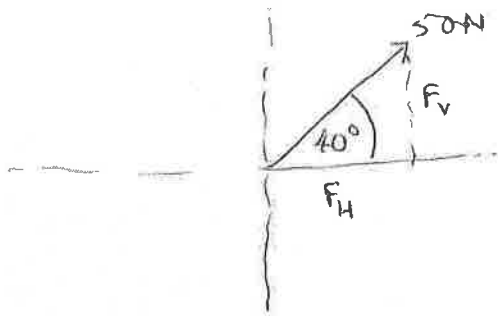


Solutions Example Sheet 1.

①

1.



Horizontal component

$$\frac{\text{adj}}{\text{hyp}} = \frac{F_H}{50} = \cos 40^\circ$$

$$F_H = 50 \cos 40^\circ$$

$$F_H = \quad \quad \quad \text{N}$$

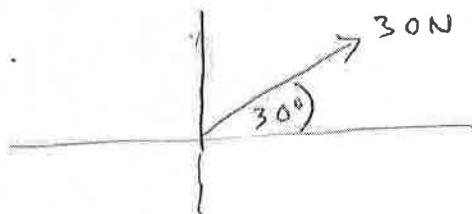
Vertical component

$$\frac{\text{opp}}{\text{hyp}} = \frac{F_V}{50} = \sin 40^\circ$$

$$F_V = 50 \sin 40^\circ \quad \left[\text{which is the same as } 50 \cos 50^\circ \right]$$

$$F_V = \quad \quad \quad \text{N}$$

2. (a).



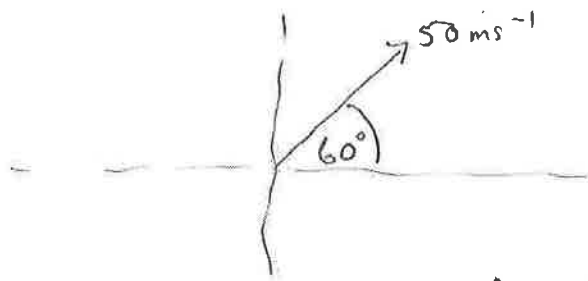
Horizontal component $F_H = 30 \cos 30^\circ = \quad \quad \quad \text{N}$

Vertical component $F_V = 30 \sin 30^\circ \quad \left[\text{or } 30 \cos 60^\circ \right]$

$$F_V = \quad \quad \quad \text{N}$$

2 (b)

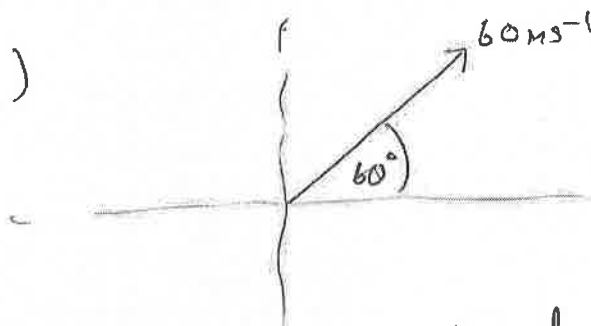
(2)



Horizontal Component of velocity $V_H = 50 \cos 60^\circ$
 $V_H = \text{ms}^{-1}$

Vertical Component of velocity $V_V = 50 \sin 60^\circ$ or $50 \cos 30^\circ$
 $V_V = \text{ms}^{-1}$

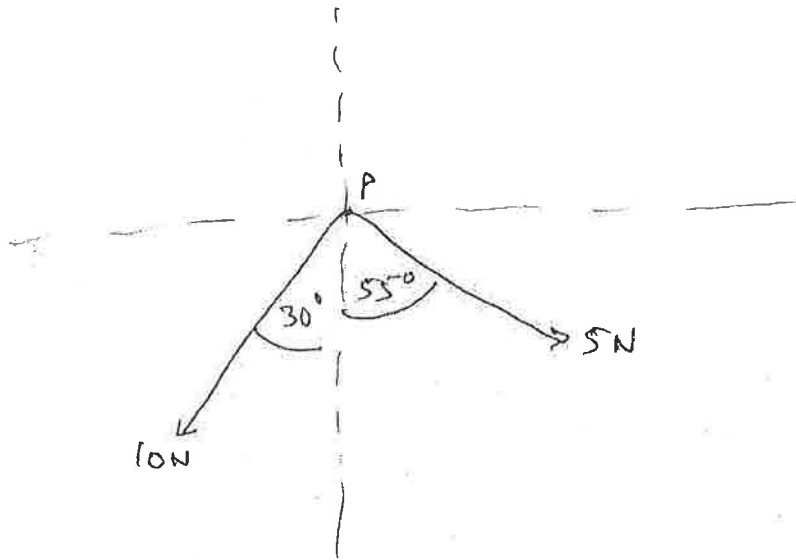
(c)



