NEW CENTURY MATHS 11
MATHEMATICS STANDARD (PATHWAY 2)

FULLY WORKED SOLUTIONS

Chapter 12

SkillCheck

Question 1

a 2

b 1.74

c 2.94

d 0.04

e 0.07

f 0

Question 2

a

x	0	1	2	3	4	5
y	4	3.7	3.4	3.1	2.8	2.5

b –0.3 (as the values drop by 0.3 each time).

Question 3

a **i** $(1+2+4+...+9+10) \div 10 = 5.5$

ii Put data in order smallest to largest. 1 2 4 4 5 | 5 7 8 9 10

Median is halfway between the two middle values.

$\therefore$ Median = $\frac{5+5}{2} = 5$

iii 4 and 5

iv largest − smallest $= 10 - 1 = 9$

v Q_1 = the middle of the lower 5 scores

$\therefore 4$

Q_3 = the middle of the top 5 scores

$\therefore 8$

$$\begin{aligned} \therefore IQR &= Q_3 - Q_1 \\ &= 8 - 4 \\ &= 4 \end{aligned}$$

b **i** $(0+1+...+14) \div 9 = 7.6$

ii Put data in order smallest to largest. 0 1 | 2 8 9 10 12 | 12 14

Median is the middle value. $\therefore$ Median = 9

iii 12

iv largest − smallest $= 14 - 0 = 14$

v Q_1 = the middle of the lower 5 scores

$\therefore 1\frac{1}{2}$ Q_3 = the middle of the top 5 scores

$\therefore 12$

$$\begin{aligned} \therefore IQR &= Q_3 - Q_1 \\ &= 12 - 1\tfrac{1}{2} \\ &= 10.5 \end{aligned}$$

Question 4

a $V = 2.3 + 8.7 \times 3$
$= 28.4$

b $S = 4.1 \times 42.3 \times (4.1 \times 42.3 + 7.2)$
$= 31\ 326.6609$
$\approx 31\ 326.7$

c $S = \dfrac{128}{3.4}$
$= 37.647$
≈ 37.6

Question 5

a $25 \times 1000 = 25\,000 \text{ m}$

b $2463 \div 1000 = 2.463 \text{ km}$

c Can use $\boxed{\circ\ '\ ''}$ button or write minutes as fractions and convert to decimal.

$3\text{ h } 45\text{ min} = 3\tfrac{45}{60}\text{ h}$
$= 3.75\text{ h}$

d Can use $\boxed{\circ\ '\ ''}$ button or multiply decimal by 60 to get minutes.
$0.2 \times 60 = 12$
$\therefore 5.2 \text{ h} = 5 \text{ h } 12 \text{ minutes}$

e Can use $\boxed{\circ\ '\ ''}$ button or multiply decimal by 60 to get minutes.
$0.\dot{3} \times 60 = \dfrac{1}{3} \times 60 = 20$
$\therefore 7.\dot{3} \text{ h} = 7 \text{ h } 20 \text{ minutes}$

f $\dfrac{20 \times 1000 \text{ m}}{1 \times 60 \times 60 \text{ s}} = \dfrac{20\,000 \text{ m}}{3600 \text{ s}}$
$= 5.555...$
$= 5.\dot{5} \text{ m/s}$

g $\dfrac{110 \times 1000 \text{ m}}{1 \times 60 \times 60 \text{ s}} = \dfrac{110\,000 \text{ m}}{3600 \text{ s}}$
$= 30.555...$
$= 30.\dot{5} \text{ m/s}$

h $\dfrac{3.5 \div 1000 \text{ km}}{1 \text{ s}} = 0.0035 \text{ km/s}$
$= 0.0035 \text{ km/s} \times 60 \times 60$
$= 12.6 \text{ km/h}$

Question 6

$$\begin{aligned} d &= 840 \times 24 \\ &= 20\ 160 \text{ km} \end{aligned}$$

Question 7

$$\begin{aligned} s &= \frac{245 \text{ km}}{3 \text{ h } 45 \text{ min}} \\ &= \frac{245 \text{ km}}{3.75 \text{ h}} \\ &= 65.3 \text{ km/h} \end{aligned}$$

