IBDP Physics – Homework 1

Kinematics at Constant Velocity + Intro to Vectors

Part A — Constant Velocity, Graphs, and Representations

1. Position–Time Interpretation

The position–time graph of an object is a straight line passing through $(t, x) = (0,\ 2\text{ m})$ and $(4\text{ s},\ 14\text{ m})$.

(a) Determine the velocity of the object.

(b) Write the equation $x(t)$.

(c) Find the position at $t = 7$ s.

2. From Table → Equation → Graph

A cart moves with constant velocity. Its measured positions are:

t (s)	x (m)
0	6
1	10
2	14
3	18

(a) Determine the velocity.

(b) Write the equation $x(t)$.

(c) Sketch or describe clearly the position–time and velocity–time graphs.

3. Piecewise Velocity → Position Graph

An object has the following velocity profile:

- $0 \le t < 2$ s: $v = +3$ m/s
- $2 \le t < 5$ s: $v = 0$ m/s
- $5 \le t < 7$ s: $v = -2$ m/s

Initial position: $x_0 = 4$ m.

(a) Calculate the position at $t = 2,\ 5,\ 7$ s.

(b) Write the complete piecewise function $x(t)$.

(c) Sketch or describe the position–time graph.

4. Relative Velocity

A train moves east at 15 m/s. A student walks toward the front of the train at 2.5 m/s relative to the train.

(a) Find the student's velocity relative to the ground.

(b) Find the student's velocity relative to a seated passenger.

(c) If the student walks toward the *back* at 1.0 m/s, repeat part (a).

5. Unit Conversions + Interpretation

A runner maintains a constant speed of 12 km/h.

(a) Convert this speed to m/s.

(b) How far does the runner travel in 9 minutes?

(c) Write the position–time equation assuming $x_0 = 0$.

Part B — Vector Displacement (2D Vectors)

6. Components and Magnitude

A displacement vector has magnitude 12 m and makes an angle of 35° above the +x-axis.

(a) Find the x- and y-components.

(b) Verify that the magnitude computed from the components equals 12 m.

7. Adding Two Displacements

A person walks:

- 8 m east,
- 6 m north.

(a) Write each displacement vector in component form.

(b) Find the resultant displacement in component form.

(c) Find its magnitude and direction (from the +x-axis).

8. Three-Step Vector Problem

A drone flies:

1. 10 m at 60° above the +x-axis,

2. 15 m horizontally west,
3. 6 m straight downward (negative y-direction).

(a) Write each displacement in component form.

(b) Add the displacements to find the net displacement vector.

(c) Find the magnitude and direction angle of the resultant.

End of Homework.