Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

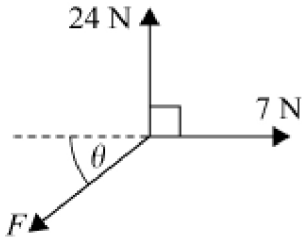
4 Forces

Exercise E, Question 2

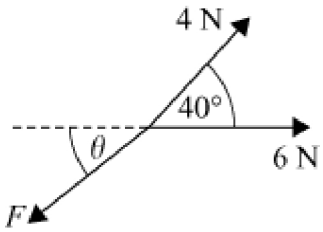
Question:

Each of the following sets of forces is in equilibrium. Find F and the angle θ.

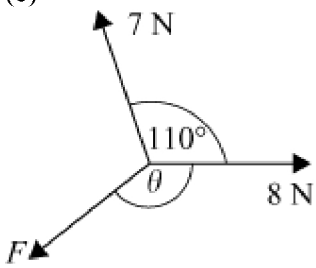
(a)



(b)



(c)



Solution:

$$\mathbf{F} + 7\mathbf{i} + 24\mathbf{j} = 0$$

$$\therefore \mathbf{F} = -7\mathbf{i} - 24\mathbf{j}$$

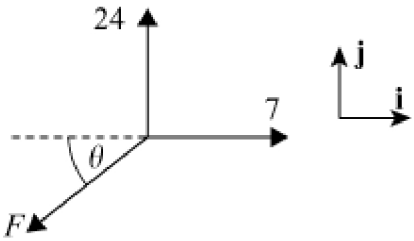
$$\therefore |\mathbf{F}| = \sqrt{7^2 + 24^2}$$

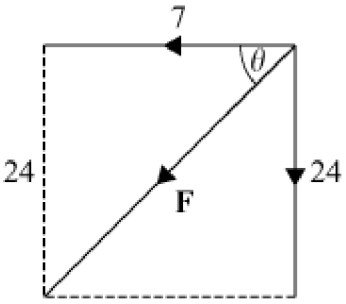
(a) $|\mathbf{F}| = 25$ N

and $\tan\theta = \frac{24}{7}$

i.e. $\theta = 73.739...°$

i.e. $\theta = 73.7°$ (3 s.f.)





(b) $F + 6i + (4 \cos 40° i + 4 \sin 40° j) = 0$

$\therefore F = (-6 - 4 \cos 40°) i - 4 \sin 40° j$

$F = -9.0641i - 2.5711j$

$|F| = \sqrt{9.0641^2 + 2.5711^2}$

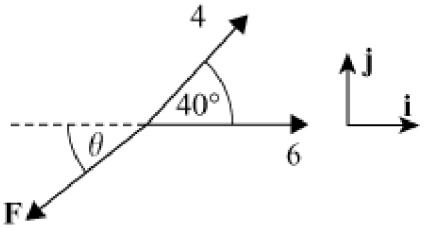
$|F| = 9.4217...$

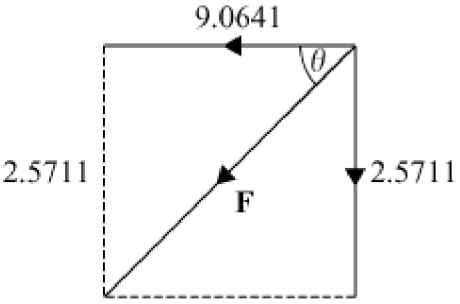
$|F| = 9.42$ N (3 s.f.)

$\tan \theta = \frac{2.5711}{9.0641}$

$\theta = 15.836...°$

i.e. $\theta = 15.8°$ (3 s.f.)





(c) $F + 8i + (-7 \cos 70° i + 7 \sin 70° j) = 0$

$\therefore F = (-8 + 7\cos 70°)\,i - 7\sin 70°\,j$

$F = -5.6058i - 6.5778j$

$|F| = \sqrt{5.6058^2 + 6.5778^2}$

$|F| = 8.6424$

$|F| = 8.64$ N (3 s.f.)

$\tan\alpha = \frac{6.5778}{5.6058}$

$\alpha = 49.561...°$

$\therefore \theta = 180° - \alpha$

$= 180° - 49.561...°$

$= 130.43...°$

$= 130°$ (3 s.f.)