Fully-Worked Solutions

FORM 4

CHAPTER 7

Self Test 1

1
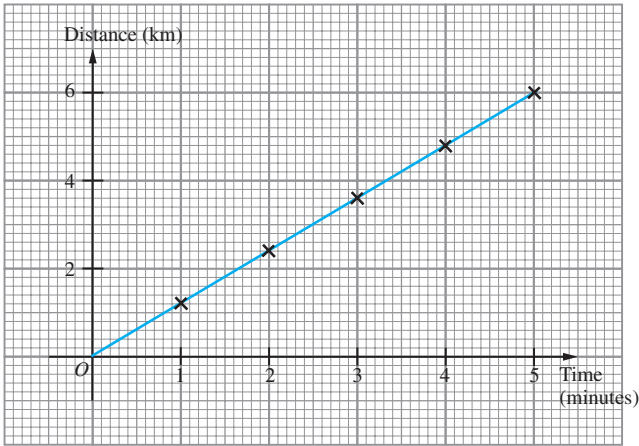
2
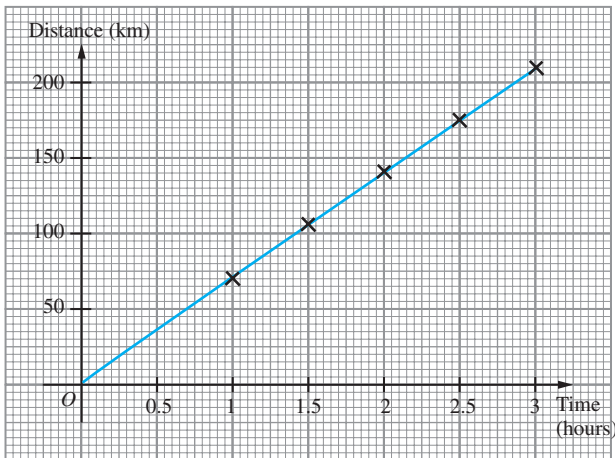
3 $s = 0.2t$

Time (minutes)	0	30
Distance (km)	0	6
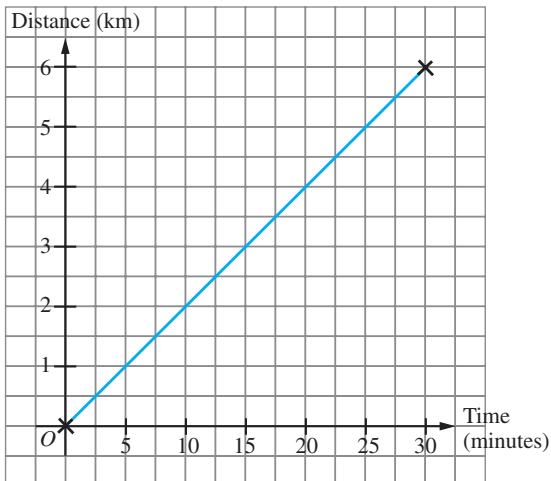
4 $s = 8 - 2t$

Time (seconds)	0	4
Distance (m)	8	0
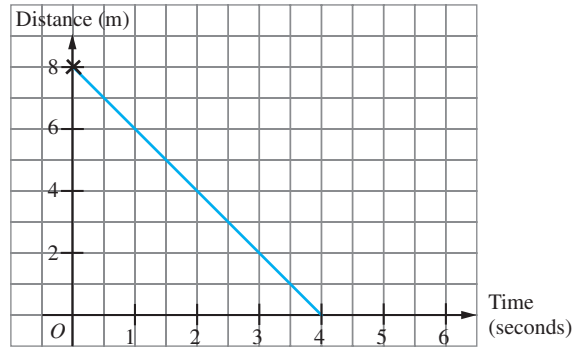
5 (a) Duration Sheila stopped = 10 – 5 minutes

$\qquad\qquad$ = 5 minutes

$\quad$ (b) Total distance = 50 km

$\quad$ (c) Speed $= \dfrac{50 - 20}{5}$ km min^{-1}

$\qquad\qquad$ = 6 km min^{-1}

$\quad$ (d) Sheila moved 20 km at a speed of 4 km min^{-1} over a period of 5 minutes before she stopped for 5 minutes. She then continued to move another 30 km at a speed of 6 km min^{-1} for the last 5 minutes.

