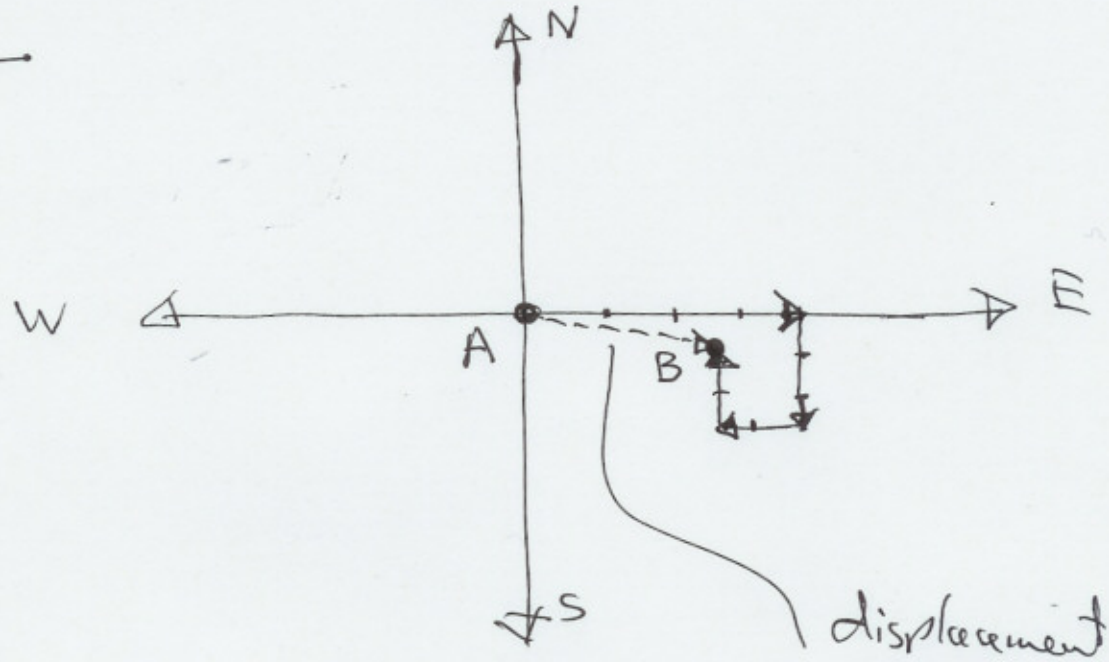
MCQ - ch3

Solutions

Question 1

(A)



a) Point B is 5 cm East of Point A and 1 cm South of Point A

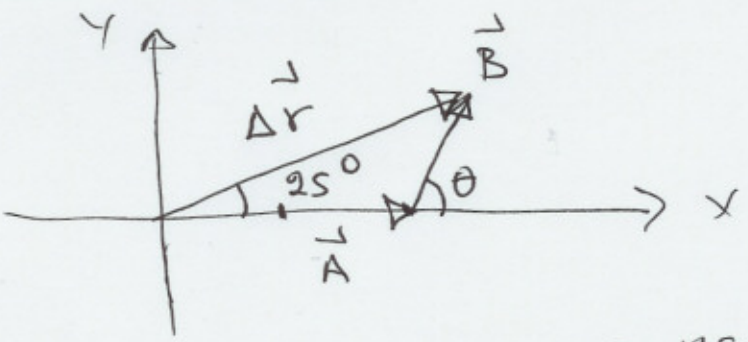
b) $|\Delta \vec{r}| = \sqrt{1^2 + 5^2} = 5.10$ cm

angle with the x-axis $\theta = \tan^{-1} \frac{1}{5}$

$\boxed{\theta = 11.3^\circ}$

Question 2

(D)



