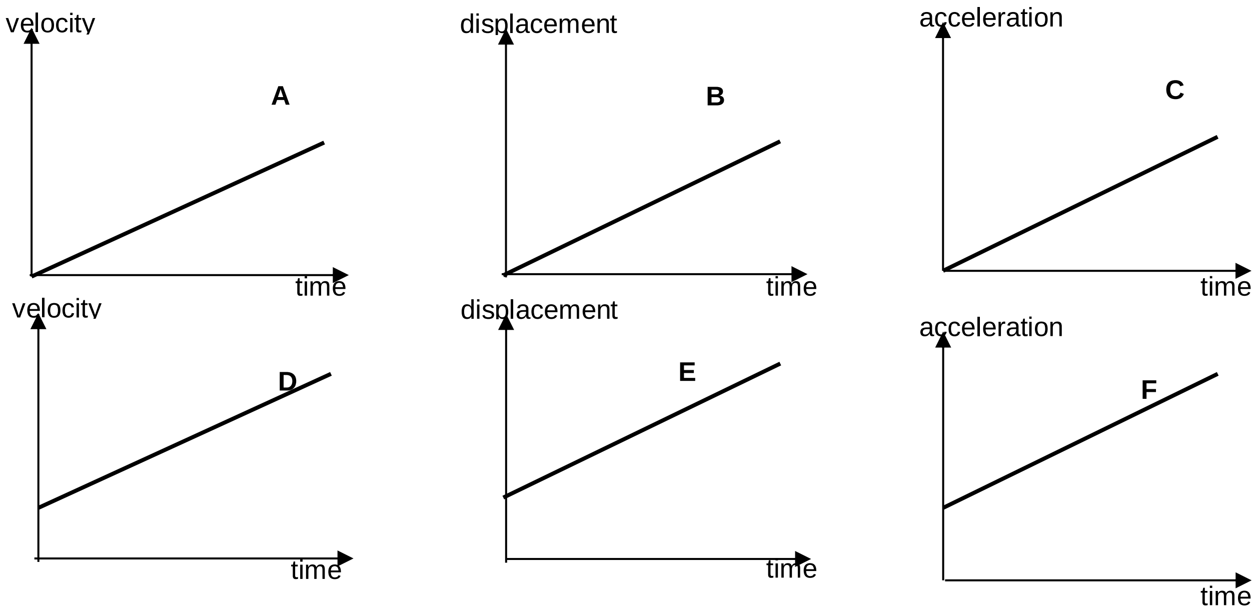
Section A

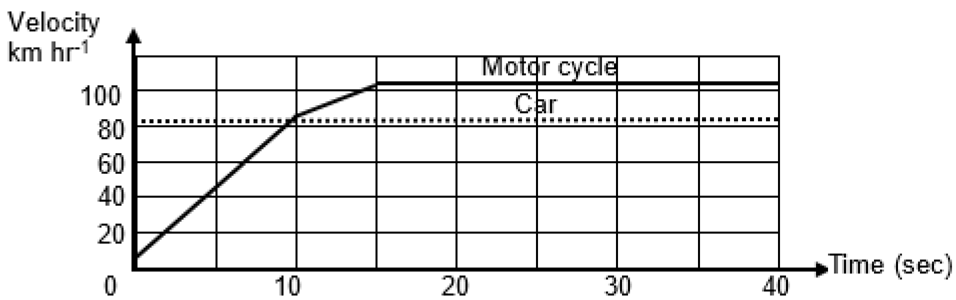
Multiple-choice questions

Example 1 (1983 Question 5, 1 mark)

Which one or more of the following graphs (**A, B, C, D, E and F**) represents the motion under constant non-zero acceleration? (one or more answers)



Graphs of velocity versus time are shown below for a car and a motorcycle travelling along the same road. The car passes the stationary motorcycle at t = 0.



