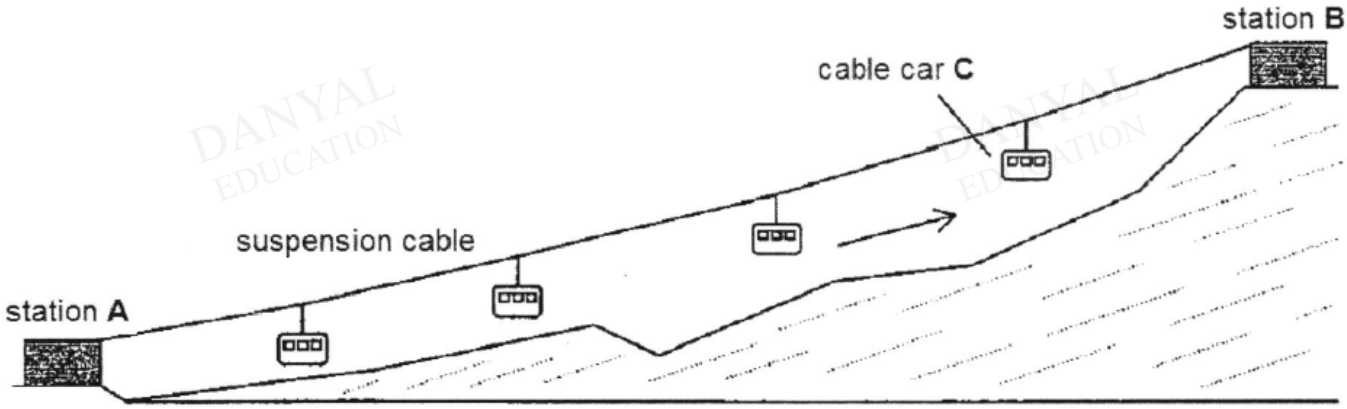
O Level Pure Physics Structured

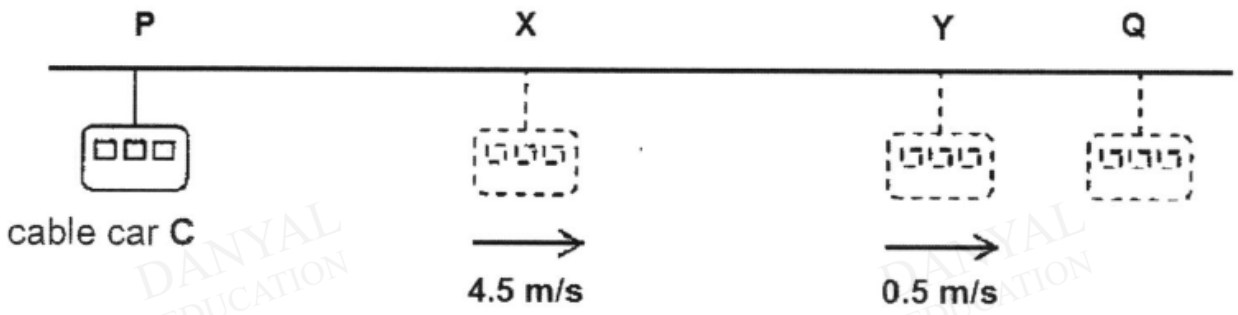
Kinematics Test 2.0

Q1

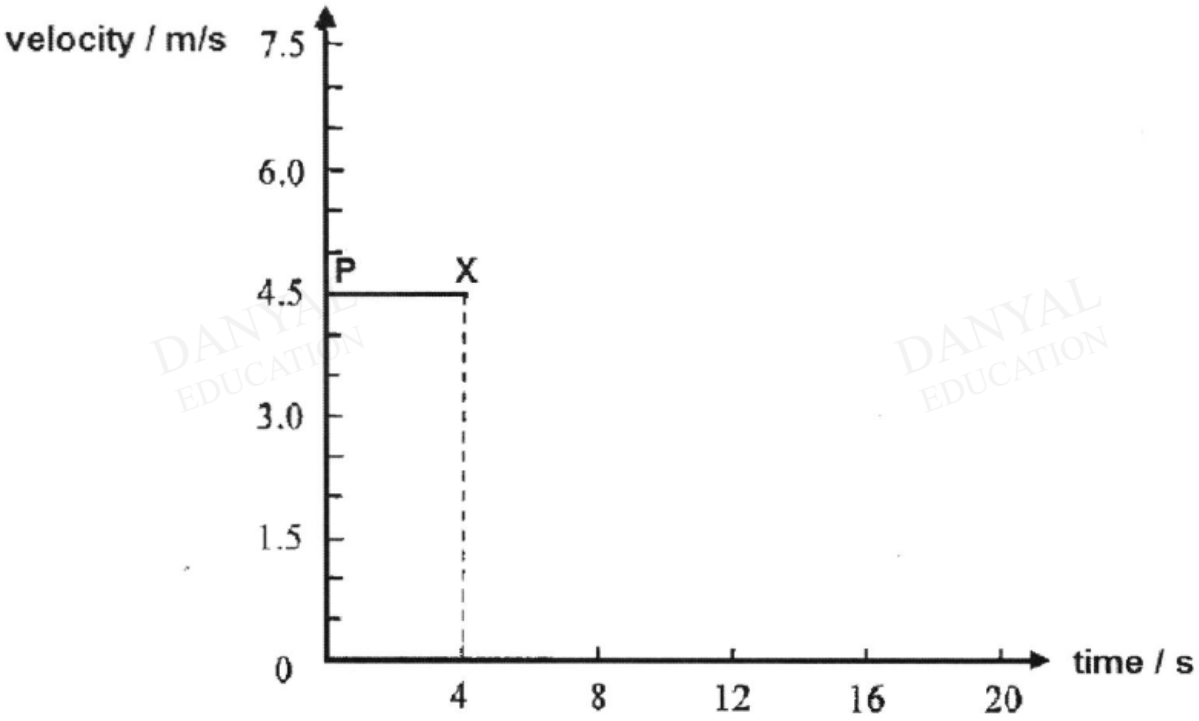
12. The figure below shows a cable car system for transporting passengers from station **A** to station **B** on top of a hill. The mass of the cable car **C** is 600 kg.



(c) The cable car **C** enters station **B** with a constant velocity of 4.5 m/ s in the horizontal direction as shown in the figure below. For passengers to leave