Motion

Question Paper 8

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	General Physics
Sub-Topic	Motion
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 8

Time Allowed: **84 minutes**

Score: **/70**

Percentage: **/100**

1 An experiment is carried out to find the acceleration of free fall.

A strip of paper is attached to a heavy object. The object is dropped and falls to the ground, pulling the paper strip through a timer. The timer marks dots on the paper strip at intervals of 0.020 s.

Fig. 1.1 shows a section of the paper strip with the first three dots marked. The first dot on the paper strip, labelled A, is marked at the instant the object is dropped.

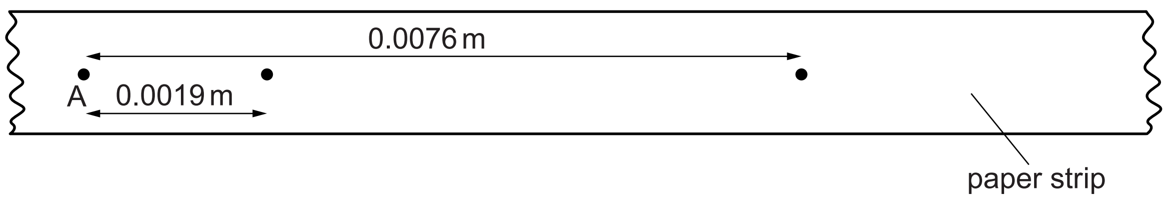

Fig. 1.1 (not to scale)

(a) State how the dots on the paper strip show that the object is accelerating.

....

....[1]

(b) Calculate the average speed of the object

(i) in the first 0.020 s after the object is dropped,

average speed = ...

(ii) in the second 0.020 s after the object is dropped.

average speed = ...
[3]

(c) Use the results from **(b)** to calculate the acceleration of the falling object.

acceleration = ...[3]

[Total: 7]

2 Fig. 2.1 shows a model fire engine used by a student to take measurements of force and motion.

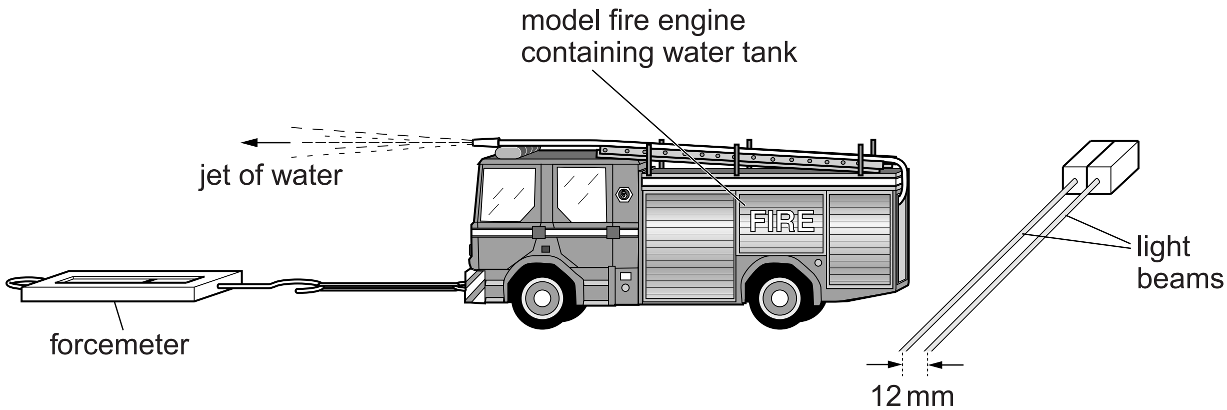

Fig. 2.1

The model projects a jet of water forwards. The forcemeter holds the model stationary. It indicates a force of 0.060 N acting on the model.

The forcemeter is now disconnected and the model accelerates to the right at $0.030\,m/s^2$.

(a) The back of the model breaks a pair of light beams and the time to pass between them is measured electronically. The beams are 12 mm apart and the second beam is broken 0.080 s after the first.

The student times with a stopwatch how long it takes from the release of the model until the beams are cut.

Calculate the time he measures.

time measured = ... [4]

(b) This experiment is carried out with the water tank in the model nearly full.

Calculate the mass of the model including the water in the tank.

mass = ... [2]

(c) The student repeats the experiment with the same force but with the water tank nearly empty.

State and explain how the acceleration will compare to that of the first experiment.

