CLASSIFIED
International Examinations Papers
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Kinematics-describing motion: 1

TOPIC- scalar and vector, distance, displacement, speed, velocity

graph and combination

Answer **all** the questions in the spaces provided.

For Examiner's Use

1 **(a)** Distinguish between *scalar* quantities and *vector* quantities.

.....

.....

..... [2]

(b) In the following list, underline **all** the scalar quantities.

acceleration force kinetic energy mass power weight [1]

(c) A stone is thrown with a horizontal velocity of $20\,m\,s^{-1}$ from the top of a cliff 15 m high. The path of the stone is shown in Fig. 1.1.

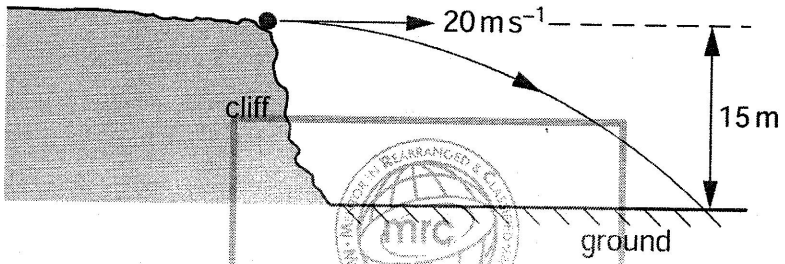

Fig. 1.1

Air resistance is negligible.

For this stone,

(i) calculate the time to fall 15 m,

time = ... s [2]

(ii) calculate the magnitude of the resultant velocity after falling 15 m,

resultant velocity = ... $m\,s^{-1}$ [3]

(iii) describe the difference between the displacement of the stone and the distance that it travels.

For Examiner's Use

.....

.....

..... [2]

For Examiner's Use

2 A girl G is riding a bicycle at a constant velocity of $3.5\,m\,s^{-1}$. At time $t = 0$, she passes a boy B sitting on a bicycle that is stationary, as illustrated in Fig. 2.1.

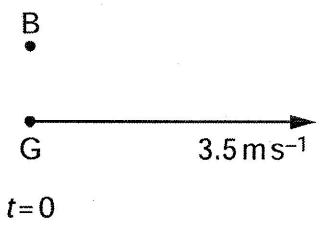

Fig. 2.1

At time $t = 0$, the boy sets off to catch up with the girl. He accelerates uniformly from time $t = 0$ until he reaches a speed of $5.6\,m\,s^{-1}$ in a time of 5.0 s. He then continues at a constant speed of $5.6\,m\,s^{-1}$. At time $t = T$, the boy catches up with the girl.
T is measured in seconds.

(a) State, in terms of T, the distance moved by the girl before the boy catches up with her.

distance = ... m [1]

(b) For the boy, determine

(i) the distance moved during his acceleration.

distance = ... m [2]

(ii) the distance moved during the time that he is moving at constant speed.
Give your answer in terms of T.

distance = ... m [1]

(c) Use your answers in **(a)** and **(b)** to determine the time T taken for the boy to catch up with the girl.

T = ... s [2]

(d) The boy and the bicycle have a combined mass of 67 kg.

(i) Calculate the force required to cause the acceleration of the boy.

force = ... N [3]

(ii) At a speed of $4.5\,m\,s^{-1}$, the total resistive force acting on the boy and bicycle is 23 N.
Determine the output power of the boy's legs at this speed.

power = ... W [2]

For Examiner's Use

0 3 A car is travelling along a straight road at speed v. A hazard suddenly appears in front of the car. In the time interval between the hazard appearing and the brakes on the car coming into operation, the car moves forward a distance of 29.3 m. With the brakes applied, the front wheels of the car leave skid marks on the road that are 12.8 m long, as illustrated in Fig. 2.1.

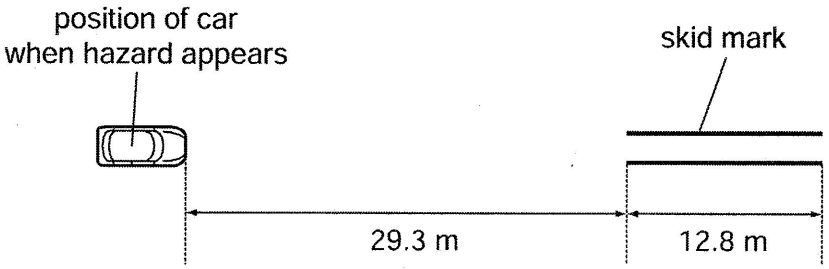

Fig. 2.1

It is estimated that, during the skid, the magnitude of the deceleration of the car is $0.85g$, where g is the acceleration of free fall.