6 (a) Duration when the particle stopped moving

$\qquad$ = (8 – 5) seconds

$\qquad$ = 3 seconds

$\quad$ (b) Average speed = 3.125 m s^{-1}

$\qquad \dfrac{\text{Total distance travelled}}{\text{Total time taken}} = 3.125$

$\qquad\qquad \dfrac{50}{t} = 3.125$

$\qquad\qquad\quad t = \dfrac{50}{3.125}$ s

$\qquad\qquad\qquad = 16$ s

$\quad$ (c) Speed $= \dfrac{(0 - 35)\ \text{m}}{(16 - 8)\ \text{s}}$

$\qquad\qquad = -4.375$ m s^{-1}

$\qquad$ The particle moved 35 m at a speed of 4.375 m s^{-1} for a period of 8 s.

7

School	Ipoh	Penang
0500	0730 – 0830	1050

205 km   156.5 km
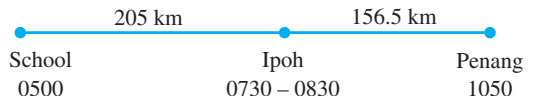
$\quad$ (a) $p = 205 + 156.5$

$\qquad\quad = 361.5$

$\qquad q = 156.5$

$\qquad r = 150 + 60$

$\qquad\quad = 210$

(b)

Distance (km), values 361.5, 156.5 on y-axis; Time (minutes) with 150, 210, 350 on x-axis.
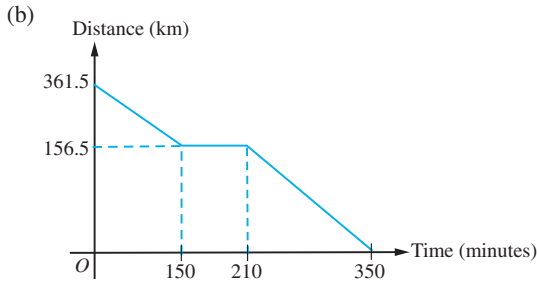
(c) Total time $= 5\,h + \left(\dfrac{50}{60}\right)h$

$= 5\dfrac{5}{6}\,h$

Average speed $= \dfrac{361.5}{5\dfrac{5}{6}}\,km\,h^{-1}$

$= 61\dfrac{34}{35}\,km\,h^{-1}$ or $61.97\,km\,h^{-1}$

8 (a) Distance of Zhong from Singapore $= (354 - 220)\,km$
$= 134\,km$

(b) Average speed of Zhong $= \dfrac{\text{Total distance}}{\text{Total time}}$

$= \dfrac{354\,km}{4\,h}$

$= 88.5\,km\,h^{-1}$

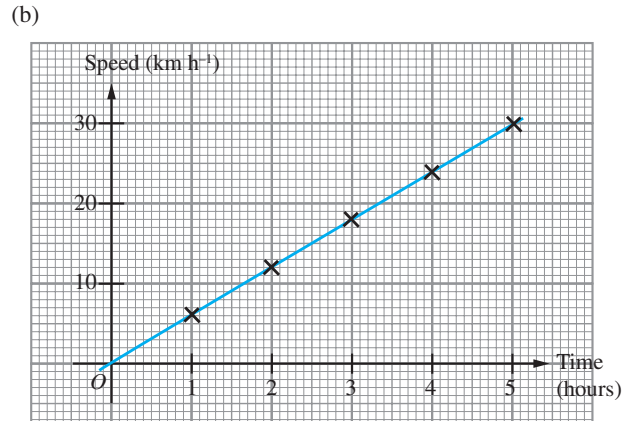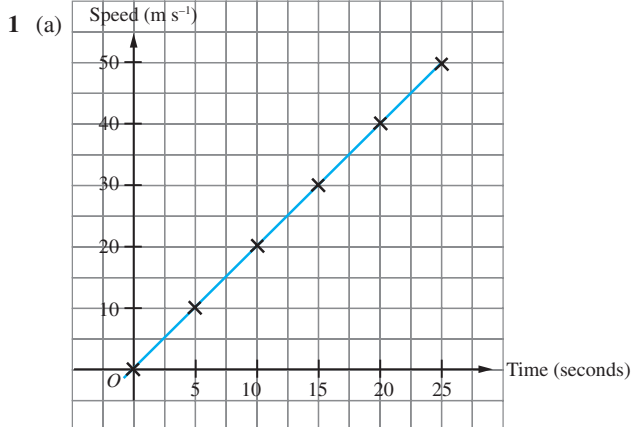(c) Average speed of Aiman $= \dfrac{354\,km}{3\,h}$