Example 2 (1978 Question 2, 1 mark)

At the instant t = 10 sec, the motorcycle's

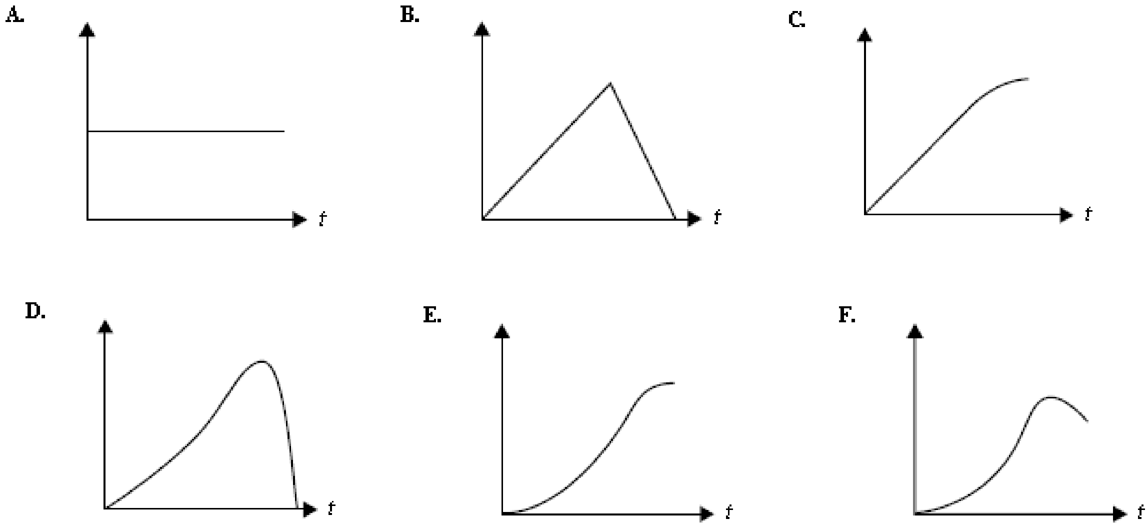
A acceleration increases, velocity decreases

B acceleration decreases, velocity increases

C acceleration and velocity both increase

D acceleration and velocity both decrease

In a road test, a car was uniformly accelerated from rest over a distance of 400 m in 19.0 s. The driver then applied the brakes, stopping the car in 5.1 s with constant deceleration.
The graphs (**A – F**) in the key below should be used when answering the two questions below. The horizontal axis represents time and the vertical axis could be velocity or distance.



Example 3 (2002 Question 3, 2 marks)

Which of the graphs (**A – F**) best represents the velocity–time graph of the car for the entire journey?

Example 4 (2002 Question 4, 2 marks)

Which of the graphs (**A – F**) best represents the distance–time graph of the car for the entire journey?

Example 5 (1967 Question 1, 1 mark)

A billiard ball travelling at 10 m s^{-1} east strikes a cushion and then travels at 10 m s^{-1} south.
Its change in velocity is

