MOTION-SET-1-QP-MS

1 Fig. 3.1 shows information about two trucks, **X** and **Y**, coming to rest under the action of the same braking force.

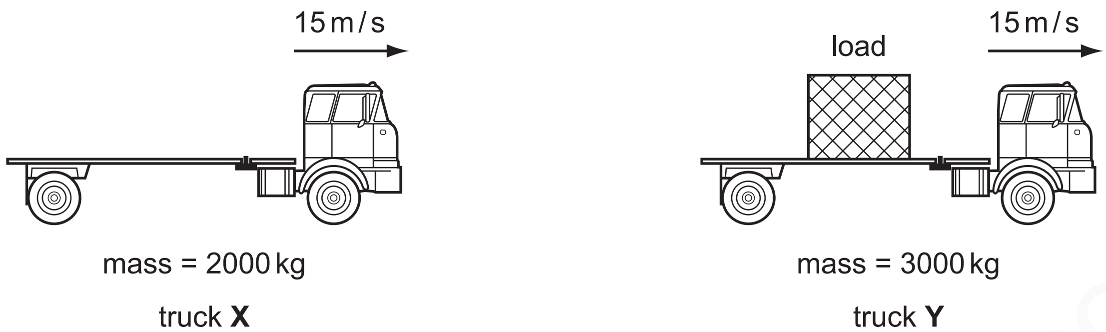


Fig. 3.1

The mass of truck **X** is 2000 kg and the mass of truck **Y** and its load is 3000 kg.

Fig. 3.2 shows the speed / time graph for the two trucks.

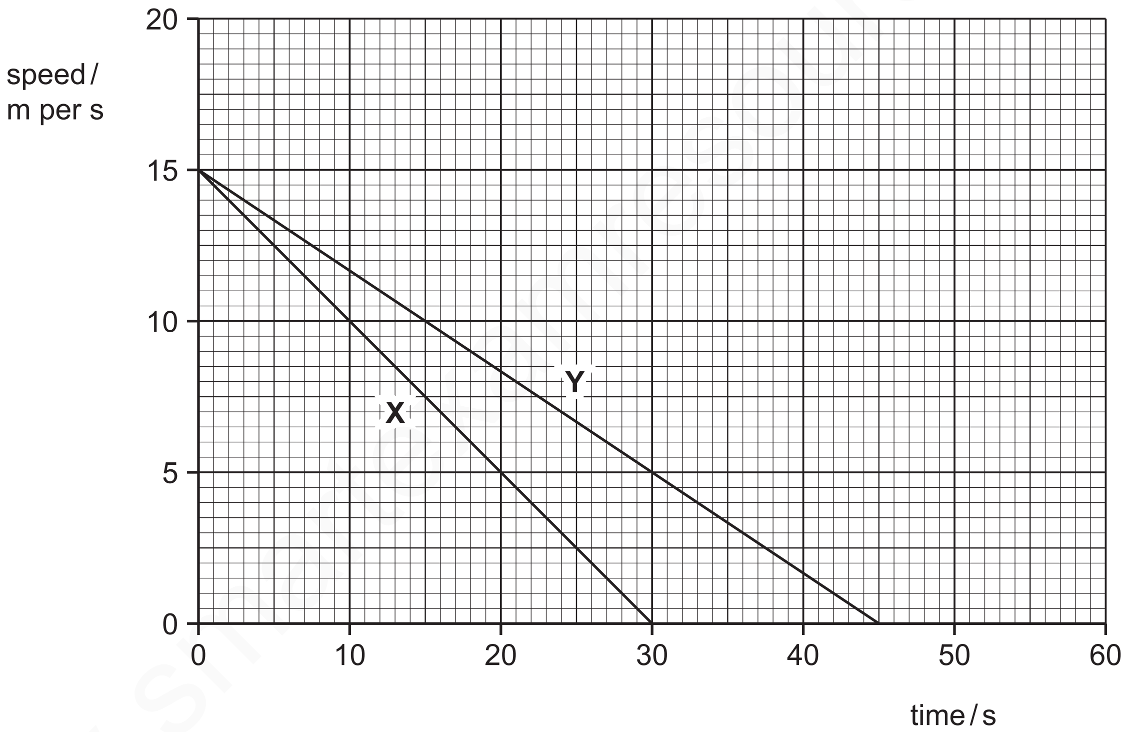


Fig. 3.2

(a) **(i)** Explain how Fig. 3.2 shows that truck **X** has the greater deceleration.