Horizontal Component of velocity $V_H = 60 \cos 60^\circ$
 $V_H = \text{ms}^{-1}$

Vertical Component of velocity $V_V = 60 \sin 60^\circ$ (or $60 \cos 30^\circ$)
 $V_V = \text{ms}^{-1}$

3.



Procedure

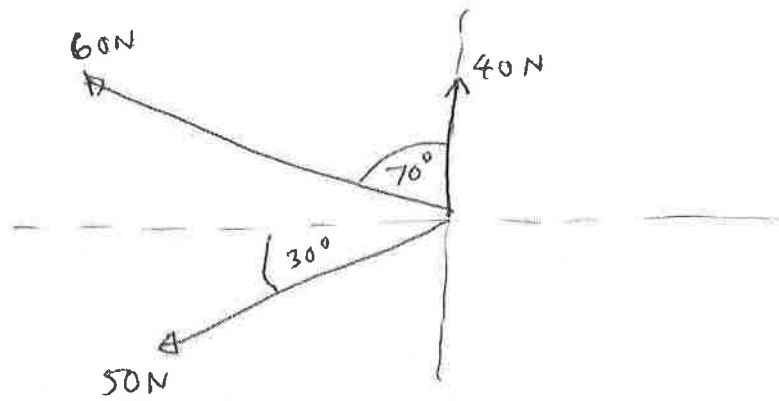
First we will find Horizontal & Vertical components of resultant force. Next we will take the complement of these components to find the force required to keep point P in static equilibrium:

Horizontal component $F_H = 5 \cos 35^\circ - 10 \cos 60^\circ$
 $F_H = 4.1 - 5 = \underline{\underline{-0.9 \text{ N}}}$

Vertical component $F_V = -5 \cos 55^\circ - 10 \cos 30^\circ$
 $F_V = -2.9 - 8.7 = \underline{\underline{-11.6 \text{ N}}}$

4.

(4)



Horizontal component of forces $F_H = -60 \cos 20^\circ - 50 \cos 30^\circ$

$$F_H = -56.4 - 43.3$$

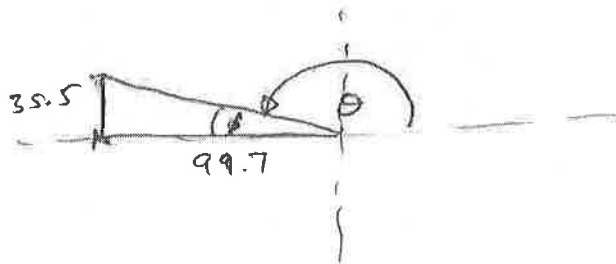
$$\underline{F_H = -99.7 \text{ N}} \quad \text{to 1 d.p.}$$

Vertical Component of forces $F_V = 40 + 60 \cos 70^\circ - 50 \cos 60^\circ$

$$F_V = 40 + 20.5 - 25$$

$$\underline{F_V = 35.5 \text{ N}} \quad \text{to 1 d.p.}$$

Draw diagram:



Resultant magnitude

$$F_R = \sqrt{F_V^2 + F_H^2}$$

$$F_R = \sqrt{(-99.7)^2 + (35.5)^2}$$

$$\underline{F_R = 106.5} \quad \text{to 1 d.p.}$$

Angle required is θ in diagram above. First find angle ϕ in triangle then subtract it from 180° to find θ .

$$\phi = \tan^{-1} \left(\frac{35.5}{99.7} \right) = 19.6^\circ \quad \text{to 1 d.p.}$$

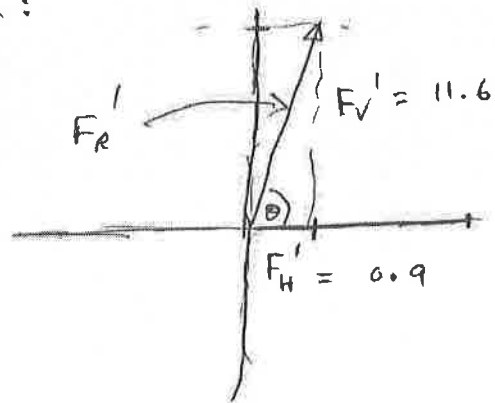
$$\therefore \underline{\theta = 180 - 19.6 = 160.4^\circ}$$

