Date: 16-04-2019   Dept. No.   Max. : 100 Marks

Time: 09:00-12:00

SECTION – A

Answer ALL questions   **(10 Ӏ 2 = 20)**

1.   What is parallelogram of forces?

2.   Two forces of equal magnitudes acting on a particle are such that the square of the magnitude of the resultant is 3 times the product of the magnitude of the frces. Find the angle between them.

3.   Define moment of a force.

4.   What is meant by cone of friction?

5.   Give an example of a body where the centre of mass is not necessarily a point of the body.

6.   What is the centre of gravity of a thin uniform rod?

7.   State Hooke's law.

8.   When do you say that a body is in neutral equilibrium?

9.   State intrinsic equation of catenary.

10.   What is a suspension bridge?

SECTION – B

Answer any FIVE questions.   **(5 Ӏ 8 = 40)**

11.   The resultant of two forces of magnitude p and q acting on a particle has magnitude $(2n + 1)\sqrt{p^2 + q^2}$ or $(2n - 1)\sqrt{p^2 + q^2}$ according as the angle between the forces is α or $90° - \alpha$. Prove that $tan\alpha = \frac{n-1}{n+1}$.

12.   State and prove Lami's theorem.

13.   Find the resultant of two unlike parallel forces with unequal magnitudes.

14.   A weight W is supported by friction on a plane inclined at an angle α to the horizon. Show that it cannot be moved up the plane by any horizontal force less than W tan 2α.

15.   Show that the centre of gravity of a uniform triangular lamina coincides with the centre of gravity of three particles of equal weights placed at the mid points of the sides of the triangle.

16. Discuss the work done in stretching an elastic string from its natural length l to the length l'.

17. A solid sphere rests inside a fixed rough hemispherical bowl of twice its radius. Show that, however large a weight is attached to the highest point of the sphere, the equilibrium is stable.

18. A string of length l hangs between two points not in the same vertical line and the tangents at the end points are inclined at an angle α and β with the horizontal. Show that the height of one extremity above the other is $\dfrac{l\sin\frac{\alpha+\beta}{2}}{\cos\frac{\alpha-\beta}{2}}$.

SECTION – C

Answer any TWO questions   **(2 × 20 = 40)**

19. (a) Determine the magnitude and direction of the resultant of two given forces with a common point of application.   **(10)**

    (b) Two strings AB and AC are knotted at A, where a weight W is attached. If the weight hangs freely and in the position of equilibrium, with BC horizontal, AB: BC : CA = 2:4:3 , show that the tensions in the strings are $\dfrac{7W}{2\sqrt{15}}$ and $\dfrac{11W}{4\sqrt{15}}$.   **(10)**

20. (a) State and prove Varignon's theorem on moments.   **(10)**

    (b) Discuss the equilibrium of a particle on a smooth inclined plane acted on an external force.

                                                                                      (10)

21. (a) Find the centre of gravity of a uniform solid right circular cone.   **(10)**

    (b) Derive the Cartesian equation of the catenary.   **(10)**

22. (a) A rod lies in equilibrium with its ends on two smooth planes inclined at an angle α,β to the horizontal, the planes intersecting in a horizontal line. Show that the inclination of the rod to the horizontal is $\tan^{-1}\left(\dfrac{\sin(\alpha\sim\beta)}{2\sin\alpha\sin\beta}\right)$.   **(10)**

    (b) A uniform chain of length l, is to be suspended from two points A and B, is the same horizontal line, so that either terminal tension is n times that at the lowest point. Show that the span AB must be $\dfrac{l}{\sqrt{n^2-1}}\log\left(n+\sqrt{n^2-1}\right)$.   **(10)**

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