....

.... [1]

(ii) Calculate the deceleration of truck **Y**.

Show your working.

deceleration = ... m/s^2 [2]

(iii) The deceleration of truck **X** is $0.5\,m/s^2$.

Calculate the braking force on truck **X**.

State the formula that you use and show your working. State the units of your answer.

formula

working

force = ... unit .... [2]

MARKING SCHEME

(a) (i) **X** – takes less time to stop / speed decreases more quickly / gradient is greater / line is steeper ; [1]

(ii) (deceleration =) $\frac{\text{change in speed}}{\text{time}}$;

$\frac{15}{45}$ = 0.33 (m / s^2) ; [2]

(iii) (force =) mass $\times$ acceleration ;

= 2000 $\times$ 0.5 = 1000 N ; [2]

2 **(a)** Fig. 4.1 shows a graph of the motion of a truck over 40 seconds.

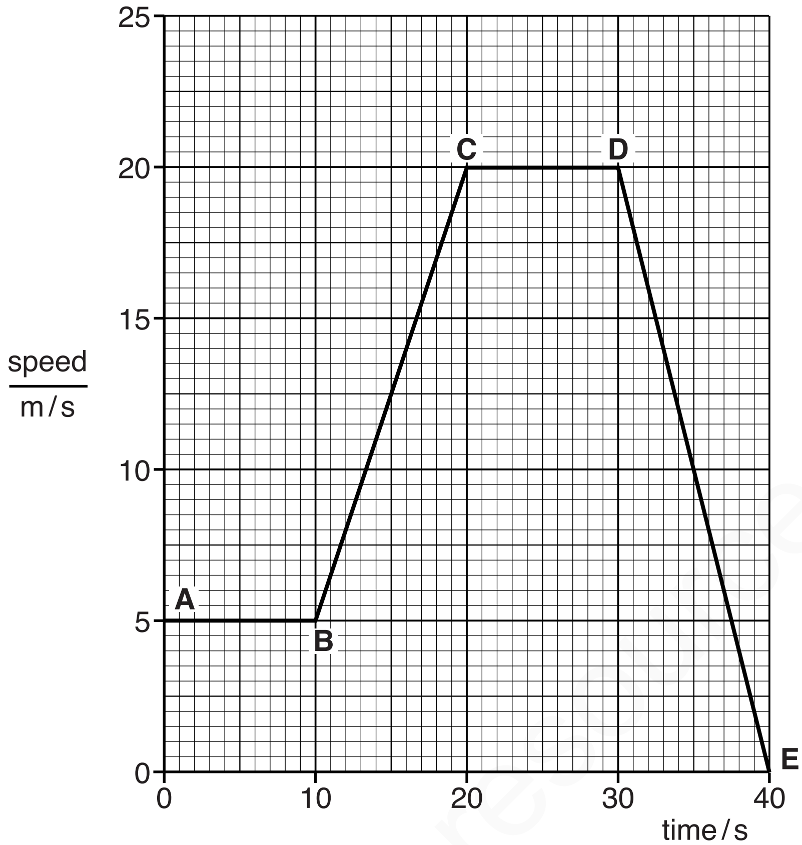


Fig. 4.1

(i) Calculate the acceleration of the truck between **B** and **C**.

Show your working.

acceleration = ... m/s^2 [2]

(ii) The mass of the truck is 2000 kg. Calculate the size of the force needed for the acceleration between **B** and **C**.

State the formula you use and show your working. State the units.

formula

working

force = ... unit = ... [3]

(iii) Calculate the distance travelled by the truck in the time that the speed is decreasing.

Show your working.

distance = ... m [2]

(b) The driver stops the truck. He receives an electric shock when he gets out of the truck.

(i) Suggest why the driver receives an electric shock.

....

....

....

....[2]

(ii) The shock is caused by a current of 0.004 A passing for 0.1 ms.

Calculate the charge which passes.

