

chap 16, Ex 16 A P 397

① too easy

$$\textcircled{2} \quad s = t^3 + t \Rightarrow v = \frac{ds}{dt} = 3t^2 + 1$$

$$\text{when } t=3, v = 28 \text{ m/s}$$

$$\textcircled{3} \quad s = 5t^2 - t^3 \Rightarrow v = \frac{ds}{dt} = 10t - 3t^2$$

$$\Rightarrow a = \frac{dv}{dt} = 10 - 6t$$

$$\text{at } t=1, a = 4 \text{ m/s}^2$$

④ /

⑤ /

$$\textcircled{6} \quad v = 4t + 5 \quad \text{and} \quad s = 10 \quad \text{when} \quad t = 1$$

$$\text{So } v = \frac{ds}{dt} = 4t + 5 \Rightarrow s = \int 4t + 5 dt \\ = 2t^2 + 5t + c$$

$$\text{But } s = 10, t = 1 \Rightarrow 10 = 2 + 5 + c \Rightarrow c = 3$$

$$\text{So } s = 2t^2 + 5t + 3$$

$$\text{Now, when } t = 2, s = 2(4) + 5(2) + 3 = 21 \text{ m}$$

(7) ✓

* (8) given $a = 6t$ and "initially at rest" $\Rightarrow t = 0, v = 0$

$$\text{So } a = \frac{dv}{dt} = 6t \Rightarrow v = \int 6t dt \\ = 3t^2 + c$$

$$\text{But } t = 0, v = 0 \text{ so } 0 = 0 + c \Rightarrow c = 0$$

$$\therefore v = 3t^2$$

$$\text{When } t = 4, v = 3(16) = 48 \text{ m/s}$$

* (9) given $a = \frac{2}{3}t$, $s = 10$ & $v = 4$ when $t = 3$,

$$\text{we have } a = \frac{dv}{dt} = \frac{2}{3}t$$

$$\text{So } v = \int \frac{2}{3}t dt = \frac{1}{3}t^2 + c$$

$$\text{But } v = 4 \text{ when } t = 3 \text{ so } 4 = \frac{1}{3} \cdot 9 + c \Rightarrow c = 1$$

$$\therefore v = \frac{1}{3}t^2 + 1$$

$$\text{Now } v = \frac{ds}{dt} = \frac{1}{3}t^2 + 1 \Rightarrow s = \int \frac{1}{3}t^2 + 1 dt$$

$$\therefore s = \frac{1}{9}t^3 + t + c$$

$$\text{But } s = 10 \text{ when } t = 3, \text{ so } 10 = 3 + 3 + c \Rightarrow c = 4$$

$$\text{So } s = \frac{1}{9}t^3 + t + 4; \text{ Then } s(6) = \frac{1}{9} \cdot 6^3 + 6 + 4 = 36 \text{ m}$$

10) given $S = t^2 - 3$ Then

when $t = 2$, $S = +1$ m

$$v = \frac{ds}{dt} = 2t \text{ (m/s)}$$

$$\text{so } v(2) = 4 \text{ m/s}$$

If $v = 8$ Then $8 = 2t \Rightarrow t = 4$ secs

Then $t = 4$ when $v = 8$ so $S(4) = 4^2 - 3 = 13$ m

11) given $S = 2t^3 - 21t^2 + 60t$

a) ✓

$$b) v = \frac{ds}{dt} = 6t^2 - 42t + 60$$

body at rest $\Rightarrow v = 0$

$$\text{so } 0 = 6t^2 - 42t + 60$$

$$\Rightarrow t^2 - 7t + 10 = 0$$

$$\Rightarrow t = \frac{7 \pm \sqrt{49 - 40}}{2} = \frac{7 \pm 3}{2} = 5, 2 \text{ secs}$$

c) initial velocity is when $t = 0 \Rightarrow v = 60$ m/s

$$d) a = \frac{dv}{dt} = 12t - 42$$

e) initial a is when $t = 0 \Rightarrow a = -42$ m/s²
i.e a deceleration

* (12) given $v = 8t - 3t^2$

a) / b) $a = \frac{dv}{dt} = 8 - 6t$

c) at $t=3$, $a = -10 \text{ m/s}^2$

d) $v = 8t - 3t^2 = \frac{ds}{dt} \Rightarrow s = \int 8t - 3t^2 dt$
 $= 4t^2 - t^3 + C$

