Motion Graphs

Question paper 4

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Kinematics
Sub Topic	Motion Graphs
Paper Type	Theory
Booklet	Question paper 4

Time Allowed: **48 minutes**

Score: **/40**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** State what is meant by *work done*.

.....

..... [1]

(b) A trolley of mass 400 g is moving at a constant velocity of 2.5 m s^{-1} to the right as shown in Fig. 3.1.

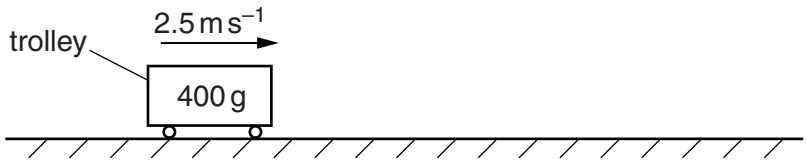

Fig. 3.1

Show that the kinetic energy of the trolley is 1.3 J.

[2]

(c) The trolley in **(b)** moves to point P as shown in Fig. 3.2.

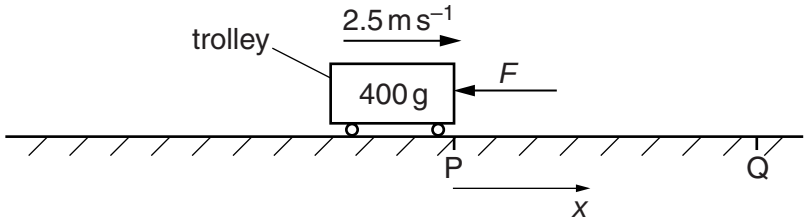

Fig. 3.2

At point P the speed of the trolley is 2.5 m s^{-1}.
A variable force *F* acts to the left on the trolley as it moves between points P and Q.
The variation of *F* with displacement *x* from P is shown in Fig. 3.3.

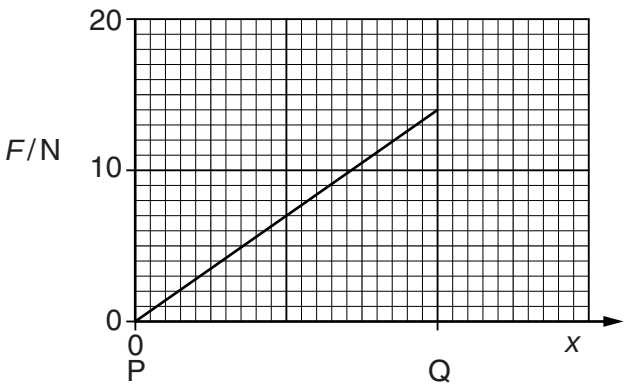

Fig. 3.3

The trolley comes to rest at point Q.

(i) Calculate the distance PQ.

distance PQ = ... m [3]

(ii) On Fig. 3.4, sketch the variation with *x* of velocity *v* for the trolley moving between P and Q.

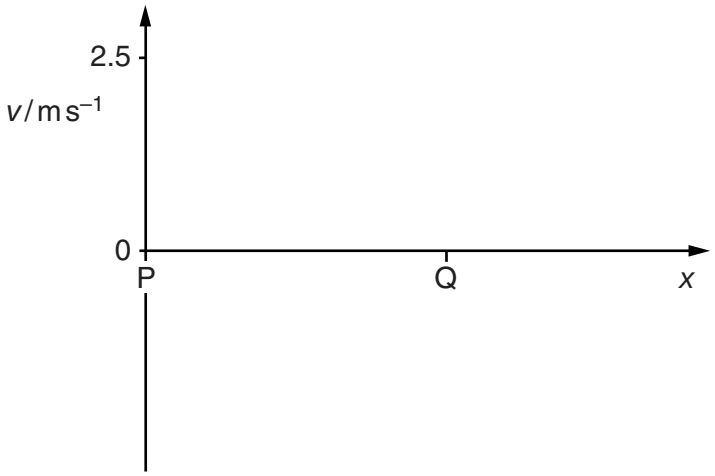

Fig. 3.4

[2]

2 **(a)** **(i)** Define *acceleration*.

