Kinematic relationships

2014 Revised AH

Marks

1. The acceleration of a particle moving in a straight line is described by the expression

$$a = 1{\cdot}2t.$$

At time, $t = 0$ s the displacement of the particle is 0 m and its velocity is $1{\cdot}4\ \text{m s}^{-1}$.

(*a*) Show that the velocity of the particle at time t is given by the expression

$$v = 0{\cdot}6t^2 + 1{\cdot}4. \qquad 2$$

(*b*) Calculate the displacement of the particle when its velocity is $3{\cdot}8\ \text{m s}^{-1}$. 3

(5)

2016 CfE AH Physics

A car on a long straight track accelerates from rest. The car's run begins at time $t = 0$.

Its velocity v at time t is given by the equation

$$v = 0{\cdot}135t^2 + 1{\cdot}26t$$

where v is measured in m s^{-1} and t is measured in s.

Using calculus methods:

(a) determine the acceleration of the car at $t = 15{\cdot}0$ s; 3

Space for working and answer

(b) determine the displacement of the car from its original position at this time. 3

Space for working and answer

1. An athlete competes in a one hundred metre race on a flat track, as shown in Figure 1A.

Figure 1A

Starting from rest, the athlete's speed for the first 3·10 seconds of the race can be modelled using the relationship

$$v = 0 \cdot 4t^2 + 2t$$

where the symbols have their usual meaning.

According to this model:

(a) determine the speed of the athlete at $t = 3 \cdot 10\,\text{s}$; **2**

Space for working and answer

(b) determine, using **calculus** methods, the distance travelled by the athlete in this time. **3**

Space for working and answer

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(a) Show that the velocity of the particle at time t is given by the expression

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(b) Calculate the displacement of the particle when its velocity is $3{\cdot}8\ \text{m s}^{-1}$. 4

Space for working and answer