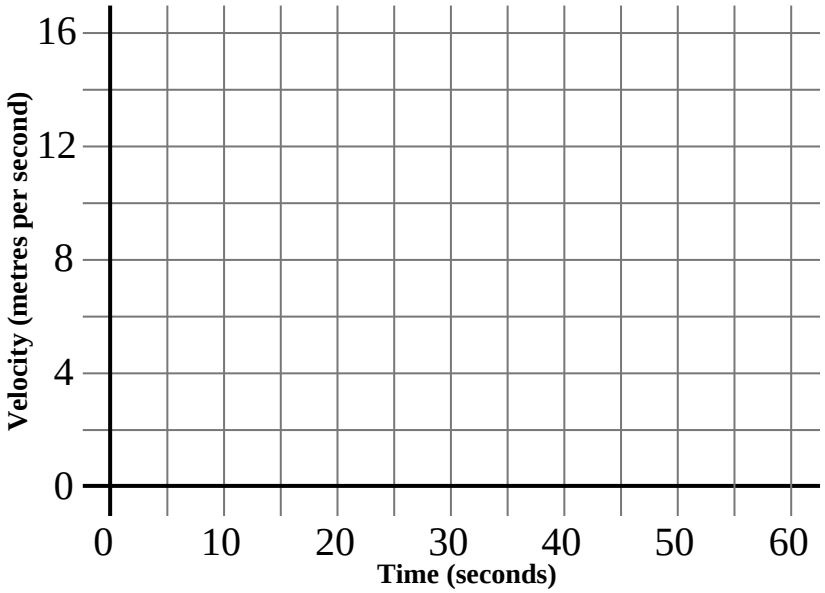
**Lesson 6**

**Constant Acceleration Kinematics**
**Applied Mathematics (Mechanics) Year 1**

## 6.1 Velocity-Time Graphs #1

A cyclist leaves home *H* and rides along a straight road with a constant acceleration.
After 10 seconds she has reached point *A* with a speed of 15 $m.s^{-1}$.
She maintains this speed for a further 20 seconds until she reaches a point *B*.
She now retards uniformly to rest at point *C*.
The whole journey takes 45 seconds.

**( i )** Draw the velocity-time graph for the journey.




**( ii )** What is the constant acceleration during the journey from *H* to *A* ?

**( iii )** What is the uniform retardation during the journey from *B* to *C* ?

**( iv )** How far down the road from Home is the cyclist when she stops ?

## 6.2 Exercise

**Question 1**

A train is moving with a speed of 20 $m.s^{-1}$ when the driver sees a red light ahead. She applies the brakes and stops in a distance of 30 metres.

**( i )** Show the shape of the velocity-time graph with a sketch.

**( ii )** How many seconds did the train take to come to rest ?

**( iii )** What was the deceleration of the train ?

**Question 2**

A lorry accelerates uniformly from rest with acceleration 1.5 $m.s^{-2}$ for 12 seconds. It then moves with constant velocity for 16 seconds before retarding uniformly to rest. The total distance travelled is 522 metres.

**( i )** Show this information on a velocity-time graph.

**( ii )** What was the greatest velocity of the lorry ?

**( iii )** What was the total time taken for the journey ?

**Question 3**

Two stations, Knapford and Tidmouth, are 570 metres apart.

A train starts from Knapford and accelerates uniformly for 16 seconds to a speed of 54 $km.h^{-1}$ which it maintains until it is 90 metres from Tidmouth. At this point it slows down uniformly to stop at Tidmouth.

**( i )** Sketch a velocity-time graph to show the motion of the train.

**( ii )** Find the total time that the journey takes.

**( iii )** Find the deceleration of the train.

**Question 4**

*Examination Question from January 2010, M1, Q2*

An athlete runs along a straight road. She starts from rest and moves with constant acceleration for 5 seconds, reaching a speed of 8 $m.s^{-1}$.
This speed is then maintained for $T$ seconds.
She then decelerates at a constant rate until she stops.
She has run a total of 500 metres in 75 seconds.

**( a )** Sketch a speed-time graph to illustrate the motion of the athlete.

**[ 3 marks ]**

**( b )** Calculate the value of $T$

**[ 5 marks ]**

**Question 5**

Two cyclists *A* and *B* are travelling in the same direction along a straight road.
*B* is travelling at a speed of 12 $m.s^{-1}$ and *A* is overtaking *B* at a speed of 14 $m.s^{-1}$.
At the moment when they are level they see a traffic light turn red 126 metres ahead.
*A* cycles for *T* seconds then decelerates uniformly.
*B* cycles for 7 seconds and then decelerates uniformly.
*A* and *B* stop at the traffic light at the same instant.

**( i )** Sketch the speed-time graphs of the two cyclists on the same diagram.

**( ii )** How many seconds after seeing the traffic light turn red did it take the cyclists to stop ?

**( iii )** Calculate the value of *T*