A. zero.

B. approximately 14 m s^{-1} south-east.

C. approximately 4 m s^{-1} south-east.

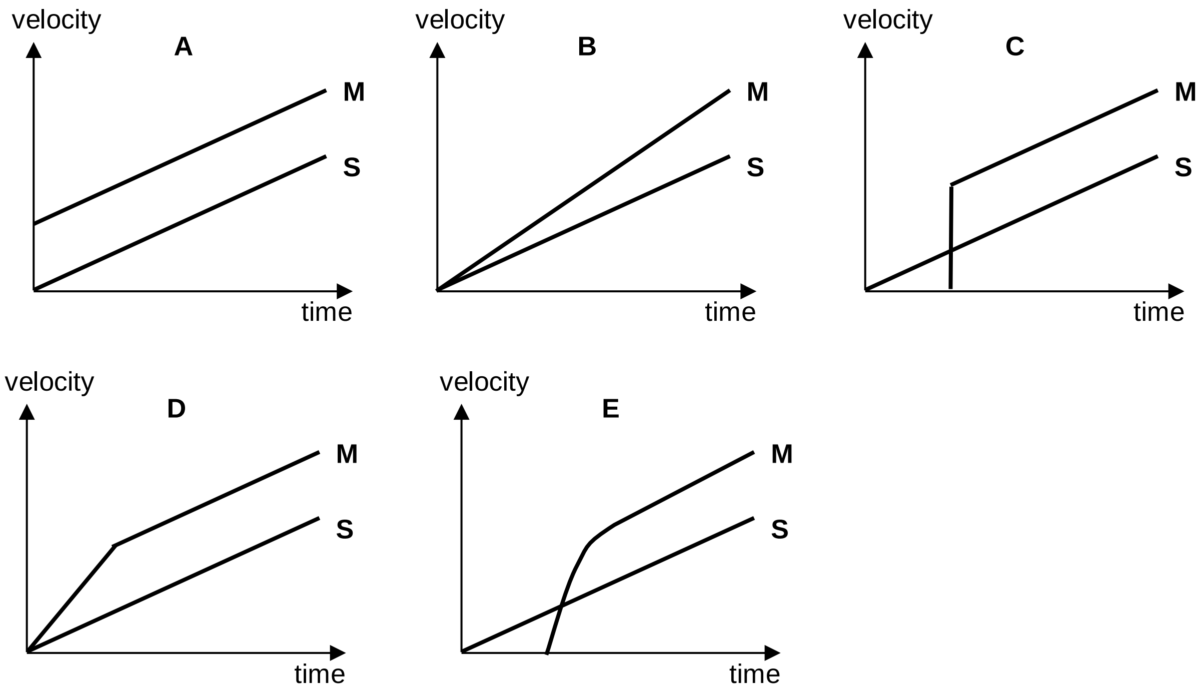
D. approximately 14 m s^{-1} south-west.

E. approximately 14 m s^{-1} north-east.

A man at the top of a building 20 m high releases a stone from rest; 0.60 second later he throws a marble vertically downwards with an initial velocity of 8.0 m s^{-1}.

Example 6 (1980 Q2, 1 mark)

Which of the following best represents the velocity-time graphs for the stone (S) and the marble (M)?



Section B
Short-answer and extended-answer questions

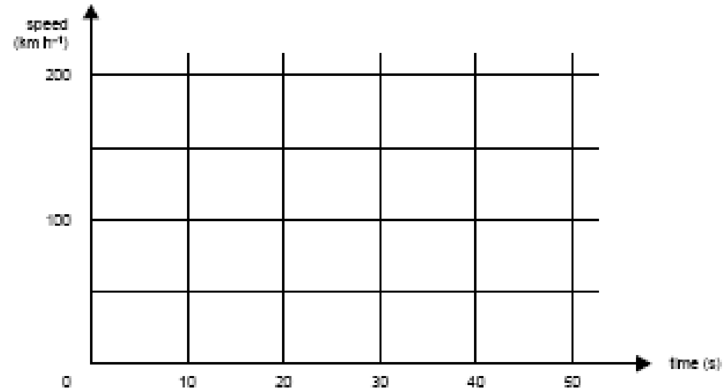
The figure below appeared in a newspaper featuring skydiving from an aircraft. In this particular example the total mass of the skydiver and equipment is 100 kg. The skydiver jumps from a height of 3000 m above the ground and reaches a constant terminal velocity of 190 km h^{-1} in a time of 15 s. She then falls at this constant speed of 190 km h^{-1} for a further 35 s before opening the parachute.

Example 7 (1998 Q1, 2 marks)