the cabin, cable car **C** begins to slow down with constant deceleration after it passes **X**. The velocity is reduced to 0.5 m/s at **Y**, and it takes 8.0 s for cable car **C** to travel from **X** to **Y**. After **Y**, the cable car travels at constant velocity for the remaining journey.



(i) Sketch the velocity-time graph of the cable car for the journey between **X** and **Q**. [2]



(ii) Hence, find the distance between **X** and **Y**.

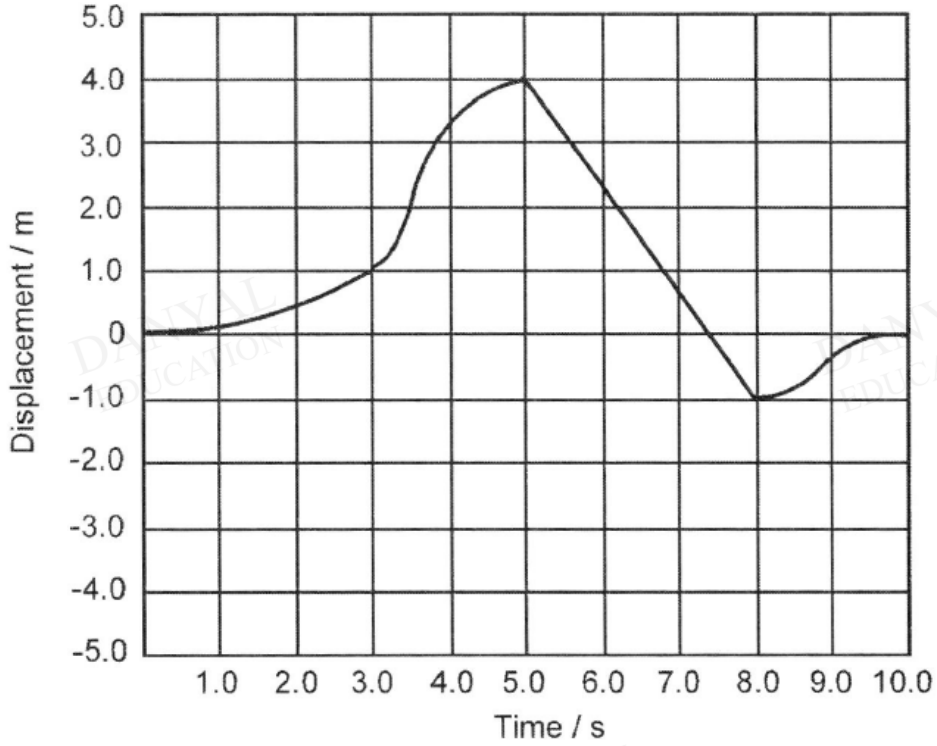
distance = _____ [2]

