Answers – Motion Graphs

1.

(a) Acceleration = gradient

$= \frac{14}{5}$

$= 2.8\,ms^{-2}$

(b) Acceleration = gradient

$= -\frac{14}{10}$

$= -1.4\,ms^{-2}$

$\therefore$ Deceleration $= 1.4\,ms^{-2}$

(c) Distance travelled

= Area

$= \frac{1}{2} \times 5 \times 14$

$= 35\,m$

(d) Distance = Area

$= \frac{1}{2}(a+b)h$

$= \frac{1}{2}(25+10) \times 14$

$= 245\,m$

2.

a) Initial acceleration

= gradient

$= \frac{20}{12}$

$= 1.7\,ms^{-2}$ (2 s.f.)

b) Total distance = Area

$= \frac{1}{2}(30+10) \times 20$

$= 400\,m$

c) Ave. speed $= \frac{\text{Total dis.}}{\text{time}}$

$= \frac{400}{30}$

$= 13.3\,ms^{-1}$ (3 s.f.)

3.

a) $a_{OA} = \frac{2}{3}\,ms^{-2}$

b) It is moving upwards with a constant deceleration.

c) Displacement = Area

$= \frac{1}{2}(12+6) \times 2$

$= 18\,m$

d) Between D and E the lift is moving downwards with a constant acceleration and then between EF it is still moving downwards but with a constant deceleration.

(e) Positive displacement

= Area above t-axis

$= \frac{1}{2}(12+6) \times 2$

$= 18\,m$

Negative displacement

$= \text{Area below t-axis}$

$= -\frac{1}{2} \times 6 \times 2$

$= -6\,m$

$\therefore$ Overall displacement

$= 18 - 6$

$= 12\,m$ upwards.

4.

a) OA: ~~A~~ Starting from rest, moves forwards with a constant acceleration.

AB: Moves forwards with a constant velocity of $15ms^{-1}$.

BC: While moving forwards, rapidly decelerates at a constant rate and finally stops.

CD: Stationary

DE: Starting from rest, moves backwards with a constant acceleration.

EF: Moves backwards with a constant velocity of $5ms^{-1}$.

FG: While moving backwards, decelerates at a constant ~~speed~~ rate and eventually stops.

b) $15ms^{-1}$ forwards.

(c) At B.

(d) No. This is because the forward displacement is much greater than the backward displacement as the area of OABC is greater than that of DEFG.

5.

(a) ~~AB:~~

Assume that the forward direction is represented by +.

AB: Starting from rest, moves forwards with a constant acceleration.

BC: Moves forwards with a constant velocity.

CD: While moving forwards, decelerates at a constant rate, ~~DE: Stat~~ and finally stops.

DE: Stationary.

EF: Starting from rest moves backwards with a constant acceleration.

FG: Moves backwards with a constant velocity.
GH: While moving backwards, decelerates at a constant rate and finally stops.
↓
Not asked in the question.

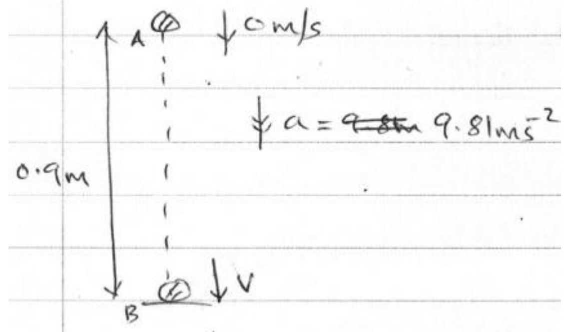
(b) Area under the graph.

(c) Distance travelled is the total length of the path along which the train has moved whereas displacement made is represented by the straight line joining the 'start' to the 'finish'. According to the graph, the train has moved forwards and backwards. This means, the size of the distance will be greater than that of the displacement

6.

We did this question during the lesson.

