EE-117 Applied Physics

Midterm-I (Solution)

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Q 1 Solution

$$\bar{A} = (0\,\hat{i} + 100\,\hat{j})\ Km$$

$$A_x = 0 \quad ; \quad A_y = 100 \qquad (2.5)$$

and

$$\bar{B} = B_x\,\hat{i} + B_y\,\hat{j}$$

Now,

$$B_x = B\cos\theta = 200\cos(-30)$$

$$B_x = 173.20\ Km \qquad (2.5)$$

and

$$B_y = B\sin\theta = 200\sin(-30)$$

$$B_y = -100\ km$$

And

$$\bar{r} = \bar{B} - \bar{A} = (B_x - A_x)\,\hat{i} + (B_y - A_y)\,\hat{j} \qquad (2.5)$$

$$\bar{r} = (173 - 0)\,\hat{i} + (-100 - 100)\,\hat{j}$$

$$\boxed{\bar{r} = (173\,\hat{i} - 200\,\hat{j})\ Km} \quad (\text{Answer}) \qquad (2.5)$$

And

$$r = \sqrt{(173)^2 + (-200)^2}$$

$$\boxed{r = 264\ Km}$$

Q 2 (a) Solution

$$V_{ix} = V_{fx} = 40 \text{ m/s}$$

$$y_i = 0 \,, \quad y_f = 100 \text{ m.}$$

$$g = 9.8 \text{ m/s}^2 \,, \quad V_{iy} = 0$$

Now,

$$y_f - y_i = V_{oy} t + \frac{1}{2} g t^2 \qquad \because a = +g \text{ vertically downward}$$

$$100 - 0 = 0 + \frac{1}{2} g t^2$$

$$t = \sqrt{\frac{2(100)}{g}}$$

$$t = 4.52 \text{ s} \qquad (3)$$

Now,

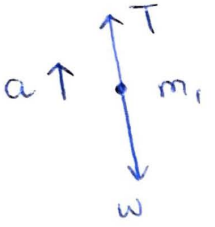
$$x_f = R = V_{fx} t$$

$$x_f = 40 (4.52)$$

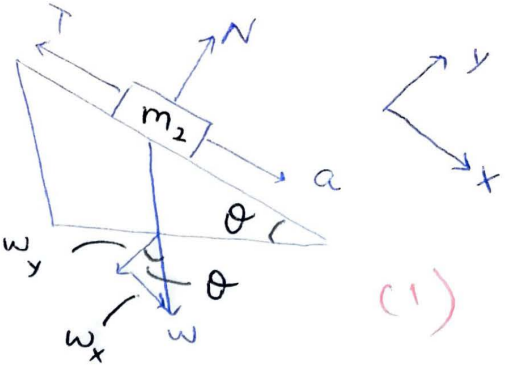
$$\boxed{x_f = 181 \text{ m}} \quad \text{(Answer)} \qquad (4)$$

Q 3 Solution

ii)



(1)



(1)

i) For m_1

$$\Sigma F_x = 0 \quad (1.5)$$

And

$$\Sigma F_y = T - m_1 g$$

$$m_1 \vec{a}_y = T - m_1 g$$

$$m_1 a = T - m_1 g \quad \text{—} \ (1) \quad (3)$$

$$\hookrightarrow T = m_1 (a + g) \quad \text{—} \ (4) \quad (1.5)$$

For m_2

$$\Sigma F_x = -T + m_2 g \sin\theta$$

$$m_2 a = -T + m_2 g \sin\theta \quad \text{—} \ (2) \quad (1.5)$$

and

$$\Sigma F_y = N - w_y$$

$$0 = N - m_2 g \cos\theta \quad \text{—} \ (3) \quad (1.5)$$

Put Eq. (4) in Eq. (2)

$$m_2 a = -m_1 (a+g) + m_2 g \sin\theta$$

$$a(m_1 + m_2) = (-m_1 + m_2 \sin\theta) g$$

(2)

$$\boxed{a = \frac{m_2 \sin\theta - m_1}{m_1 + m_2} g} \quad \text{(Answer)}$$