Edexcel AS Mathematics Kinematics

Section 1: Displacement and distance

Exercise level 2

1. The position of a particle moving along a straight horizontal track is modelled by $x = 2 + (t-1)(t+2)$ where x is measured in metres and t in seconds $0 \le t \le 3$.
   (i) What is the position of the particle at times t = 0, 0.5, 1, 1.5, 2, 2.5 and 3?
   (ii) Draw a graph of the particle's position against time, marking its position at the times in (i).
   (iii) Find the displacement of the particle relative to its initial position at t = 2.4 s.

2. A boy throws a ball vertically upwards so that its position after t seconds is modelled by $y = 8t - 5t^2 + 4$.
   (i) Write down the position of the ball when t = 0, 0.2, 0.6, 1.0, 1.4, 1.8, and 2.0, and sketch the position-time graph.
   (ii) Calculate the displacement relative to the starting point at each of these times.
   (iii) What is the total distance travelled in the 2 seconds?

3. A girl drops a stone from the top of a cliff 40 m high into the sea below. The height above sea level of the stone after t seconds is modelled by $y = 40 - 4.9t^2$.
   (i) Find the position of the stone at t = 0, 0.4, 0.8, 1.2, 1.6, 2.0, 2.4, 2.8 and 3.0, and plot the position–time graph.
   (ii) What can you deduce happens between t = 2.8 and t = 3?

4. Every school morning, Naima walks due south from her house to the newsagents to buy some sweets. She walks at an average speed of 5 km/h and the newsagents is 500 m from her home. She takes 5 minutes to buy her sweets and then walks to school at the same speed as before. School is 2000 m north of her house.
   (i) Draw the position-time graph of Naima's journey.
   (ii) Find the total time of Naima's journey.
   (iii) What assumptions have you made? Do you think the total time for her journey will be the same every day? Explain your answer.

5. At 11.00 a.m. a man started cycling from Newcastle to Hexham, 30 km away. He rode at a steady 10 km/h. He stopped for 30 minutes at 12.30 pm to have lunch and then resumed his journey at the same steady speed. A car left Hexham for Newcastle at 11.30 a.m. doing a steady speed of 50 km/h on the same road as the cyclist. Draw a distance time graph to show the two journeys and use it to find the approximate time and place at which the car and the cyclist passed each other. How realistic are the assumptions made in this question?

6. A bus travelling at an average speed of 30 km/h leaves Norwich for Thetford at 5.00 p.m. A woman driving a car at 45 km/h leaves Thetford for Norwich at 5.30 p.m. It is 50 km from Norwich to Thetford on the road that they are both using.
   (i) Draw a distance time graph showing both journeys
   (ii) Use your graph to estimate the time at which they passed each other.
   (iii) How far from Norwich were they when this happened?
   (iv) What factors might affect the accuracy of your estimates in (ii) and (iii)?

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7. A car travels 40 km from A to B at an average speed of 60 km/h. It stops at B for 20 minutes and then returns to A. The average speed for the whole journey is 60 km/h. Find
   (i) the average speed from B to A.
   (ii) the average velocity for the whole journey.

8. A, B and C are points on the same straight line such that AB = 60 m and AC = 80 m. An object moves from A to B at an average speed of 10 m/s, then goes from B to C in 4 seconds. The object then returns to B. The average speed for the whole journey is 5 m/s.
   (i) Find the average speed from B to C.
   (ii) Find the average speed from A to C.
   (iii) Find the time taken to go from C to B.
   (iv) Find the average velocity for the whole motion.