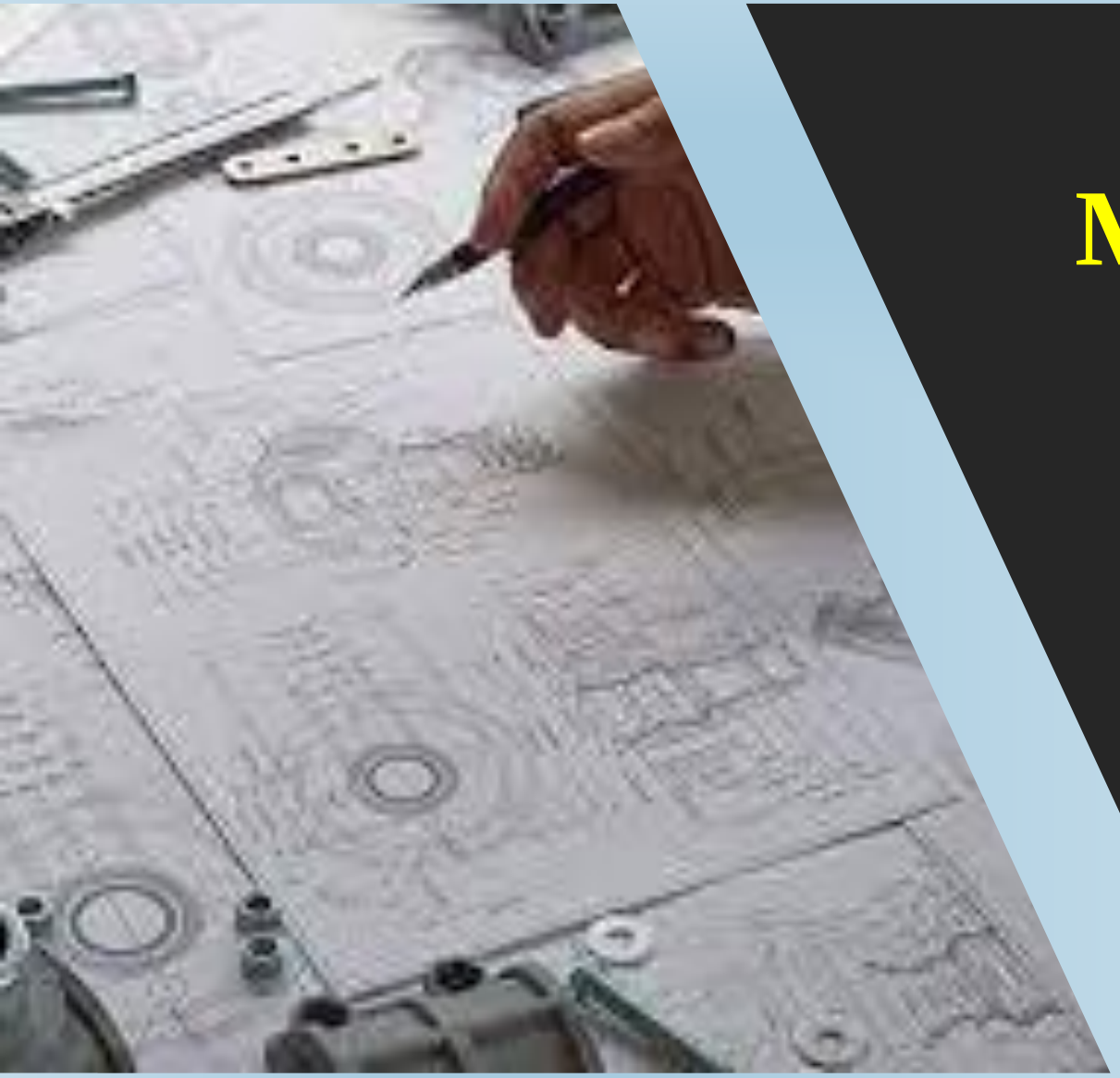

MECHANICS

Lecture No.4

Principles Dynamic

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Principles Dynamic

Dynamic is the branch of mechanics which deals with the study of bodies in motion state.

Two branches of Dynamic:

Kinematics - is used to define motion of a practical or body without consideration of the forces causing the motion. It essentially deals with relation between displacement (S), Velocity (V), acceleration (a).