State the formula you use and show your working.

formula

working

charge = ... C [2]

MARKING SCHEME

a) **(i)** (acceleration =) change in speed / time or
(acceleration =) 15 / 10 ;
= 15 (m / s^2) ; [2]

(ii) (force =) mass × acceleration or
(force) = 2000 × 1.5 ;
= 3000 ;
N ; [3]

(iii) area under graph or evidence on graph or
$\frac{1}{2} \times 20 \times 10$;
100 (m) ; [2]

(b) **(i)** charge ;
friction ;
electron transfer ;
(complete circuit) to / from earth ; [max 2]

(ii) (charge =) current × time or
= 0.004 × 0.0001 ;
= 0.0000004 / 4×10^{-7} (C) ; [2]

[Total: 11]

3 Fig. 7.1 shows the motion of a bus from one stop to the next.

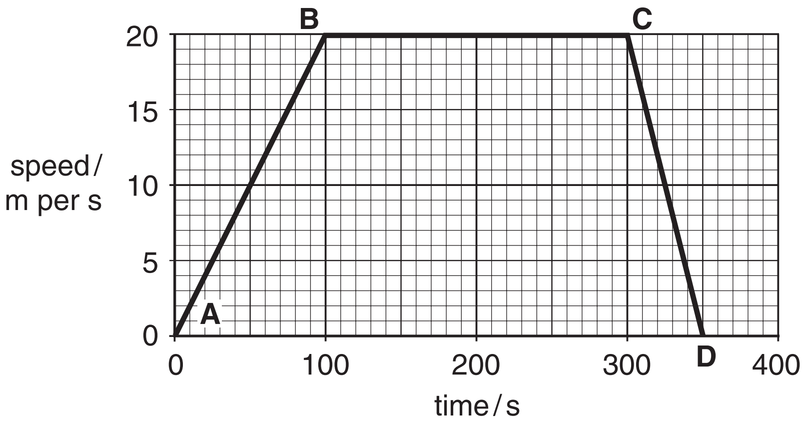


Fig. 7.1

(a) Describe the motion of the bus during **BC** and during **CD**.

BC ....

....

CD ....

....[2]

(b) Calculate the distance covered by the bus from **A** to **D**. Show your working.

....[3]

(c) Fig. 7.2 shows two toy buses. Bus **A** has a mass of 0.5 kg and bus **B** has a mass of 0.3 kg. Both buses are moving in the same direction.

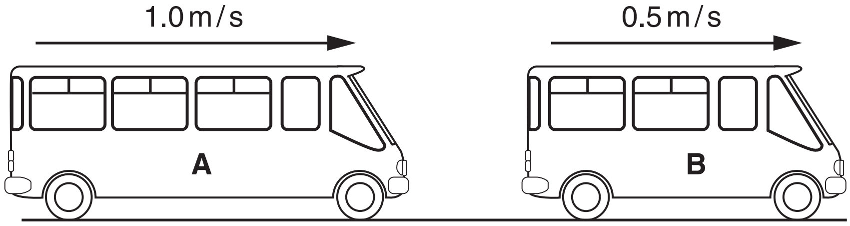


Fig. 7.2

Bus **A** is travelling at 1.0 m / s and bus **B** is travelling at 0.5 m / s. When they collide, bus **A** and bus **B** join together and move in the same direction.

Calculate the speed at which they continue to move.

Show your working and state the formula that you use.

formula used

working

....[3]

MARKING SCHEME

(a	BC constant speed/20 ms^{-1}; CD slowing (to a stop)/decelerating (to 0 ms^{-1});	**2**
(b)	evidence of working; AB 1000 m, BC 4000 m, CD 500 m; total distance = 5500 m;	**3**
(c)	momentum = mass x velocity *or* formula showing initial momentum = final momentum; working; v = 0.8125 ms^{-1};	**3**