But body is initially at 0 $\Rightarrow t=0 \Rightarrow s=0$

So $C=0 \Rightarrow s = 4t^2 - t^3$

So when $t=3$, $s = 4(9) - 27 = 9 \text{ m}$

(13) /

(14) given $a = 2t$ & $v=0$ when $t=0$ (initially at Rest)

So $a = \frac{dv}{dt} \Rightarrow v = \int 2t dt$
 $= t^2 + C$

But $v=0$ when $t=0 \Rightarrow 0 = 0 + C \Rightarrow C=0$

So $v = t^2$. Then when $t=3$, $v = 9 \text{ m/s}$

For distance, $v = \frac{ds}{dt} = t^2$ so $s = \int t^2 dt = \frac{1}{3}t^3 + C$

Now, when $t=0$, $s=0 \Rightarrow C=0$, so $s = \frac{1}{3}t^3$

So when $t=3$, $s = \frac{1}{3}(27) = 9 \text{ m}$.

(15)

(16) given $\underline{s} = t^3 \underline{i} + 9t \underline{j}$

so $\underline{v} = \frac{d\underline{s}}{dt} = 3t^2 \underline{i} + 9 \underline{j}$

when $t=2$, $\underline{v} = 3(4) \underline{i} + 9 \underline{j}$ so $|\underline{v}| = \text{speed} = \sqrt{12^2 + 9^2} = 15 \text{ m/s}$

(17) given $\underline{v} = 2t^2 \underline{i} + 6 \underline{j}$ Then

$$\underline{a} = \frac{d\underline{v}}{dt} = (4t) \underline{i}$$

so when $t=3$, $\underline{a} = 12 \underline{i} \text{ m/s}^2$

(*) (18) given $\underline{v} = 3t^2 \underline{i} + 10t \underline{j}$

Then $\underline{v} = \frac{d\underline{s}}{dt} \Rightarrow \underline{s} = \int (3t^2 \underline{i} + 10t \underline{j}) dt$
 $= t^3 \underline{i} + 5t^2 \underline{j} + \underline{c}$

But $\underline{s}_0 = (4 \underline{i} - 4 \underline{j}) \text{ m}$ at $t=0$

so $4 \underline{i} - 4 \underline{j} = 0 + 0 + \underline{c}$

so $\underline{s} = t^3 \underline{i} + 5t^2 \underline{j} + 4 \underline{i} - 4 \underline{j} = (t^3 - 4) \underline{i} + (5t^2 - 4) \underline{j}$

When $t=2$, $\underline{s} = (4 \underline{i} + 16 \underline{j}) \text{ m}$.

But $\underline{s}_0 = (4 \underline{i} - 4 \underline{j})$ so location of \underline{s} from \underline{s}_0 is $\underline{s} - \underline{s}_0$ i.e.

$\underline{s} - \underline{s}_0 = (4 \underline{i} + 16 \underline{j}) - (4 \underline{i} - 4 \underline{j}) = 20 \underline{j}$, $\therefore |\underline{s} - \underline{s}_0| = 20 \text{ m}$

(19) given $\underline{a} = (4t+2)\underline{i} - 3\underline{j}$ & $\underline{v} = 0$ when $t=0$

$$\begin{aligned}\text{Then } \underline{a} &= \frac{d\underline{v}}{dt} \Rightarrow \underline{v} = \int (4t+2)\underline{i} - 3\underline{j} dt \\ &= (2t^2 + 2t)\underline{i} - 3t\underline{j} + \underline{c}\end{aligned}$$

But $0\underline{i} + 0\underline{j} = 0\underline{i} - 0\underline{j} + \underline{c}$ so $\underline{c} = 0\underline{i} + 0\underline{j}$

$$\therefore \underline{v} = (2t^2 + 2t)\underline{i} - 3t\underline{j}$$

when $t=3$, $\underline{v} = (24\underline{i} - 9\underline{j})$ m/s

(20) given $\underline{a} = 6t\underline{i} + 2\underline{j}$

$$\begin{aligned}\text{Then } \underline{a} &= \frac{d\underline{v}}{dt} = 6t\underline{i} + 2\underline{j} \Rightarrow \underline{v} = \int 6t\underline{i} + 2\underline{j} dt \\ &= 3t^2\underline{i} + 2t\underline{j} + \underline{c}\end{aligned}$$