....

....

....

....

....[2]

[Total: 8]

3 **(a)** Complete the table below to identify the physical quantities as scalars or vectors.

physical quantity	scalar or vector
speed	
velocity	
distance	
force	
kinetic energy	

[3]

(b) Fig. 1.1 shows the path of a football as it is kicked along the ground between three players. The distances between the players are shown on Fig. 1.1.

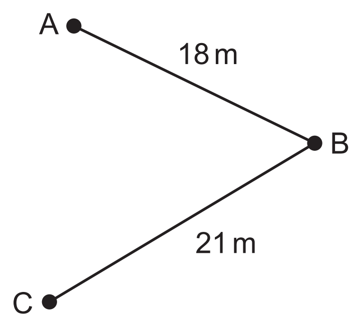

Fig. 1.1

The ball takes 1.2 s to travel from player A to player B.

(i) Calculate the average speed of the ball between A and B.

average speed = ...[2]

(ii) Player B kicks the ball to player C.
It travels with the same average speed.
Calculate the time taken for the ball to travel from B to C.

time = ...[2]

(iii) Suggest why the speed of the ball might change during its motion from A to B.

....

....[1]

(iv) Discuss whether the average velocities, from A to B and from B to C, are the same.

....

....

....[1]

[Total: 9]

4 **(a)** Define *acceleration*. Explain any symbols in your definition.

....

....[1]

(b) Fig. 1.1 shows a graph of speed against time for a train. After 100 s the train stops at a station.

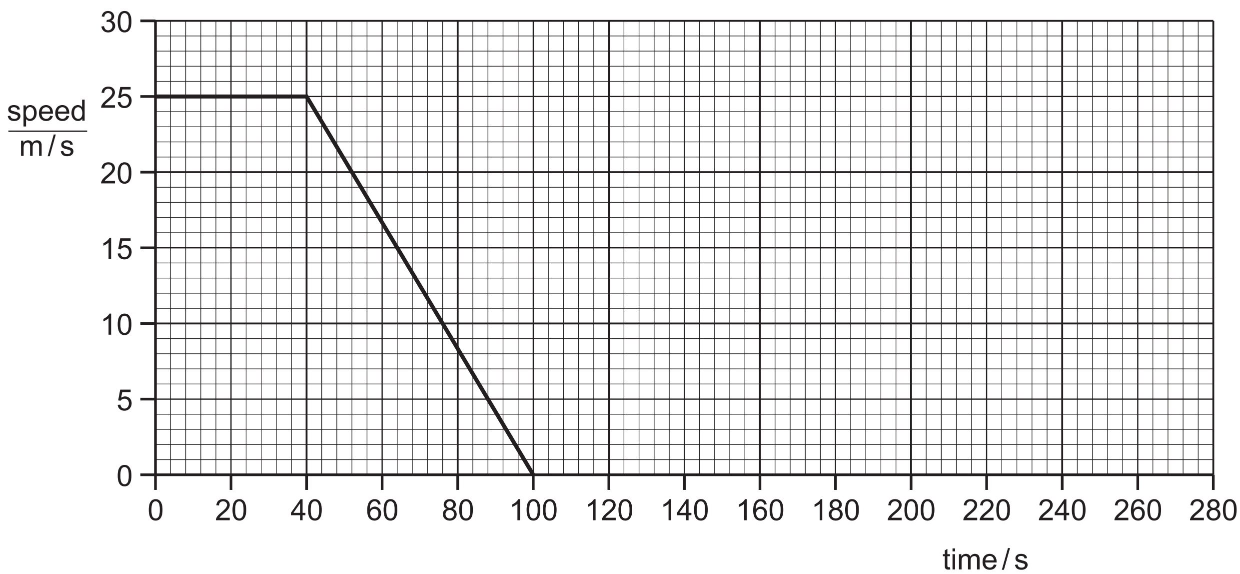

Fig. 1.1

(i) For the time interval between 40 s and 100 s, calculate the distance travelled by the train.

distance = ...[2]

(ii) The train stops for 80 s, then accelerates to 30 m / s with an acceleration of 0.60 m / s^2. It then travels at constant speed.

Complete the graph for the interval 100 s to 280 s, showing your calculations in the space below.