7.



a) A → B

$s = 0.9$
$u = 0$
$v = ?$
$a = 9.81$
$t = x$

$v^2 = u^2 + 2as$

$v^2 = 0^2 + 2(9.81)(0.9)$

$v = 4.20\ ms^{-1}$ (3 s.f.)

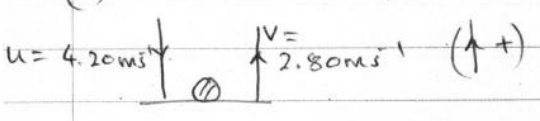
b) (i) Change in speed

$= \frac{1}{3}$ of value in (a)

$= \frac{1}{3} \times 4.20$

$= 1.40\ ms^{-1}$

(ii)



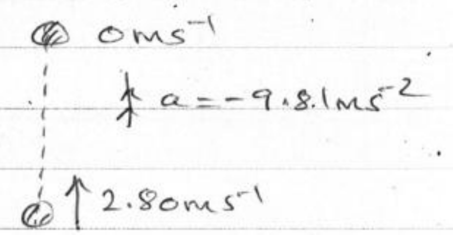
. Change in velocity

$= v - u$

$= 2.80 - (-4.20)$

$= 7 ms^{-1}$ //

(c) Upward journey after 1st ~~&~~ bounce:-



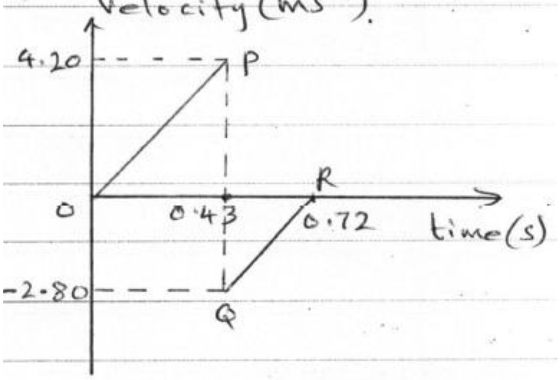
$v = u + at$

$0 = 2.80 + (-9.81)t$

$t = 0.29 \text{ s}$

$0.43 + 0.29 = \underline{0.72 \text{ s}}$

Assume the ~~downward~~ downward direction as positive.



[On your sketch, OP and QR must be parallel as they should have the same gradient.].

8.

a) 56 ms^{-1}

b) Distance = Area

To estimate the area, draw vertical lines ~~through~~ to split it into triangles & trapeziums.

For example, you can draw vertical lines through time = 5 s, time = 8 s and time = 13 s.

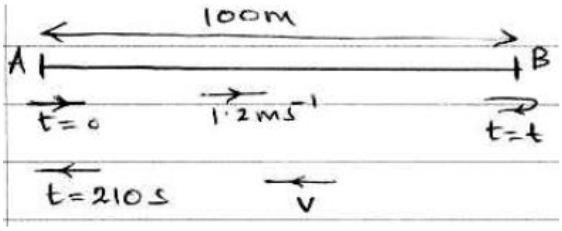
$\text{Area} = \left(\frac{1}{2} \times 5 \times 42\right) + \frac{1}{2}(42 + 50) \times 3 + \frac{1}{2}(50 + 56) \times 5$

$= 508 \text{ m}$

$\therefore$ Distance fallen $\approx \underline{508 \text{ m}}$

(c) As the speed increases the ~~air~~ drag force increases and at one point the drag balances the weight. Hence the resultant force becomes zero. As a result he/she moves with a constant speed in the same direction.

9.



(a)

(i) Time taken to swim from A to B

$= \frac{100}{1.2}$

$= 83 \text{ s } (2 \text{ s.f.})$

(ii) $210 - 83.\dot{3}$

$= 126.66\ldots$

$= 130 \text{ s } (2 \text{ s.f.})$

(b) ~~Velo~~ speed for the return journey $= \frac{100}{126.66\ldots}$

$= 0.79\,\text{ms}^{-1}$

(i) Take the direction of $\overrightarrow{AB}$ as positive.