But given $\underline{v} = 4\underline{i} - \underline{j}$ when $t=1$, Then

$$4\underline{i} - \underline{j} = 3\underline{i} + 2\underline{j} + \underline{c}$$

$$\begin{aligned}\Rightarrow \underline{c} &= \underline{i} - 3\underline{j} \text{ so } \underline{v} = 3t^2\underline{i} + 2t\underline{j} + \underline{i} - 3\underline{j} \\ &= (3t^2 + 1)\underline{i} + (2t - 3)\underline{j}\end{aligned}$$

$$\begin{aligned}\text{Now, } \underline{v} &= \frac{d\underline{s}}{dt} \text{ so } \underline{s} = \int (3t^2 + 1)\underline{i} + (2t - 3)\underline{j} dt \\ &= (t^3 + t)\underline{i} + (t^2 - 3t)\underline{j} + \underline{c}\end{aligned}$$

But given $\underline{s} = 2\underline{i} + 3\underline{j}$ when $t=1$ Then

$$2\underline{i} + 3\underline{j} = 2\underline{i} - 2\underline{j} + \underline{c} \Rightarrow \underline{c} = 5\underline{j}$$

$$\text{So } \underline{s} = (t^3 + t)\underline{i} + (t^2 - 3t)\underline{j} + 5\underline{j}$$

$$\text{So when } t=3, \underline{s} = (30\underline{i} + 5\underline{j}) \text{ m}$$

(21) Given $\underline{s} = (2 \sin t)\underline{i} + (3 \cos t)\underline{j}$

$$\text{Then } \underline{v} = \frac{d\underline{s}}{dt} = (2 \cos t)\underline{i} - (3 \sin t)\underline{j}$$

$$\text{So } \underline{a} = \frac{d\underline{v}}{dt} = (-2 \sin t)\underline{i} - (3 \cos t)\underline{j}$$

$$\text{When } t = \frac{\pi}{2}, \underline{a} = (-2\underline{i}) \text{ m/s}^2$$

(22) ✓

(23) ✓

(24) Given $\underline{v} = (4 \cos 2t)\underline{i} + (2 \sin 2t)\underline{j}$

$$\text{Then } \underline{v} = \frac{d\underline{s}}{dt} \Rightarrow \underline{s} = \int (4 \cos 2t)\underline{i} + (2 \sin 2t)\underline{j} dt$$

using integration by substitution ($u = 2t \dots$) we obtain

$$\underline{s} = (2 \sin 2t)\underline{i} - (\cos 2t)\underline{j} + \underline{c}$$

Given $\underline{s} = 6\underline{i} - 2\underline{j}$ when $t = \frac{\pi}{4}$ Then

$$6\underline{i} - 2\underline{j} = 2\underline{i} - 0\underline{j} + \underline{c} \Rightarrow \underline{c} = 4\underline{i} - 2\underline{j}$$

$$\text{So } \underline{s} = (2 \sin 2t + 4)\underline{i} - (\cos 2t + 2)\underline{j}$$

$$\text{So when } t = \pi, \underline{s} = 4\underline{i} - 3\underline{j}$$

$$\text{So distance is } \sqrt{4^2 + 3^2} = 5 \text{ m}$$

(25) /

(26) Given $\underline{a} = (6 \sin 6t)\underline{i} + (9 \cos 3t)\underline{j}$ Then

$$\begin{aligned} \underline{a} &= \frac{d\underline{v}}{dt} \Rightarrow \underline{v} = \int (6 \sin 6t)\underline{i} + (9 \cos 3t)\underline{j} dt \\ &= (-\cos 6t)\underline{i} + (3 \sin 3t)\underline{j} + \underline{c} \end{aligned}$$

(use integration by substitution to obtain This answer)

Given $\underline{v} = \underline{i} + 3\underline{j}$ when $t = \frac{\pi}{6}$ we have

$$\underline{i} + 3\underline{j} = \underline{i} + 3\underline{j} + \underline{c} \Rightarrow \underline{c} = 0\underline{i} + 0\underline{j}$$

$$\text{So } \underline{v} = (-\cos 6t)\underline{i} + (3 \sin 3t)\underline{j}$$

$$\text{Now } \underline{v} = \frac{d\underline{s}}{dt} \Rightarrow \underline{s} = \int (-\cos 6t)\underline{i} + (3 \sin 3t)\underline{j} dt$$

$$= \left(-\frac{1}{6} \sin 6t\right)\underline{i} - (\cos 3t)\underline{j} + \underline{c}$$

(... again by integration by substitution)

Given $\underline{s} = 5\underline{i} + 2\underline{j}$ when $t = \frac{\pi}{6}$ Then

$$5\underline{i} + 2\underline{j} = 0\underline{i} + 0\underline{j} + \underline{c}$$

So $\underline{s} = \left(-\frac{1}{6} \sin 6t + 5\right)\underline{i} + (-\cos 3t + 2)\underline{j}$.