[5]

[Total: 8]

5 The racing car shown in Fig. 2.1 uses a Kinetic Energy Recovery System (KERS). This system stores within the car some of the kinetic energy lost when the car slows down for a corner. The driver can later release the stored energy when maximum power is required.

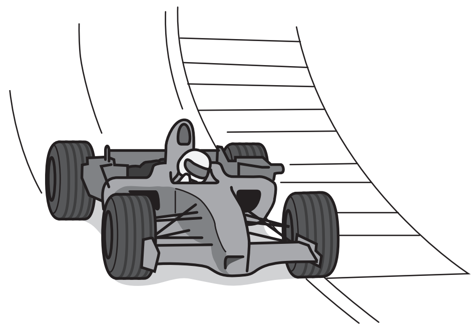

Fig. 2.1

(a) The car approaches a corner and decelerates from 82 m / s to 61 m / s in 0.90 s. Calculate the deceleration.

deceleration = ... [2]

(b) **(i)** The energy lost during the braking in **(a)** is 8.4×10^5 J. 40% of this lost energy is directed to the KERS system. Determine the amount of energy stored.

energy stored = ...

(ii) The driver later uses all of this stored energy to give 60 kW of useful extra power for 3.0 s. Calculate the energy released.

energy released = ...

(iii) Calculate the efficiency of the KERS system.

efficiency = ...
[4]

(c) Suggest a possible device to store energy when a moving vehicle slows down. For this device, state the change that occurs as more energy is stored.

device ....

change ....

....

.... [2]

[Total: 8]

6 A hillside is covered with snow. A skier is travelling down the hill.

Fig. 1.1

The table below gives the values of the acceleration of the skier at various heights above the bottom of the hill.

height / m	350	250	150	50
acceleration / m/s^2	7.4	3.6	1.2	0

(a) On Fig. 1.2, plot the values given in the table, using dots in circles.

Draw the best curve for these points. [2]