(d) A 50 kg person sits in the cable car. Calculate the magnitude of the resultant force on the person during the deceleration from **X** to **Y**.

resultant force = _____ [2]

Q2

A displacement-time graph of a particle in linear motion is shown below.



(a) How many time(s) is the particle instantaneously at rest?

..... [1]

(b) Write down the total distance travelled by the particle.

..... [1]

(c) When was the particle moving the fastest?

..... [1]

(d) How many time(s) is the particle at the starting point?

..... [1]

(e) Calculate the velocity of the particle at 7.0 s.

Velocity = ... [2]

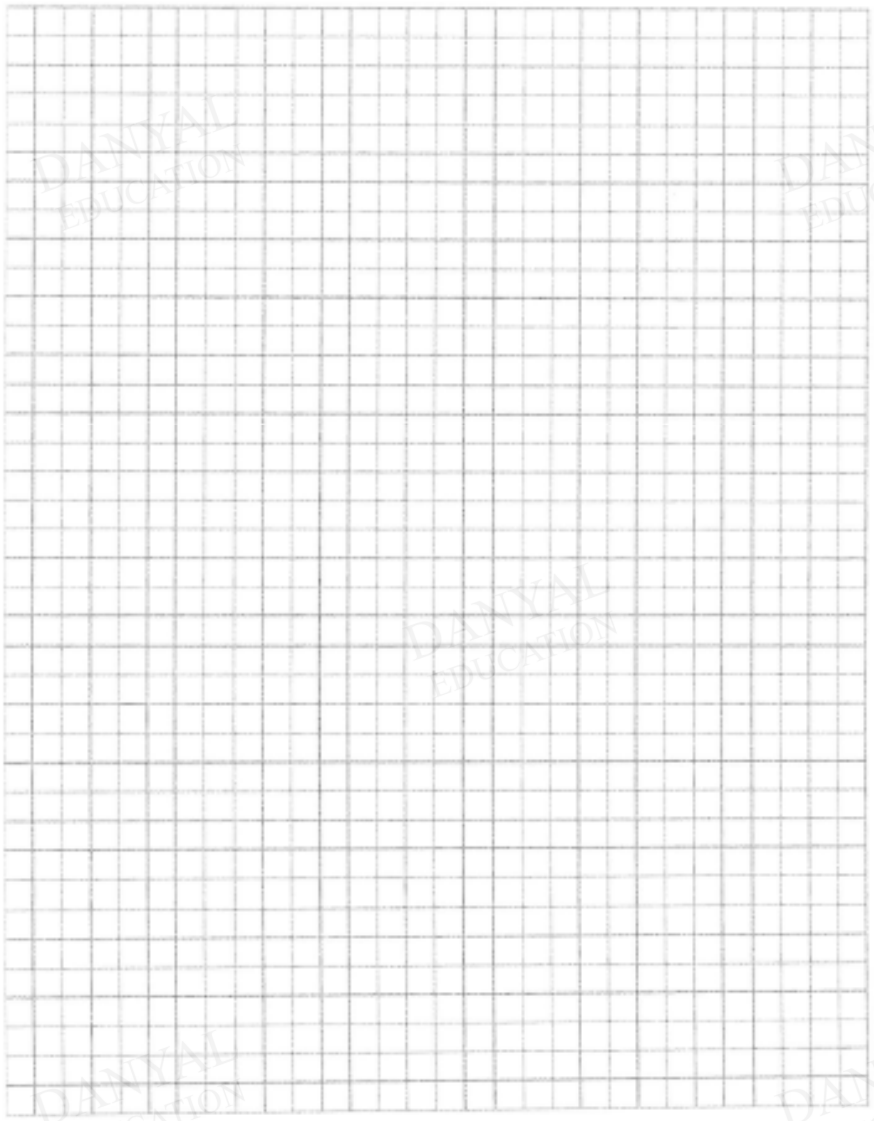
Q3

The following data is collected in a kinematics experiment using a toy car.

t/s	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
$v/(ms^{-1})$	0.35	0.46	0.59	0.70	0.83	0.94	1.10	1.18