∴ The force required to keep P in static equilibrium ⁽⁵⁾
 will be the complement of F_H and F_V i.e.
 change the signs of F_H and F_V to get
 F'_H and F'_V which we will call the
 components of the required force

$$\therefore F'_H = 0.9 \text{ N}$$

$$F'_V = 11.6 \text{ N}$$

Now we find the resultant of these components, F'_R
 It helps to draw diagram:



The magnitude is from
 Pythagoras

$$F'_R = \sqrt{(F'_H)^2 + (F'_V)^2}$$

$$F'_R = \sqrt{(0.9)^2 + (11.6)^2} = \underline{11.6 \text{ N}} \quad \text{to 1 d.p.}$$

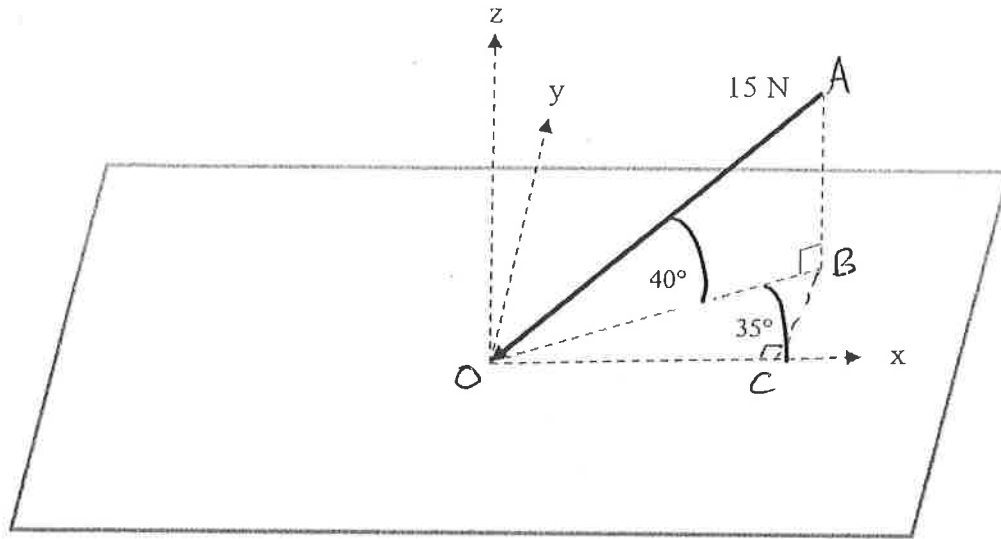
and this resultant makes an angle θ as shown above

$$\text{where} \quad \theta = \tan^{-1} \left(\frac{F'_V}{F'_H} \right) = \tan^{-1} \left(\frac{11.6}{0.9} \right)$$

$$\underline{\theta = 85.6^\circ} \quad \text{to 1 D.P.}$$

(6)

5. Determine the components of the 15N force in the x,y plane and in the z direction



Consider $\triangle OAB$:

AB is the z component, F_z , of the 15 N force
 AB is the opposite side to the 40° angle, $\therefore$ use sin

$$F_z = 15 \sin 40^\circ$$

$$F_z = 9.64 \text{ N to z D.P.}$$

To find the x and y components, F_x , F_y of the 15 N force we look on the x y plane and construct a right angled $\triangle OBC$ as shown

n . n

We must calculate OB, the hypotenuse, first
 then from that we can determine F_x (which is OC)
 and F_y (which is BC)

First: Determine OB

(7)

$$\text{In } \triangle OAB : \quad OB = 15 \cos 40^\circ$$
$$OB = 11.491 \quad \text{N}$$

Now that we have determined OB we can consider $\triangle OBC$:

In $\triangle OBC$

$$OC = F_x = 11.491 \cos 35^\circ$$
$$\underline{F_x = 9.41 \quad \text{to 2 D.P.}}$$

and $BC = F_y = 11.491 \sin 35^\circ$

$$\underline{F_y = 6.59 \quad \text{to 2 D.P.}}$$