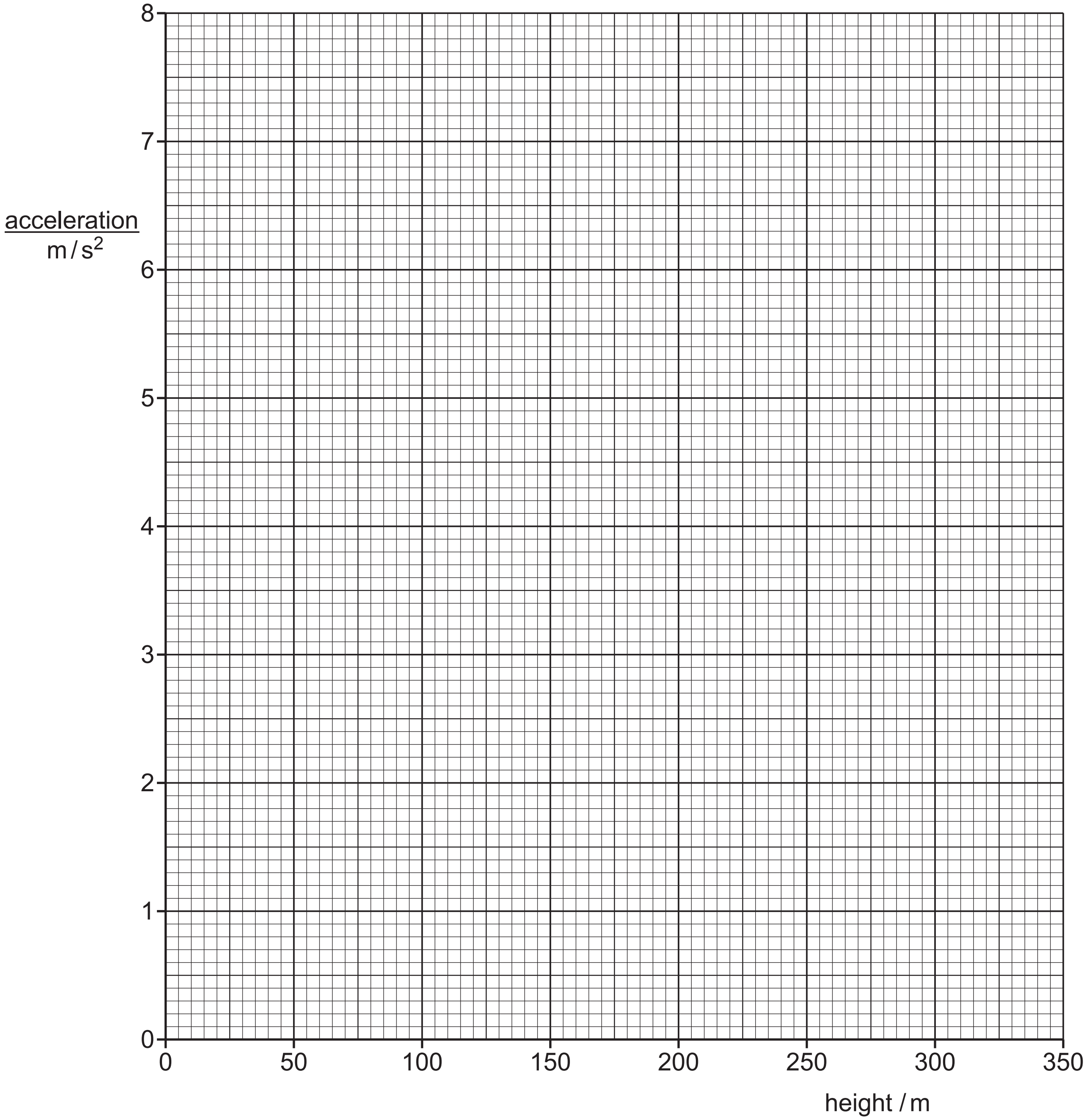

Fig. 1.2

(b) Describe what is happening, during the descent, to

(i) the acceleration of the skier,

....

....

.... [1]

(ii) the speed of the skier.

....

....

.... [1]

(c) The acceleration becomes zero before the skier reaches the bottom of the hill.

Use ideas about forces to suggest why this happens.

....

.... [1]

(d) Below a height of 50 m, further measurements show that the acceleration of the skier has a negative value.

What does this mean is happening to the speed of the skier in the last 50 m?

....

.... [1]

(e) The skier has a mass of 60 kg.

Calculate the resultant force on the skier at a height of 250 m.

resultant force = ... [3]

[Total: 9]

7 Fig. 1.1 shows apparatus used to find a relationship between the force applied to a trolley and the acceleration caused by the force.

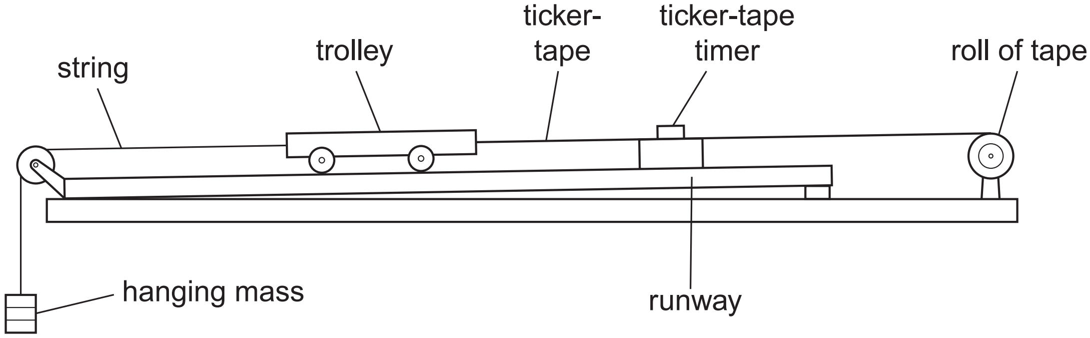

Fig. 1.1

For each mass, hung as shown, the acceleration of the trolley is determined from the tape. Some of the results are given in the table below.

weight of the hanging mass / N	**acceleration of the trolley** **m/s^2**
0.20	0.25
0.40	0.50
0.70	
0.80	1.0

(a) **(i)** Explain why the trolley accelerates.

....

.... [2]

(ii) Suggest why the runway has a slight slope as shown.

....

.... [1]

(b) Calculate the mass of the trolley, assuming that the accelerating force is equal to the weight of the hanging mass.

mass = ... [2]

(c) Calculate the value missing from the table. Show your working.

value = ... [2]

(d) In one experiment, the hanging mass has a weight of 0.4 N and the trolley starts from rest.