(a) Determine

(i) the speed v of the car before the brakes are applied.

v = ... ms^{-1} [2]

(ii) the time interval between the hazard appearing and the brakes being applied.

time = ... s [2]

(b) The legal speed limit on the road is 60 km per hour.
Use both of your answers in **(a)** to comment on the standard of the driving of the car.

For Examiner's Use

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..... [3]

4 A student takes measurements to determine a value for the acceleration of free fall. Some of the apparatus used is illustrated in Fig. 4.1.

For Examiner's Use

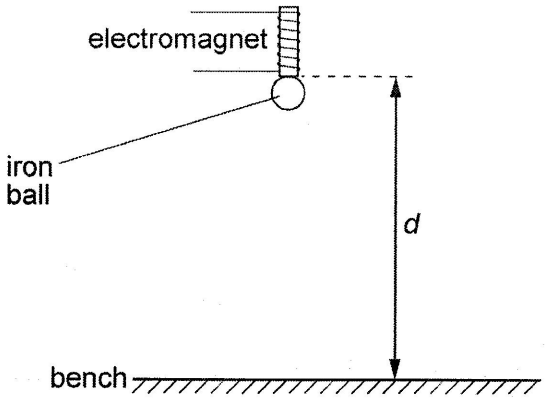


Fig. 4.1

The student measures the vertical distance d between the base of the electromagnet and the bench. The time t for an iron ball to fall from the electromagnet to the bench is also measured.

Corresponding values of t^2 and d are shown in Fig. 4.2.