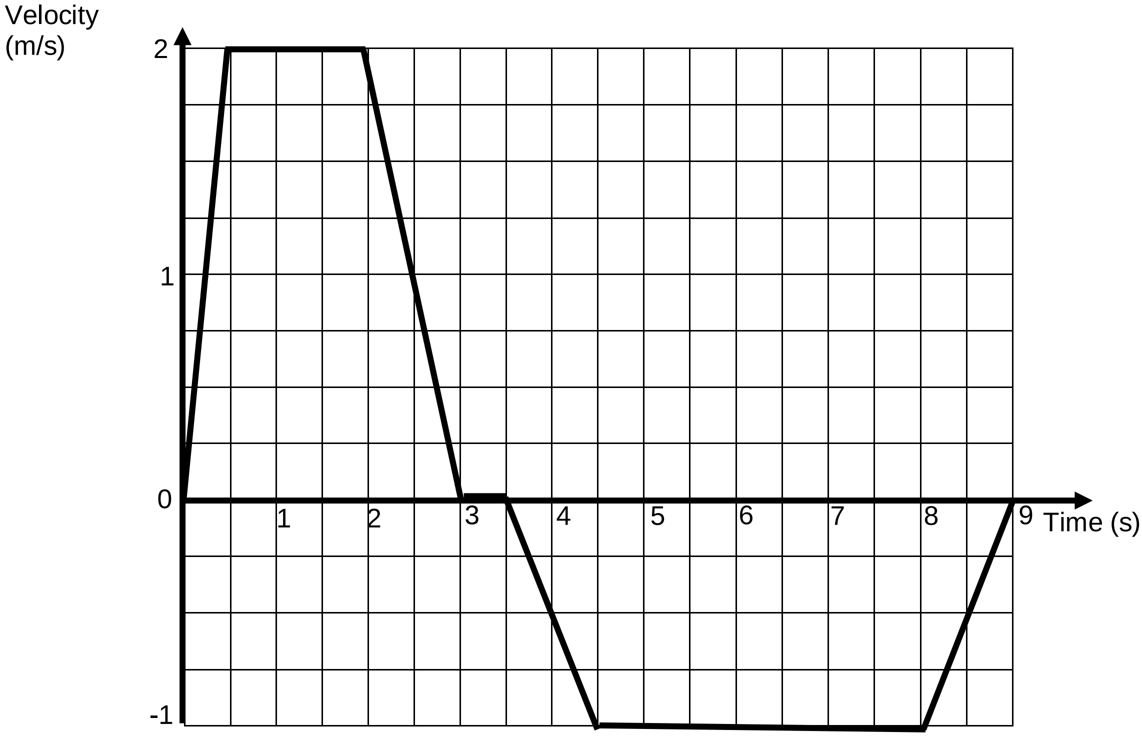
Convert 190 km h^{-1} into m s^{-1}.

Example 8 (1998 Q2, 3 marks)

On the set of axes, sketch a graph of the motion of the skydiver for the first 50 s of falling. (**Air resistance cannot be neglected**.)



An object moves along a straight path. Below is a graph of velocity verses time of the object's motion.



Example 9 (1983 Q1, 1 mark)

What is the **average** speed of the object's motion during the first 3.0 second?

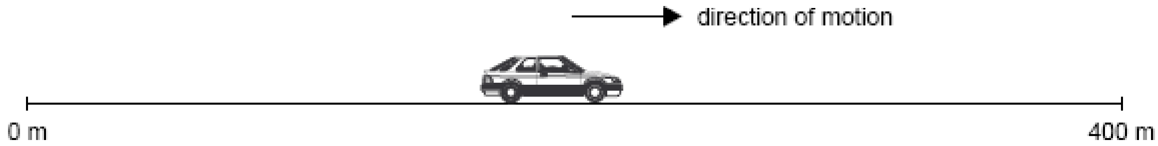
Example 10 (1983 Q2, 1 mark)

What is the object's distance from the starting point at 9.0 second?

Example 11 (1983 Q3, 1 mark)

What is the acceleration of the object at 8.5 second (magnitude and sign)?

The ‘standing 400 m’ time for a car is the time that it takes to travel 400 m on a level road, accelerating from rest.



The standing 400 m time of a car was 16.0 s.

Example 12 (2000 Q1, 2 marks)

Calculate the acceleration of the car, assuming constant acceleration for the entire journey.

A man at the top of a building 20 m high releases a stone from rest; 0.60 second later he throws a marble vertically downwards with an initial velocity of 8.0 m s^{-1}.