4 Fig. 6.1 shows the speed-time graph for a car for the first 24 seconds of a journey.

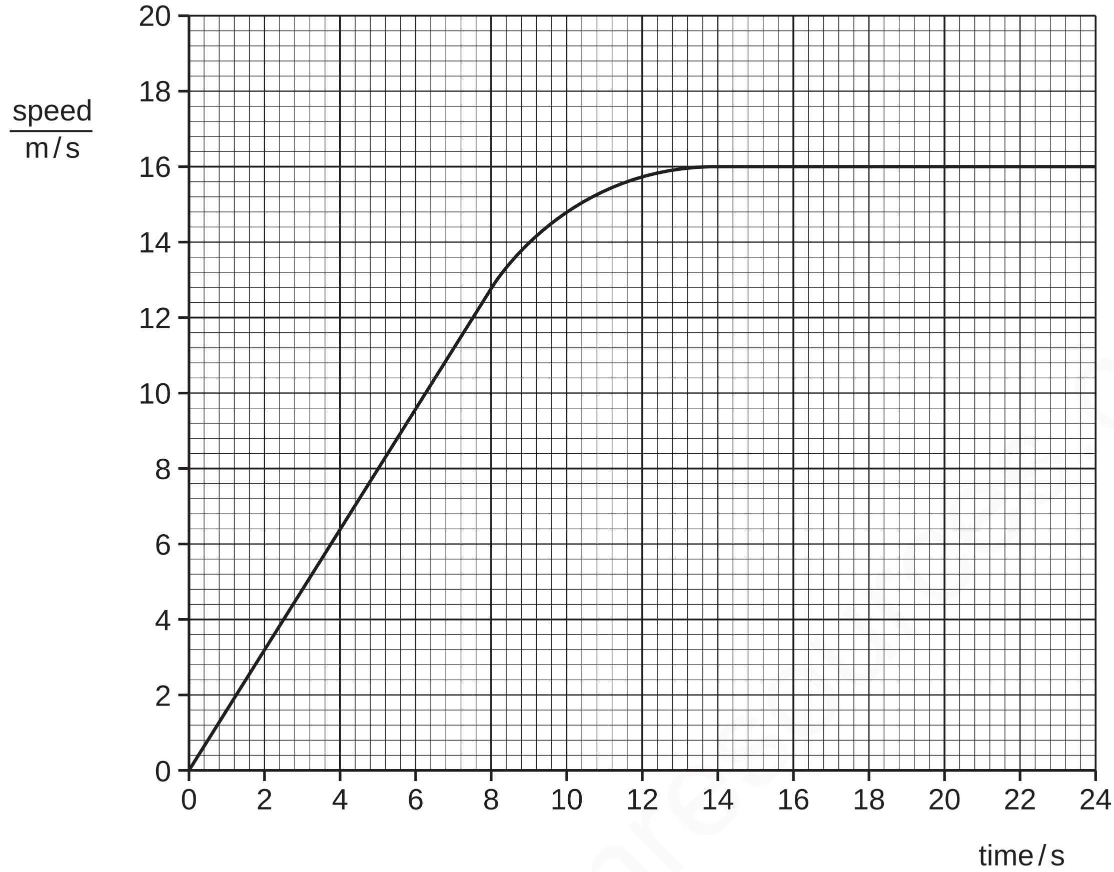


Fig. 6.1

(a) On the graph, label with an **A** a section when the car is accelerating. [1]

(b) Calculate the distance covered in the first 8 seconds.

Show your working.

.... [2]

(c) The mass of the car is 800 kg.

Calculate the kinetic energy of the car when travelling at its maximum speed on this journey.

State the formula that you use and show your working.

formula used

working

.... [3]

(d) When the speed of a car doubles, its momentum also doubles but its kinetic energy is four times greater.

Explain why.

....

....

....

.... [2]

MARKING SCHEME

(a) **A** written anywhere between 0 and 13 seconds ; [1]

(b) area under graph / other working ;
½ × 12.8 × 8 = 51.2 m ; [2]

(c) maximum speed = 16 m / s
KE = ½ mv^2 ;
= 0.5 × 800 × 16 × 16 = 102 400 J ; [3]

(d) momentum is directly proportional to v / momentum = mv ;
KE is directly proportional to v^2 / explained using numbers ; [2]

[Total: 8]

5 **(a)** Fig. 7.1 shows a speed-time graph for the performance of an athlete in a race.