Use data from the table to calculate

(i) the speed of the trolley after 1.2 s,

speed = ... [2]

(ii) the distance travelled by the trolley in 1.2 s.

distance = ... [2]

[Total: 11]

8 Fig. 1.1 shows a model car moving clockwise around a horizontal circular track.

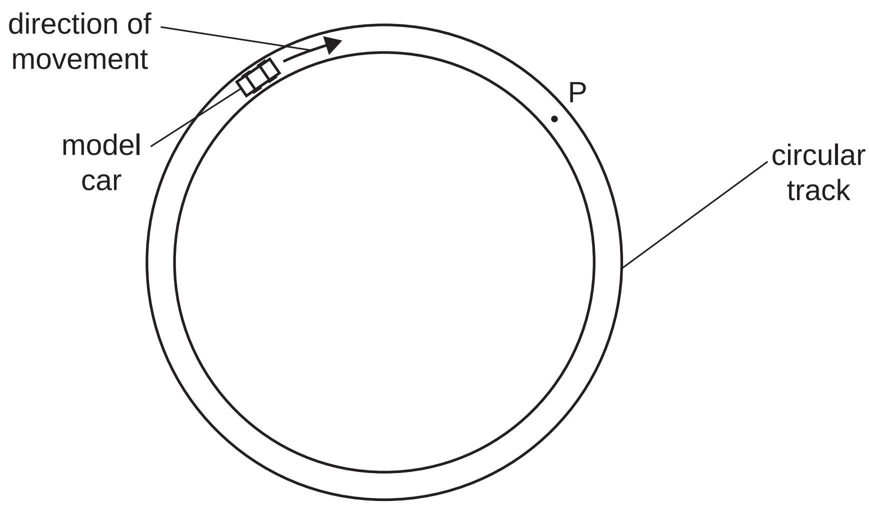

Fig. 1.1

(a) A force acts on the car to keep it moving in a circle.

(i) Draw an arrow on Fig. 1.1 to show the direction of this force. [1]

(ii) The speed of the car increases. State what happens to the magnitude of this force.

.... [1]

(b) **(i)** The car travels too quickly and leaves the track at P. On Fig. 1.1, draw an arrow to show the direction of travel after it has left the track. [1]

(ii) In terms of the forces acting on the car, suggest why it left the track at P.

....

....

.... [2]

(c) The car, starting from rest, completes one lap of the track in 10 s. Its motion is shown graphically in Fig. 1.2.

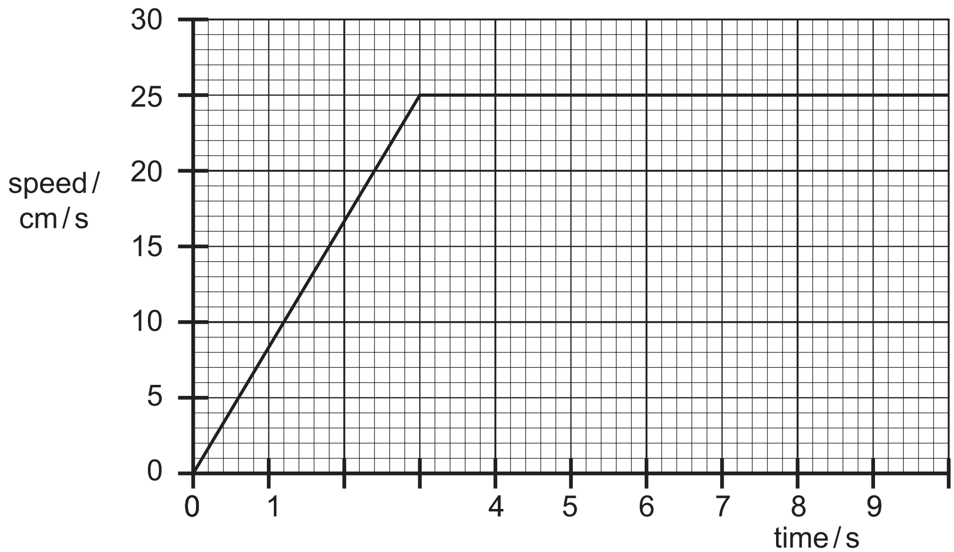

Fig. 1.2

(i) Describe the motion between 3.0 s and 10.0 s after the car has started.

.... [1]

(ii) Use Fig. 1.2 to calculate the circumference of the track.

circumference = ... [2]

(iii) Calculate the increase in speed per second during the time 0 to 3.0 s.

increase in speed per second = ... [2]

[Total: 10]