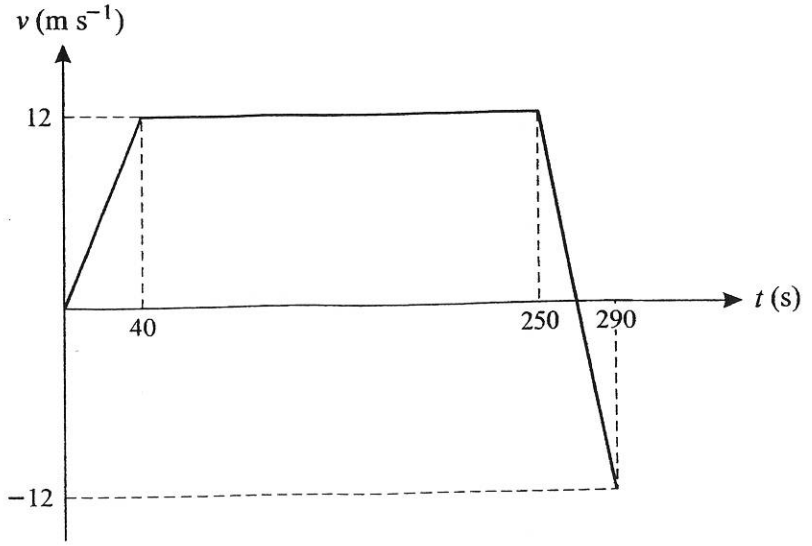
Kinematics (Ch 1)

2

Jun '07



A particle starts from the point A and travels in a straight line. The diagram shows the (t, v) graph, consisting of three straight line segments, for the motion of the particle during the interval $0 \leqslant t \leqslant 290$.

(i) Find the value of t for which the distance of the particle from A is greatest. [2]

(ii) Find the displacement of the particle from A when $t = 290$. [3]

(iii) Find the total distance travelled by the particle during the interval $0 \leqslant t \leqslant 290$. [2]

2 The driver of a car accelerating uniformly from rest sees an obstruction. She brakes immediately bringing the car to rest with constant deceleration at a distance of 6 m from its starting point. The car travels in a straight line and is in motion for 3 seconds.

Jun '09

(i) Sketch the (t, v) graph for the car's motion. **[2]**

(ii) Calculate the maximum speed of the car during its motion. **[3]**

(iii) Hence, given that the acceleration of the car is $2.4\,\text{m s}^{-2}$, calculate its deceleration. **[4]**

3 A man travels 360 m along a straight road. He walks for the first 120 m at $1.5\,\text{m s}^{-1}$, runs the next 180 m at $4.5\,\text{m s}^{-1}$, and then walks the final 60 m at $1.5\,\text{m s}^{-1}$. The man's displacement from his starting point after t seconds is x metres.

Jun '06

(i) Sketch the (t, x) graph for the journey, showing the values of t for which $x = 120$, 300 and 360. [5]

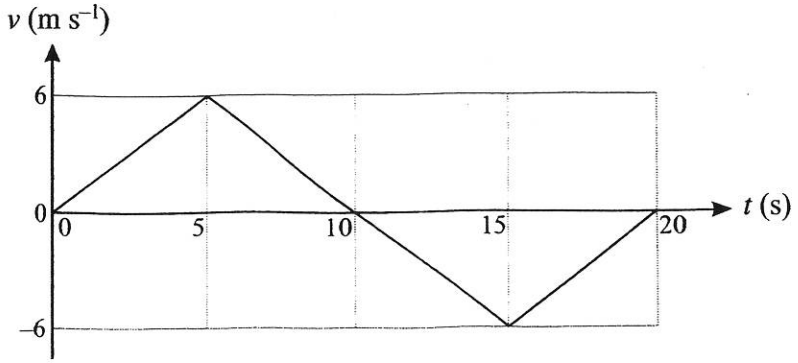
A woman jogs the same 360 m route at constant speed, starting at the same instant as the man and finishing at the same instant as the man.

(ii) Draw a dotted line on your (t, x) graph to represent the woman's journey. [1]

(iii) Calculate the value of t at which the man overtakes the woman. [5]

3

Jun '08



An athlete runs in a straight line from point A to point B, and back to point A. The diagram shows the (t, v) graph for the motion of the athlete. The graph consists of three straight line segments.

(i) Calculate the initial acceleration of the athlete. [2]

(ii) Calculate the total distance the athlete runs. [3]

(iii) Calculate the velocity of the athlete when $t = 17$. [3]

5 A man drives a car on a horizontal straight road. At $t = 0$, where the time t is in seconds, the car runs out of petrol. At this instant the car is moving at $12\,\text{m s}^{-1}$. The car decelerates uniformly, coming to rest when $t = 8$. The man then walks back along the road at $0.7\,\text{m s}^{-1}$ until he reaches a petrol station a distance of 420 m from his car. After his arrival at the petrol station it takes him 250 s to obtain a can of petrol. He is then given a lift back to his car on a motorcycle. The motorcycle starts from rest and accelerates uniformly until its speed is $20\,\text{m s}^{-1}$; it then decelerates uniformly, coming to rest at the stationary car at time $t = T$.

