

- 4 A cyclist travels along a straight road with constant acceleration. He passes through points A, B and C. The cyclist takes 2 seconds to travel along each of the sections AB and BC and passes through B with speed 4.5 m s^{-1} . The distance AB is $\frac{4}{5}$ of the distance BC.

(a) Find the acceleration of the cyclist.

[5]

AB: $S = 4x$ | $S = vt - \frac{1}{2}at^2$ (useful fifth sum formula - learn!)

$u =$ | $4x = 4.5 \times 2 - \frac{1}{2} \times a \times 2^2$

$v = 4.5$ | $4x = 9 - 2a$ (1)

$a =$

$t = 2$

BC: $S = 5x$ | $S = ut + \frac{1}{2}at^2$

$u = 4.5$ | $5x = 4.5 \times 2 + \frac{1}{2} \times a \times 2^2$

$v =$ | $5x = 9 + 2a$ (2)

$a =$

$t = 2$

(1) + (2): $9x = 18$

$x = 2$

Sub into (2): $5(2) = 9 + 2a$

$10 = 9 + 2a$

$1 = 2a$

$a = 0.5 \text{ m s}^{-2}$

(b) Find AC.

[2]

$$\begin{aligned} AC &= 4x + 5x \\ &= 9x \end{aligned}$$

$x=2$:

$$\begin{aligned} AC &= 9 \times 2 \\ &= \underline{\underline{18m}} \end{aligned}$$

- 4 A particle A , moving along a straight horizontal track with constant speed 8 ms^{-1} , passes a fixed point O . Four seconds later, another particle B passes O , moving along a parallel track in the same direction as A . Particle B has speed 20 ms^{-1} when it passes O and has a constant deceleration of 2 ms^{-2} . B comes to rest when it returns to O .

- (a) Find expressions, in terms of t , for the displacement from O of each particle t seconds after B passes O . [3]

A : In the 4 seconds before B passes O , A travels:

$$8 \times 4 = 32 \text{ m}$$

After that A travels: $8 \times t = 8t$

So for A : $S_A = \underline{32 + 8t}$

B : $S =$

$$u = 20$$

$$v =$$

$$a = -2$$

$$t =$$

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

$$= 20t + \frac{1}{2}(-2)t^2$$

$$= 20t - t^2$$

$$\rightarrow S_B = \underline{20t - t^2}$$

- (b) Find the values of t when the particles are the same distance from O .

[3]

$$S_A = S_B:$$

$$32 + 8t = 20t - t^2$$

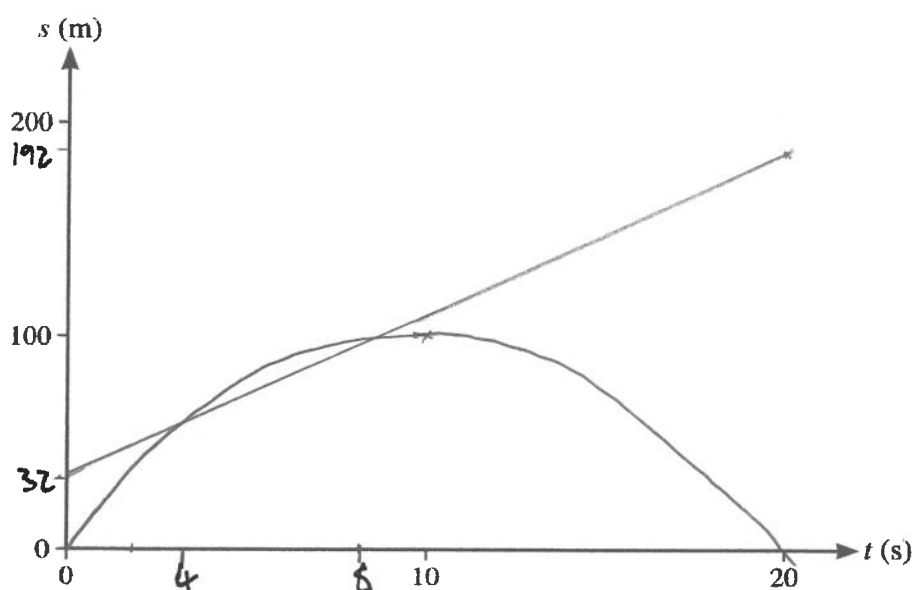
$$t^2 - 12t + 32 = 0$$

$$(t - 4)(t - 8) = 0$$

$$\underline{t = 4s} \text{ and } \underline{t = 8s}$$

- (c) On the given axes, sketch the displacement-time graphs for both particles, for values of t from 0 to 20.

[3]



A: at $t = 20$:

$$S_A = 32 + 8 \times 20 \\ = \underline{192}$$

B: roots: $20t - t^2 = 0$

$$t(20 - t) = 0$$

$$\underline{t = 0} \text{ or } \underline{t = 20}$$

turning point: $t = 10$:

$$S = 20 \times 10 - 10^2$$

$$= \underline{100}$$

$\rightarrow (10, 100)$

- 4 A particle P travels in the positive direction along a straight line with constant acceleration. P travels a distance of 52 m during the 2nd second of its motion and a distance of 64 m during the 4th second of its motion.

(a) Find the initial speed and the acceleration of P .

[5]

$t=1:$

$$S = S_1 = ut + \frac{1}{2}at^2$$

$$u = u \quad S_1 = u \times 1 + \frac{1}{2} \times a \times 1^2$$

$$v = S_1 = u + \frac{1}{2}a \quad (1)$$

$$a = a$$

$$t = 1$$

$t=2:$

$$S = S_1 + 52 \quad S = ut + \frac{1}{2}at^2$$

$$u = u \quad S_1 + 52 = 2u + \frac{1}{2} \times a \times 2^2$$

$$v = S_1 + 52 = 2u + 2a \quad (2)$$

$$a = a$$

$$t = 2$$

Sub. (1) into (2): $u + \frac{1}{2}a + 52 = 2u + 2a$

$$\frac{1}{2}a + 52 = u + 2a$$

$$52 = u + 1.5a \quad (A)$$

$t=3:$

$$S = S_3 = ut + \frac{1}{2}at^2$$

$$u = u \quad S_3 = 3u + \frac{1}{2} \times a \times 3^2$$

$$v = S_3 = 3u + 4.5a \quad (3)$$

$$a = a$$

$$t = 3$$

$t=4:$

$$S = S_3 + 64 \quad S = ut + \frac{1}{2}at^2$$

$$u = u \quad S_3 + 64 = 4u + \frac{1}{2} \times a \times 4^2$$

$$v = S_3 + 64 = 4u + 8a \quad (4)$$

$$a = a$$

$$t = 4$$

Sub. (3) into (4): $3u + 4.5a + 64 = 4u + 8a$

$$4.5a + 64 = u + 8a$$

$$64 = u + 3.5a \quad (B)$$

continued $\rightarrow$

$$\textcircled{B} - \textcircled{A}: 12 = 2a$$

$$a = \underline{6 \text{ ms}^{-2}}$$

sub into $\textcircled{A}$:

$$52 = u + 1.5 \times 6$$

$$52 = u + 9$$

$$43 = u$$

$$u = \underline{43 \text{ ms}^{-1}}$$

horrible question!

- (b) Find the distance travelled by P during the first 10 seconds of its motion.

[2]

$S =$	$S = ut + \frac{1}{2}at^2$
$u = 43$	$= 43 \times 10 + \frac{1}{2} \times 6 \times 10^2$
$v =$	$= 430 + 300$
$a = 6$	$= \underline{730 \text{ m}}$
$t = 10$	