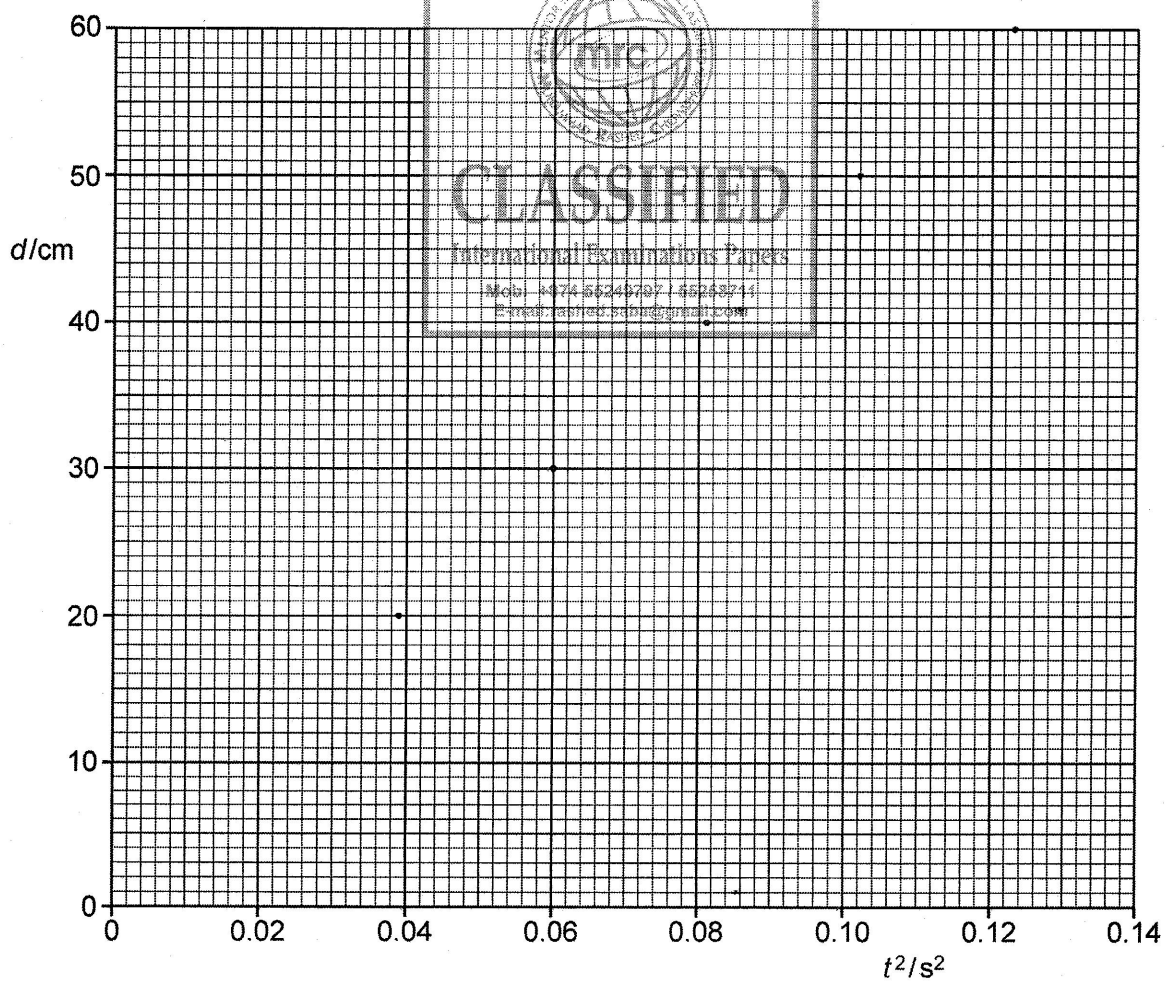


Fig. 4.2

(a) On Fig. 4.2, draw the line of best fit for the points. [1]

(b) State and explain why there is a non-zero intercept on the graph of Fig. 4.2.

.....

.....

..... [2]

(c) Determine the student's value for

(i) the diameter of the ball,

diameter = ... cm [1]

(ii) the acceleration of free fall.

acceleration = ... ms^{-2} [3]

For Examiner's Use

05 **(a)** Complete Fig. 2.1 to show whether each of the quantities listed is a vector or a scalar.

For Examiner's Use

	vector / scalar
distance moved	.....
speed	.....
acceleration	.....

Fig. 2.1

[3]

(b) A ball falls vertically in air from rest. The variation with time t of the distance d moved by the ball is shown in Fig. 2.2.

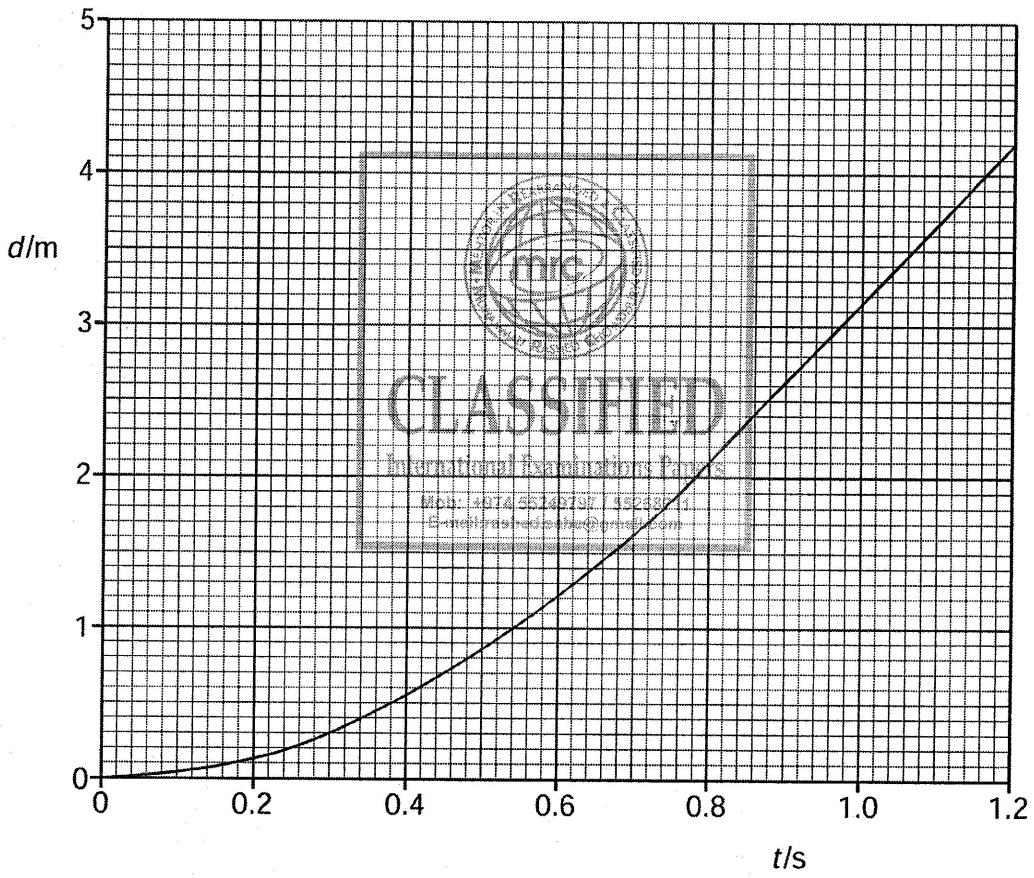


Fig. 2.2

(i) By reference to Fig. 2.2, explain how it can be deduced that

For Examiner's Use

1. the ball is initially at rest,

.....