When $t = \frac{\pi}{3}$, $\underline{s} = (5\underline{i} + 3\underline{j}) \text{ m}$

(27) Given $\underline{s} = \begin{pmatrix} t^2 - 5 \\ t^2 - 3t + 2 \end{pmatrix}$

a) Particle crosses x-axis when $y=0$. So

$$t^3 - 3t + 2 = 0 \Rightarrow (t-1)(t-2) = 0$$

$\therefore t = 1 \text{ sec}$ or 2 sec .

b) $\underline{v} = \frac{d\underline{s}}{dt} = \begin{pmatrix} 2t \\ 2t-3 \end{pmatrix}$

So when $t=6$, $\underline{v} = \begin{pmatrix} 12 \\ 9 \end{pmatrix}$, So speed = $|\underline{v}|$

$$= \sqrt{12^2 + 9^2}$$

$$= 15 \text{ m/s}$$

c) $\underline{a} = \frac{d\underline{v}}{dt} = \begin{pmatrix} 2 \\ 2 \end{pmatrix} = 2\underline{i} + 2\underline{j}$; Then $\underline{F} = m\underline{a}$ implies

$$\underline{F} = 6(2\underline{i} + 2\underline{j}) = (12\underline{i} + 12\underline{j}) \text{ N}$$

(28) / Same principle as (27)

(29) given

$$\underline{s} = \begin{pmatrix} t^3 - t^2 - 4t + 3 \\ t^3 - 2t^2 + 3t - 7 \end{pmatrix}$$

and mass = 4 kg Then

a) For particle to cross the line $y = x$ we have

$$t^3 - t^2 - 4t + 3 = t^3 - 2t^2 + 3t - 7$$

$$\therefore t^2 - 7t + 10 = 0 \Rightarrow (t-5)(t-2) = 0$$

So $t = 5$ secs or 2 secs

b) $\underline{v} = \frac{d\underline{s}}{dt} = \begin{pmatrix} 3t^2 - 2t - 4 \\ 3t^2 - 4t + 3 \end{pmatrix}$, so when $t = 4$ we have

$$\underline{v} = \begin{pmatrix} 36 \\ 35 \end{pmatrix} = (36\hat{i} + 35\hat{j}) \text{ m/s}$$

c) $\underline{a} = \frac{d\underline{v}}{dt} = \begin{pmatrix} 6t - 2 \\ 6t - 4 \end{pmatrix}$; given $t = \frac{2}{3}$ we have

$$\underline{a} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$$

Given $m = 4$ kg, $\underline{F} = m\underline{a} \Rightarrow \underline{F} = 4 \begin{pmatrix} 2 \\ 0 \end{pmatrix} = \begin{pmatrix} 8 \\ 0 \end{pmatrix} \text{ N}$

(30) / Same principle as (29)

(31) given $\underline{s} = \begin{pmatrix} 2 - \cos 3t \\ 6 \sin 2t \end{pmatrix}$

a) if \underline{s} never crosses y-axis, x term can never be 0. So set x term to 0 & find a contradiction.

$$\therefore 2 - \cos 3t = 0 \Rightarrow \cos 3t = 2$$

But \cos of any angle is always in range $[-1, 1]$
So can never become 2. Hence particle never crosses y-axis

b) $\underline{v} = \frac{d\underline{s}}{dt} = \begin{pmatrix} 3 \sin 3t \\ 12 \cos 2t \end{pmatrix}$. At $t = \frac{\pi}{6}$ we have

$$\underline{v} = \begin{pmatrix} 3 \\ 6 \end{pmatrix} \text{ m/s}$$

c) $\underline{F} = m \underline{a}$, where $\underline{a} = \frac{d\underline{v}}{dt} = \begin{pmatrix} 9 \cos 3t \\ -24 \sin 2t \end{pmatrix}$.

