

Past-paper walk-through

Forces and equilibrium ■ 4.1

eXercise

Questions in this set

- 9709/41 N25 Q3 ■ 6 marks
- 9709/42 N25 Q7 ■ 11 marks
- 9709/41 J25 Q2 ■ 4 marks

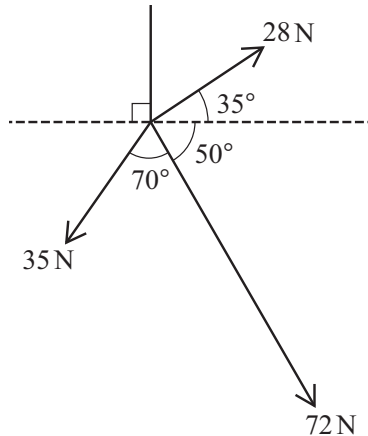
Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 3

9709/41 N25 ■ Q3 ■ 6 marks

Coplanar forces of magnitudes 45 N, 28 N, 72 N and 35 N act at a point in the directions shown in the diagram. Find, in either order, the magnitude and direction of the resultant force. **[6]**



Solution 3

Mark scheme

- Resolving (right/up positive): $\sum F_x \approx 57.3 \text{ N}$, $\sum F_y \approx -27.0 \text{ N}$. Resultant $\approx 63.3 \text{ N}$ at $\approx 25.2^\circ$ below the horizontal.

Question 7

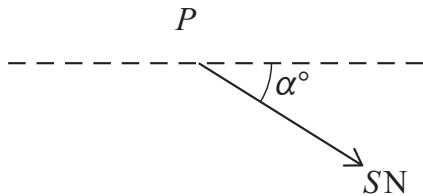
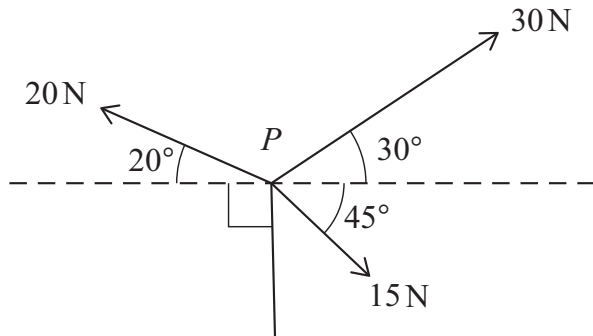
9709/42 N25 ■ Q7 ■ 11 marks

Four coplanar forces of magnitudes 20 N, 30 N, 15 N and 25 N act at a point P in the directions shown in Fig. 7.1. The forces act in a vertical plane. The resultant of these forces has magnitude S N and acts at an angle α below the horizontal as shown in Fig. 7.2.

(a) Find the value of S and the value of α . **[6]**

(b) A small ring of mass 0.6 kg is threaded on a rough straight horizontal wire. The four forces shown in Fig. 7.1 act on the ring and are in the same vertical plane as the wire. The ring starts from rest and takes 3 s to travel a distance of 2 m along the wire. Find the coefficient of friction between the ring and the wire. **[5]**

Question 7



Solution 7

(a)

Mark scheme

- Resolving (right/up positive):

$$\sum F_x = -20 \cos 20 + 30 \cos 30 + 15 \cos 45 \approx 17.8 \text{ N};$$

$$\sum F_y = 20 \sin 20 + 30 \sin 30 - 15 \sin 45 - 25 \approx -13.8 \text{ N}.$$

$$S = \sqrt{17.8^2 + 13.8^2} \approx 22.5 \text{ N}; \alpha = \tan^{-1} \frac{13.8}{17.8} \approx 37.7 \text{ below the horizontal}.$$

Solution 7

(b)

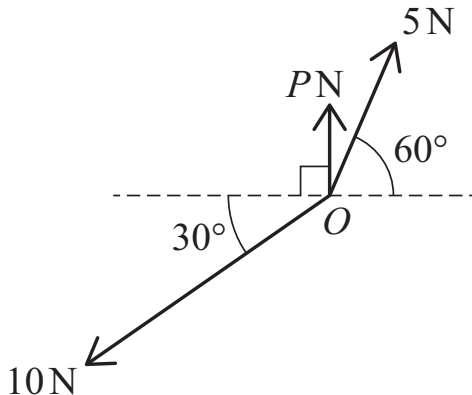
Mark scheme

- Along the wire the driving component is $\sum F_x \approx 17.8 \text{ N}$; the wire's vertical reaction is $|\sum F_y| + 0.6g \approx 13.8 + 6 = 19.8 \text{ N}$.
 $s = \frac{1}{2}at^2 \Rightarrow 2 = \frac{1}{2}a(9) \Rightarrow a = \frac{4}{9}$. Then $17.8 - \mu(19.8) = 0.6 \cdot \frac{4}{9} \Rightarrow \mu \approx 0.887$.

Question 2

9709/41 J25 ■ Q2 ■ 4 marks

Three coplanar forces of magnitudes P N, 5 N and 10 N act at a point O , as shown in the diagram. The resultant of the three forces has magnitude Q N and acts in a direction perpendicular to the force of magnitude P N. Find the value of P and the value of Q . [4]



Solution 2

Mark scheme

- Resolving along the line of P :

$$P + 5 \sin 60 - 10 \sin 30 = 0 \Rightarrow P = 5 - \frac{5\sqrt{3}}{2} = 0.670. \text{ Resultant}$$

$$Q = 10 \cos 30 - 5 \cos 60 = 5\sqrt{3} - \frac{5}{2} = 6.16.$$