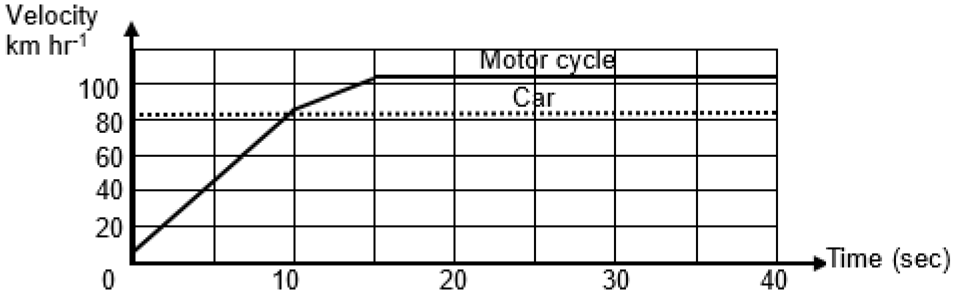
Example 13 (1980 Q1, 1 mark)

How long does it take the stone to reach the ground?

Example 14 (1980 Q3, 1 mark)

How long after the stone was dropped does the marble pass the stone?

Graphs of velocity versus time are shown below for a car and a motorcycle travelling along the same road. The car passes the stationary motorcycle at t = 0.



Example 15 (1978 Q1, 1 mark)

What is the average acceleration of the motorcycle during the first 15 seconds?

Example 16 (1978 Q3, 1 mark)

At what time does the motorcycle overtake the car?

Example 17 (2001 Q12, 3 marks)

A recent car advertisement states: 'you can legally floor the throttle for 5.9 seconds'.
This means that it takes 5.9 s to reach a speed of 100 km h^{-1} starting from rest.
Assume that this situation can be modelled as uniform acceleration.

Calculate the magnitude of the uniform acceleration of this car and state the unit of this acceleration.

Magnitude = Unit =

Example 18 (2001 Q13, 2 marks)

Calculate the distance travelled in this time of 5.9 seconds.

In a road test, a car was uniformly accelerated from rest over a distance of 400 m in 19.0 s. The driver then applied the brakes, stopping the car in 5.1 s with constant deceleration.

Example 19 (2002 Q1, 2 marks)

Calculate the acceleration of the car for the first 400 m.

Example 20 (2002 Q2, 2 marks)

Calculate the average speed of the car for the entire journey, covering both the acceleration and braking sections.

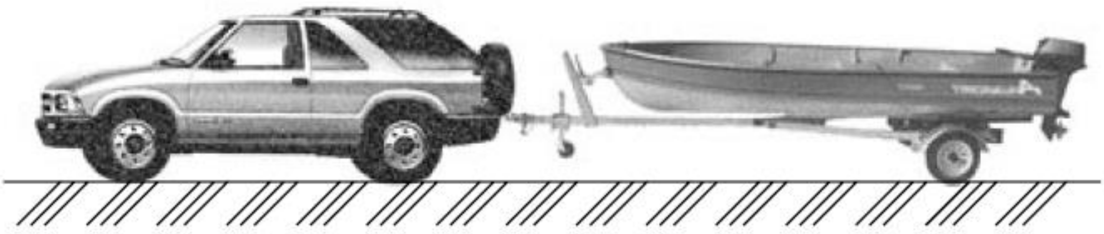


Figure 1

To overtake another car the driver accelerates at a constant rate of 1.20 m s^{-2} from 72 km h^{-1} until reaching 108 km h^{-1}.

Example 21 (2004 Q2, 3 marks)
Calculate the distance covered during this acceleration.

Figure 1 shows the speed vs time graph of a racing car accelerating through the gears with constant acceleration in each gear. The car was initially at rest.

