VIVA QUESTIONS

1. -Mechanics is the branch of applied mathematics dealing with motion and forces producing motion.
-Statistics is the practice or science of collecting and analysing numerical data in large quantities, especially for the purpose of inferring ~~por~~ proportions in a whole from those in a representative sample.
-Dynamics is branch of physical science and subdivision of mechanics that is concerned with the motion of material objects in relation to the physical factors that affect them, force, mass, momentum and energy.
= Dynamics is the study of a body in motion.

2. A scalar quantity is a physical quantity with only magnitudes Eg. mass, & distance.
A vector quantity is a physical quantity ~~with~~ that has both magnitudes and direction.
Eg. force, weight, displacement.

3. Force is defined as an agency ~~with~~ which changes or tends to change the state of rest or of uniform motion the body
Unit of force: N (SI Unit)

4. Newton's law of Motion
① A body remains at rest, or in a state of uniform motion ~~until~~ unless an external unbalanced force acts on it.
② The acceleration of the body is directly proportional to the force acting on the body and inversely proportional to the mass of the body.
③ Every action has equal and opposite reaction which acts simultaneously.

5. Principle of Transmisibity states that, "A force being a sliding vector continues to act along its line of action and therefore makes no changes if it acts from different point on its line of action on a rigid body."

6. The rotational effect of a force is known as moment and the concerned point is known as moment centre.

$M = F \times d$ (Unit is 'N·m' (SI Unit))

7. Resolution or resolving of forces implies breaking the force into components, such that the components combined together would have the same effect as the original force.

8. (1) Concurrent force system: All forces meet at a point.
(2) Parallel force system: Forces all parallel with each other.
(3) General force system: Also known as 'non-concurrent' and 'non-parallel' force system.
(4) Non-Coplaner force system: Forces do not lie in a same plane. (They are termed as non-coplaner forces or space forces).

9. i) Concurrent force system.
(1) Resolve the inclined forces.
(2) find ΣF_x and ΣF_y; and resultant $R = \sqrt{(\Sigma F_x)^2 + (\Sigma F_y)^2}$
(3) The direction of resultant force is the angle θ made by it with the X-axis.

$$\tan\theta = \frac{|\Sigma F_y|}{|\Sigma F_x|}$$

(4) Decide the quadrant of resultant upon the sign convention of ΣF_y and ΣF_x.
(5) Draw diagram showing resultant.

ii) Parallel force system:

① forces directed towards only one direction, can be simply added up with sign convection.

② Resultant is found using 'Varrignon's Theorem'. The resultant is initially assumed to act either to the right or left of the reference point and at a perpendicular distance.

③ Applying varignon's theorem.

$$\sum M_A^f = \sum M_A^R$$

③ Assuming perpendicular is 'd'. If 'd' is positive then resultant will lie in assumed direction. If 'd' is negative then resultant will lie in the opposite direction (i.e. our assumption of 'd' is opposite).

iii) General force system:

① follow the same procedure to find the resultant as concurrent force system.

② To locate position of resultant use varrignon's theorem.

10. If number of forces acting at a point represented in magnitude, direction and sense by the sides of polygon taken in order, then the closing side of the polygon represents the resultant taken in opposite order.

11. Algebric sum of the moment of a system of coplaner forces about any point in the plane is equal to the moment of the resultant force of the system about the same point.

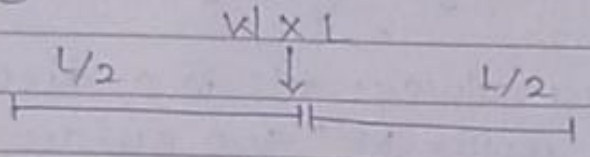
12. Couple is a special case of parallel forces, where two parallel forces of equal magnitude and opposite direction forms a couple. Unit N·m.

(for difference refer Q.6 and Q.12).

13. A diagram ~~the~~ formed by isolating the body from its surroundings and then showing all the forces acting on it is called FBD.

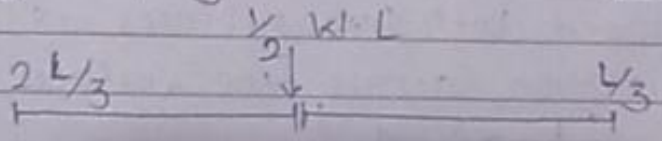
14. ① Hinge support (2 types of rxns) $\xrightarrow{H_A}$ $\uparrow V_A$
② Roller support (1 rxn) $\uparrow R_A$
③ Fixed support (3 types of rxn) $\rightarrow H_A$, $V_A \uparrow$, M_A ↺
④ Smooth surface support (perpendicular rxn at point of contact)
⑤ String / Tension support (rxn acting outside from the origin)
⑥

15. i) Uniformly distributed load ~~w x L/m~~

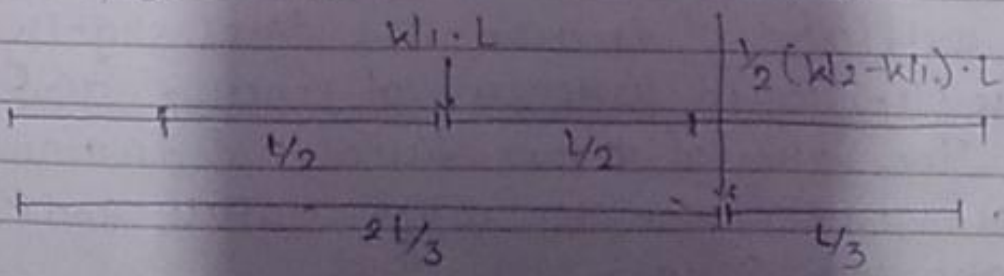


wl = ? (weight ?)
L = Length

ii) Uniformly Varying load



iii) Trapezoidal load (½ UDL & ½ UVL).



