

Exercise walk-through

5.1

Scalars, vectors, types of force and resultant forces (4.5.1.1–4.5.1.4)

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Exercises 2.1·2.3

2.1 Sort into scalars and vectors: speed, displacement, mass, weight, energy, acceleration. [2]

2.2 Give one contact and one non-contact force acting on a book resting on a table. [2]

2.3 A box is pushed with 45 N east and 30 N east. State the resultant. A second box gets 45 N east and 30 N **west**. State that resultant. [2]

3 Exam-style questions

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2.2 Contact: the normal contact force from the table (or friction). Non-contact: gravity / the Earth's gravitational pull on the book.

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3 Exam-style questions

2.3 $45 + 30 = \mathbf{75}$ N east; $45 - 30 = \mathbf{15}$ N east.

Exercise 3.1

3.1 A car tows a caravan. The caravan pulls back on the car with a tow-bar force of 900 N; the car's driving force is 2100 N.

- (a) Calculate the resultant force on the car. [2]
- (b) (HT) Draw a free-body diagram of the caravan showing the horizontal forces named. [2]
- (c) The car travels at a steady velocity. State what this shows about the resultant force and the resistive forces. [2]

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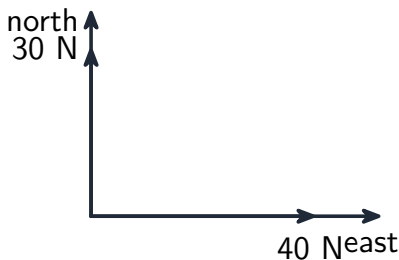
3.1 (a) Opposite directions, subtract: $R = 2100 - 900 = \mathbf{1200}$ N forward (C1, A1). (b) Two labelled arrows on the caravan: tow-bar force forward (from the car), drag/friction backwards; drawn from the caravan itself, labelled with names. (c) The resultant force is zero; the driving force balances all resistive forces – tow-bar plus air resistance plus friction.

Exercise 3.2

3.2 Two forces act at right angles on a small boat: 30 N north and 40 N east (HT).

(a) Use a scale drawing to find the magnitude and direction of the resultant. State your scale. [4]

(b) Without a drawing, state the size of the equilibrant needed to balance the boat. [1]

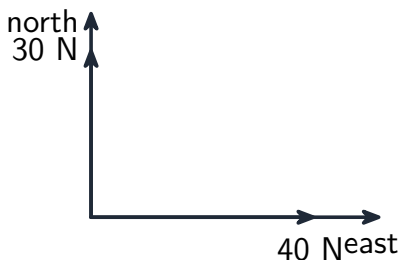


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3.2 (a) Scale stated, e.g. 1 cm : 10 N; both arrows drawn at right angles with correct lengths 3.0 cm and 4.0 cm; resultant drawn nose-to-tail / parallelogram; measured 5.0 cm → **50 N** at **53°** east of north (accept 50 N, 37° north of east). (b) 50 N in the opposite direction to the resultant.

Exercise 3.3

3.3 An aeroplane in level flight has a forward thrust of 12 kN, drag of 12 kN, weight of 60 kN.

- (a) State the resultant force on the aeroplane. [1]
- (b) Name the fourth force and its size. [2]
- (c) (HT) The plane turns in a circle at constant speed. Explain why its velocity is changing. [2]

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(c) (HT) The plane turns in a circle at constant speed. Explain why its velocity is changing. [2]

3.3 (a) Thrust balances drag horizontally, so the resultant of those two is zero – with weight also balanced, the total resultant force is **zero**. (b) Lift from the wings; 60 kN upward, balancing the weight. (c) Velocity is a vector: speed AND direction; turning changes the direction, so the velocity changes even at constant speed.