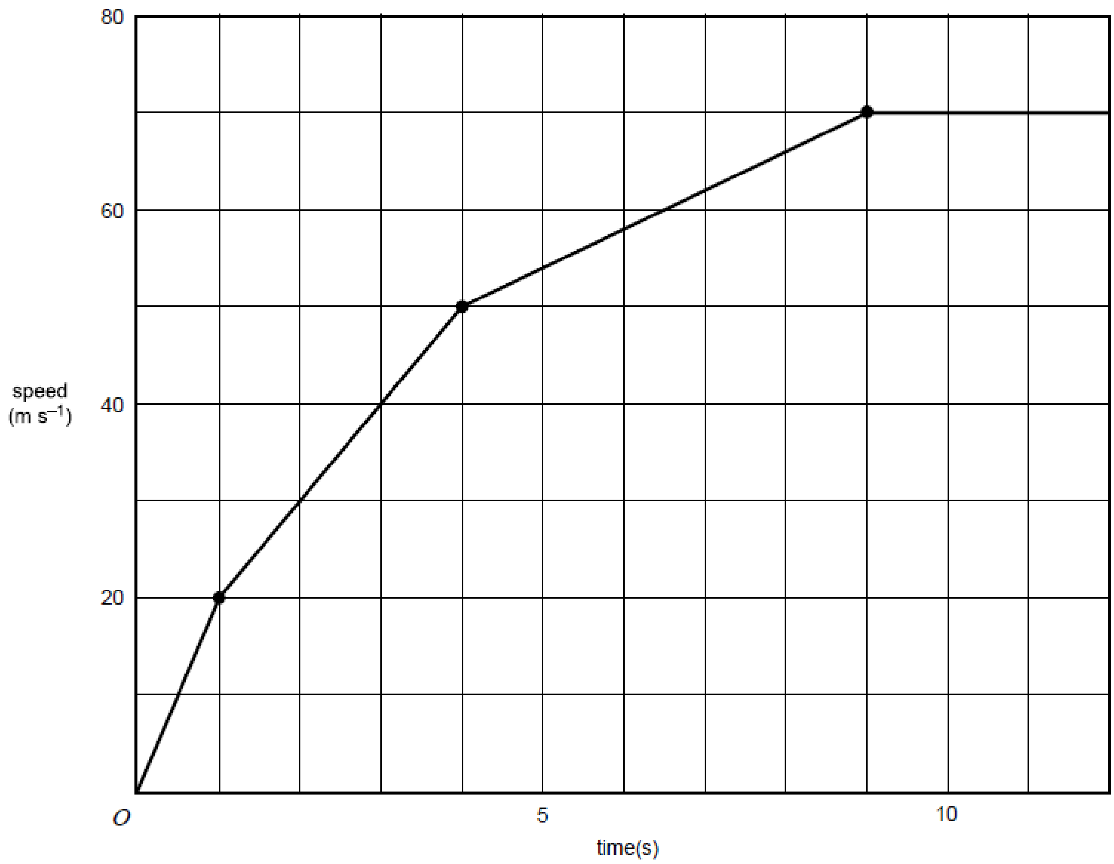


Figure 1

Example 22 (2003 Q1, 2 marks)
Calculate the distance travelled by the car uring the first **four** seconds of the motion.

Example 23 (2003 Q2, 2 marks)
Determine the magnitude of the acceleration of the car at ***t* = 3.0 s**.

Example 24 (2003 Q3, 3 marks)
Calculate the average speed of the car during the first **twelve** seconds of the motion.