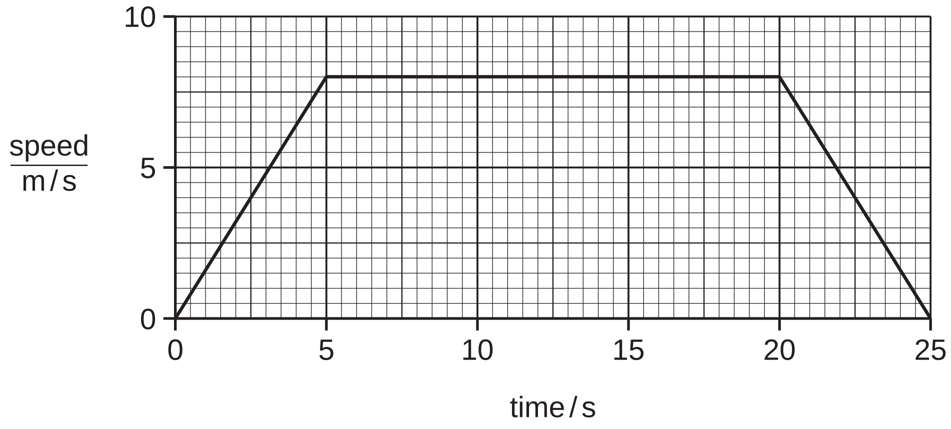


Fig. 7.1

Calculate the distance the athlete travelled between 0 and 25 seconds.

Show your working.

.... [3]

(b) Another athlete in the race has a mass of 70 kg. Her initial forward acceleration was 1.5 m/s^2.

Calculate the force needed to give this acceleration.

State the formula that you use and show your working.

formula

working

.... [2]

(c) The power output of the athlete is 600 W.

Calculate the amount of work done by the athlete over 5 seconds.

Show your working.

.... [2]

(d) After the race, the athletes are sweating. The sweat evaporates from the surface of their skin.

Describe the process of evaporation in terms of particles.

....

....

....

....

.... [3]

MARKING SCHEME

(a) working may be shown on graph / idea of area under graph ;
(½ × 5 × 8) + (15 × 8) + (½ × 5 × 8) ;
= 160 m ; [3]

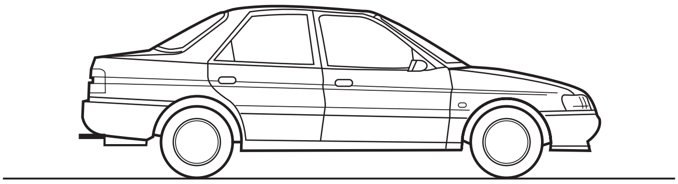
(b) force = mass × acceleration ;
= 70 × 1.5 = 105 N ; [2]

(c) work = power × time ;
= 600 × 5 = 3000 J ; [2]

(d) heat transferred into (water) particles (from surroundings) ;
(water) changes from liquid to gas ;
ref. attraction between particles in the liquid ;
fastest moving / more energetic, particles escape ;
(escape) at surface / ref. to process happening at temperature below boiling point ;
average energy of rest of particles reduced / heat removed from liquid ; [max 3]

[Total: 10]

6 A car is being driven on a journey.



(a) **(i)** State the **two** quantities needed to find the momentum of the car.

.... and .... [1]

(ii) The car turns a corner without changing speed.

Explain why the momentum of the car has changed.

....

....

.... [2]

(b) Fig 3.1 shows a speed–time graph for part of the car's journey, during which the brakes are used.

