Exercise 2C (odd numbered only)

(1) given: $u = 0$, $a = 4 m/s^2$, $t = 8$ sec | want: $s$

So $s = ut + \frac{1}{2} at^2 \Rightarrow s = \frac{1}{2}(4)(8)^2 = 128 m$

(3) given: $u = 0 m/s$, $a = 2 m/s^2$, $t = 4$ sec | want: $s$

So $s = ut + \frac{1}{2} at^2 \Rightarrow s = \frac{1}{2}(2)(16) = 16 m$

(5) given: $u = 3 m/s$, $v = 5 m/s$, $s = 2 m$ | want: $a$

So $v^2 = u^2 + 2as \Rightarrow 25 = 9 + 2\cdot(2)\cdot a$

$\therefore a = \frac{25-9}{4} = 4 m/s^2$

(7) given: $u = 7 m/s$, $v = 3 m/s$, $s = 5 m$ | want: $a$

So $v^2 = u^2 + 2as \Rightarrow 9 = 49 + 2(5) a$

$\therefore a = \frac{9-49}{10} = -4 m/s^2 \Rightarrow$ object is decellarating

(9) given: $s = 20m$ | want: $t$
$u = 3m/s$
$v = 7m/s$

So $s = \frac{u+v}{2} . t \Rightarrow 20 = \frac{3+7}{2} . t$

$\therefore t = \frac{40}{10} = 4$ secs

(11) given: $u = 2m/s$ | want: $a$
$v = 50m/s$
$t = 16$ secs

So $v = u + at \Rightarrow 50 = 2 + 16a$

$\therefore a = \frac{50-2}{16} = 3m/s^2$

(13) given: $u = 10m/s$ | want: $s$
$v = 2m/s$
$a = -4m/s^2$

So $v^2 = u^2 + 2as \Rightarrow 4 = 100 + 2(-4).s$

$\therefore s = \frac{4-100}{-8} = 12m$

(15) given: $u = 5m/s$, $a = 1m/s^2$, $s = 12m$;
want: $t$.

So $s = ut + \frac{1}{2}.at^2 \Rightarrow 12 = 5t + \frac{1}{2}(1).t^2$

$\therefore \frac{1}{2}t^2 + 5t - 12 = 0 \Rightarrow t^2 + 10t - 24 = 0$

$\therefore (t+12)(t-2) = 0 \Rightarrow t = 2$ secs or $t = -12$ secs

Since time is positive, $t = 2$ secs

or $v^2 = u^2 + 2as \Rightarrow v^2 = 25 + 2.(1).12 = 49$

$\therefore v = \pm 7$ m/s . Since $v$ is positive, $v = 7$ m/s

From $v = u + at$ we have $7 = 5 + 1.t \Rightarrow t = 2$ secs.

(17) given: $u = 5$ m/s
$V = 36$ km/h $= 10$ m/s
$a = 1\frac{1}{4}$ m/s$^2$

want: $s$

So $v^2 = u^2 + 2as \Rightarrow 100 = 25 + 2.(\frac{5}{4}).s$

$\therefore s = \frac{150}{5} = 30$m

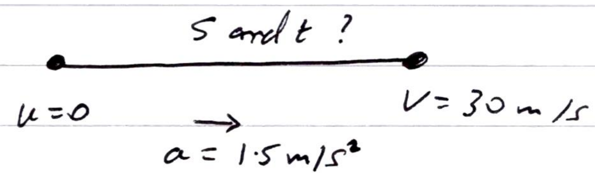
(19) given: $a = 2$ m/s$^2$
$v = 10$ m/s
$t = 2$ sec

want: $s$

So $v = u + at \Rightarrow 10 = u + 2\times2 \Rightarrow u = 6$ m/s

Then $s = \frac{u+v}{2}.t \Rightarrow s = (6+10)/2 \times 2 = 16$ m

) given : $u = 0$ m/s | want: s and t
$a = 1.5$ m/s$^2$
$v = 30$ m/s




$v^2 = u^2 + 2as \Rightarrow 900 = 0 + 2(1.5).s$

$\therefore s = 300$m

N $v = u + at \Rightarrow 30 = 0 + 1.5t$

$\therefore t = 20$ secs

) given : $u = 0$ m/s | want: a
$v = 90$ km/h $= 25$ m/s
$t = 10$

So $v = u + at \Rightarrow 25 = 0 + 10a$, $\therefore a = 2.5$ m/s$^2$

) given : $u = 20$ m/s
$s = 30$ m
$v = 0$ : The question should be more precise by saying "... distance of 30 m to come to a stop"

want: a, t.

