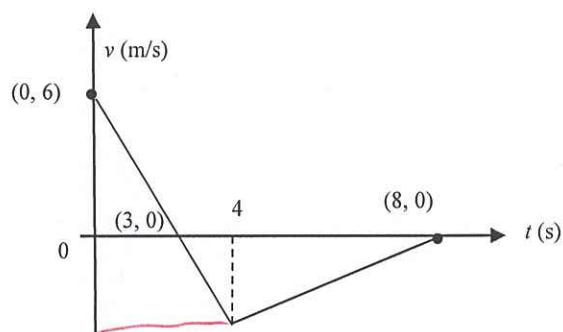


- 15 The velocity-time graph of a particle moving in a straight line is as shown.



In 8 seconds the particle travels:

- A 9 m
- B 14 m
- C 18 m
- D 28 m
- E 12 m

MULTIPLE CHOICE ANSWERS

1	2	3	4	5
E	A	E	B	D
6	7	8	9	10
D	A	C	A	C
11	12	13	14	15
C	B	A	E	B

Short-answer questions

- 1 A particle moves in a straight line so that its position x cm from a fixed point O at time t seconds ($t \geq 0$) is given by $x = t^2 - t - 12$.

a What is the particle's initial position?

ANSWER:

-12 cm

b What is the particle's initial velocity?

$$v = 2t - 1$$

ANSWER:

-1 cm/s

c At what time(s) does it pass through O ?

$$\begin{aligned} 0 &= t^2 - t - 12 \\ 0 &= (t+3)(t-4) \end{aligned}$$

ANSWER:

4 s

- 2 The velocity, v m/s, of a moving body is given by $v = 3t^2 + 6t - 4$. If the body's initial displacement from O is 8 m, find its displacement, x m, and acceleration, a m/s², at any time t s.

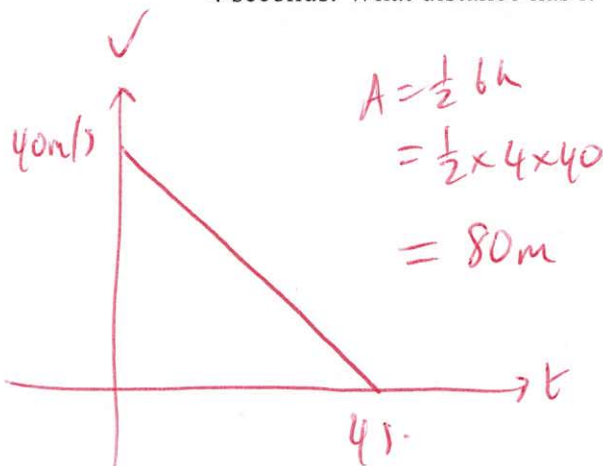
DISPLACEMENT:

$$x = t^3 + 3t^2 - 4t + 8$$

ACCELERATION:

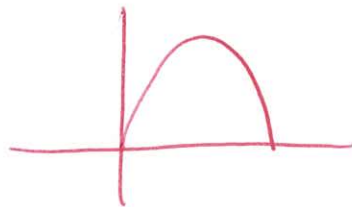
$$a = 6t + 6$$

- 3 A car travelling at 40 m/s is brought to a stop with uniform retardation in 4 seconds. What distance has it travelled?



ANSWER:

80 m



$$a = 9.8 \text{ m/s}^2$$

$$v = 9.8t + C$$

$$19.6 = 9.8(0) + C \therefore C = 19.6$$

$$v = -9.8t + 19.6$$

$$x = -\frac{9.8t^2}{2} + 19.6t + C$$

$$C = 0$$

$$x = -4.9t^2 + 19.6t$$

$$\text{let } x = 0$$

$$0 = -4.9t^2 + 19.6t$$

$$t = 0 \text{ or } t = 4$$

- 4 An object is projected upward from the ground with a velocity of 19.6 m/s. If the acceleration due to gravity is 9.8 m/s² in a downward direction, find:

a the maximum height reached

ANSWER:

19.6 m

b the time taken for it to return to the ground.

ANSWER:

4 s

- 5 Two particles, travelling in the same direction, pass a given point together at 8 m/s. Thereafter, one particle begins to slow down with a constant retardation of $\frac{2}{7} \text{ m/s}^2$. The other continues for 6 seconds at 8 m/s and then slows down with a retardation of $\frac{1}{9}(t-6) \text{ m/s}^2$ where t seconds is the time after the two particles were together. Find how far each of the particles has travelled when they come to rest.

