Kinematics 1

1.

A car comes to a stop from a speed of $30\ \text{m s}^{-1}$ in a distance of $804\ \text{m}$. The driver brakes so as to produce a deceleration of $\frac{1}{2}\ \text{m s}^{-2}$ to begin with, and then brakes harder to produce a deceleration of $\frac{3}{2}\ \text{m s}^{-2}$. Find the speed of the car at the instant when the deceleration is increased, and the total time the car takes to stop.

2.

A car starts from rest at the point A and moves in a straight line with constant acceleration for 20 seconds until it reaches the point B. The speed of the car at B is $30\ \text{m s}^{-1}$.
Calculate

(a) the acceleration of the car,

(b) the speed of the car as it passes the point C, where C is between A and B and $AC = 40\ \text{m}$. (OCR)

3.

A motorist travelling at $u\ \text{m s}^{-1}$ joins a straight motorway. On the motorway she travels with a constant acceleration of $0.07\ \text{m s}^{-2}$ until her speed has increased by $2.8\ \text{m s}^{-1}$.

(a) Calculate the time taken for this increase in speed.

(b) Given that the distance travelled while this increase takes place is $1050\ \text{m}$, find u. (OCR)

4.

A cyclist, travelling with constant acceleration along a straight road, passes three points A, B and C, where $AB = BC = 20\ \text{m}$. The speed of the cyclist at A is $8\ \text{m s}^{-1}$ and at B is $12\ \text{m s}^{-1}$. Find the speed of the cyclist at C. (OCR)

5.

A train is slowing down with constant deceleration. It passes a signal at A, and after successive intervals of 40 seconds it passes points B and C, where $AB = 1800\ \text{m}$ and $BC = 1400\ \text{m}$.

(a) How fast is the train moving when it passes A?

(b) How far from A does it come to a stop?

6.

A particle is moving along a straight line with constant acceleration. In an interval of T seconds it moves D metres; in the next interval of $3T$ seconds it moves $9D$ metres. How far does it move in a further interval of T seconds?

7.

A car travelling at $10\ \text{m s}^{-1}$ is 25 metres from a pedestrian crossing when the traffic light changes from green to amber. The light remains at amber for 2 seconds before it changes to red. The driver has two choices: to accelerate so as to reach the crossing before the light changes to red, or to try to stop at the light. What is the least acceleration which would be necessary in the first case, and the least deceleration which would be necessary in the second?

8.

A cheetah is pursuing an impala. The impala is running in a straight line at a constant speed of $16\ \text{m s}^{-1}$. The cheetah is 10 m behind the impala, running at $20\ \text{m s}^{-1}$ but tiring, so that it is decelerating at $1\ \text{m s}^{-2}$. Find an expression for the gap between the cheetah and the impala t seconds later. Will the impala get away?

9.

A cyclist travels from A to B, a distance of 240 metres. He passes A at $12\ \text{m s}^{-1}$, maintains this speed for as long as he can, and then brakes so that he comes to a stop at B. If the maximum deceleration he can achieve when braking is $3\ \text{m s}^{-2}$, what is the least time in which he can get from A to B?

10.

Two villages are 900 metres apart. A car leaves the first village travelling at $15\ \text{m s}^{-1}$ and accelerates at $\frac{1}{2}\ \text{m s}^{-2}$ for 30 seconds. How fast is it then travelling, and what distance has it covered in this time?

The driver now sees the next village ahead. and decelerates so as to enter it at $15\ \text{m s}^{-1}$. What constant deceleration is needed to achieve this? How much time does the driver save by accelerating and decelerating, rather than covering the whole distance at $15\ \text{m s}^{-1}$?