.....

..... [1]

(ii) State Newton's first law of motion.

.....

..... [1]

(b) The variation with time *t* of vertical speed *v* of a parachutist falling from an aircraft is shown in Fig. 1.1.

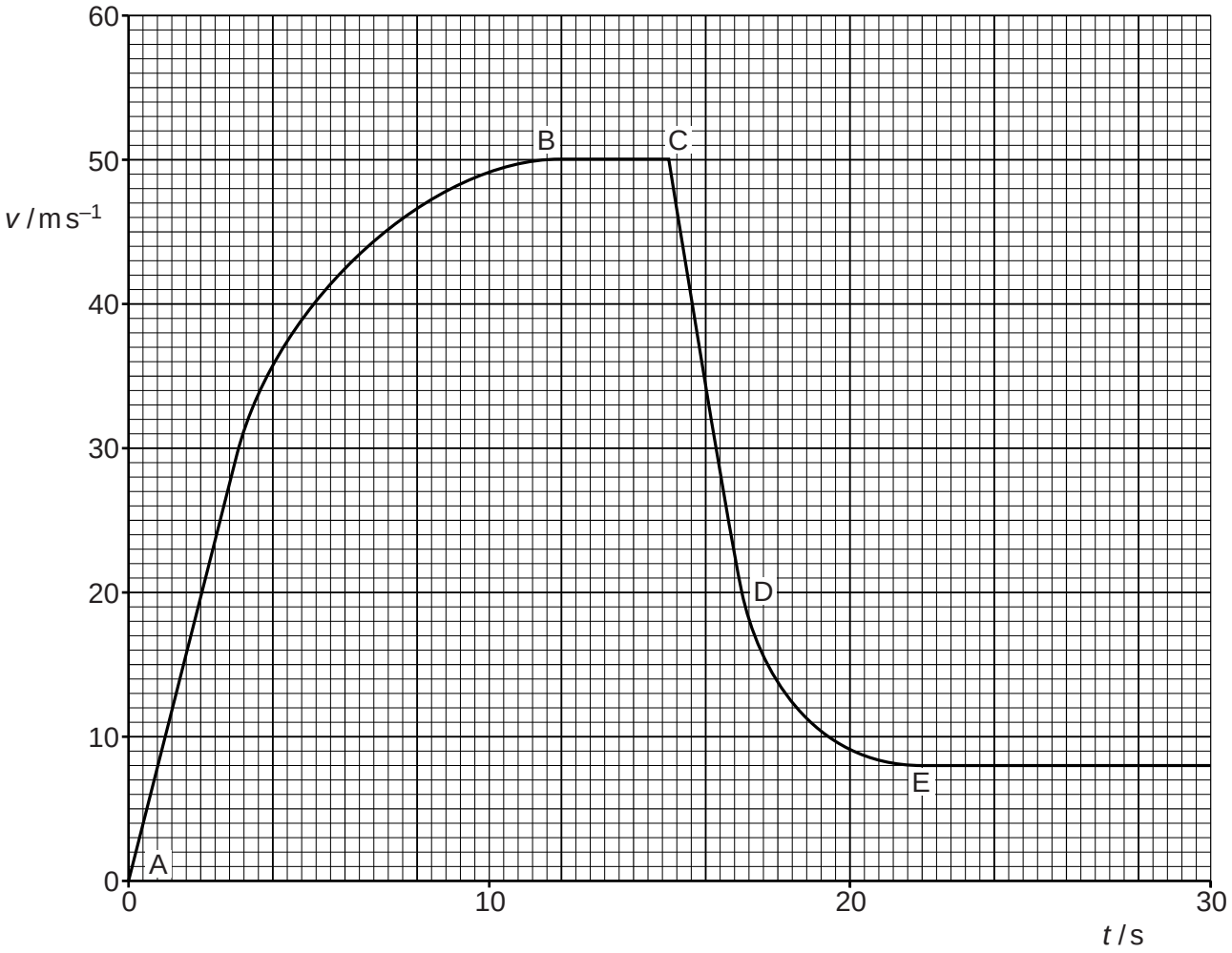

Fig. 1.1

(i) Calculate the distance travelled by the parachutist in the first 3.0 s of the motion.

distance = ... m [2]

(ii) Explain the variation of the resultant force acting on the parachutist from t = 0 (point A) to t = 15 s (point C).