$v^2 = u^2 + 2as \Rightarrow 0 = 400 + 2.a.30$, $\therefore a = \frac{-400}{60} = -6\frac{2}{3}$ m/s$^2$

So a Retardation of $6\frac{2}{3}$ m/s$^2$

Then $v = u + at \Rightarrow 0 = 20 - 6\frac{2}{3} . t$

$\therefore \quad t = \frac{-20}{-6^2/_3} = 3$ secs.

(27) given: $u = 2$ m/s
$V = 18$ m/s
$t = 10$ secs

want: a, s.

So $V = u + at \Rightarrow 18 = 2 + 10a$ ; $\therefore \quad a = 1.6 \, m/s^2$

Also $s = \frac{u+v}{2} . t \Rightarrow s = \frac{2+18}{2} . 10 = 100$ m

(29) given: $t = 0$
$u = 10$ m/s
$a = -2 \, m/s^2$

(a) want: s
given: $t = 7$ secs

Hence $s = ut + \frac{1}{2}at^2 \Rightarrow s = 10(7) + \frac{1}{2}(-2)(7)^2$

$= 21$ m

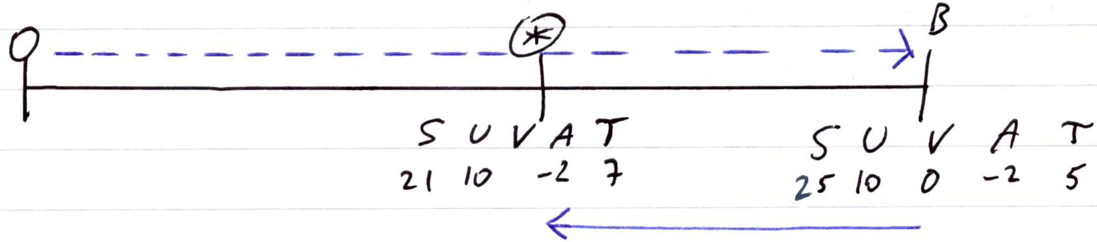
(b) given: $v = 0$
want: s, t

hence $v^2 = u^2 + 2as \Rightarrow 0 = 100 + 2(-2)s$

$\therefore \quad s = \frac{100}{4} = 25$ m we now have $u = 10$, $v = 0$, $a = -2$; we want $t$

So $v = u + at \Rightarrow 0 = 10 - 2t$, $\therefore t = 5$ secs

(c) A line diagram for this problem would look like this

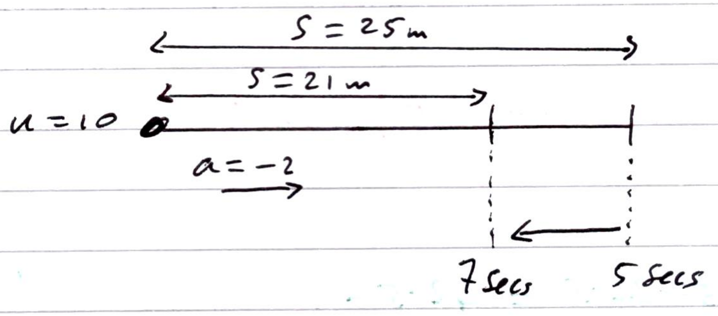



$\therefore$ object takes 5 secs to stop, at 25 m away. (use $s = ut + \frac{1}{2}at^2$)
Then it returns toward O to travel to (*) for 2 secs.

Displacement from O to (*) = net distance from O after 7 secs & is 21 m (after already having passed through B).
We want total distance O → B → (*).

$\therefore$ So distance is $s = 25 + (25 - 21) = 29$ m

The only way to get the answer in the book is to assume the body Returns along its path at $t = 7$ secs, i.e




∴ Extra distance covered is $25 - 21 = 4$ m

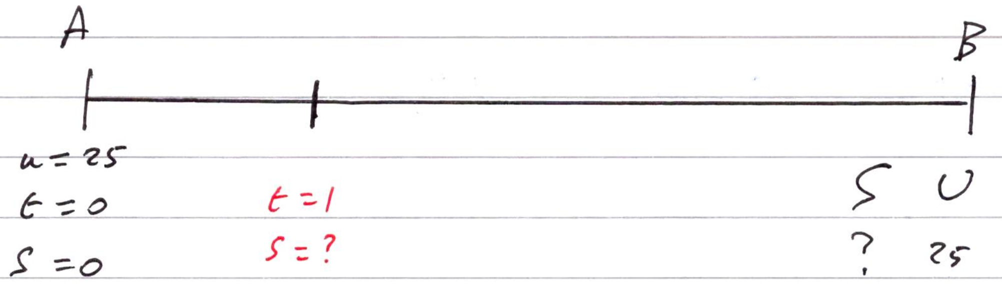
∴ Total distance covered is $25 + 4 = 29$ m

My opinion is That The idea of a Return journey should have been stated in The wording of The question?