$= 118\,km\,h^{-1}$

The difference in speed between Aiman and Zhong
$= (118 - 88.5)\,km\,h^{-1}$
$= 29.5\,km\,h^{-1}$

(d) Total time $= \dfrac{\text{Total distance}}{\text{Total time}}$

$= \dfrac{354\,km}{800\,km\,h^{-1}}$

$= 0.4425\,h \times 60$
$= 26.55$ minutes
≈ 27 minutes

Arrival time of Aiman in Singapore
$= 1000$ hours $+ 27$ min
$= 1027$ hours or 10.27 a.m.

Self Test 2

1 (a)

Speed (m s⁻¹) vs Time (seconds) graph with points at (5,10), (10,20), (15,30), (20,40), (25,50).

(b)

Speed (km h⁻¹) vs Time (hours) graph with points rising through (1,6), (2,12), (3,18), (4,24), (5,30).
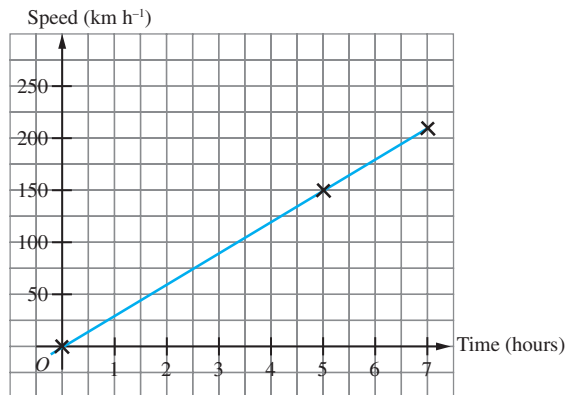
2 (a) $v = 20 - 3t$ for $0 \leqslant t \leqslant 6$ where v is the speed in m s⁻¹ and t is the time in seconds.

Time, t (seconds)	0	6
Speed, v (m s⁻¹)	20	2

Speed (m s⁻¹) vs Time (seconds) graph, line from (0,20) to (6,2).
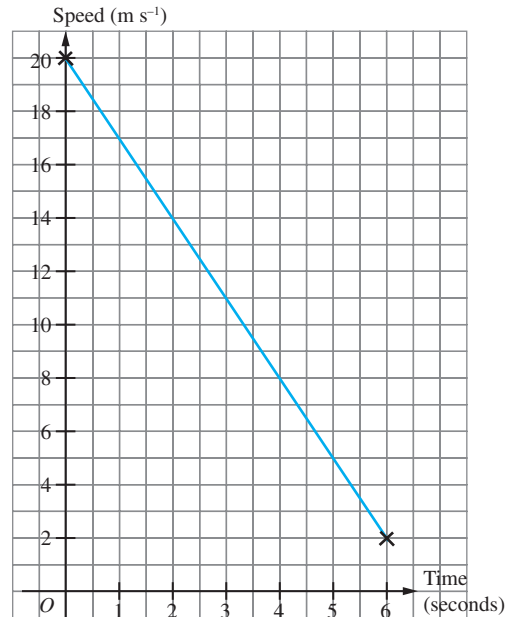
(b) $v = 30t$ for $0 \leqslant t \leqslant 7$ where v is the speed in km h⁻¹ and t is the time in hours.

Time, t (h)	0	5	7
Speed, v (km h⁻¹)	0	150	210

Speed (km h⁻¹) vs Time (hours) graph, line through (0,0), (5,150), (7,210).