Kinetics - is used to relate the force acting on a body to its mass and acceleration, when acceleration of a body caused by the forces acting on it has been determined.

Differential Kinematic Equations of Motion

$$a = \frac{dv}{dt}$$ acceleration = rate of change of velocity

$$v = \frac{ds}{dt}$$ Velocity = time of change of displacement.

Equations of Motion

$$V_2 = V_1 + at$$

$$V_2^2 = V_1^2 + 2aS$$

$$S = V_1 t + \frac{1}{2} a t^2$$

Example (1): The position S, of a particle moving along a horizontal straight line is given by the equation $S = 6t^2 - 4$, Where S in feet and t is the time in second, Determine the velocity and acceleration of the particle when t is 4 sec

$$V = \frac{ds}{dt} = 12t$$

$$V = 12 * 4 = 48 \frac{ft}{s}$$

$$a = \frac{dv}{dt} = 12$$

At 4 sec acceleration $= 12\ fps^2$

Example (2): On a certain stretch of track, train run at 60 kph. How far back of a stopped train should a warning torpedo be placed to single an on coming train? Assume that the brakes are applied at once and retard the train at the uniform rate of 2 fps.

60 kps = 16.667 mps = 16.667 * 3.28 = 54.68 fps

$$V_2^2 = V_1^2 + 2aS$$

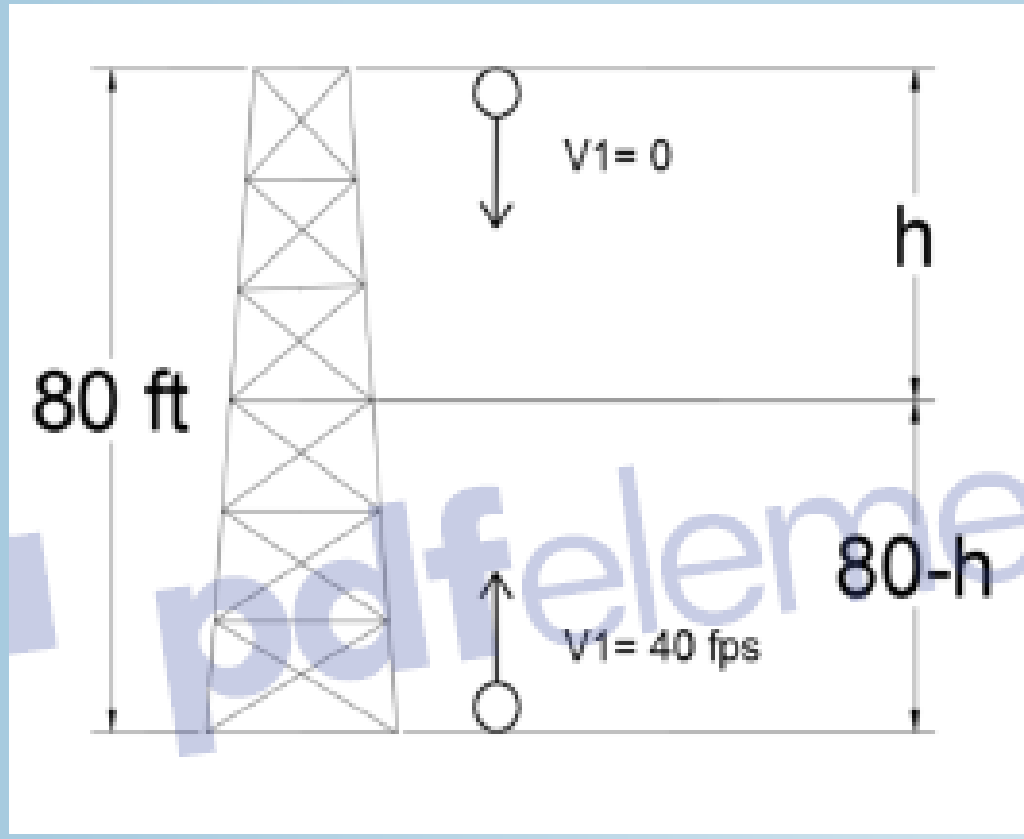
$$0 = 54.68^2 - 2 * 2 * S$$

$$S = 747.48\ ft$$

Example (4): A ball is dropped from the top of a tower 80 ft high at the same instant that a second ball is thrown upward from the ground with an initial velocity of 40 fps.

