leave Q2 till last . . .

Accelerated Linear Motion
5th App. Maths Test
Answer All Questions.

(50) 1. A train travelling at 20 m/s undergoes a retardation of $2\,m/s^2$ when the brakes are applied. Calculate,
i) The time required for the train to stop
ii) The distance travelled by the train from the time when the brakes were applied.

(50) 2. A train takes 80 seconds to travel between two stations 367m apart. Starting from rest at one station, it is uniformly accelerating to a speed of 22 km/hr and maintains this speed until it is brought to stop at the second station by a constant retardation. The time taken in accelerating is twice that spent decelerating. Find,
i) the acceleration
ii) the distance travelled at maximum speed.

50 3. A train travelling along a straight line with constant acceleration is observed to travel consecutive distances of 1 km in times 30 s and 60 s, respectively. Find the retardation of the train.

50 4. Two particles are travelling along a straight line AB of length 20m. At the same instant one particle starts from rest at A and travels towards B with a constant acceleration $2\,m/s^2$, and a second particle starts from rest at B and travels toward A with a constant acceleration of $5\,m/s^2$.
How far from A do the particles collide.

1. $u = 20$ (5)
$a = -2$ (5)
$v = 0$ (5)
$t = ?$
$s = ?$

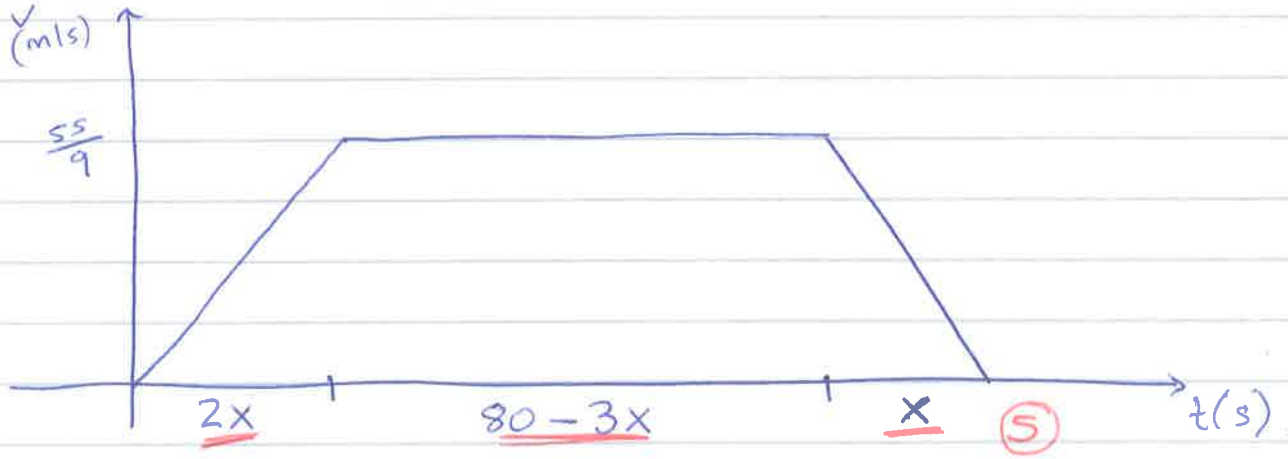
$v = u + at$ (5)
$0 = 20 - 2t$ (5)
$-20 = -2t$
$\boxed{t = 10\,s}$ (5)

$s = ut + \frac{1}{2}at^2$ (5)
$= 20(10) + \frac{1}{2}(-2)(10^2)$ (5)
$= 200 - 100$
$\boxed{s = 100\,m}$ (5)

+5

2. $t = 80$
$s = 367$
$u = 0$
$v = 22\,km/hr = \frac{22000}{3600} = \frac{55}{9}\ m/s$ (6.1) (5) $6\frac{1}{9}$

non uniform accel $\Rightarrow$



(5)

Area = 367 = displacement

$\frac{1}{2}(2x)\left(\frac{55}{9}\right) + (80-3x)\left(\frac{55}{9}\right) + \frac{1}{2}(x)\left(\frac{55}{9}\right) = 367$ (5)

$\frac{55x}{9} + (80-3x)\left(\frac{55}{9}\right) + \frac{55x}{18} = 367$

$110x + 110(80-3x) + 55x = 6606$

$165x + 8800 - 330x = 6606$

$2194 = 165x$

$x = \frac{2194}{165} = 13.3\,s$ (5)

i)

$v = u + at$ (5) $\quad \frac{55}{9} = 0 + a\left(2 \cdot \frac{2194}{165}\right)$ (5)

$a = \frac{3025}{13164} = 0.23\,m/s^2$ (5)

ii) $S = (80 - 3x)\left(\frac{55}{9}\right)$ (5)

$= \left[80 - 3\left(\frac{2194}{165}\right)\right]\left(\frac{55}{9}\right)$ (5)