3 (a) Total distance $= 80(2.5) - \dfrac{1}{2}[2.5 + (1.5 - 0.5)](80 - 50)$

$$= 200 - 52.5$$
$$= 147.5 \text{ km}$$

(b) Total distance $= \dfrac{1}{2}(12 + 20)(14) + \dfrac{1}{2}(20)(18 - 14)$

$$= 224 + 40$$
$$= 264 \text{ m}$$

4 (a) Total distance $= \dfrac{1}{2}(10 + 50)\left(\dfrac{5}{60}\right) + \left(\dfrac{10 - 5}{60}\right)(50) +$

$$\dfrac{1}{2}(50 + 100)\left(\dfrac{20 - 10}{60}\right)$$

$$= 2.5 + 4\dfrac{1}{6} + 12.5$$

$$= 19\dfrac{1}{6} \text{ km}$$

Average speed $= \dfrac{\text{Total distance travelled}}{\text{Total time taken}}$

$$= \dfrac{19\dfrac{1}{6}}{\dfrac{20}{60}} \text{ km h}^{-1}$$

$$= 57.5 \text{ km h}^{-1}$$

(b) Total distance $= \dfrac{1}{2}(10 + 18)(2) + \dfrac{1}{2}(5 - 2)(10)$

$$= 28 + 15$$
$$= 43 \text{ m}$$

Average speed $= \dfrac{\text{Total distance travelled}}{\text{Total time taken}}$

$$= \dfrac{43}{5} \text{ m s}^{-1}$$

$$= 8.6 \text{ m s}^{-1}$$

5 (a) Rate of change of speed $= \dfrac{15 - 45}{15} \text{ m s}^{-2}$

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

(b) Duration $= (35 - 15)$ s
$$= 20 \text{ s}$$

(c) Rate of change of speed $= \dfrac{(60 - 15) \text{ m s}^{-1}}{(60 - 35) \text{ s}}$

$$= 1.8 \text{ m s}^{-2}$$

Distance $= \dfrac{1}{2}(15 + 60)(25)$

$$= 937.5 \text{ m}$$

The robot moved 937.5 m with an acceleration of 1.8 m s^{-2} in the last 25 seconds.

(d) Total distance $= \dfrac{1}{2}(15 + 45)(15) + (35 - 15)(15) +$

$$\dfrac{1}{2}(15 + 60)(25)$$

$$= 450 + 300 + 937.5$$
$$= 1\,687.5 \text{ m}$$

Average speed $= \dfrac{\text{Total distance travelled}}{\text{Total time taken}}$

$$= \dfrac{1\,687.5 \text{ m}}{60 \text{ s}}$$

$$= 28.125 \text{ m s}^{-1}$$

6 (a) Duration $= 12$ seconds

(b) Distance $= \dfrac{1}{2}(24 + 36)(36 - 12)$

$$= 720 \text{ m}$$

(c) $\dfrac{36 - 24}{36 - 12} = \dfrac{1}{3} \times \dfrac{-(0 - 36)}{t - 36}$

$$\dfrac{12}{24} = \dfrac{12}{t - 36}$$

$$t - 36 = 12(2)$$
$$t = 24 + 36$$
$$= 60$$

7 (a) Duration $= 5$ seconds

(b) $5(5) + \dfrac{1}{2}(5 + v)(15 - 5) = 2 \times \dfrac{1}{2}(7)(v)$

$$25 + 5(5 + v) = 7v$$
$$25 + 25 + 5v = 7v$$
$$2v = 50$$
$$v = 25$$

(c) Rate of change of speed $= \dfrac{0 - 25}{7} \text{ m s}^{-2}$

$$= -3\dfrac{4}{7} \text{ m s}^{-2} \text{ or } -3.57 \text{ m s}^{-2}$$

SPM PRACTICE

Paper 1

1 C Duration $= 25 - 15$
$$= 10 \text{ s}$$

2 D Speed of $JK = \dfrac{8 - 2}{10} \text{ km min}^{-1}$

$$= 0.6 \text{ km min}^{-1}$$

Speed of $MN = \dfrac{8}{40 - 30} \text{ km min}^{-1}$

$$= 0.8 \text{ km min}^{-1}$$

3 B Acceleration $= \dfrac{45 - 30}{60 - 45} \text{ m s}^{-2}$

$$= \dfrac{15}{15} \text{ m s}^{-2}$$

$$= 1 \text{ m s}^{-2}$$

Total distance $= 45(30) + \dfrac{1}{2}(30 + 45)(60 - 45)$

$$= 1\,350 + 562.5 \text{ m}$$
$$= 1\,912.5 \text{ m}$$

Average speed $= \dfrac{1\,912.5}{60} \text{ m s}^{-1}$

$$= 31.875 \text{ m s}^{-1}$$

4 C
A uniform speed
B uniform speed
C speed increases
D speed decreases

5 D Total distance $=$ average speed $\times$ total time
$$= 90 \text{ km h}^{-1} \times 2.5 \text{ h}$$
$$= 225 \text{ km}$$

