AP PHYSICS 1 • EXERCISE SHEET

1.1 Scalars and Vectors in One Dimension

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS vector 矢量 • direction 方向 • scalar 标量 • collinear 共线 • origin 原点

Objective

Build the skills to answer exam questions on **scalars and vectors in one dimension** — using signs for direction, choosing a coordinate system, and combining collinear vectors.

You must be able to:

- distinguish a **scalar** 标量 (magnitude only) from a **vector** 矢量 (magnitude **and** direction 方向)
- use a **positive or negative sign** to show a 1-D vector's direction along a chosen axis
- set up a **coordinate system** 坐标系 — an **origin** 原点 and a positive direction
- add and subtract **collinear** 共线 vectors to get a single **resultant** 合矢量

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Scalar or vector?

A **scalar** has size only; a **vector** has size **and** direction. Decide by asking: "does a direction belong to this quantity?"

scalar	vector
distance 距离, speed	displacement 位移, velocity
mass, time, energy	force, acceleration, momentum
temperature	any push or pull with a direction

■ Signs for direction in 1-D

Once you pick a positive direction, a vector along that line is just a **signed number**. Take **east as positive**:

- $+6$ m s^{-1} means 6 m s^{-1} east
- -6 m s^{-1} means 6 m s^{-1} **west** — same speed, opposite direction

The sign is the direction; the magnitude is the number without its sign, $|-6| = 6$ m s^{-1}.

■ Choosing a coordinate system

State the **origin** and the **positive direction** *before* putting numbers on anything. A ball starts at the origin, moves +3 m (right), then −8 m (left). Its position is

$$x = (+3) + (-8) = -5 \text{ m},$$

i.e. 5 m to the left of the start.

■ Adding and subtracting collinear vectors

Collinear vectors lie on one line, so **add the signed values**. Two forces on a box, right positive: $F_1 = +12$ N, $F_2 = -5$ N.

$$F_{\text{net}} = (+12) + (-5) = +7 \text{ N} \quad (7 \text{ N to the right}).$$

To **subtract** a vector, add its negative: $\vec{A} - \vec{B} = \vec{A} + (-\vec{B})$ — reverse $\vec{B}$, then add.

2 Practice

Now apply the methods above.

2.1 State whether each quantity is a scalar or a vector: (a) temperature, (b) velocity, (c) distance, (d) force. [2]

2.2 Taking **up as positive**, write the signed value of a displacement of 4 m **downward**. [1]

2.3 A drone flies +50 m then −30 m along an east-positive axis. Find its **resultant** displacement, with direction. [2]

2.4 Two collinear forces act on a trolley (right positive): +8 N and −15 N. Find the net force, with direction. [2]

3 Exam-style questions

3.1 Which quantity is a vector? [1]

- **A** distance
- **B** speed
- **C** acceleration
- **D** mass

3.2 A car moves along a straight road. Taking north as positive, its velocity is -25 m s^{-1}. This means the car moves [1]

- **A** at 25 m s^{-1} north
- **B** at 25 m s^{-1} south
- **C** at -25 m s^{-1} north
- **D** with a decreasing speed

3.3 An object on a number line starts at $x = +2$ m and undergoes a displacement of -9 m.

(a) Find its final position. [1]

(b) State how far it is from the origin, and on which side. [1]

3.4 Three collinear forces act at a point, with rightward positive: $+10$ N, -4 N and -2 N.

(a) Calculate the resultant force. [2]

(b) State whether the point is in equilibrium 平衡, and give a reason. [1]

Solutions

2.1 (a) scalar; (b) vector; (c) scalar; (d) vector.

2.2 -4 m.

2.3 $(+50) + (-30) = +20$ m; 20 m east.

2.4 $(+8) + (-15) = -7$ N; 7 N to the left.

3.1 **C** — acceleration is a vector; the others are scalars.

3.2 **B** — the sign gives the direction (south), and the speed is $|-25| = 25$ m s^{-1}.

3.3 (a) $x = (+2) + (-9) = -7$ m. (b) 7 m from the origin, on the negative side.

3.4 (a) $(+10) + (-4) + (-2) = +4$ N. (b) No — the resultant is not zero ($+4$ N), so the point is not in equilibrium.