.....

.....

.....

.....

..... [3]

(iii) Describe the changes to the frictional force on the parachutist

1. at t = 15 s (point C),

.....

.....

..... [1]

2. between t = 15 s (point C) and t = 22 s (point E).

.....

.....

..... [1]

(iv) The mass of the parachutist is 95 kg.

Calculate, for the parachutist between t = 15 s (point C) and t = 17 s (point D),

1. the average acceleration,

acceleration = ... $m\,s^{-2}$ [2]

2. the average frictional force.

frictional force = ... N [3]

3 A motor drags a log of mass 452 kg up a slope by means of a cable, as shown in Fig.

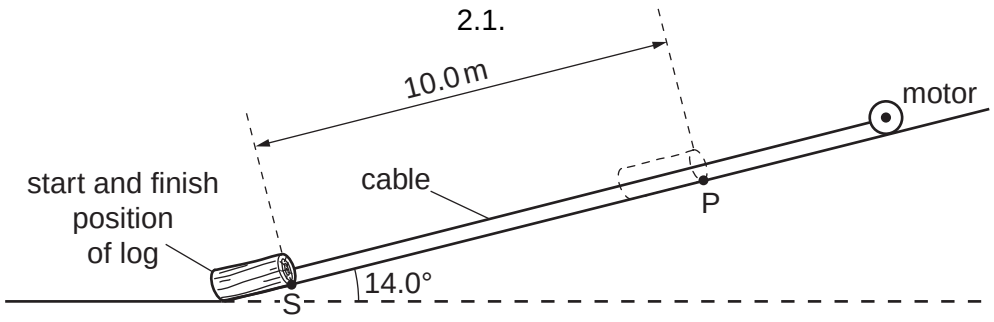

Fig. 2.1

The slope is inclined at 14.0° to the horizontal.

(a) Show that the component of the weight of the log acting down the slope is 1070 N.

[1]

(b) The log starts from rest. A constant frictional force of 525 N acts on the log. The log accelerates up the slope at 0.130 m s^{-2}.

(i) Calculate the tension in the cable.

tension = ... N [3]

(ii) The log is initially at rest at point S. It is pulled through a distance of 10.0 m to point P.

Calculate, for the log,

1. the time taken to move from S to P,

time = ... s [2]

2. the magnitude of the velocity at P.

velocity = ... $m\,s^{-1}$ [1]

(c) The cable breaks when the log reaches point P. On Fig. 2.2, sketch the variation with time *t* of the velocity *v* of the log. The graph should show *v* from the start at S until the log returns to S. [4]

Fig. 2.2

4 A student has been asked to determine the linear acceleration of a toy car as it moves down a slope. He sets up the apparatus as shown in Fig. 3.1.

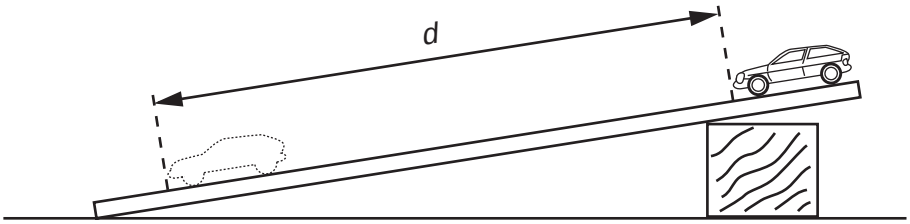

Fig. 3.1

The time t to move from rest through a distance d is found for different values of d. A graph of d (y-axis) is plotted against t^2 (x-axis) as shown in Fig. 3.2.