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Question 2

$$\Delta\vec{r} = \vec{A} + \vec{B}$$

$$\Rightarrow \begin{cases} \Delta r_x = A_x + B_x \\ \Delta r_y = A_y + B_y \end{cases} \Rightarrow \begin{cases} 77.0 = 50 + B\cos\theta \\ 35.9 = B\sin\theta \end{cases} \Rightarrow \begin{cases} 27.0 = B\cos\theta \\ 35.9 = B\sin\theta \end{cases}$$

Divide (2) by (1) $\Rightarrow \frac{35.9}{27.0} = \frac{B\sin\theta}{B\cos\theta} \Rightarrow \tan\theta = 1.$

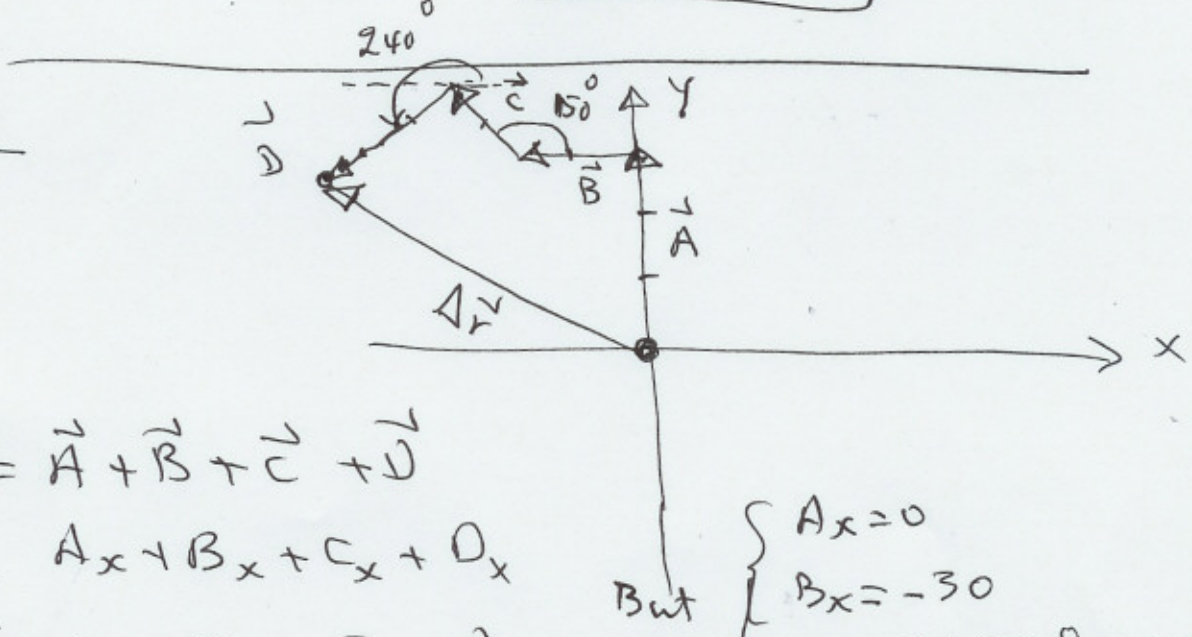
$$\boxed{\theta = 53^\circ}$$

Now using (1) or (2) $\Rightarrow 27.0 = B\cos 53^\circ$

$$\boxed{B = 45\ cm}$$

Question 3

(D)



$$\Delta\vec{r} = \vec{A} + \vec{B} + \vec{C} + \vec{D}$$

$$\begin{cases} \Delta r_x = A_x + B_x + C_x + D_x \\ \Delta r_y = A_y + B_y + C_y + D_y \end{cases}$$

But

$$\begin{cases} A_x = 0 \\ B_x = -30 \\ C_x = 40\cos 150^\circ = -34.6 \\ D_x = 50\cos 240^\circ = -25 \end{cases}$$