.....

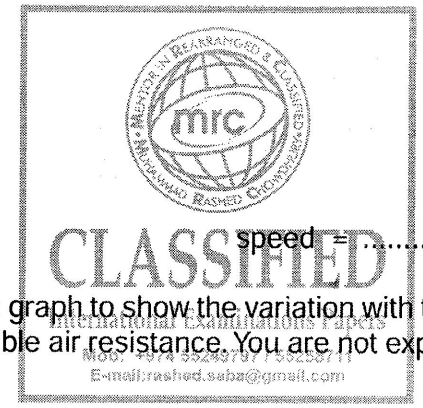
..... [2]

2. air resistance is not negligible.

.....

..... [1]

(ii) Use Fig. 2.2 to determine the speed of the ball at a time of 0.40 s after it has been released.



speed = ... $m\ s^{-1}$ [2]

(iii) On Fig. 2.2, sketch a graph to show the variation with time t of the distance d moved by the ball for negligible air resistance. You are not expected to carry out any further calculations. [3]

Answer **all** the questions in the spaces provided.

U 6 **(a)** The distance between the Sun and the Earth is 1.5×10^{11} m. State this distance in Gm.

distance = ... Gm [1]

(b) The distance from the centre of the Earth to a satellite above the equator is 42.3 Mm. The radius of the Earth is 6380 km.
A microwave signal is sent from a point on the Earth directly below the satellite.

Calculate the time taken for the microwave signal to travel to the satellite and back.

time = ... s [2]

(c) The speed v of a sound wave through a gas of density ρ and pressure P is given by

$$v = \sqrt{\frac{CP}{\rho}}$$

where C is a constant.

Show that C has no unit.

[3]

(d) Underline all the scalar quantities in the list below.

acceleration energy momentum power weight [1]

(e) A boat travels across a river in which the water is moving at a speed of $1.8\,m\,s^{-1}$. The velocity vectors for the boat and the river water are shown to scale in Fig. 1.1.

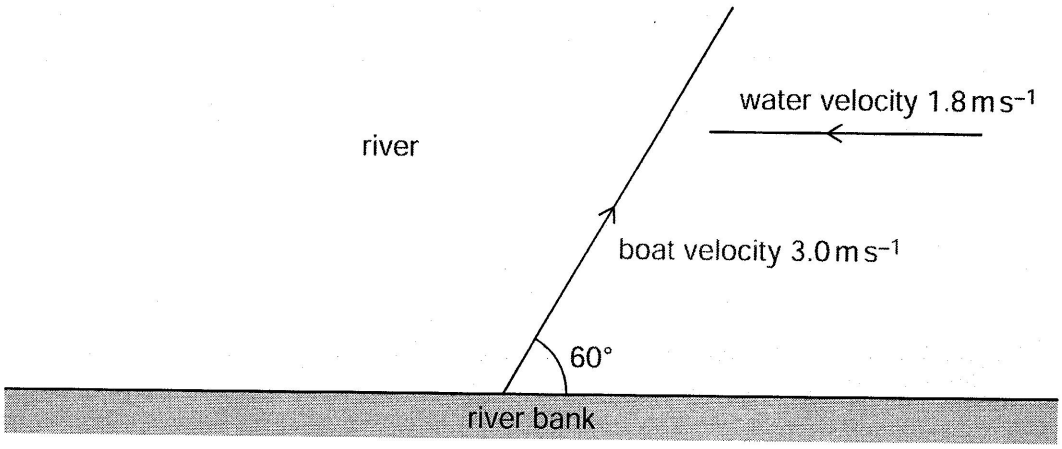


Fig. 1.1 (shown to scale)

In still water the speed of the boat is $3.0\,m\,s^{-1}$. The boat is directed at an angle of 60° to the river bank.

(i) On Fig. 1.1, draw a vector triangle or a scale diagram to show the resultant velocity of the boat. [2]

(ii) Determine the magnitude of the resultant velocity of the boat.

resultant velocity = ... $m\,s^{-1}$ [2]