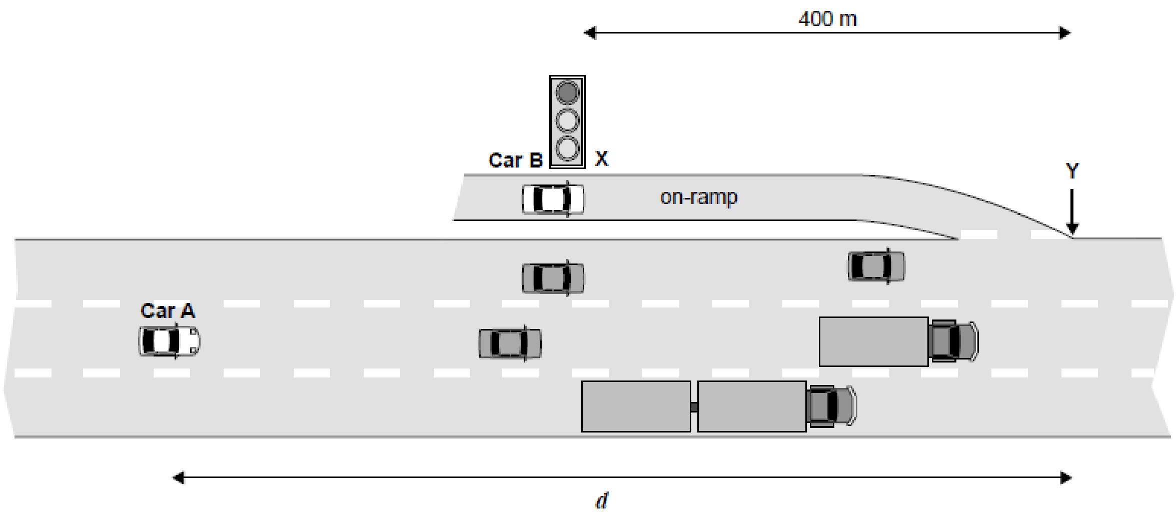


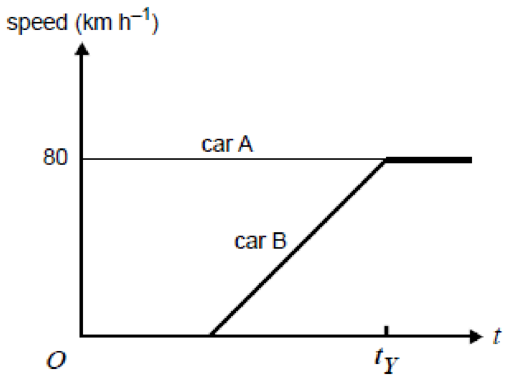
Figure 2

Figure 2 shows the merging lane of the on-ramp of a busy freeway. A set of traffic lights is installed at **X**, 400 m from **Y** where the cars merge into the traffic flow. The vehicles on the busy freeway are travelling at a constant speed of 80 km/h. When car **A**, a distance ***d*** along the road from point **Y**, is at the position shown, the traffic light at **X** changes to green. Car **B,** at the traffic light, is then expected to uniformly accelerate to 80 km/h at **Y** and merge into traffic beside car **A**.

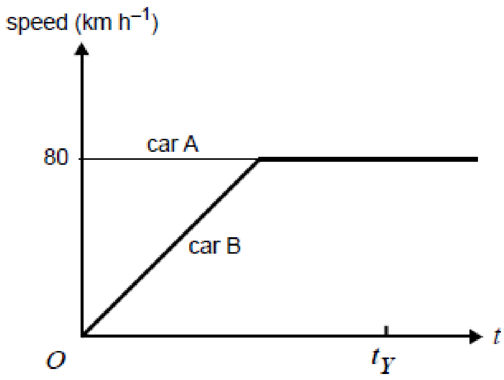
Example 25 (2003 Q4, 3 marks)
Calculate the distance ***d***. (You **must** show your working.)

Example 26 (2003 Q5, 2 marks)
Which of the speed – time graphs (A.–D.) best describes the motion of car B waiting at the traffic light and the motion of car A, from when the light changes to green (t = 0) until car B merges at time t_Y.

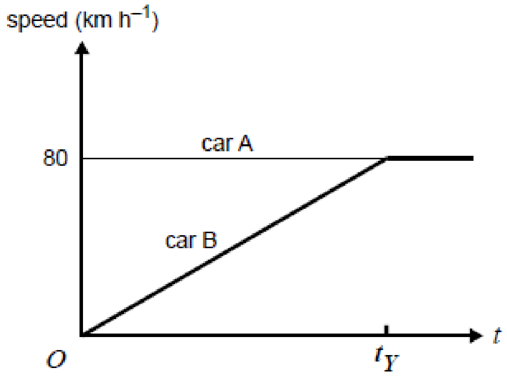
A.



B.



C.



D.