a. Plot the graph of *v* vs. t with the data and extend your line back to t = 0.

[2]



b. What is the displacement of the toy car from t = 0 to t = 0.90 s?

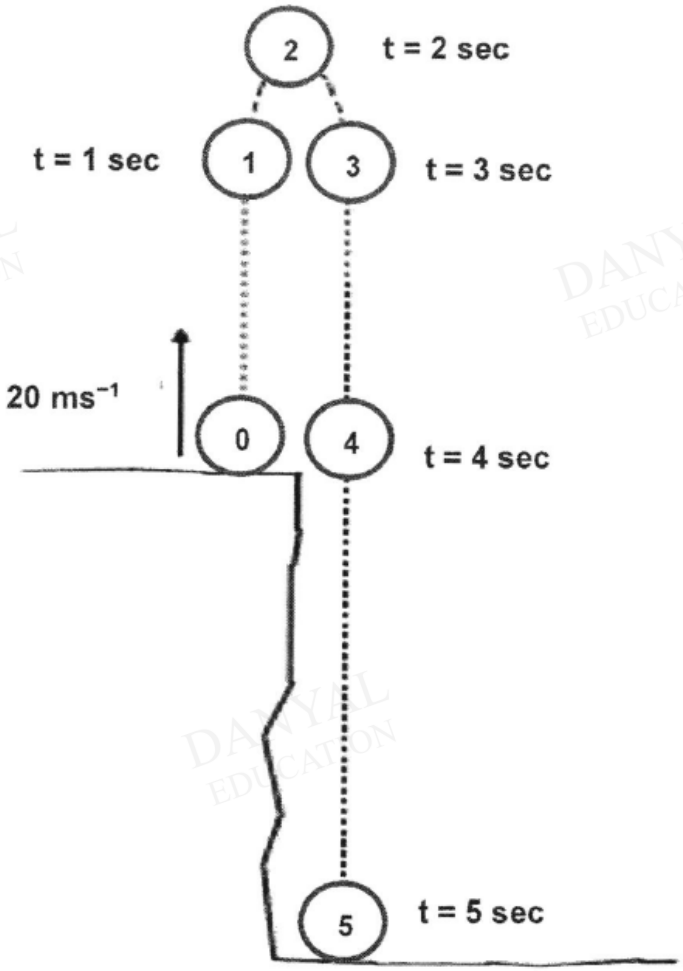
[2]

c. What does the y-intercept of the graph represent?

[1]

Q4

A stone is projected almost vertically upwards at 20 ms^{-1} from the edge of a cliff as shown. It finally lands on the ground at the base of the cliff. The sequence diagram below shows the position of the stone at one-second intervals. Image 0 is just after projection, and Image 5 is just before landing. Gravitational acceleration is taken as 10 ms^{-2} and air resistance is ignored.



a. State whether the acceleration of the stone is upward, downward or zero in each of the following cases:

i. when the stone is on its way up, _____ [1]

ii. when the stone is on its way down, _____ [1]