Paper 2

Section A

1 (a) Distance travelled by Linda $= 90$ km

Distance travelled by Rozita $= \dfrac{1}{2}(30 + 90)(0.9) + \dfrac{1}{2}$
$$(1.5 - 0.9)(90)$$
$$= 54 + 27$$
$$= 81 \text{ km}$$

Difference in the distance travelled $= 90 - 81$ km
$$= 9 \text{ km}$$

(b) Distance during deceleration $= \dfrac{1}{2}(1.5 - 0.9)(90)$

$$= 27 \text{ km}$$

2 Rate of change of speed in the first 10 minutes

$$= \dfrac{(90 - 60) \text{ km h}^{-1}}{(10 \div 60) \text{ h}}$$

$$= 180 \text{ km h}^{-2}$$

Rate of change of speed of the last 20 minutes

$$= \frac{(0-90) \text{ km h}^{-1}}{(20 \div 60) \text{ h}}$$

$$= -270 \text{ km h}^{-2}$$

Distance for the first 10 minutes $= \frac{1}{2}\left(\frac{10}{60}\right)(60+90)$ km

$$= 12.5 \text{ km}$$

Distance between the 10$^{\text{th}}$ minute and the 40$^{\text{th}}$ minute

$$= \left(\frac{30}{60} \times 90\right) \text{km}$$

$$= 45 \text{ km}$$

Distance for the last 20 minutes $= \frac{1}{2}\left(\frac{20}{60}\right)(90)$ km

$$= 15 \text{ km}$$

For the first 10 minutes, Sharifah moved 12.5 km with an acceleration of 180 km h^{-2}.

Between the 10$^{\text{th}}$ minute to the 40$^{\text{th}}$ minute, Sharifah moved another 45 km at a uniform speed of 90 km h^{-1}.

In the last 20 minutes, Sharifah moved 15 km with a deceleration of 270 km h^{-2}.

3 (a) 1840 hours

(b) 0 km h^{-1} (Shin Ling did not move from the 15$^{\text{th}}$ minute to 40$^{\text{th}}$ minute)

(c) Average speed of Aminah $= \dfrac{6 \text{ km}}{(60-15) \div 60 \text{ h}}$

$$= 8 \text{ km h}^{-1}$$

4 20 min $= \dfrac{20}{60}$h

$$= \dfrac{1}{3}\text{h}$$

Distance $= (2 \text{ m s}^{-1})(20 \times 60 \text{ s})$
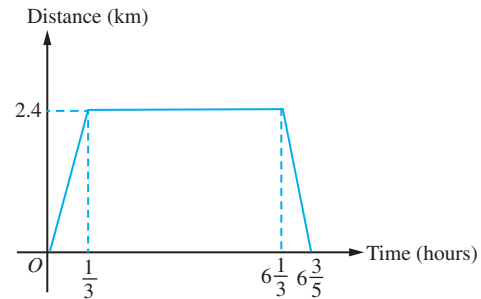
$$= 2\,400 \text{ m}$$

$$= 2.4 \text{ km}$$

Duration for return journey $= \dfrac{2\,400 \text{ m}}{2.5 \text{ m s}^{-1}}$

$$= 960 \text{ s}$$

$$= \dfrac{4}{15} \text{ h}$$

Time $= 6\dfrac{1}{3} + \dfrac{4}{15}$

$$= 6\dfrac{3}{5}$$

Section B

5 (a) Duration $= (3.5 - 1.5) \times 60$ min

$$= 120 \text{ min}$$

(b) $\dfrac{1}{2}(3.5+2)(v-26) + \dfrac{1}{2}(v-26+v)(4-3.5) + \dfrac{1}{2}(1)(v)$

$$= 357 \text{ km}$$

$2.75v - 71.5 + 0.5v - 6.5 + 0.5v = 357$

$3.75v = 357 + 78$

$$= 435$$

$v = 116 \text{ km h}^{-1}$

(c) Rate of change of speed $= \dfrac{0-116}{1}$ km h^{-2}

$$= -116 \text{ km h}^{-2}$$

FULLY-WORKED SOLUTIONS