At $t = \pi$, $\underline{a} = \begin{pmatrix} -9 \\ 0 \end{pmatrix}$, so $\underline{F} = 2 \begin{pmatrix} -9 \\ 0 \end{pmatrix} = \begin{pmatrix} -18 \\ 0 \end{pmatrix} \text{ N}$

(for $m = 2$).

(32) given
$$\underline{s} = \begin{pmatrix} 2 \sin t + \sin 2t \\ 4 \cos t + \cos 2t \end{pmatrix}$$

a)
$$\underline{v} = \frac{d\underline{s}}{dt} = \begin{pmatrix} 2 \cos t + 2 \cos 2t \\ -4 \sin t - 2 \sin 2t \end{pmatrix}$$

so when $t = \frac{\pi}{3}$,
$$\underline{v} = \begin{pmatrix} 0 \\ -3\sqrt{3} \end{pmatrix} \text{ m/s}$$

b)
$$\underline{a} = \frac{d\underline{v}}{dt} = \begin{pmatrix} -2 \sin t - 4 \sin 2t \\ -4 \cos t - 4 \cos 2t \end{pmatrix}$$

so when $t = \frac{\pi}{2}$,
$$\underline{a} = \begin{pmatrix} -2 \\ +4 \end{pmatrix} \text{ m/s}^2$$

c) At $t = \frac{\pi}{3}$,
$$\underline{a} = \begin{pmatrix} -3\sqrt{3} \\ 0 \end{pmatrix} \text{ m/s}^2$$

now, $\underline{F} = m \underline{a} \Rightarrow$ gradient of \underline{F} is same as gradient of \underline{a}

so gradient of \underline{a} must be flat $\Rightarrow \theta = 0$.

Test:
$$\theta = \tan^{-1} \frac{y}{x} \Rightarrow \theta = \tan^{-1} \frac{0}{-3\sqrt{3}} = 0^\circ$$

so \underline{F} & \underline{a} is // to x-axis

(33) - (43) : /

(47) given $a = \frac{3t^2}{2}$ Then

$$a = \frac{dv}{dt} = \frac{3t^2}{2} \Rightarrow v = \int \frac{3t^2}{2} dt$$
$$= \frac{t^3}{2} + c$$

But at 0, $v = 1$ when $t = 2 \Rightarrow 1 = \frac{8}{2} + c \Rightarrow c = -3$

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

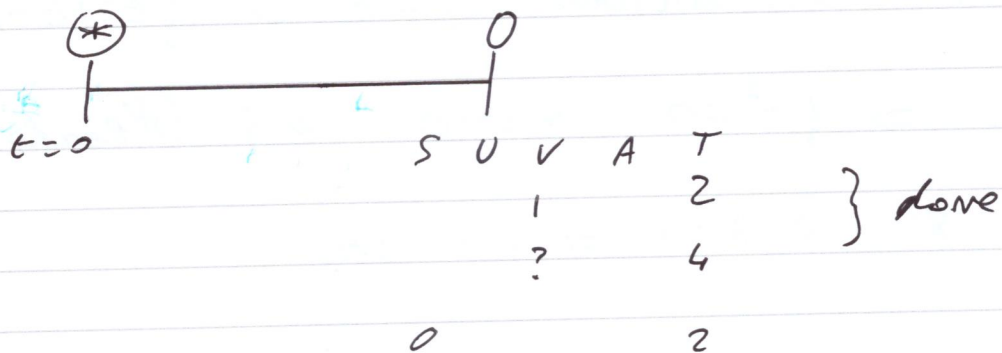
So at $t = 4$, $v = \frac{4^3}{2} - 3 = 29 \text{ m/s}$

Then

$$v = \frac{ds}{dt} = \frac{t^3}{2} - 3 \quad \text{So}$$

$$s = \int \left(\frac{t^3}{2} - 3 \right) dt = \frac{1}{4} \frac{t^4}{2} - 3t + c$$

Now consider the diagram below



$s = 0$ at $t = 2$ (see question). So

$$0 = \frac{1}{4} \frac{2^4}{2} - 3(2) + c \Rightarrow c = 4$$

So distance from 0 after $t=4$ secs is distance from \odot minus distance $\odot O$. I.e. $S(4) - S(2)$

$$\begin{aligned} \text{So distance} &= \frac{1}{4} \frac{4^4}{2} - 3(4) + 4 - \left(\frac{1}{4} \frac{2^4}{2} - 3(2) + 4 \right) \\ &= 24 - 0 = 24 \text{ m} \end{aligned}$$

(45) given $a = 2t$ Then $a = \frac{dv}{dt} = 2t \Rightarrow v = \int 2t dt$.

