SOLUTION

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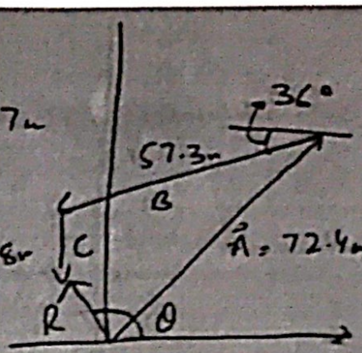
a) $\vec{R} = \vec{A} + \vec{B} + \vec{C}$




$A_x = A\cos\theta_A = 72.4\cos 58° = 38.37m$

$A_y = A\sin\theta_A = 72.4\cos 58° = 61.40$

$\theta_B = 216°$ $B_x = -46.36m$ $B_y = -33.68$ 17.8m

~~θ=450~~

$\theta = 270°$ $C_x = 0$ $C_y = -17.8m$

$R_x = -7.99m$ $R_y = 9.92m$

$R = 12.7$

$\theta = \tan^{-1}\left(\frac{9.92}{-7.99}\right) = -51°$

$\theta = 180° - 51° = 129°$

**Q1(ii).**Use concept of operators to find the directional derivative of $\phi$ (x,y,z) = $x^2yz + 4xz^2$ at (1,-2,1) in the direction of $2\hat{\imath} - \hat{\jmath} - 2\hat{k}$.

$\nabla\phi = (2xyz + 4z^2)\hat{i} + (x^2z)\hat{j} + (x^2y + 8xz)\hat{k}$

$(1, -2, 1)$

$(-4+4)i + j + (-2+8)k$

$\nabla\phi = j + 6\hat{k}$



$\hat{a} = \frac{2i - j - 2k}{\sqrt{4+1+4}} \Rightarrow \frac{1}{3}(2\hat{i} - \hat{j} - 2\hat{k}) = \hat{a}$

$$\bar{\nabla}\phi \cdot \hat{a} = (\hat{j} + 6\hat{k}) \cdot \frac{1}{3}(2\hat{i} - \hat{j} - 2\hat{k})$$

$$\boxed{\nabla\phi \Rightarrow -13/3}$$

Q.2 (i)

(a) $\Delta y = -144\ ft \qquad V_i = 0 \qquad a = g = 32 ft/s^2$.

$$\Delta y = V_i t - \frac{1}{2} g t^2$$

$$144 ft = 0 - 16 t^2$$

$$\boxed{t = 3s}$$

$$\boxed{V_f = V_i - g t = 0 - (32)(3) = -96 ft/s}$$

(b) $V_i = -96 \qquad V_f = 0 \qquad \Delta y = 1.50 ft$.

$$a = \frac{V_f^2 - V_i^2}{2 \Delta y} = 3.07 \times 10^3 ft/s^2$$

(c)
$$\bar{V} = \frac{\Delta y}{\Delta t} = \frac{V_i + V_f}{2} = \frac{\Delta y}{\Delta t}$$

$$\Delta t = \frac{\Delta y}{\frac{V_f + V_i}{2}} = \qquad \Delta t = 3.13 \times 10^{-2} s$$

Q.2 (ii)

a) $$y = y_0 + x\tan\theta_0 - \frac{gx^2}{2v_0^2\cos^2\theta}$$

$$= 3 + 23\tan 53^\circ - \frac{(9.8)(23)^2}{2(26.5)^2(\cos 53^\circ)^2}$$

$$= 23.3$$

$$\boxed{\Delta y = 23.3 - 18 = 5.3\,m}$$

b) $$y = y_0 + x\tan\theta_0 - \frac{gx^2}{2v_0^2\cos^2\theta_0}$$

$$= 3 + 34.5\tan 53^\circ - \frac{9.8\,(34.5)^2}{2(26.52)^2(\cos 53)^2}$$

$$= 25.9$$

$$\boxed{\Delta y = 25.9 - 18 = 7.9\,m}$$

c) $$\boxed{R = x = \frac{v_0^2\sin 2\theta}{g} = 69\,m}$$

$Q_2$ (iii)

$$y = \frac{1}{2} a_y t^2 \quad y_A = y_B \quad 30 = \frac{1}{2}(0.4 \cos\theta) t^2 \quad \text{--- } 1$$

$$x_A = x_B$$

$$3t = \frac{1}{2}[(0.4)\sin\theta]\, t^2 \quad \text{--- } 2$$

Using ~~F~~ eq 2.

$$t = \frac{2V}{a_x}$$

Substituting in 1.

$$30 = \frac{1}{2}(0.4 \cos\theta)\left(\frac{2(3)}{0.4 \sin\theta}\right)^2$$

$$\sin^2\theta = 1 - \cos^2\theta$$

$$30 = \frac{90}{0.20} \quad \frac{\cos\theta}{1-\cos^2\theta}$$

$$\boxed{\cos\theta = \frac{1}{2}}$$

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