(31) given: $u = 25$ m/s | want: $S$ (car to tree when $V = 0$)
$a = -5$ m/s$^2$
$V = 0$

So $V^2 = u^2 + 2aS \Rightarrow 0 = 625 + 2(-5)S$

∴ $S = 62.5 \Rightarrow$ car stops at $65 - 62.5 = 2.5$ m in front of tree




| S | U | V | A | T |
|---|---|---|---|---|
| ? | 25 | 0 | −5 | |
| ? | 25 | | −5 | 1 |
| 42.5 | 25 | ? | −5 | |

So distance travelled after 1 second:

$$s = ut + \frac{1}{2}at^2 \Rightarrow s = 25(1) + \frac{1}{2}(-5).1^2$$
$$= 22.5\text{ m}$$

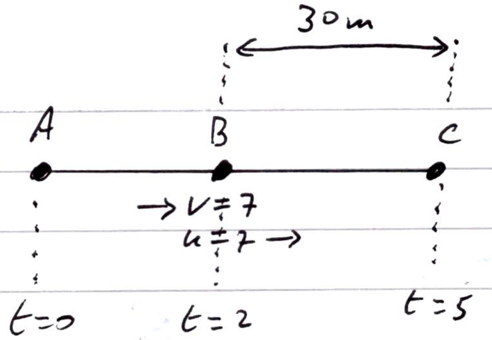
Distance remaining: $s = 65 - 22.5 = 42.5$m

So $v^2 = u^2 + 2as \Rightarrow v^2 = 25^2 + 2(-5)(42.5)$

$\Rightarrow v = 14.14$ m/s

by the time car hits tree.

33




given: $u = 7\ m/s$
$S = 30\ m$
$t = 3$ secs

want: $a$

$\therefore \quad s = ut + \frac{1}{2}at^2 \Rightarrow 30 = 7(3) + \frac{1}{2}a(3)^2$

$\therefore \quad a = 2\ m/s^2$

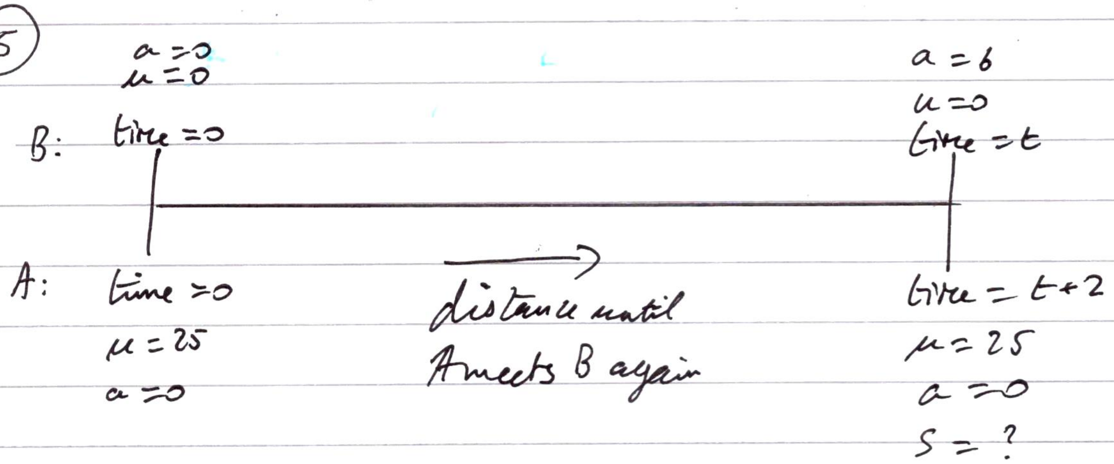
Now given: $a = 2\ m/s^2$ (Since $a$ is uniform / const throughout whole motion)

