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Reg. No.:.....

Code No. : 30011 E **Sub. Code : GMMA 63 / GMMC 63**

B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2020.

Sixth Semester

Mathematics/Mathematics with CA — Main

MECHANICS

(For those who joined in July 2012–2015 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer

1. If the resultant of two forces acting at a point is greatest, then the angle between them is

(a) 180° (b) 90°

(c) 0° (d) 45°

2. If, P,Q are two forces then the least resultant is _____

(a) $P+Q$ (b) $P-Q$

(c) P/Q (d) Q/P

3. If three coplanar forces acting on a regid body keep it is equilibrium then they must be

(a) 0

(b) Perpendicular

(c) Either concurrent or parallel

(d) Parallel

4. If three forces acting at a point are in equilibrium then each force is proportional to the _____ of the angle between the other two

(a) Cosine (b) Sine

(c) Tan (d) Sec

5. The horizontal velocity of a projectile is _____

(a) $u\sin\alpha$ (b) $u\cos\alpha$

(c) $u\tan\alpha$ (d) $2u\sin\alpha$

6. The time of flight of a particle is

(a) $\frac{2u\sin\alpha}{g}$ (b) $\frac{2u\cos\alpha}{g}$

(c) $\frac{u\sin\alpha}{2g}$ (d) $\frac{\sin\alpha}{2g}$

7. The period of a simple harmonic motion is _____

(a) $\sqrt{\frac{2\pi}{\mu}}$ (b) $\frac{\pi\sqrt{2}}{\mu}$

(c) $\frac{\sqrt{2\pi}}{\mu}$ (d) $\frac{2\pi}{\sqrt{\mu}}$

8. In a simple harmonic motion the frequency of oscillation is _____

(a) $\frac{\pi}{\sqrt{\mu}}$ (b) $\frac{2\pi}{\sqrt{\mu}}$

(c) $\frac{\sqrt{\mu}}{2\pi}$ (d) $\frac{\sqrt{\pi}}{\mu}$

9. The $(p-r)$ equation of a parabola is _____

(a) $p^2 = ar$ (b) $p^2 = ar^3$

(c) $p = ar$ (d) $p = ar^2$

10. Radial velocity = ————————

(a) $\dot{r}$ (b) $\ddot{r}$

(c) $r\dot{\theta}$ (d) $-r\dot{\theta}$

PART B — ($5 \times 5 = 25$ marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) State and prove the triangle law of forces.

Or

(b) If three parallel forces are in equilibrium, then show that each is proportional to the distance between other two.

12. (a) If three coplanar forces acting on a rigid body keep it in equilibrium, then prove that they must be concurrent or parallel.

Or

(b) State and prove just Trigonometrical theorem.

13. (a) If the greatest height attained by the particle is a quarter of its range of the horizontal plane through the point of projection, then find the angle of projection.

Or

(b) If h and h' are the greatest heights in the two paths of a projectile with a given velocity for a given range R, then prove that $R = 4\sqrt{hh'}$.

14. (a) A particle moving with simple Harmonic motion and while making on oscillation from one extreme position to the other, its distance from the centre of oscillation at 3 consecutive seconds are x_1, x_2, x_3. Prove that the period of oscillation is $\frac{2\pi}{\cos^{-1}\left(\frac{x_1 + x_3}{2x_2}\right)}$.

Or

(b) A particle executing a simple harmonic equation has velocities v_1, and v_2 when its distance from mean position are d_1 and d_2 respectively. Find the amplitude, period of velocity when its distance form the mean position is $\frac{d_1 + d_2}{2}$

15. (a) If a point moves so that its radial velocity is k times its transverse velocity, then show that its path is an equiangular spiral.

Or

(b) Derive the $p - r$ equation of a central orbit

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

16. (a) State and prove Lami's theorem.

Or

(b) State and prove Varignon's theorem.

17. (a) A uniform rod of length a, hands against a smooth vertical wall being supported by means of a string, of lengths l, tied to one end of the rod, the other end of the string being attached to a point in the wall. Show that the rod can inclined to the wall at an angle θ given by $\cos^2\theta = \frac{\left(l^2 - a^2\right)}{3a^2}$.

Or

(b) A rod of length $(a+b)$ whose centre of gravity divides it in the ratio a: b is at rest with its ends in contact with a smooth vertical wall and a smooth inclined plane inclined with the wall at an angle if the rod is inclined at an angle θ with the vertical, then show that $\tan\alpha \tan\theta = \frac{a+b}{a}$ or $\frac{a+b}{b}$.

18. (a) Show that the greatest height which a particle with initial velocity v can reach on a vertical wall out a distance a from the point of projection is $\frac{v^2}{2g} - \frac{ga^2}{2v^2}$. Also prove that particle in its flight is $\frac{v^6}{2g\left(v^4 + g^2 a^2\right)}$

Or

(b) Show that for a given velocity of projection the maximum range down an inclined plane of inclination α hears to the maximum range up the inclined plane the ratio $\frac{1+\sin\alpha}{1-\sin\alpha}$.

19. (a) Obtain the differential equation of simple Harmonic equation and solve it completely.

Or

(b) Find the composition of two simple harmonic motions of the same period in the same straight line and the composition of two simple harmonic motions of the same period in two perpendicular directions.

20. (a) Find the law of force towards the pole under which the curve $u^n = a^n \cos\theta$ can be described.

Or

(b) Obtain the differential equation of the central orbit in the form $\frac{d^2u}{d\theta^2} + u = \frac{p}{h^2u^2}$.
