



Date: 02-11-2018  
Time: 09:00-12:00

Dept. No.

Max. : 100 Marks

**PART –A**

**Answer ALL questions**

10 \* 2 = 20

1. When two forces of equal magnitudes are inclined at the angle  $2\alpha$ , their resultant is twice as great as when they are inclined at the angle  $2\beta$ . Prove that  $\cos\alpha = 2\cos\beta$ .
2. Write the conditions for equilibrium of a system of concurrent forces.
3. Define like parallel forces with an example.
4. Define couples.
5. Define angular acceleration.
6. Write the equation of the motion of a particle moving along a straight line with uniform acceleration  $f$ .
7. State any two Newton's law.
8. Define motion of centre of inertia.
9. Define horizontal range.
10. Define projectile of a particle.

**PART-B**

**Answer any FIVE questions**

5 \* 8 = 40

11. Find the magnitude and direction of the resultant of two given forces with a common point of application.
12. Two forces of equal magnitudes acting on a particle are such that the square of the magnitude of the resultant is three times the product of the magnitude of the forces. Find the angle between the forces.
13. A uniform rod AB of length  $2a$  and weight  $W$  is resting on two pegs  $C$  and  $D$  in the same level at a distance  $d$  apart. The greatest weights that can be placed at A and B without tilting the rod are  $\frac{W_1}{(W+W_1)} + \frac{W_2}{(W+W_2)} = \frac{d}{a}$ .
14. Two unlike parallel forces of P and Q are such that when P is doubled, the line of action of Q is midway between the lines of action of the new resultant and first resultant. Show that  $4P = 3Q$ .
15. A stone is dropped into a well and it reaches the bottom a velocity of 96'/sec and sound of splash of water reaches the top of the well in 219/70 secs from the time the stone is dropped. Find the velocity of sound.

16. A train of mass 200 tons is running at the rate of 40 m.p.h. down an incline of 1 in 120. Find the resistance necessary to stop the train in half a mile.
17. Show that the time of descent down a smooth inclined plane of given base is least when inclination is  $\frac{\pi}{4}$ .
18. A ball is thrown with a velocity of 96 feet/sec from the top of a tower 200 feet high. If the angle of projection is 45 degree, find at what distance from the foot of the tower the ball will strike the ground.

**PART -C**

**Answer any TWO question**

2 \* 20 = 40

19.a) Find the resultant of two like parallel forces.

b) State and prove Varignon's theorem on moments any two cases.

20.a) State and prove Lami's theorem.

b) 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  $\alpha$  or  $90 - \alpha$ . Prove that  $\tan\alpha = \frac{n-1}{n+1}$ .

21.a) A body, sliding down a smooth inclined plane, is observed to cover equal distance, each equal to a, in consecutive intervals of time  $t_1, t_2$ . Show that the inclination of plane to the horizon is  $\sin^{-1} \left[ \frac{2a(t_1 - t_2)}{gt_1 t_2 (t_1 + t_2)} \right]$ .

b) Derive the equation of motion of two particles connected by a string.

22a) Show that the path of projectile is a parabola.

b) From a point on the ground at a distance  $p$  from the foot of a vertical wall, a ball is thrown at an angle 45 degree which just clears the wall and afterwards strikes the ground at a distance  $q$  on the other side. Show that the height of the wall is  $\frac{pq}{p+q}$ .

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