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3 - Continues

$$\begin{cases} A_y = 60 \\ B_y = 0 \\ C_y = 50 \sin 50^0 = 20 \\ D_y = 50 \sin 24^0 = -43.3 \end{cases}$$

$$\Rightarrow \begin{cases} \Delta r_x = 0 - 30 - 34.6 - 25 = -89.6 \text{ mm} \\ \Delta r_y = 60 + 0 + 20 - 43.3 = 36.7 \text{ mm} \end{cases}$$

$$\Delta r = \sqrt{\Delta r_x^2 + \Delta r_y^2} = 96.8 \simeq 97 \text{ mm}$$

$$\theta = \tan^{-1} \frac{36.7}{-89.6} = 158^0$$

Question 4

$$\vec{F}_R = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$$

(D)

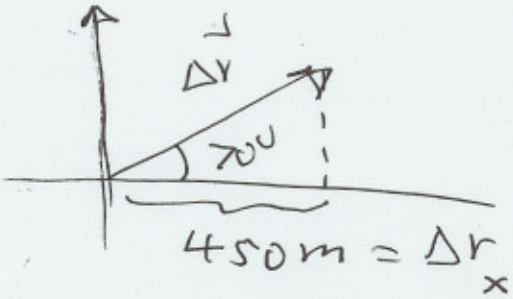
$$\Rightarrow \begin{cases} F_{R_x} = F_{1x} + F_{2x} + F_{3x} = \cdots = 136.6 \text{ N} \\ F_{R_y} = F_{1y} + F_{2y} + F_{3y} = \cdots = 63.4 \text{ N} \end{cases}$$

$$F_R = \sqrt{F_{R_x}^2 + F_{R_y}^2} = 150.6 \text{ N} \simeq \boxed{0.15 \text{ kN}}$$

$$\theta = \tan^{-1} \frac{F_{R_y}}{F_{R_x}} \Rightarrow \boxed{\theta \simeq 25^0}$$

Question 5

(A)



a) $\Delta r_x = \Delta r \cos 70^\circ$

$\downarrow$

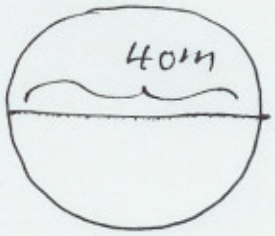
$450 = \Delta r \cos 70^\circ \rightarrow \Delta r = \frac{450}{\cos 70^\circ} = 1316\ m$

$\simeq 1.3\ km$

b) $\Delta r_y = \Delta r \sin 70^\circ = 1236\ m \simeq 1.2\ km$

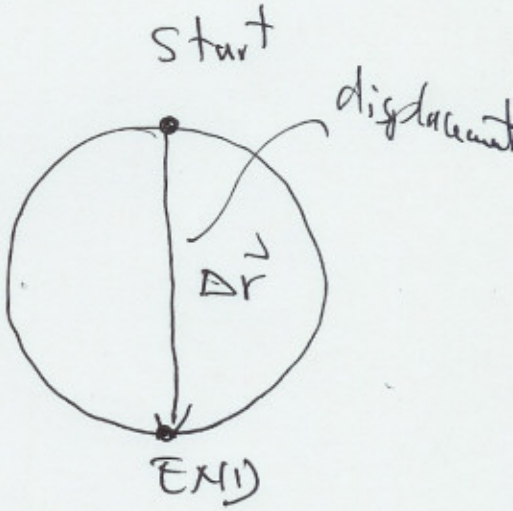
Question 6

a) $V_{ave} = \frac{\Delta r = distance}{\Delta t} = \frac{(126m)(1.5)}{50\ s}$



$= 3.8\ m/s$

b) $\vec{V}_{ave} = \frac{|\Delta \vec{r}|}{\Delta t} = \frac{40}{50} = 0.8\ m/s$



(A)

Question 7

$V_{ave} = 200$ km/h

(B)

a) $\Delta r = V_{ave} \times \Delta t$

$= (200 \text{ km/h})\left(\frac{45}{60} \text{ h}\right) = 150$ km

b) At the end of the 3rd lap, the car is at the starting point $\Rightarrow \Delta \vec{r} =$

$\Rightarrow \vec{V}_{ave} = 0$