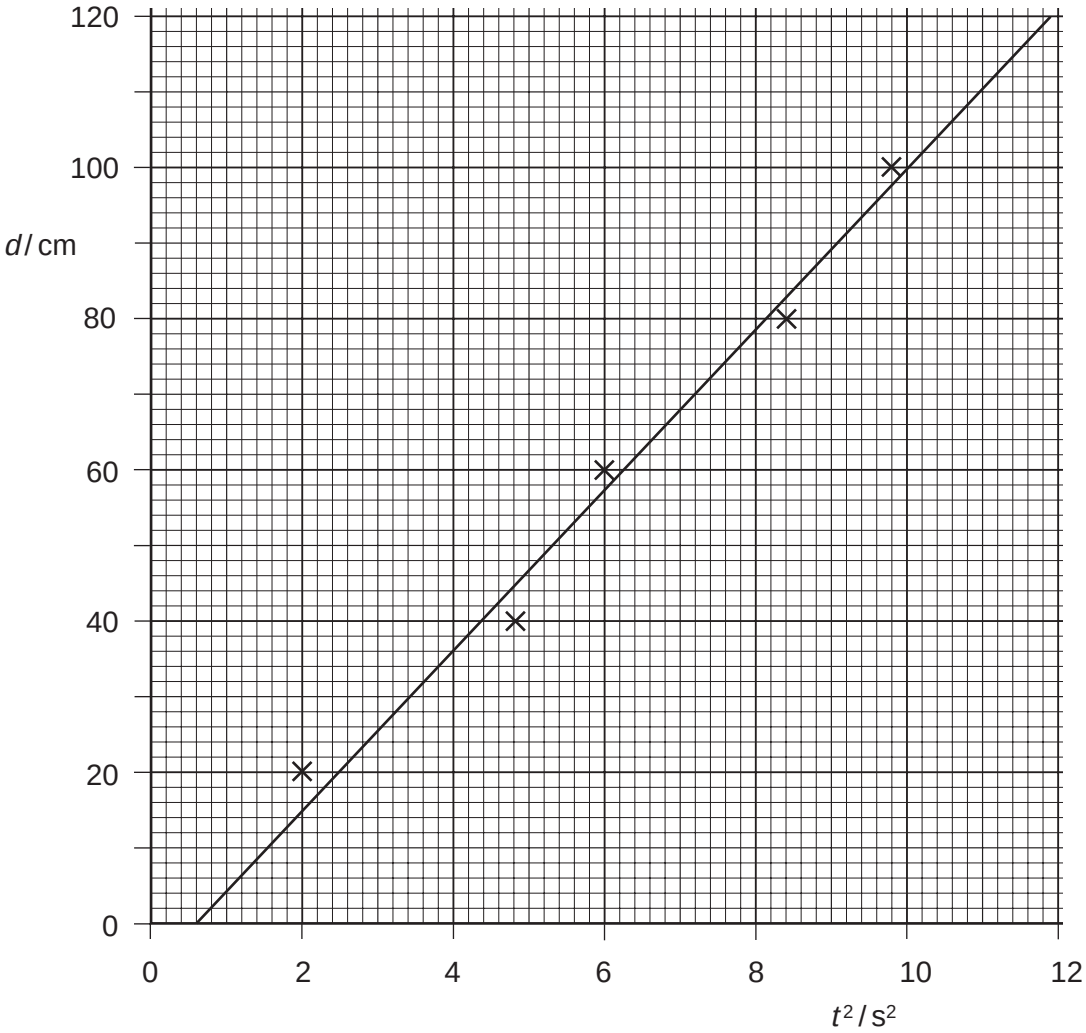

Fig. 3.2

(a) Theory suggests that the graph is a straight line through the origin.
Name the feature on Fig. 3.2 that indicates the presence of

(i) random error,

.....

(ii) systematic error.

.....
[2]

(b) **(i)** Determine the gradient of the line of the graph in Fig. 3.2.

gradient = ... [2]

(ii) Use your answer to **(i)** to calculate the acceleration of the toy down the slope.
Explain your working.

acceleration = ... $m\,s^{-2}$ [3]