FREE BODY DIAGRAM :-

⇒ A body is said to be 'free' when it is singled out from other bodies for the purposes of dynamic (or) static Analysis.

⇒ To represent all Known and Unknown, Reactions, Tension, Thrust acting on a body under a system of forces through a diagram, called FBD.

* procedure to Draw FBD :-

↦ Separate the body from its Surrounding

↦ Draw all Known & unKnown forces acting on body.

↦ Find all reactions, Horizontal and vertical Components, Tension, and Thrust.

↦ Draw all angles of sides, arms etc.

↦ Write all Geometrical relations.

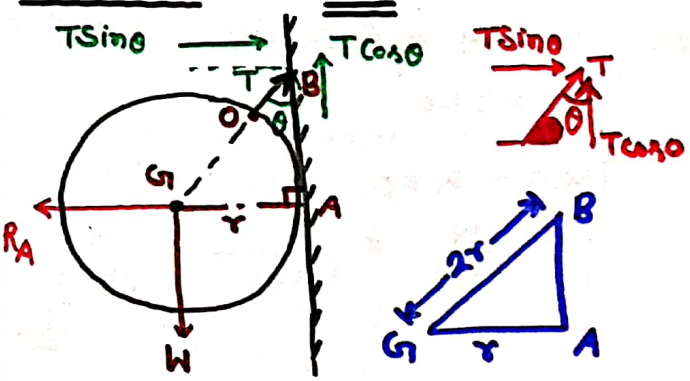
Question :- [B.T.E.U.P. 1990]

A sphere is hanging with the help of a rope from a smooth vertical wall. The weight of the sphere is (W). Length of the rope is equal to the radius of sphere. Then find-

(1) Tension in the rope.
(2) Its inclination from vertical.
(3) Reactions of sphere on wall.

Given data :

FBD



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↦ Weight of W is acting on G.
↦ R_A $\perp^r$ to wall, along AG.
↦ T in rope along GB.

According to question-

$OB = OG = AG = r$

$\angle BAG = 30°$

(ii) Consider $\triangle$ BGA.

$$\sin\theta = \frac{GA}{GB} = \frac{r}{2r} = \frac{1}{2}$$

$$\theta = \sin^{-1}\left(\frac{1}{2}\right)$$

$$\boxed{\theta = 30°}$$ Ans.

(i) In General equ^m Condition-

$$\Sigma Y = 0$$

$$T\cos\theta - W = 0$$

$$\left\{T = \frac{W}{\cos\theta} = \frac{W}{\cos 30°} = \frac{2W}{\sqrt{3}}\right\}$$ Ans

(iii) Similarly for equilibrium condition-

$$\Sigma X = 0$$

$$T\sin\theta - R_A = 0$$

$$R_A = T\sin\theta = T \times \sin 30 = T \times \frac{1}{2}$$

$$R_A = \frac{T}{2} = \frac{\frac{2W}{\sqrt{3}}}{2} = \frac{2W}{\sqrt{3}} \times \frac{1}{2}$$

$$\left[R_A = \frac{W}{\sqrt{3}}\right]_{//}$$ Ans.

Hence;

$$\left\{T = \frac{2W}{\sqrt{3}} \; ; \quad \theta = 30° \; ; \quad R_A = \frac{W}{\sqrt{3}}\right\}_{//}$$

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