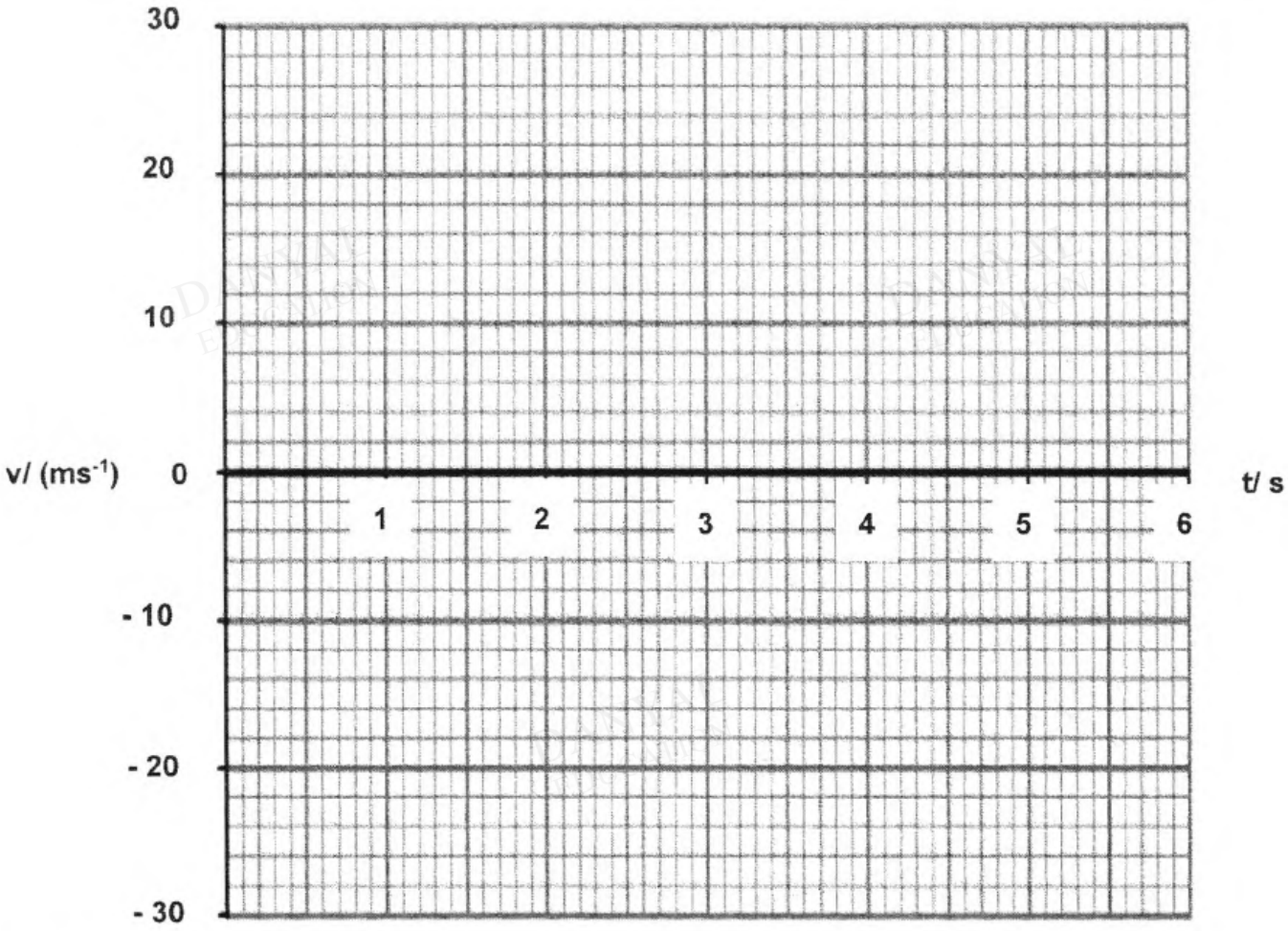
iii. when the stone is at the top of its path. _____ [1]

b. Next to each of the six images, draw in a vector to represent the instantaneous velocity at that stage of the motion. The vector at image 0 has been drawn in for you. Show clearly the direction and relative lengths of the vectors, and label them with their magnitudes in ms^{-1}.

[3]

c. In the grid below, draw a velocity–time graph to represent the motion of the stone. On the graph label the stages representing upward motion and downward motion, and label the topmost point of the motion.

[1]



d. What does the gradient of the graph represent?

[1]

e. Determine the height of the cliff.

