Kinematics

5 A toy car is travelling along a straight horizontal path with constant acceleration. It passes points A, B and C in that order, where $AB = 1.5$ m and $BC = 5$ m. It takes the car 3 seconds to get from A to B, and 4 seconds to get from B to C.

a) Find the acceleration of the toy car.

$a =$ .....

(6 marks)

b) Calculate the speed of the toy car at the instant it passes B.

.....

(2 marks)

6 A particle P sets off from the origin at $t = 0$ and starts to move along the x-axis in the direction of increasing x. After t seconds, P has velocity v ms^{-1}, where v is given by:

$$v = \begin{cases} 11t - 2t^2 & 0 \leq t \leq 5 \\ 25 - 4t & t > 5 \end{cases}$$

a) Find the displacement of P from the origin at $t = 5$.

.....

(4 marks)

b) Find the time taken for P to return to the origin.

.....

(5 marks)

Kinematics

7 A student is attempting to model the flight of a toy rocket. He models the rocket as a light particle that sets off from rest at the origin and travels along the y-axis in the direction of y increasing.
He models the acceleration, a ms^{-2}, of the rocket with the equation $a = 3t^2 - \frac{t^3}{3}$, where t is time in seconds.

a) According to the model, explain what happens to the rocket at $t = 9$ s.

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.....

(2 marks)

b) The student observes that it actually takes the toy rocket 5 s to reach a vertical height of 75 m. Comment on the accuracy of the student's model in light of this observation. Justify your claims.

.....

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(7 marks)

c) Suggest one way in which this model could be improved.

.....

(1 mark)

8 The displacement, x m, of a particle from a fixed point O at time t s is $x = t^4 - 4t^3 - 8t^2 + 1$, where $t \geq 0$.

a) Determine the times at which the particle is stationary.

.....

(5 marks)

b) Find the total distance travelled by the particle during the first 5 seconds of motion.

.....

(4 marks)

c) Determine the time at which the particle's acceleration is zero.

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(5 marks)

EXAM TIP

Look out for questions which mention 'constant' or 'uniform' acceleration — that's your cue to break out the suvat equations. If acceleration varies with time, you'll need to use calculus, so make sure you're completely happy with it. You also need to be really confident with when to differentiate and when to integrate — you don't want to get mixed up in the exam.

Score