a . When do they pass each other?

b . Where do they pass each other?



$$S = V_1 t + \frac{1}{2} a t^2$$

$$h = \frac{1}{2} g t^2$$

$$80 - h = 40t - \frac{1}{2} g t^2$$

$$80 - \frac{1}{2} g t^2 = 40t - \frac{1}{2} g t^2$$

$$t = 2\ sec$$

$$h = \frac{1}{2} g t^2$$

$$h = \frac{1}{2} 32.2 * 2^2$$

$$h = \frac{1}{2} 32.2 * 2^2$$

$h = 64.4\ ft$ from the top of tower.

Example (8): Determine the moment of inertia of the shaded area in the fig. (7) With y-axis.

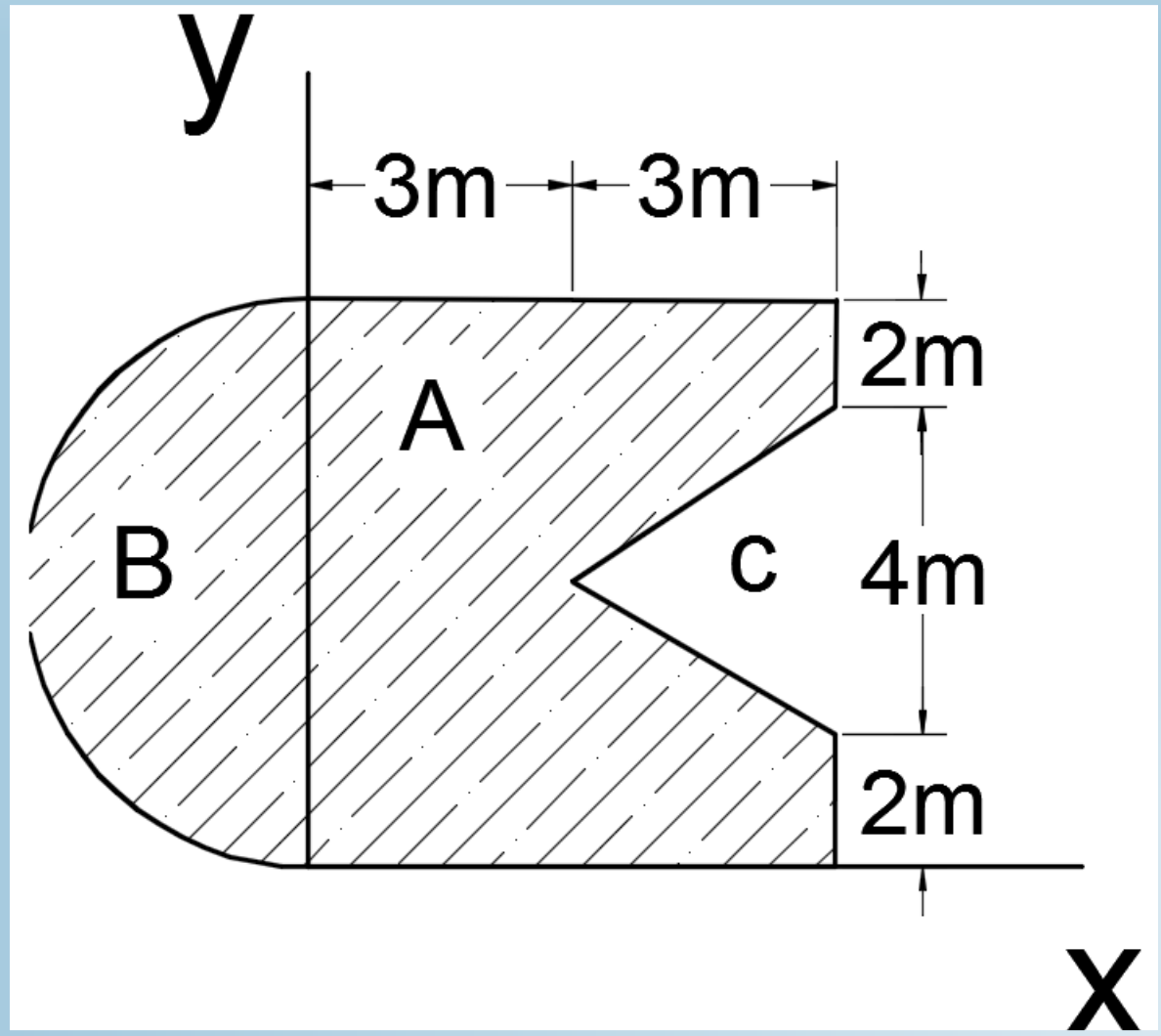
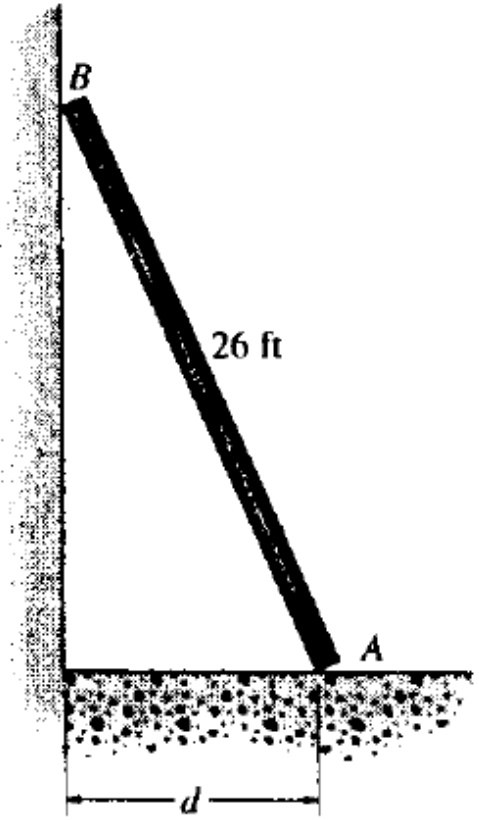