So $v = t^2 + C$. But $v=0$ when $t=0 \Rightarrow C=0$

$$\text{So } v = t^2.$$

Then $v = \frac{ds}{dt} = t^2 \Rightarrow s = \int t^2 dt = \frac{t^3}{3} + C$

But $s=0$ when $t=0 \Rightarrow C=0$.

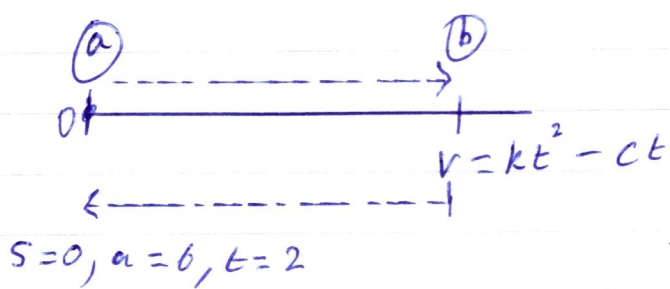
$$\text{So } s = \frac{t^3}{3}.$$

For $s=v$ we have $\frac{t^3}{3} = t^2 \Rightarrow \frac{1}{3} t^2 (t-3) = 0$

$$\Rightarrow \frac{1}{3} t^2 = 0 \Rightarrow t=0 \quad (\text{Already given})$$

$$\& \quad t-3=0 \Rightarrow t=3 \text{ secs.}$$

(46)



given ①: $v = kt^2 - ct$, $\therefore a = 2kt - c$ (2)

\int $s = \frac{1}{3}kt^3 - \frac{1}{2}ct^2 + A$ (3)

"t seconds after 0": $s=0$ and $t=0$ at 0, so into (3)

$$0 = 0 - 0 + A \Rightarrow A = 0$$

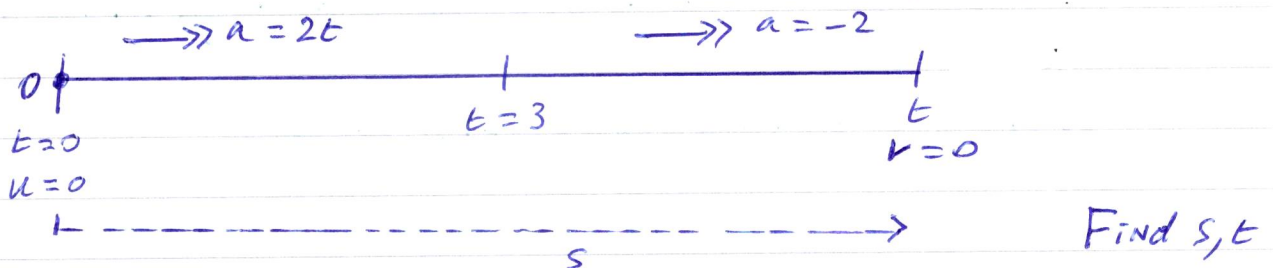
$$\therefore s = \frac{1}{3}kt^3 - \frac{1}{2}ct^2$$
 (4)

By (4) Returning to (a): $0 = \frac{8}{3}k - 2c$ (5)

By (2) Returning to (a): $6 = 2k(2) - c$
 $6 = 4k - c$ (6)

Solve (5) & (6) to get $k = 2\frac{1}{4}$ & $c = 3$

(47)



① $a = \frac{dv}{dt} = 2t$, $\therefore v = \int 2t dt = t^2 + c$.

At $t=0, v=u=0 \Rightarrow 0 = 0 + c \Rightarrow c = 0$

So $v = t^2$. At $t=3, v = 9 \text{ m/s}$.

$$v = \frac{ds}{dt} = t^2 \Rightarrow s = \int t^2 dt = \frac{1}{3} t^3 + c$$

$$\text{At } t=0, s=0, \therefore 0 = 0 + c \Rightarrow c = 0$$

$$\text{So } s = \frac{1}{3} t^3. \text{ At } t=3, s=9 \text{ m.}$$

(II) Since $a = -2 \text{ m/s}^2$ use SUVAT.

