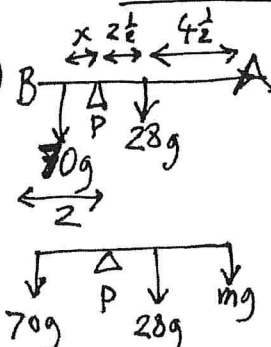


Mechanics 4 - Forces 1 SOLUTIONS

SECT 1


1) $\uparrow = \downarrow P = Q + 60N$ ($\hookrightarrow, \leftarrow$) $1 \times P = 2 \times 30 + 4 \times 20 + 5 \times 10$
 $\Rightarrow \underline{Q = 130N}$ $P = 60 + 80 + 50 = \underline{190N}$

2)  a) ($\hookrightarrow, \leftarrow$) $x \times 70g = 2\frac{1}{2} \times 28g \Rightarrow x = \frac{70}{70} = \underline{1m}$

b) ($\hookrightarrow, \leftarrow$) $2 \times 70g = 2\frac{1}{2} \times 28g + 7 \times mg$
 $140 - 70 = 7m \quad \underline{m = 10kg}$

3) a) $Q_1 = 121, Q_2 = 187, Q_3 = 260, IQR = 260 - 121 = 139$

b) $Q_1 - 1.5IQR = 121 - 1.5 \times 139 = -87.5$ No OUTLIERS
 $Q_3 + 1.5IQR = 260 + 1.5 \times 139 = 468.5$ No OUTLIERS

4)  $\textcircled{1} 6g - T = 6a$ $\textcircled{2} T - 4g = 4a$ ADD $\Rightarrow 2g = 10a \Rightarrow \underline{a = \frac{1}{5}g}$
 $\textcircled{2} \Rightarrow \underline{T = 4\frac{4}{5}g}$

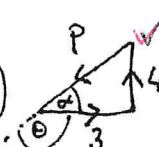
SECTION 2

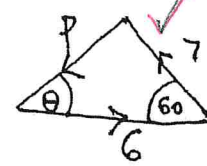
1) a) $x = 8 \cos 30^\circ = \underline{6.928N}$ b) $x = 0$ c) $x = -10 \cos 40^\circ = \underline{-7.66N}$
 $y = 8 \sin 30^\circ = \underline{4N}$ $y = 10N$ $y = 10 \sin 40^\circ = \underline{6.428N}$


2) a) $16 \cos 60^\circ \underline{i} + 16 \sin 60^\circ \underline{j} = \underline{8i + 13.86j}$

b) $\sqrt{2} \cos 45^\circ \underline{i} - \sqrt{2} \sin 45^\circ \underline{j} = \underline{i - j}$

c) $-3\sqrt{2} \cos 30^\circ \underline{i} - 3\sqrt{2} \sin 30^\circ \underline{j} = \underline{-\frac{3}{2}\sqrt{6}i - \frac{3\sqrt{2}}{2}j}$

3) a)  $P^2 = 3^2 + 4^2 \Rightarrow \underline{P = 5}$ $\alpha = \tan^{-1}\left(\frac{4}{3}\right) = 53.13^\circ$
 $\Rightarrow \theta = 180^\circ - 53.13^\circ = \underline{126.9^\circ}$

b)  $P^2 = 6^2 + 7^2 - 2 \times 6 \times 7 \cos 60^\circ = 43 \quad \underline{P = 6.56}$
 $\frac{\sin \theta}{7} = \frac{\sin 60^\circ}{P} \Rightarrow \sin \theta = \frac{7 \sin 60^\circ}{P} = 0.924\dots$
 $\Rightarrow \underline{\theta = 67.6^\circ}$

c)  $P^2 = 3^2 + 10^2 - 2 \times 3 \times 10 \cos 60^\circ = 79 \Rightarrow \underline{P = 8.89}$
 $\frac{\sin \alpha}{10} = \frac{\sin 60^\circ}{P} \Rightarrow \alpha = 77^\circ = \theta$ ($\alpha = 103^\circ$)
 FROM DIAGRAM

4) a)

x	y
$-4\sqrt{3}$	
$P \cos 30^\circ$	$P \sin 30^\circ$
	Q
	-6

$P \cos 30^\circ = 4\sqrt{3} \Rightarrow P = 8 \text{ N}$
 $Q + P \sin 30^\circ = 6$
 $Q = 6 - 8 \sin 30^\circ = 2 \text{ N}$

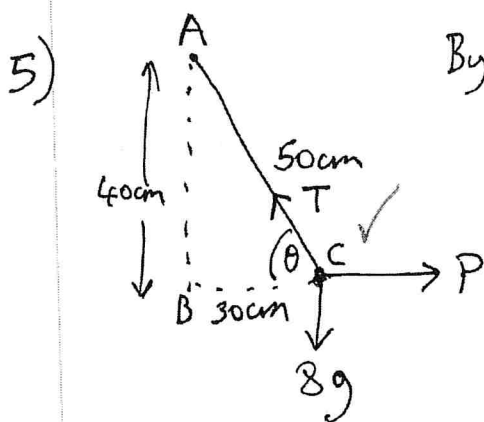
b)

x	y
$-Q \cos 60^\circ$	$Q \sin 60^\circ$
$P \cos 30^\circ$	$P \sin 30^\circ$
$-10 \cos 60^\circ$	$-10 \sin 60^\circ$
	-8

$P \cos 30^\circ = Q \cos 60^\circ + 10 \cos 60^\circ$
 $\frac{\sqrt{3}}{2} P = \frac{1}{2} Q + 5$ (1)
 $P \sin 30^\circ + Q \sin 60^\circ = 8 + 10 \sin 60^\circ$
 $\frac{1}{2} P + \frac{\sqrt{3}}{2} Q = 8 + 5\sqrt{3}$ (2)

$\times \sqrt{3}$
 $\frac{\sqrt{3}}{2} P + \frac{3}{2} Q = 8\sqrt{3} + 15$ (2)
 $\frac{3}{2} Q = 8\sqrt{3} + 15 - \frac{1}{2} Q - 5$
 $2Q = 8\sqrt{3} + 10 \Rightarrow Q = 11.93$

(1) $\Rightarrow P = \frac{2}{\sqrt{3}} (\frac{1}{2} \times 11.93... + 5)$
 $P = 12.66$



By Pythagoras $AB = 40 \text{ cm}$

HORIZONTAL

$P = T \cos \theta = T \times \frac{3}{5}$ (1)

VERTICAL

$8g = T \sin \theta = T \times \frac{4}{5}$ (2)

$\Rightarrow T = \frac{5}{4} \times 8g = 10g$

(1) $\Rightarrow P = 10g \times \frac{3}{5} = 6g$