Fig. (7)

$Iy_0(m^4)$	A (m^2)	$x^2(m^2)$	A. x^2	Iy (m^4)
$A = \frac{hb^3}{12} = 144$	48	9	432	576
$C = \frac{hb^3}{36} = -3$	-6	25	-150	-153
$B = 0.1098R^4 = 28$	25.12	2.88	72.5	100.5
Total				523.5

The uniform pole has a weight of 30 lb and a length of 26 ft. Determine the maximum distance d it can be placed from the smooth wall and not slip. The coefficient of static friction between the floor and the pole is $\mu_s = 0.3$.



$+\uparrow \Sigma F_y = 0;$ $\quad N_A - 30 = 0$

$$N_A = 30 \text{ lb}$$

$$F_A = (F_A)_{max} = 0.3\,(30) = 9 \text{ lb}$$

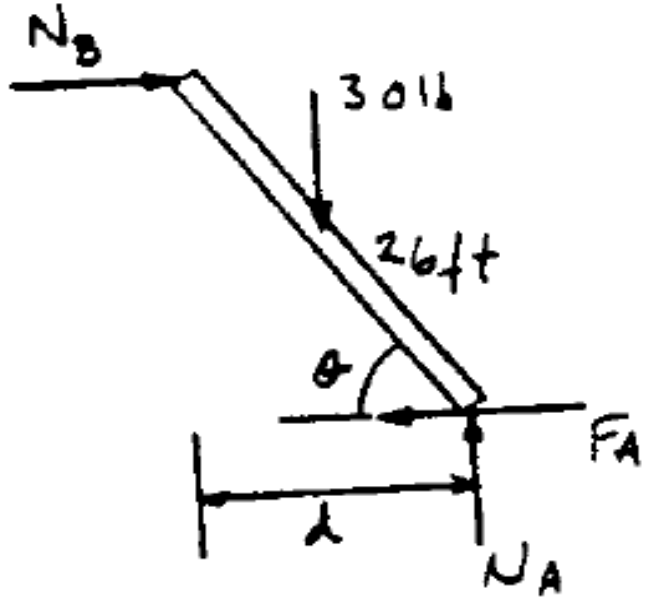
$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $\quad N_B - 9 = 0$

$$N_B = 9 \text{ lb}$$

$\circlearrowleft +\Sigma M_A = 0;$ $\quad 30\,(13 \cos \theta) - 9\,(26 \sin \theta) = 0$

$$\theta = 59.04°$$

$$d = 26 \cos 59.04° = 13.4 \text{ ft} \quad \text{Ans}$$



Thank you for listening