16. If three concurrent forces are acting at a point are in equilibrium, then the ratio of any of the forces is equal to the sine of the angle bet^n the remaining two forces.

$$\frac{F_1}{\sin\gamma} = \frac{F_2}{\sin\alpha} = \frac{F_3}{\sin\beta}$$

17. For coplanar force system, scalar eq^n of equilibrium are,
① $\Sigma F_x = 0$ (horizontal) ② $\Sigma F_y = 0$ (vertical) ③ $\Sigma M = 0$ (moment)

18. = Centroid is the term used for centre of gravity of all plane geometrical figures.

OR

Centroid is the geometrical center of a given figure.
= Geometrical center is a point through which the whole weight of the body is assumed be acting.

19. Rectangle: $\bar{x} = b/2$ $\bar{y} = h/2$
Right Angled Triangle: $\bar{x} = b/3$ $\bar{y} = h/3$
Semi circle: $\bar{x} = r$ $\bar{y} = 4r/3\pi$
Quater circle: $\bar{x} = 4r/3\pi$ $\bar{y} = 4r/3\pi$

20. ① A frictional force always acts in a direction that opposes relative motion betn two surface of contacts.
② The maximum frictional force (limiting friction) that can be developed betn two surfaces is proportional to the normal reaction across the surface of contact.

$$f_{max} = \mu_s$$

③ If the body is in motion w.r.t surface in contact, the coefficient of friction now takes slightly lesser value (μ_k) called coefficient of kinetic friction.
④ The value of two efficients of friction μ_s and μ_k are greater for rough surface and lesser for smoother surface.
⑤ At no velocity of relative motion between two surfaces friction is practically independent of velocity.

21. When a block is placed on a rough inclined plane, and the inclination of plane is gradually increased at a particular angle θ, the block gets the impending motion (a body just begins to move). This θ is called angle of repose.

The angle made by the resultant of normal reaction and limiting friction is called angle of friction.

22. = Friction is defined as the tangential force which opposes the motion of the body. (Unit: Newton (N))
= Coefficient of friction is a measure of amount of friction existing between two surfaces. (Denoted by μ)

23.

24. ~~Moment = force x distance~~
~~M = Fxd~~

24. ① Convert force in the vector form. ($F = f_x i + f_y j + f_z k$)
25. ② Find the position vector extending from the moment's center to any point on the force.
($\bar{r} = r_x i + r_y j + r_z k$)
③ Perform the cross product of the position vector and the force vector to get the moment vector.

$$\bar{M} = \bar{r} \times \bar{F} = \begin{vmatrix} i & j & k \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

25. ~~$F = F_x i + f_y j + f_z k$~~

$$\bar{F} = F \times \hat{e}_{pq}$$

F: ~~Peg~~ magnitude
$\hat{e}_{pq}$: position / unit vector

26. (Refer Q. 9 (i), (ii))

27. In Kinematics ~~If~~ the motion of a body is influenced by the forces acting on the body. ~~the analysis doesn't involve for~~ We only study the geometry of motion without analysing the cause behind that motion. Displacement, acceleration velocity etc.

The branch of dynamics which deals with the relationship of the motion of the body with forces acting on is called kinetics.
Momentum, impulse K.E, P.E

28. $v = u + at$
$v^2 = u^2 + 2as$
$s = ut + \frac{1}{2}at^2$.

29. Position time graph (x-T graph) we can find velocity.
Velocity time graph (V-T graph) we can find acceleration at a particular instant.

29. Position time graph (x-T):
We can find velocity.
$$v = \frac{y_2 - y_1}{x_2 - x_1}$$ (using slope formula)
Velocity time graph (V-T).
We can find acceleration at a particular instant.
$$a = \frac{dv}{dt}$$
And displacement = Area under the graph.
Acceleration time graph (a-T)
We can find velocity.
Change in velocity = Area under the graph.

30. If the particle travels along the curved path then its motion is called curvilinear motion.

31. Radius of curvature (ρ)

$$\rho = \frac{v^3}{|v_x a_y - v_y a_x|}$$

$$\rho = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\frac{d^2y}{dx^2}}$$

$\rho = \frac{v^3}{a}$

$$\rho = \frac{(v_x^2 + v_y^2)^{3/2}}{v_x a_y - v_y a_x}$$

$$\boxed{\rho = \frac{(v_x^2 + v_y^2)^{3/2}}{v_x a_y - a_x v_y}}$$

32. Projectile motion is the motion of an object thrown or projected into the air, ~~subject~~ and is influenced only by downward force of gravity.

~~Range (R) = $u^2 \sin 2\alpha / g$~~

Range(R) = $\frac{u^2 \sin 2\alpha}{g}$

Time of light = $\frac{2u_0 \sin \alpha}{g}$

Maximum height (S) = $\frac{(u \sin \theta)^2}{2g}$

33. Equation of path of projectile.

$$y = x \tan \alpha - \frac{gx^2}{2u^2 \cos^2 \alpha}$$

34. (i) Translation motion (all particles forming body travells along a parallel path)

(ii) fixed axis motion: rigid body moves around an axis which has fixed position and is ⊥ar to plane of motion).

iii) General plane motion: (Neither translation nor fixed axis).

35. General plane motion: If a rigid body performs plane motion which cannot be classified as translation or fixed axis motion then it is gp motion.

36 ICR is point about which a GP body rotates, at a given instant.

How to find ICR:

① Locate 2 points on GP body whose magnitude and direction is known and another point whose velocity is known.

② Draw perpendiculars to the direction of velocities and extend them to intersect at a point (point I)

~~③ Treat GP body as rotating body and using~~

③ This point 'I' is the ICR (Instantaneous centre of rotation).

37. (same as Q-36)???