$t = 2$ sec

$v = 7$

$\therefore \quad v = u + at \Rightarrow 7 = u + 2(2) \Rightarrow u = 3\ m/s.$

35




PTO

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

For A: $s = 25(t+2) + \frac{1}{2}(0)t^2 = 25t$ } ⊛

B: $s = (0)t + \frac{1}{2}.6.t^2 = 3t^2$

when B meets A: $3t^2 = 25t + 50$

$\Rightarrow \quad 3t^2 - 25t - 50 = 0$

So $t = \dfrac{+25 \pm \sqrt{25^2 + (12)(50)}}{6}$

$= \dfrac{25 \pm 35}{6} = 1\frac{2}{3}, \ 10$

time $t \neq 1\frac{2}{3}$. why? Because by ⊛ :

for A: $s = 25(1\frac{2}{3}) + 50 = 91\frac{2}{3}$ m

B: $s = 3(1\frac{2}{3})^2 = 8\frac{1}{3} \neq 91\frac{2}{3}$ m

So $t = 10$: for A: $s = 25(10) + 50 = 300$m

B: $s = 3(10)^2 = 300$m ✓

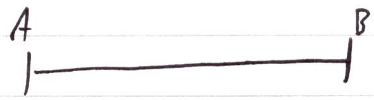
## Exercises 2C, P27 (even N°s only)

(2)


| S | U | V | A | T |
|---|---|---|---|---|
|  | 3 | ? | 2 | 6 |

So $v = u + at \Rightarrow v = 3 + 2 \times 6 = 15\ m/s$

(4)




| S | U | V | A | T |
|---|---|---|---|---|
| ? | 3 | 5 |  | 10 |

$s = \frac{u+v}{2} \cdot t \Rightarrow s = \frac{3+5}{2} \cdot 10 = 40\ m$

(6)


| S | U | V | A | T |
|---|---|---|---|---|
|  | ? | 27 | 8 | 2 |

So $v = u + at \Rightarrow 27 = u + (8)(2) \Rightarrow u = 11\ m/s$

(8)


| S | U | V | A | T |
|---|---|---|---|---|
| 28 | ? |  | 1 | 4 |

So $s = ut + \frac{1}{2} at^2 \Rightarrow 28 = 4u + \frac{1}{2}(1)(16)$

$\Rightarrow u = 5\ m/s$

(10)


| S | U | V | A | T |
|---|---|---|---|---|
| ? | 6 | 8 | $\frac{1}{2}$ | |

So $v^2 = u^2 + 2as \Rightarrow 64 = 36 + 2(\frac{1}{2})s$

$\Rightarrow s = \ldots$

(12)


| S | U | V | A | T |
|---|---|---|---|---|
| 500 | 1 | | ? | 10 |

So $s = ut + \frac{1}{2}at^2 \Rightarrow 500 = (1)(10) + \frac{1}{2}(10)^2 a$

$\Rightarrow a = 9.8\ m/s^2$

(14)


| S | U | V | A | T |
|---|---|---|---|---|
| | 30 | 10 | -4 | ? |

So $v = u + at \Rightarrow 10 = 30 - 4t \Rightarrow t = 5$ secs.

(16)


| S | U | V | A | T |
|---|---|---|---|---|
| 60 | ? | 8 | | 12 |

So $s = \frac{u+v}{2} \cdot t \Rightarrow 60 = \left(\frac{u+8}{2}\right) \cdot 12$

$\Rightarrow u = 2\ m/s$

Ditto for (18) & (20).

(22)


| S | U | V | A | T |
|---|---|---|---|---|
| 25 | 0 | 30 | ? | |

So $v^2 = u^2 + 2as \Rightarrow 30^2 = 0^2 + 2a(25)$

$\Rightarrow a = 18 \, m/s^2$

(24)


| S | U | V | A | T |
|---|---|---|---|---|
| 0.7 | 0 | 210 | ? ✓ | ? |

So $v^2 = u^2 + 2as \Rightarrow 210^2 = 0^2 + 2a(0.7)$

$\Rightarrow a = 31\,500 \, m/s^2$

Then $v = u + at \Rightarrow 210 = 0 + 31500t$

$\Rightarrow t = \frac{1}{150}$ secs

(26)


| S | U | V | A | T |
|---|---|---|---|---|
| ? | 0 | | 4 | 2 ← (a) |
| | | | | 3 ← (b) |

(a) So $s = \left(\frac{u+v}{2}\right)t \Rightarrow s =$ | × does not help

So $s = ut + \frac{1}{2}at^2 \Rightarrow s = 0(2) + \frac{1}{2}(4)(2)^2 = 8 \, m$

(b) So $s = ut + \frac{1}{2}at^2 \Rightarrow s = 0(3) + \frac{1}{2}(4)(3)^2 = 18 \, m$

So object travels 10 m in the third second.