$\therefore v = u + at$. $v=9$ at End of (I), So $u=9$ at Start of part (II) when $t=3$. Along with $v=0$ & $a=-2$ at end of part (II):

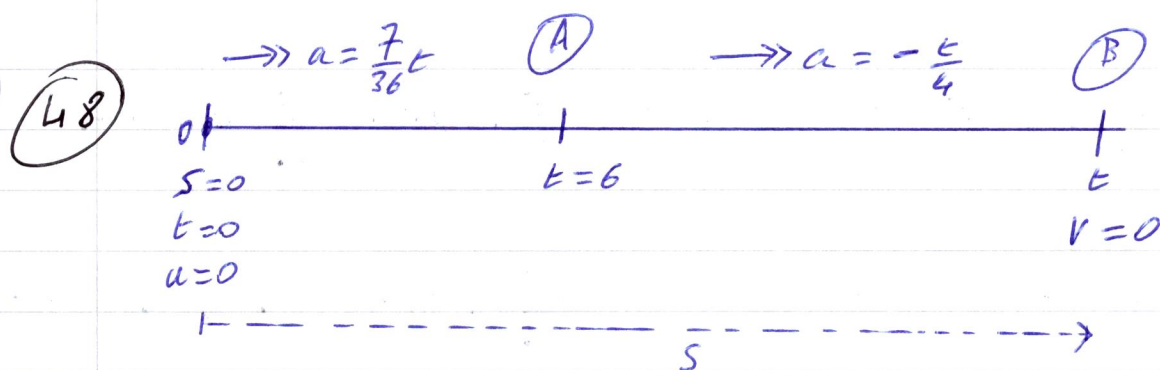
$$0 = 9 - 2t \Rightarrow t = 4\frac{1}{2} \text{ sec}$$

$$\text{So total time From } O = 3 + 4\frac{1}{2} = \underline{7\frac{1}{2} \text{ sec}}$$

And $s = ut + \frac{1}{2} at^2 \Rightarrow s = 9(4\frac{1}{2}) - \frac{1}{2}(2)(4.5)^2$ From time $t=3$ to End. $\therefore s = 20.25 \text{ m}$ From $t=3$ position to end.

$$\therefore \text{total distance from } O = 9 + 20.25 = \underline{29\frac{1}{4} \text{ m.}}$$





From 0 to (A): $a = \frac{dv}{dt} = \frac{7t}{36} \Rightarrow v = \int \frac{7t}{36} dt = \frac{7}{72}t^2 + C_1$

But $v = u = 0$ at $t=0$ so $0 = 0 + C_1 \Rightarrow C_1 = 0$

$\therefore v = \frac{7}{72}t^2$

At $t=6$, $v = 3.5 \text{ m/s}$ at (A)

Also $v = \frac{ds}{dt} = \frac{7}{72}t^2 \Rightarrow s = \int \frac{7}{72}t^2 dt = \frac{7}{216}t^3 + C_2$

But $s=0$ at $t=0$ so $0 = 0 + C_2 \Rightarrow C_2 = 0$

$\therefore s = \frac{7}{216}t^3$

At $t=6$, $s = 7 \text{ m}$ at (A)

From (A) to (B): $a = \frac{dv}{dt} = -\frac{t}{4} \Rightarrow v = \int -\frac{t}{4} dt = -\frac{t^2}{8} + C_3$

But $v = 3.5$ at $t=6$, so $3.5 = -\frac{36}{8} + C_3 \Rightarrow C_3 = 8$

$\therefore v = -\frac{t^2}{8} + 8$

When at rest at (B), $v=0$, so $0 = -\frac{t^2}{8} + 8 \Rightarrow t = 8 \text{ sec}$,

$$v = \frac{ds}{dt} = -\frac{t^2}{8} + 8 \Rightarrow s = \int -\frac{t^2}{8} + 8 dt = -\frac{t^3}{24} + 8t + C_4$$

$$\text{But } s = 7 \text{ at } t = 6 \text{ so } 7 = -\frac{6^3}{24} + 8(6) + C_4 \Rightarrow C_4 = -32$$

$$\therefore s = -\frac{t^3}{24} + 8t - 32$$

At $t = 8$, $s = 10\frac{2}{3}$ m from (A) to (B)

So total distance from O is $7 + 10\frac{2}{3} = 17\frac{2}{3}$ m.