[2]

Q5

In Fig. 2.1, a balloon is filled with air and is attached to a puck. Air is continuously released from the balloon through a hole at the bottom of the puck. The puck is given an initial push. It then moves on a horizontal table along a straight path formed by a pair of tracks.

Fig. 2.2 shows the speed-time graph of the puck.

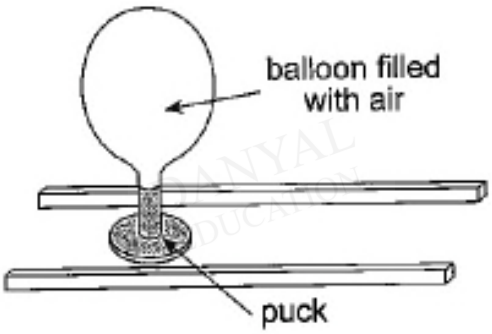


Fig. 2.1

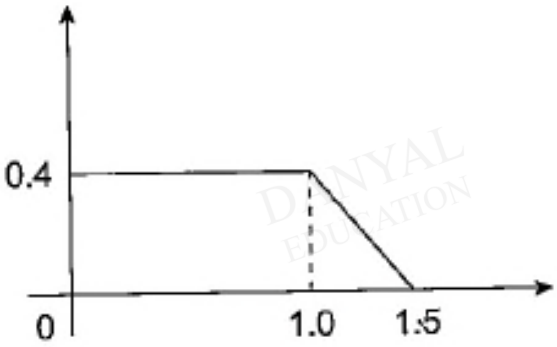


Fig. 2.2

(a) **(i)** Describe the motion of the puck from $t = 0$ to $t = 1.5$ s.

[2]

(ii) Explain the change in motion of the puck at $t = 1.0$ s.

[2]

(b) The experiment is repeated with less air in the balloon. The initial speed of the balloon remains at 0.4 m/s.

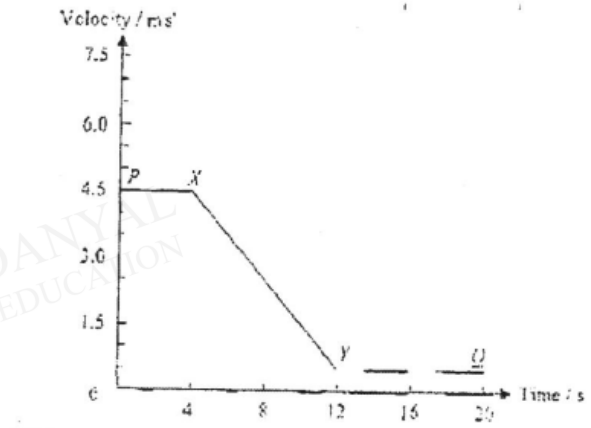
On Fig. 2.2, sketch the new speed-time graph of the puck. [1]