(28)

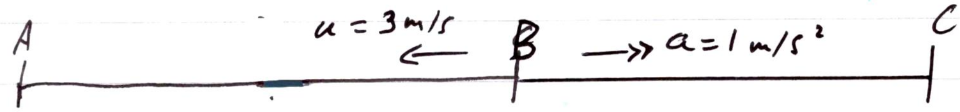

| S | U | V | A | T | |
|---|---|---|---|---|---|
| ? | $\frac{1}{4}$ | | 1.5 | 3 | ← (a) |
| | | | | 4 | ← (b) |

So $S = ut + \frac{1}{2}at^2 \Rightarrow S = \frac{1}{4} \times 3 + \frac{1}{2}(1.5)(3) = 3m$

Also $S = ut + \frac{1}{2}at^2 \Rightarrow S = \frac{1}{4} \times 4 + \frac{1}{2}(1.5)(4)^2 = 13m$

So object travels 10m in the fourth second

(30)




| S | U | V | A | T |
|---|---|---|---|---|
| ? | 3 | 0 | -1 | ? |

0 ↓ has to be if Body Returns to C

$\therefore v = u + at$

$\Rightarrow 0 = 3 - t$

$\Rightarrow t = 3$ secs

So t for A→B is also t = 3 secs

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

$= 3(3) - \frac{1}{2}(1).9$

$= \frac{9}{2}$ m

So total S From B→A→B is S = 9m

And BC = 20 So total Distance is 20 + 9 = 29m ✓

| S | U | V | A | T |
|---|---|---|---|---|
| 24.5 | 0 | | 1 | ? |

24.5 ↓ FROM A to B to C

0 ↓ Start FROM A

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

$\Rightarrow 24.5 = 0 + \frac{1}{2}t^2$

$\therefore 49 = t^2 \Rightarrow t = 7$ sec FROM A to C

But t = 3 FROM B to A

So total time FOR B→A→B→C is

t = 7 + 3 = 10 secs

(32)


Stage ③

| S | U | V | A | T |
|---|---|---|---|---|
| ? | 20 | 0 | −2 | ? |

Stage ①

| S | U | V | A | T |
|---|---|---|---|---|
| ? | 0 | 20 | 1¼ | ? |

Stage ②

| S | U | V | A | T |
|---|---|---|---|---|
| 1560 | 20 | ? | 0 | ? |

## Stage

① So $v^2 = u^2 + 2as \Rightarrow 20^2 = 0 + 2(1\tfrac{1}{4}).s$

$\Rightarrow s = 160$ m

② $s = ut + \tfrac{1}{2}at^2 \Rightarrow 1560 = 20t + \tfrac{1}{2}(0)t$

$\Rightarrow t = 78$ secs

① $v = u + at \Rightarrow 20 = 0 + 1.25t$

$\Rightarrow t = 16$ sec

② $v = u + at \Rightarrow v = 20 + (0)t = 20$

Makes sense since speed is constant in Stage ②

③ $v^2 = u^2 + 2as \Rightarrow 0^2 = 20^2 + 2(-2)s$

$\Rightarrow s = 100$ m

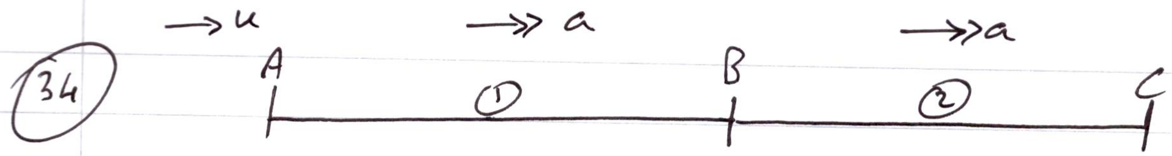
✗ $v = u + at$

$\Rightarrow 0 = 20 - 2t \Rightarrow t = 10$ secs

→ So total $s = 160 + 1560 + 100 = 1820 = 1.82$ km ✓

$t = 78 + 16 + 10 = 104$ sec $= 1$m $44$ sec ✓

(34)




| S | U | V | A | T |
|---|---|---|---|---|
| 95 | u | ? | a | 5 |

| S | U | V | A | T |
|---|---|---|---|---|
| 80 | | | a | 2 |

$u+5a$ → $u+5a$

**Stage ①:** $v = u + at \Rightarrow v = u + 5a$

$\nearrow$ $s = ut + \frac{1}{2}at^2 \Rightarrow 95 = 5u + \frac{25}{2}a$ i)

**Stage ②:** $s = ut + \frac{1}{2}at^2 \Rightarrow 80 = (u+5a).2 + \frac{1}{2}.a.4$

$\Rightarrow 80 = 2u + 12a$ ii)

**Solve i) & ii):**

$2 \times$ i) : $190 = 10u + 25a$

$5 \times$ ii) : $400 = 10u + 60a$

$210 = 0 + 35a \Rightarrow a = 6m$…

$\therefore u = 4m/s$