SAIVA BHANU KSHATRIYA COLLEGE

(Aruppukottai Nadargal Uravinmurai Pothu Abi Viruthi Trustuku Pathiyapattathu)

ARUPPUKOTTAI

DEPARTMENT OF MATHEMATICS

QUESTION BANK

Class :	B.Sc., MATHEMATICS		
Semester (UG - III & V; PG - III) :	UG-III	Subject Code :	SMTJC31
Name of the Subject :	Mechanics		

Section A (Multiple Choice Questions)

Unit I: (Force acting at a point)

1. If two forces P and Q act in the same direction then the resultant is equal to _____
   (a) P+Q (b) P-Q (c) P (d)Q
2. Law of parallelogram of forces:
   (a) AB+DA=AC (b) AB*AD=AC (c) AB-AD=AC (d)AB+AD=AC
3. The result of two equal forces at an angle α is _____ in a direction.
   (a) 2P cos α/2 (b) 3P cos α (c) 2P cos² α/2 (d)None of the above
4. If three forces acting at a point are in equilibrium, each forces is proportional to the sine of angle between the other two.
   (a) triangle of forces (b) Lemi's theorem (c) Varigon's theorem (d)None of the above
5. When θ =0 L cos θ =1. The resolved part =_____
   (a) 1 (b) F (c) 0 (d)2

Unit II: (Parallel forces and Moments)

6. The maximum value of friction is _____
   (a) μ /R (b) R/ μ (c) R (d) μ
7. The coefficient of friction is equal to ____
   (a) tan λ (b) cos λ (c) sin λ (d) cot λ
8. If three forces acting on a rigid body are in equilibrium they must be _____
   (a) Parallel (b) Equal (c) Concurrent (d)Zero
9. Coefficient of friction is denoted by _____
   (a) F (b) μ (c) λ (d)None of the above
10. If F is a friction and R is a normal reaction between two bodies when equilibrium is non-limiting then _____
    (a) $\frac{F}{R}$ < R (b) $\frac{F}{R}$ > R (c) $\frac{F}{R}$ =R (d) $\frac{F}{R} \geq$ R

Unit III: (Projectile)

11. The time taken to reach the greatest height of a projectile is of _____
    (a) u sin α / g (b) u sin α / 2g (c) u² sin α / g (d) u² sin 2α
12. The horizontal range R of a projectile is
    (a) u² sin 2α / g (b) u³ sin 2α / g (c) u⁴ sin 2α / g (d) u² sin α / g
13. The _____ is the path which the particle describes.
    (a) angle of projection (b) friction (c) trajectory (d)none of the above
14. The maximum horizontal range of a projectile is _____
    (a) u² / g (b) u² / 2g (c) u / g (d) u² / 3g
15. The time of flight of a projectile is _____
    (a) 2u sin α / g (b) u sin α / g (c) sin α / g (d) 3u sin α / g

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Unit IV: (Impulsive Forces)

16. The impulse of a force is measured as follows:
    (a)change in momentum (b)change in velocity (c) change in acceleration (d) None
17. By Newton's principle of impact $v_1 - v_2 =$ ____ .
    (a) e $(u_1 - u_2)$ (b) e $(u_2 - u_1)$ (c) -e $(u_2 - u_1)$ (d) $(u_2 - u_1)$
18. Bodies for which e=1 are said to be _____
    (a) Inelastic (b) perfectly elastic (c) Path (d) trajectory
19. If two sphere are perfectly elastic and of equal mass then
    (a) e=1 & $m_1 = m_2$ (b) e=1 & $m_1 \neq m_2$ (c) e≠1 & $m_1 = m_2$ (d) e>1 & $m_1 = m_2$
20. For oblique impact when e=1, the loss of kinetic energy is _____
    (a) 1 (b) 2 (c) 0 (d)3

Unit V: (Motion under the action of central forces)