$= 245\frac{1}{9}$

$= \frac{2206}{9} = 245.1\,m$ (5)

3. 1km 1km

30 60

km not m -3

1st km (5)

$u = u$

$a = a$

$t = 30$

$s = 1000$

$s = ut + \frac{1}{2}at^2$ (5)

$1000 = 30u + \frac{1}{2}(a)(30^2)$ (5)

$1000 = 30u + 450a$

$\boxed{100 = 3u + 45a}$ (5)

1st 2km (5)

$u = u$

$a = a$

$t = 90$

$s = 2000$

$s = ut + \frac{1}{2}at^2$ (5)

$2000 = 90u + \frac{1}{2}(a)(90^2)$ (5)

$2000 = 90u + 4050a$

$\boxed{200 = 9u + 405a}$ (5)

$9u + 405a = 200$

$3u + 45a = 100$

(5)

$9u + 405a = 200$

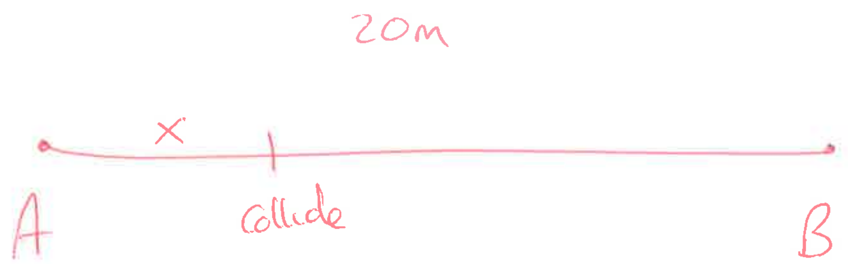
$-9u - 135a = -300$

$270a = -100$

(5) $\boxed{a = -\frac{10}{27}\,m/s^2}$

$= .37\,m/s^2$

4.



$$S_A + S_B = 20$$

$$ut + \frac{1}{2}at^2 \qquad\qquad ut + \frac{1}{2}at^2$$

$$0(t) + \frac{1}{2}(2)(t^2) \qquad\qquad 0(t) + \frac{1}{2}(5)(t^2)$$

$$t^2 \qquad\qquad \frac{5t^2}{2}$$

$$t^2 + \frac{5t^2}{2} = 20$$

$$t^2 = \frac{40}{7}$$

$$t = \sqrt{\frac{40}{7}} \text{ or } 2.39$$

Find :

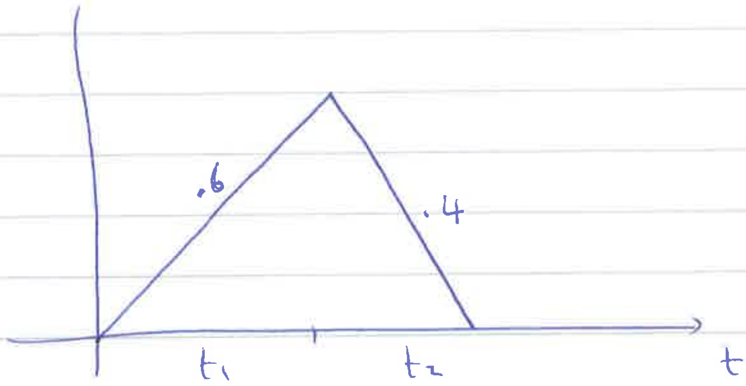
$$x = S_A$$

$$= t^2$$

$$= \frac{40}{7} \text{ or } 5.7\text{m}$$

v=u+at

5.



T = 10

$t_1 : t_2$ = d : a

.4 : .6

$\frac{.4}{1}$: $\frac{.6}{1}$

$t_1 = \frac{.4}{1}$ of 10 = 4 s

$t_2 = \frac{.6}{1}$ of 10 = 6 s

$V = u + at$

$V = 0 + (.6)(4)$

$V = 2.4$ m/s

S = Area

$= \frac{1}{2}(10)(2.4)$

= 12m

UCM

2010

1. (a) A car is travelling at a uniform speed of 14 ms^{-1} when the driver notices a traffic light turning red 98 m ahead.

Find the minimum constant deceleration required to stop the car at the traffic light,

(i) if the driver immediately applies the brake

(ii) if the driver hesitates for 1 second before applying the brake.

(b) A particle passes P with speed 20 ms^{-1} and moves in a straight line to Q with uniform acceleration.