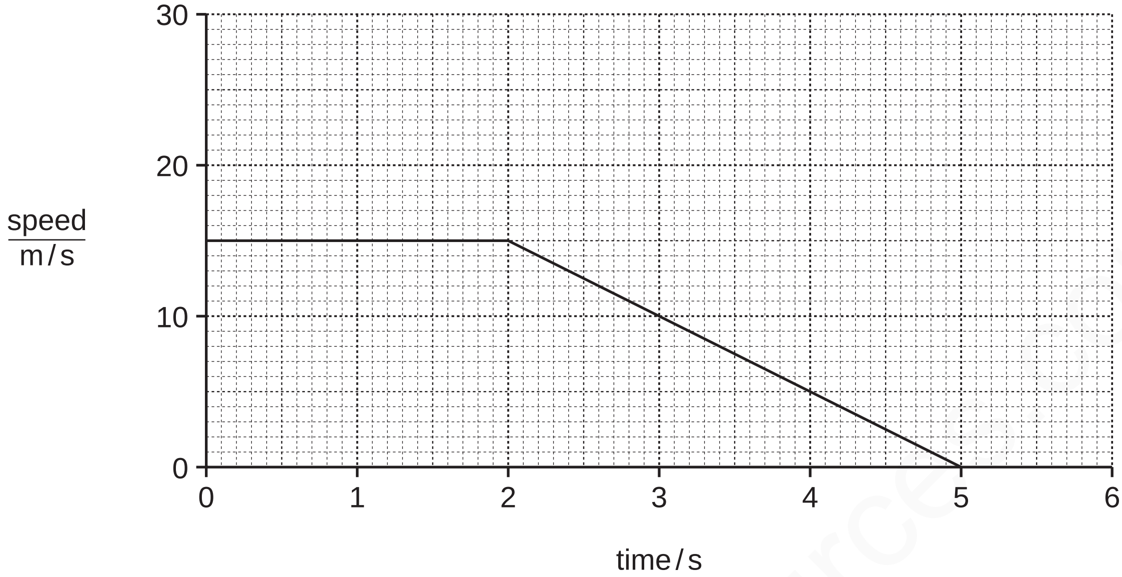


Fig. 3.1

(i) Mark with an **X** the point on the graph at which the brakes are applied. [1]

(ii) Calculate the deceleration of the car.

Show your working.

.... [2]

(iii) Calculate the distance travelled by the car during deceleration.

Show your working.

.... [2]

(c) Fig 3.2 shows the circuit diagram of the parallel circuit used to supply electrical energy to two identical headlamps in the car.

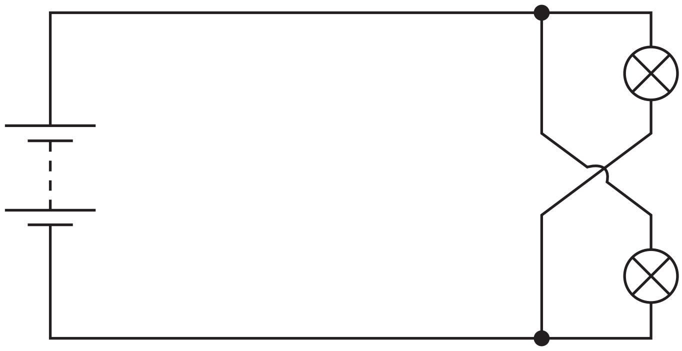


Fig 3.2

The current through the filament of one headlamp is 2.4 A. The potential difference across each of the headlamps is 12 V.

(i) Calculate the resistance of the headlamp filament whilst in use.

State the formula that you use and show your working.

formula used

working

.... [2]

(ii) Calculate the total resistance of the two headlamps in parallel.

State the formula that you use and show your working.

formula used

working

.... [3]

MARKING SCHEME

(a) **(i)** mass and velocity ; [1]

(ii) velocity / momentum are vector quantities ;
direction has changed ; [2]

(b) **(i)** **X** at 2 seconds ; [1]

(ii) (deceleration =) change in speed / time (or gradient) **OR** 15 / 3 **OR** rise ÷ run ;
= 5 m / s^2 ; [2]

(iii) area under graph ;
22.5 m ; [2]

(c) **(i)** (resistance =) voltage / current ;
= 12 / 2.4 = 5 Ω ; [2]

(ii) 1 / R = 1 / R1 + 1 / R2 ;
= 1 / 5 + 1 / 5 ;
(R = 5 / 2 =) 2.5 Ω ; [3]

[Total: 13]

7 Fig. 9.1 shows a toy car of mass 0.5 kg being pushed along a plastic surface.

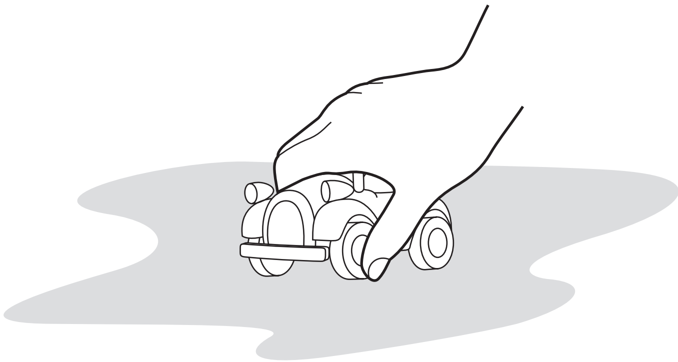


Fig. 9.1

(a) The car is moving at a steady speed of 0.5 m / s.