21. Pedal equation of the central orbit _____
    (a) $\frac{h^2}{p^3}\frac{dp}{dr}$ (b) $\frac{h^3}{p^3}\frac{dp}{dr}$ (c) $\frac{p^2}{h^3}\frac{dp}{dr}$ (d) $\frac{h^2}{p^3}\frac{dr}{dp}$
22. The areal velocity of a particle moving in a central orbit is ____
    (a) $\frac{1}{2}pv$ (b) pv (c) $\frac{1}{3}pv$ (d) $\frac{1}{2}p$
23. Velocity in a central orbit: ____
    (a) $\frac{h}{p}$ (b) $\frac{h^2}{p}$ (c) $\frac{h}{p^2}$ (d) $\frac{h^2}{p^3}$
24. Pedal equation of parabola - pole at focus: ____
    (a) $p^3=ar$ (b) $p=ar^2$ (c) $p^2=ar$ (d)p=ar
25. The radial component of the velocity in a central orbit is ____
    (a) $\frac{dr}{dt}$ (b) $\frac{d^2r}{dt^2}$ (c) $\frac{1}{r}\frac{dr}{dt}$ (d) $\frac{1}{r^2}\frac{dr}{dt}$

Section B (7 mark Questions)

Unit I: (Force acting at a point)

26. State and prove parallelogram of forces.
27. State and prove triangle of forces.
28. Two forces act on a particle. Of the sum and difference of the forces are at right angels to each other, show that the forces are of equal magnitude.
29. Show that a given force may be resolved into three components, acting in three given lines which are not all parallel or all concurrent.
30. ABC is a triangle, with a right angle at A. AD is the perpendicular on BC. Prove that the resultant of the forces $\frac{1}{AB}$ acting along AB and $\frac{1}{AC}$ acting along AC is $\frac{1}{AD}$ acting along AD

Unit II: (Parallel forces and Moments)

31. If three parallel forces are in equilibrium, each is proportional to the distance between the other two.
32. State and prove three coplanar forces theorem.
33. State and prove two trigonometrical theorems.
34. Explain law of friction.
35. Write coefficient of friction.

Unit III: (Projectiles)

36. Write a characteristics of the motion oa a projectile.
37. Show that the greatest height which a particle with initial velocity v can reach on vertical wall at a distance 'a' from the point of projection is $\frac{v^2}{2g} - \frac{g\,a^2}{2\,v^2}$
38. Show that, for a given velocity of a projection the maximum range down and inclined plane of inclination α bears to the maximum range up the inclined plane ratio 1+ sin α / 1- sin α
39. Find the velocity of the projectile in magnitude and direction at the end of time t.
40. If v_1 and v_2 be the velocities of a projectile at the ends of a focal chord of its path and U is the velocity at the vertex. Prove that $v_1^{-2} + v_2^{-2} = U^{-2}$

Unit IV: (Impulsive Forces)

41. Write loss of kinetic energy in impact.
42. Explain fundamental laws of impact.
43. A smooth sphere, or particle whose mass is m and whose coefficient of restitution is e, impinges obliquely on a smooth fixed plane; to find the velocity and direction of motion after impact.
44. A particle is projected from a point on an inclined plane and at the rth impact it strikes the plane perpendicularly and at the nth impact is at the point of projection. Show that $e^n - 2e^r + 1 = 0$
45. Explain the Direct impact of two smooth spheres.

Unit V: (Motion under the action of central forces)

46. Derive the pedal equation of a central orbit.
47. Explain the two fold problems in central orbit.
48. Derive the pedal equation of (a). Circle – pole at any point (b). Parabola – pole at focus.
49. Derive velocities in a central orbit.
50. A particle moves in an ellipse under a force which is always directed towards its focus. Find the law of force, the velocity at any point of the path and its period time.

Section C (10 mark Questions)

Unit I: (Forces acting at a point)

51. State and prove Lami's theorem.
52. ABC is a given triangle. Forces P,Q,R acting along the lines OA, OB, OC are in equilibrium. Prove that (i) $P:Q:R=a^2(b^2+c^2-a^2):b^2(c^2+a^2-b^2):c^2(a^2+b^2-c^2)$ of O is the circumcenter of the triangle. (ii) P:Q:R=a:b:c if O is the orthocenter of the triangle.

Unit II: (Parallel forces and Moments)

53. State and prove Varigon's theorem.
54. A body is at rest on a rough plane inclined to the horizon at an angle greater than the angle of friction and is acted upon by a force, parallel to the plane and along the line of greatest slope; to find the limits between which the force must lie.

Unit III: (Projectile)

55. Show that path of a projectile is a parabola.
56. Explain range on a inclined plane.

Unit IV: (Impulsive Forces)

57. Explain loss of kinetic energy due to Direct impact of two smooth spheres.
58. Explain Oblique impact of two smooth spheres.

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Unit V：(Motion under the action of central forces)

59. Derive the differential equation of a central orbit.
60. Find the law of forces towards the pole under which the curve $r^n = a^n \cos n\theta$