PARTICLE 1:

112 m

PARTICLE 2:

72 m

- 6 A particle moves in a straight line so that its distance x m from a fixed point O on the line is given by $x = 2t^2 - 4t + 9$ for $0 \leq t \leq 3$, where t is the time in seconds after passing through a point B on the line. Find:

a the position of point B on the line relative to O

ANSWER:

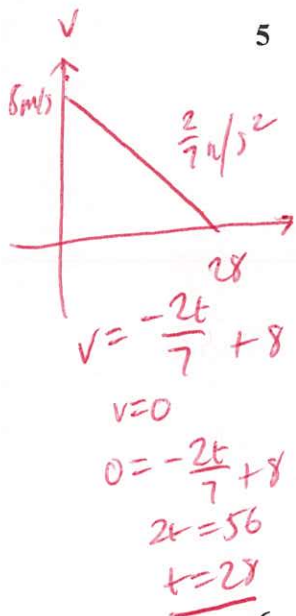
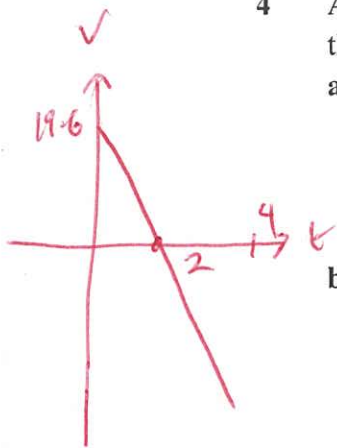
9 m from O

b the distance of the particle from O when it is instantaneously at rest

ANSWER:

7 m from O

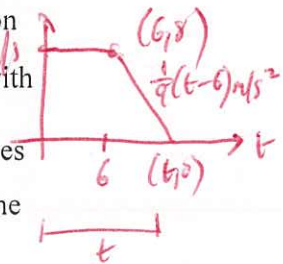
Total distance = 72 m



$$A = \frac{1}{2}bh$$

$$= \frac{1}{2} \times 28 \times 8$$

$$= 112 \text{ m}$$



$$a = \frac{1}{9}(t-6)$$

$$a = \frac{1}{9}t - \frac{2}{3}$$

$$v = \frac{t^2}{18} - \frac{2t}{3}$$

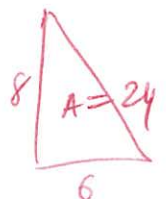
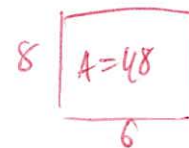
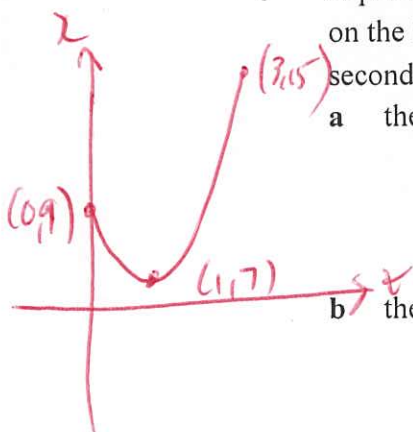
$$\text{when } v = 0$$

$$0 = \frac{t^2}{18} - \frac{2t}{3}$$

$$0 = 3t^2 - 36t$$

$$0 = 3t(t-12)$$

$$t = 0 \text{ or } t = 12$$



c the total distance travelled by the particle in the period $t = 0$ to $t = 3$

ANSWER:

10m

d the velocity of the particle when $t = 3$.

ANSWER:

