the form of a sector of circle of radius R and subtending an angle 2α and have x axis as axis of symmetry is given by [ ]

a) 2R cos α/3π b) 2R sin α/3α c) 2R cos α/2π d) 2R cos α/2α

15.An equilateral triangular lamina is suspended at its one of vertices. Its edge makes an angle of ------- with vertical. [ ]

a) $30^0$ b)$60^0$ c)$90^0$ d) $12^0$

16. The centroid of arc of a radius R and symmetric about the X- axis with subtended

angle 2α is…. [ ]

a) $\frac{2R}{\alpha}$ b) $\frac{R\tan\alpha}{\alpha}$ c) $\frac{R\cos\alpha}{\alpha}$ d) $\frac{R\sin\alpha}{\alpha}$

17. The centre of gravity of a 10 x 15 x 5cm T section from its bottom is…… [ ]
a) 7.5 cm b) 5.0 cm c) 8.75 cm d) 7.85 cm

18. If 'r' is the radius of a hemisphere then the C.G. of solid hemisphere will lie on the central radius at a distance of…… [ ]
a) 3r/ 4ô from the plane base b) 4r/ 3ô from the plane base
c) 3r/ 8 from the plane base d) 5r/ 8 from the plane base

19. The centroid of a plane lamina will not be at its geometrical centre if it is a… [ ]
a) circle b) equilateral triangle c) rectangle d) right angled triangle

**ANSWERS:**

01.c 02.c 03.d 04.d 05.b 06.d 07.a 08.a 09.c 10.a 11.d 12.b 13.b
14.b 15.a 16.d 17.c 18.c 19.d

**FRICTION**

1. A block of weight 50N remains in the state of limiting equilibrium under the action of a horizontal force 'P'. If $\mu_s$=0.27 & $\mu_k$ = 0.2, the frictional force acting on the block is
a)13.5 N b)20 N c)50 N d)15 N

2. A block of 50 kg mass is pushed up the inclined by a force of 100N acting parallel to the incline. If $\mu_s$=0.25, decide what will happen to the block under the action of these forces. The inclination of the plane with horizontal is 30º.
a)Block slides up b) Block slides down
c) Block remains stationary d) Block overturns

3. A 6m long ladder weighing 100N rests against a smooth vertical wall at an angle 30º to the wall. If a man of 750 N weight climbs up the ladder and stays at 4m from the bottom, determine the horizontal force required to be applied at the bottom of the ladder to prevent it from slipping.
a)952.6 N b) 367.5 N c) 173.2 N d)86.67 N

4. A block of weight 50 N is placed on a rough horizontal surface when a horizontal force of 18 N is applied, the block is just on the verge of motion. The angle of friction is
a)17.80º b) 18.80º c) 19.80º d)20.80º

5. Determine value of force P applied on a block of weight 600N to prevent it from moving down. Block is resting on inclined surface making an angle of 35º with horizontal. P is making an angle of 60º with horizontal. Take $\mu_s$= 0.25 and $\mu_k$= 0.2

a)233.56 N b) 562.32 N c) 276.68 N d) 145.29 N

6. What is the minimum angle $\Theta$ (with the horizontal)at which the uniform plank may be placed against the wall without slipping. The coefficient of friction for all surface in contact is $\mu$ and weight of plank is W.

a)$\Theta = \tan^{-1}(1+ \mu^2/ 2\mu)$ b) $\Theta = \tan^{-1}(1- \mu^2/ 2\mu)$

c)$\Theta = \tan^{-1}(2\mu / 1+ \mu^2)$ d) None of these

7. For a static body which is not in impending motion which of the following is true.

a)Fr (actual) = Fr(limit) b) Fr (actual) < Fr(limit)

c)Fr (actual) > Fr (limit) d) None of these

8. A horizontal force P is applied on a 50 kg. block placed on an inclined plane, inclined at 40º with horizontal. What is the value of P required to just push the block up the plane? $\mu = 0.2$

a)P = 386 N b) P=543 N c) P=732 N d) P=612.5 N

9. A flat belt passing over a Pulley is used to transmit power. If the tension on tight side is $T_1$ and tension in slack side is $T_2$ and the belt makes lap angle b then the ratio of $T_1/ T_2$ is equal to

a)$e^{\mu\beta}$ b) $e^{1/\mu\beta}$ c) $\mu\beta$ d) None of these

10. For an impending motion which of the following is not true

a)Angle of friction = Angle of repose b) $\mu_k < \mu_s$

c) $\mu_s = \frac{Fr}{N}$ d) None of these

11. At the point of impending motion, static frictional force is,

a)Zero b) Maximum c) Minimum d) Infinite

12. A rope males 1 1/2 turn over a fixed pulley. The value of load that can be moved by applying a force of 1 Kn with $\mu = 0.20$ is…….. when load moves down.

a) 6.59 kN b) 5 kN c) 5.45 kN d) 4.29 kN

13. A block weighing 1 OON rests on a plane tends to move downwards, when the plane makes an angle of 20° to horizontal. The coefficient of friction between the block and the plane is……

a) 0.36 b) 0.34 c) 0.40 d) 0.50

14. A body of weight W is resting on a plane inclined at 30° to horizontal. It is attached to a string making an angle 60° with horizontal, If angle of friction be 30°, the tension in the string would be…….

a) b)W c)zero d)2W

15. A block of mass 10kg is placed on horizontal plane. A horizontal force of 30 N is applied and the block is just on the verge of motion. The angle of friction is…..

a) 17° b) 30º c) 45 d) 60°

16. A block of weight 100N is placed on a rough horizontal plane with μs=0.3 and μk = 0.2. It is acted upon by a 20N horizontal pushing force. Will it move?

a) No b) move slightly and then stop c) yes d)none of these

17. A block of weight 100 Nis placed on a rough horizontal plane with μs = 0.3 and μk= 0.2. A horizontal force of 50N is pulling the block rightwards. How much frictional force the block will experience during motion?

a) 50N b) 30N c) 20N d) 10N

18. A block of weight 1 OON is placed on a rough horizontal plane with p = 0.3 and K = C.2. It is on the verge of sliding towards right. Then how much force is acting on it in the direction of motion?

a)10 N b)20N c)40N d)30N