Calculate the kinetic energy of the car.

State the formula that you use and show your working.

formula used

working

.... [2]

(b) While the car is moving, the wheels are rubbing against the plastic surface. The car becomes electrostatically charged with a positive charge.

Explain how this happens.

....

....

....

....

.... [3]

(c) A speed – time graph for the car is shown in Fig. 9.2. It shows the motion of the car over a 25 second period.

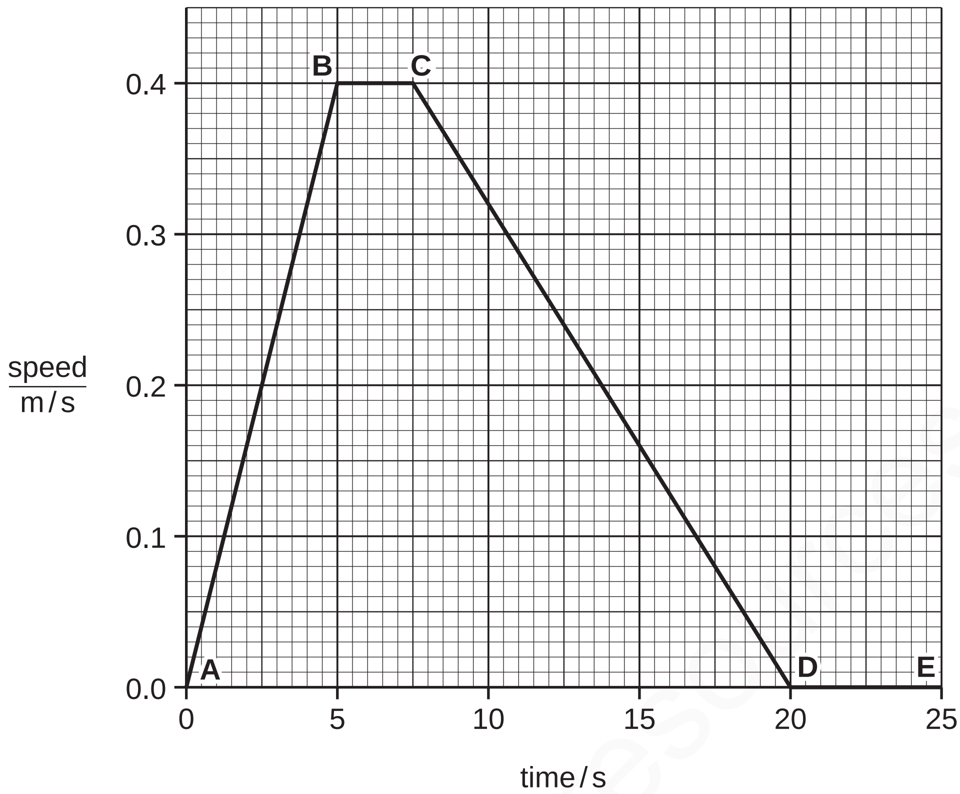


Fig. 9.2

(i) State **one** part of the graph when the car was moving at constant speed and write down the value of this speed.

part of graph ....

speed .... [1]

(ii) Calculate the distance travelled by the car between **A** and **D**.

Show your working.

.... [3]

MARKING SCHEME

(a) (KE) = ½ mv^2 ;
= ½ × 0.5 × 0.5 × 0.5 = 0.0625 J ; [2]

(b) friction ;
between materials / as / when wheels rub against plastic (conditional on friction) ;
electrons are lost from car / gained by plastic surface ;
reference to charge imbalance / unequal numbers of protons and electrons ; [3]

(c) **(i)** **B** to **C** / 5 to 7.5 **and** 0.4 (m / s) ; [1]

(iii) area under graph ;
= (½ × 0.4 × 5) (+ 0.4 × 2.5) + (0.4 × 12.5 × ½) / = (1 + 1.0 + 2.5) ;
= 4.5 m ; [3]

[Total:9]