**Kinematics using graphs**

1. A car accelerates uniformly from a velocity of 10ms-1 to a velocity of 40ms-1 in a time of 10s. Sketch a velocity-time graph and find the acceleration and the distance covered by the car in this time of 10s.
2. A train is brought to rest from a velocity of 24ms-1 by a constant acceleration of -0.8ms-2. Sketch a velocity-time graph and find the distance covered by the train while it is decelerating.
3. A particle moving in a straight line moves from rest with a uniform acceleration of 4ms-2 for 4 seconds. It is then brought to rest again by a uniform acceleration of -2ms-2. Sketch a velocity-time graph and find the total distance covered by the particle.
4. A particle moves from rest to in a straight line with an acceleration of 4ms-2 for 3 seconds. It maintains a uniform velocity for 6 seconds and then is brought to rest again in a time of 4 seconds with a uniform retardation. Sketch a velocity-time graph and find the final acceleration and the final displacement of the particle from its starting point.
5. A particle moves in a straight line with a constant velocity of 5ms-1 for 2 seconds. It then moves with a constant acceleration of -2ms-2 for 8 seconds. Sketch a velocity-time graph for the interval of 10 seconds and find:
   1. the final velocity,
   2. the total distance covered by the particle,
   3. the increase in displacement of the particle.
6. A particle moves in a straight line. It has a velocity of 6ms-1 when it is subjected to an acceleration of -3ms-2 for 3 seconds. It maintains a uniform velocity for 2 seconds and is then brought to rest in a time of 2 seconds. Sketch a velocity-time graph and find, for the seven second interval:
   1. the final acceleration,
   2. the distance covered,
   3. the increase in displacement.
7. An aeroplane is travelling along a straight line at a constant speed of 140ms-1. Sketch a graph of speed against time for this motion. Use this graph to find the distance travelled by the aeroplane in:
   1. 5 seconds,
   2. *T* seconds.

What is the gradient of the line and what is the acceleration of the aircraft?

1. A hot air balloon rises vertically with a speed that is assumed to increase at a constant rate from 0 to 2ms-1 over a thirty second period.
   1. What is the acceleration of the balloon? Use this to find an expression for the speed of the balloon.
   2. Assuming that the balloon’s speed continues to increase at the same rate, find the distance that the balloon rises in:

**i)**  10 seconds **ii)** 40 seconds **iii)**  *T* seconds.

* 1. Sketch a graph of the distance the balloon rises against the time.

1. A ball is dropped from a height of 18m. As it falls, its speed at time *t* seconds is given by *v* = 9.8*t* ms-1.
   1. Sketch a graph of speed against time for the ball, and find its acceleration.
   2. Find a formula for the distance travelled by the ball in *t* seconds.
   3. How long does it take for the ball to reach the ground?
2. A car is travelling at 10ms-1 when it begins to increase its speed at a constant rate of 1.2ms-2. The car travels in a straight line.
   1. Sketch a graph to show how the speed increases. Assume the speed starts to increase when *t =* 0.
   2. Find the speed of the car when *t* = 0.
   3. Find the distance travelled by the car between:

**i)** *t* = 0 and *t* = 5, **ii)**  *t* = 0 and *t* = *T*.

* 1. Sketch a graph of distance against time for the car.

**ANSWERS**

1. 3ms-2, 250m
2. 360m
3. 96m
4. -3ms-2, 114m
5. **a)** -11ms-1 **b)** 46.5m **c)** 14m
6. **a)** +1.5ms-2 **b)** 16.5m **c)**  -4.5m
7. **a)** 200m **b)** 20t
8. **a)** 0.33, v = t**/**3 **b)**  **i)** 4.17m **ii)** 37.5m **iii)** t²**/**6
9. **a)** 0.8ms-2 **b)**  0.4t² **c)** 1.73s, 1.39ms-1
10. **b)** 15s **c)** 225m **d)**  -2ms-2