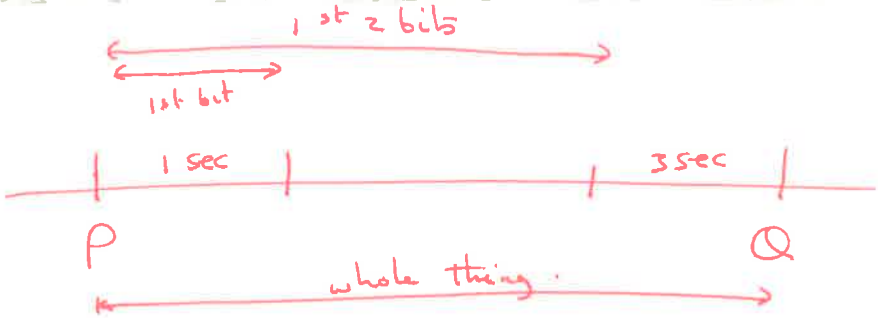
In the first second of its motion after passing P it travels 25 m.

In the last 3 seconds of its motion before reaching Q it travels $\frac{13}{20}$ of $|PQ|$.

Find the distance from P to Q.

ULM 2010(b)

Hint:



Call distance from P to Q = X

Call total time from P to Q = T

1st bit:

} Find a

1st 2 bits:

} get equation with X 2 T's (1)

whole thing:

} get equation with X & T's (2)

Combine eq (1) & (2) somehow, to get T and X.

2010

1\. a.

$u = 14$
$v = 0$
$s = 98$
$a =$

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

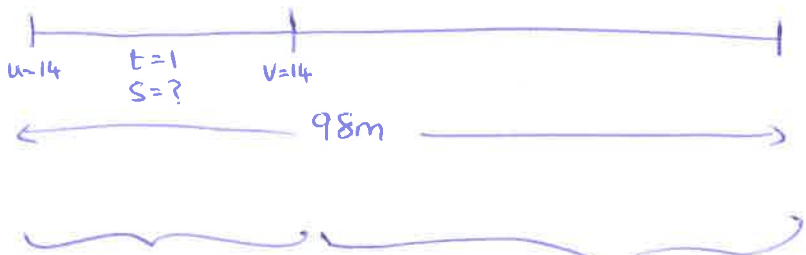
$$0 = 14^2 + 2(a)(98)$$

$$-196 = 196a$$

$$\boxed{-1\,m/s^2 = a}$$

10

ii)



no a.

$s = ut + \frac{1}{2}at^2$

$s = 14(1)$

$= 14m$

$u = 14$
$v = 0$
$s = 98 - 14 = 84$
$a =$

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

$$0 = 14^2 + 2(a)(84)$$

$$-196 = 168a$$

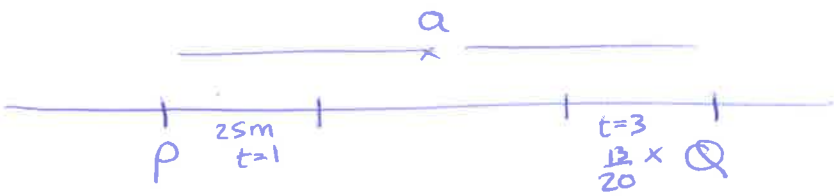
$$-\frac{7}{6} = a$$

$$\boxed{-1.17\,m/s^2 = a}$$

10

2010

1.b



$u = 20$

1st bit:

$u = 20$
$s = 25$
$t = 1$
$a = ?$

$s = ut + \frac{1}{2}at^2$

$25 = 20 + \frac{1}{2}a$

$5 = \frac{1}{2}a$

$\boxed{10 = a}$

5

1st 2 bits:

$u = 20$
$a = 10$
$s = \frac{20}{20}x - \frac{13}{20}x = \frac{7x}{20}$
$t = T - 3$

$s = ut + \frac{1}{2}at^2$

$\boxed{\frac{7x}{20} = 20(T-3) + 5(T-3)^2}$

$\frac{7x}{20} = 20T - 60 + 5T^2 - 30T + 45$

$\boxed{\frac{7x}{20} = 5T^2 - 10T - 15}$

whole thing:

$u = 20$
$a = 10$
$s = x$
$t = T$

$s = ut + \frac{1}{2}at^2$

$\boxed{x = 20T + 5T^2}$

① ÷ ②

$\frac{7x}{20x} = \frac{5T^2 - 10T - 15}{20T + 5T^2}$

$7(20T + 5T^2) = 20(5T^2 - 10T - 15)$

$140T + 35T^2 = 100T^2 - 200T - 300$

$= 65T^2 - 340T - 300 = 0$

$= 13T^2 - 68T - 60 = 0$

15

$(13T \quad)(T \quad) = 0$

5	12
3	20
2	30

$$\frac{68 \pm \sqrt{68^2 - 4(13)(-60)}}{2(13)}$$

$$\frac{68 \pm \sqrt{7744}}{26}$$

$$\frac{68 \pm 88}{26}$$

6 or ~~-0.76~~

$T = 6$ S

$$x = 20T + 5T^2$$
$$= 20(6) + 5(36)$$
$$= 120 + 180$$
$$= 300$$

S