Answers

Kinematics Test 2.0

Q1

(c) **(i)**



XY **[1]**
YQ **[1]**

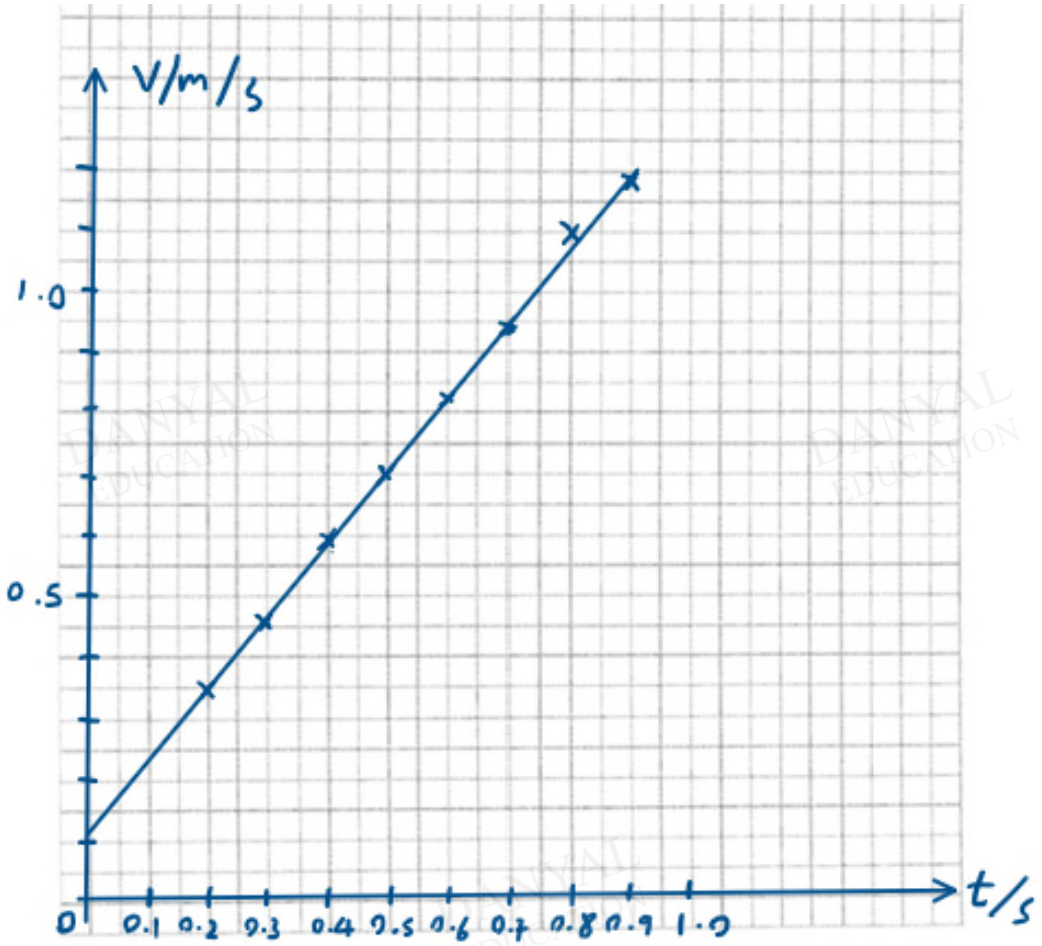
(ii) distance = ½ x (4.5 + 0.5) x 8 **[1]**
= 20 m **[1]**

(d) acceleration = (0.5 – 4.5) / 8
= - 0.5 m/s² **[1]**
resultant force = 50 x 0.5
= 25 N **[1]**

Q2

a	4	[1]
b	10 m	[1]
c	3.5 s	[1]
d	3	[1]
e	Velocity = $\frac{-1.0-4.0}{8.0-5.0} = \frac{-5.0}{3.0} \approx -1.7$ m s^{-1} (2 or 3 s.f)	Working [1] Ans [1]

Q3



b. What is the displacement of the toy car from t = 0 to t = 0.90 s? [2]

$\text{Displacement} = \frac{1}{2}(0.1 + 1.18) \times 0.9$

$= 0.5355\ \text{m}$ //

c. What does the y-intercept of the graph represent? [1]

It represents the distance of the toy car from the fixed point, at the start of the experiment.

Q4

State whether the stone's acceleration is upward, downward or zero in each of the following cases:

i. when the stone is on its way up

[1]