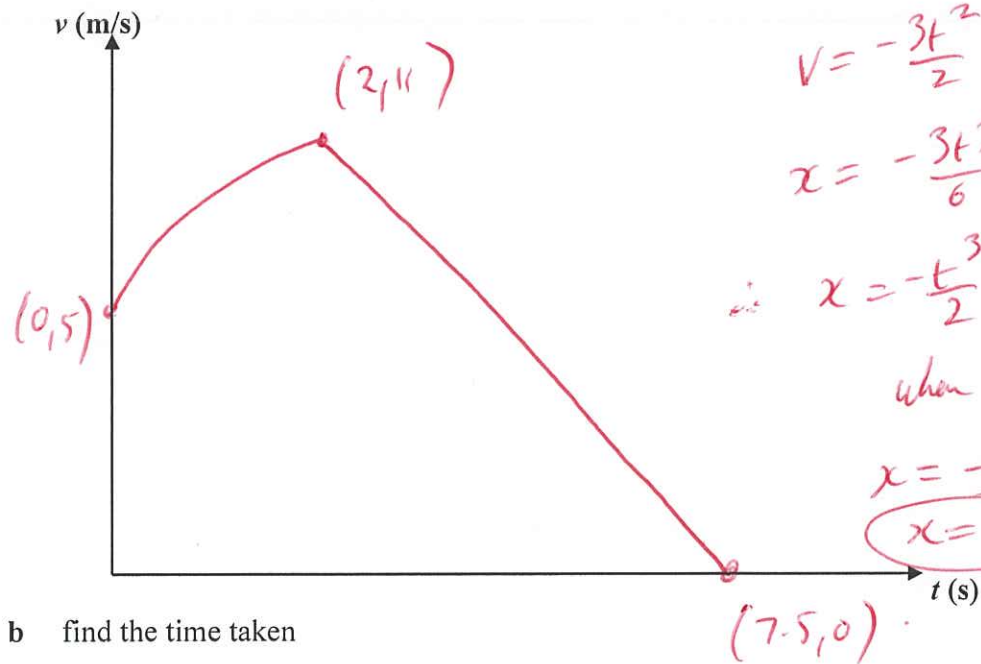
8m/s

when $t=3$
 $v = 4t - 4$
 $v = 8$

7 A car moves along a straight horizontal road so that t seconds after passing a fixed point O with a speed of 5 m/s, its acceleration, a m/s², is given by $a = 6 - 3t$. On reaching its greatest speed, the brakes are applied and the car decelerates at 2 m/s², coming to rest at a point A . For the journey from O to A :

a sketch the velocity-time graph, labelling the following three points:

- Initial velocity
- Maximum/greatest velocity
- Car at rest



b find the time taken

ANSWER:

7.5 s

c find the distance travelled.

ANSWER:

48.25 m

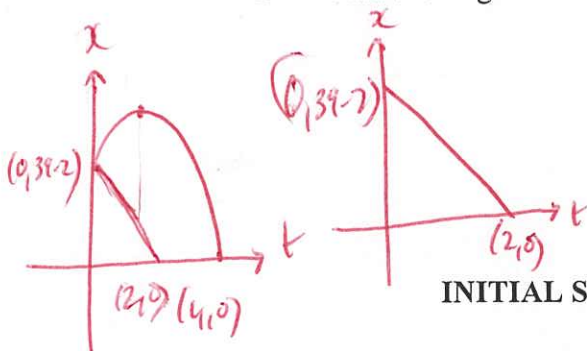
$A = \frac{1}{2}at^2$
 $= \frac{1}{2} \times 5.5 \times 11$
 $= 30.25$

Total distance = $30.25 + 18$
 $= 48.25$ m

Extended-response questions

Two stones are thrown from the top of a building at the same instant. The first stone is thrown vertically upward and reaches the ground in 4 seconds. The second stone is thrown vertically downward with the same initial speed as the first stone and reaches the ground in two seconds. (Use 9.8 m/s^2 as the magnitude of the acceleration due to gravity.)

- 1 Find the height of the building and the initial speed of each stone.

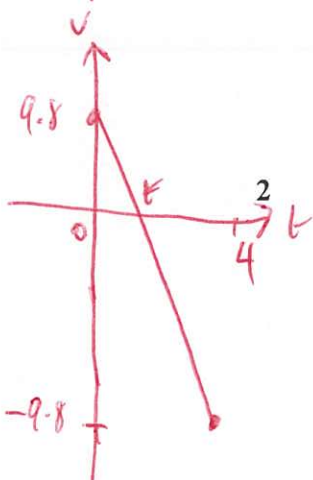


HEIGHT OF BUILDING:

39.2m

INITIAL SPEED OF EACH STONE:

9.8m/s



- 2 Find the maximum distance between the two stones during their motion.

MAX DISTANCE IS

39.2m AS

WHEN FIRST STONE

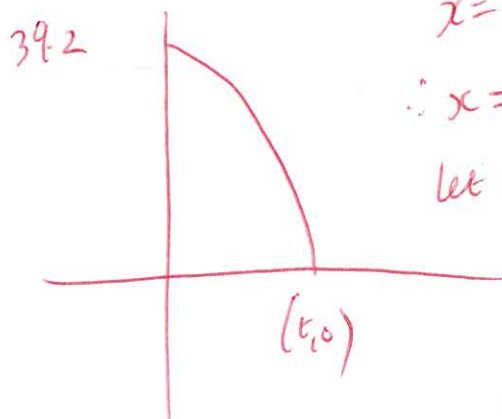
IS AT ITS MAX HEIGHT, THE SECOND STONE HAS JUST

ANSWER:

39.2m

CAS: * SUBMIT EQUATION OF BUILDING STONE FROM FIRST STONE * DIFFERENTIATE * SOLVE FOR t WHEN $\frac{dx}{dt} = 0$

- 3 A third stone is dropped from the top of the building and reaches the ground at the same instant as the first stone. How long after the first two stones were thrown was the third stone dropped (correct to two decimal places)?



$$x = at^2 + 39.2$$

$$\therefore x = -4.9t^2 + 39.2$$

$$\text{let } x = 0$$

$$0 = -4.9t^2 + 39.2$$

solve for t.

$$t = \pm \sqrt{8}$$

$$\text{reject } -\sqrt{8}$$

ANSWER:

1.17s

$$v = 39.2 - 9.8t$$

$$x = -4.9t^2 - 39.2t$$

calculate discriminant $x = 39.2$ $x = 0$ $\therefore 39.2$ $39.2m$

$$t = \sqrt{8}$$

$$\text{Time After} = 4s - \sqrt{8}s$$

$$= 1.17s$$

END OF PRACTICE TEST