Jan '06

(i) Sketch the shape of the (t, v) graph for the man for $0 \leqslant t \leqslant T$. [Your sketch need not be drawn to scale; numerical values need not be shown.] [5]

(ii) Find the deceleration of the car for $0 < t < 8$. [2]

(iii) Find the value of T. [4]

5 A car is travelling at $13\ \text{m s}^{-1}$ along a straight road when it passes a point A at time $t = 0$, where t is in seconds. For $0 \leqslant t \leqslant 6$, the car accelerates at $0.8t\ \text{m s}^{-2}$.

(i) Calculate the speed of the car when $t = 6$. **[5]**

(ii) Calculate the displacement of the car from A when $t = 6$. **[5]**

(iii) Three (t, x) graphs are shown below, for $0 \leqslant t \leqslant 6$.

Jan '09

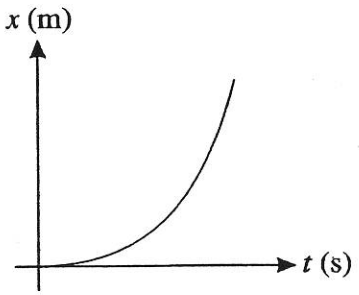


Fig. 1

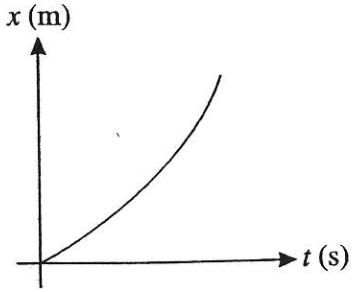


Fig. 2

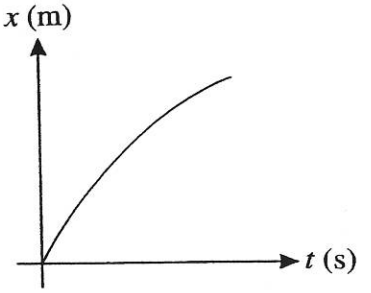
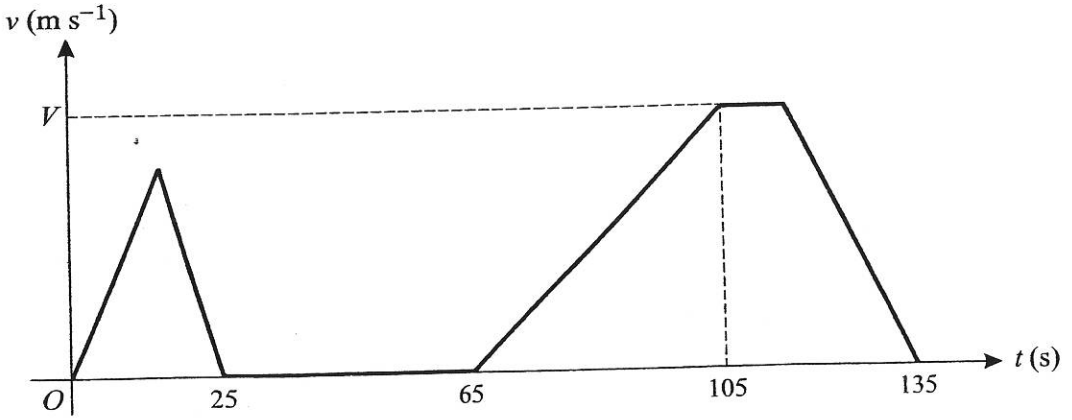


Fig. 3

(a) State which of these three graphs is most appropriate to represent the motion of the car. **[1]**

(b) For each of the two other graphs give a reason why it is not appropriate to represent the motion of the car. **[2]**

6



Jan '07

The diagram shows the (t, v) graph for the motion of a hoist used to deliver materials to different levels at a building site. The hoist moves vertically. The graph consists of straight line segments. In the first stage the hoist travels upwards from ground level for 25 s, coming to rest 8 m above ground level.

(i) Find the greatest speed reached by the hoist during this stage. [2]

The second stage consists of a 40 s wait at the level reached during the first stage. In the third stage the hoist continues upwards until it comes to rest 40 m above ground level, arriving 135 s after leaving ground level. The hoist accelerates at $0.02\ \text{m s}^{-2}$ for the first 40 s of the third stage, reaching a speed of $V\ \text{m s}^{-1}$. Find

(ii) the value of V, [3]

(iii) the length of time during the third stage for which the hoist is moving at constant speed, [4]

(iv) the deceleration of the hoist in the final part of the third stage. [3]