downwards *A1*

ii. when the stone is on its way down

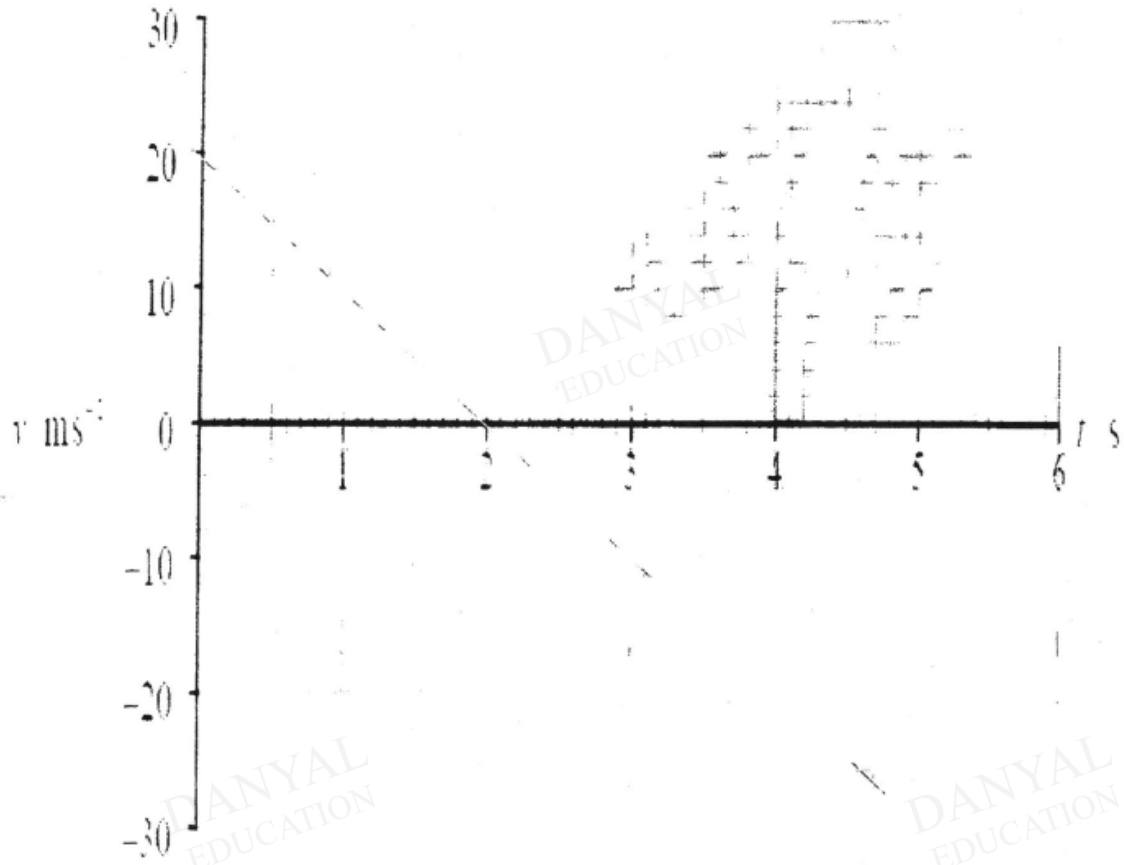
[1]

downwards *A1*

iii. when the stone is at the top of its path

[1]

downwards *A1*



d. What does the gradient of the graph represent?

[1]

aceleration *A1*

e. Determine the height of the cliff.

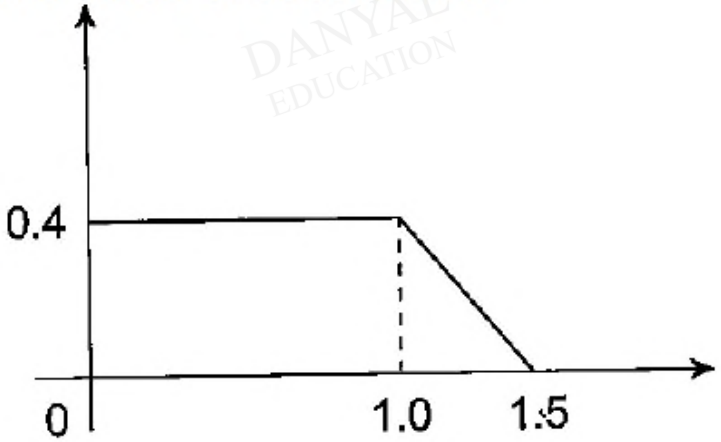
[2]

Height = Area under graph

Height = ½ x 3 x 30 – ½ x 2 x 20 *A1*

Height = 25 m *A1*

Q5

(a)	**(i)**	From t = 0 to 1.0 s, the puck moves at a constant speed of 0.4 m/s. From t = 1.0 to 1.5s, it moves with a constant deceleration / speed decreases constantly (uniformly / linearly) until it comes to rest.	[1] [1]
	(ii)	After t = 1.0 s, no more air can be released from the balloon, so the puck will come into contact with the table. It will experience friction which opposes the motion of the puck, hence the puck begins to decelerate.	[1] [1]
(b)		Deceleration begins before 1.0 s Same value of deceleration  	[1]