Question 8

a $\begin{aligned} 14\% \text{ of } \$35.80 &= 0.14 \times 35.80 \\ &= \$5.01 \end{aligned}$

b $\begin{aligned} 9.5\% \text{ of } \$26\ 580 &= 0.095 \times 26\ 580 \\ &= \$2525.10 \end{aligned}$

c $\begin{aligned} 12.5\% \text{ of } \$298.60 &= 0.125 \times 298.60 \\ &= \$37.33 \end{aligned}$

Exercise 12.01 Blood alcohol content (BAC)

Question 1

B

Question 2

B

Question 3

a Mabel: $\text{BAC} = \dfrac{10\times 4 - 7.5\times 4}{5.5\times 94}$

$= 0.019...$

≈ 0.02

Madge: $\text{BAC} = \dfrac{10\times 3 - 7.5\times 4}{5.5\times 87}$

$= 0$

$\therefore$ Mabel had the higher blood alcohol content.

b 7% of $94 = 0.07\times 94$

$= 6.58$ L

Question 4

$\text{A}: \quad \dfrac{10\times 8 - 7.5\times 4}{6.8\times 72} = 0.102...$

$\text{B}: \quad \dfrac{10\times 9 - 7.5\times 5}{5.5\times 65} = 0.146...$

$\text{C}: \quad \dfrac{10\times 7 - 7.5\times 6}{5.5\times 82} = 0.055...$

$\text{D}: \quad \dfrac{10\times 10 - 7.5\times 7}{6.8\times 93} = 0.075...$

$\therefore \text{C}$

Question 5

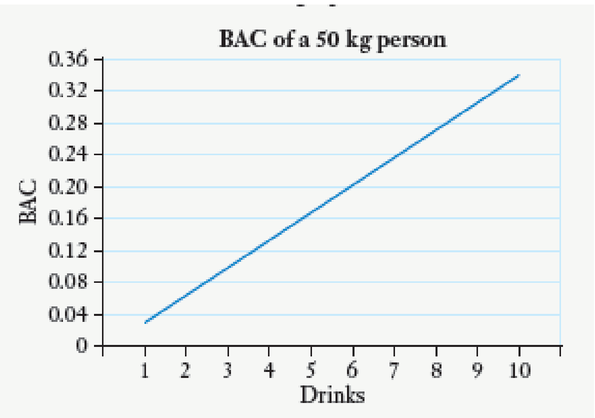
a 2

b 3

c 73 kg

d 0.25

e



Question 6

a heavy drinker

b **i** $\dfrac{0.1}{5 \text{ hours}} = 0.02\text{ / h}$

ii $\dfrac{0.1}{5.9 \text{ hours}} = 0.0169\ldots\text{ / h}$

$\approx 0.017\text{ / h}$

c 0.07

d 0.028 approx.

e $\text{Difference} = 0.05 - 0.04 = 0.01$ approx..

f A heavy person gets rid of alcohol in their blood system more quickly.

Question 7

a $N = 15, \quad H = 6, \quad M = 72$

$$\begin{aligned}\text{BAC} &= \frac{10 \times 15 - 7.5 \times 6}{6.8 \times 72} \\ &= 0.2144... \\ &\approx 0.21\end{aligned}$$

b $$\begin{aligned}0.21 \div 0.02 &= 10.5 \text{ h} \\ &= 10 \text{ h } 30 \text{ min}\end{aligned}$$

c 12 midnight + 10 h 30 min = 10.30 a.m. next day

Question 8

a $M = 61 \quad N = 9 \quad H = 4$

$$\begin{aligned}\text{BAC} &= \frac{10 \times 9 - 7.5 \times 4}{5.5 \times 61} \\ &= 0.1788 \\ &\approx 0.18\end{aligned}$$

b $$\begin{aligned}0.1788... \div 0.015 &= 11.92... \text{ h} \\ &\approx 12 \text{ h}\end{aligned}$$

c 2 am + 12 h = 2 p.m. the next day

Question 9

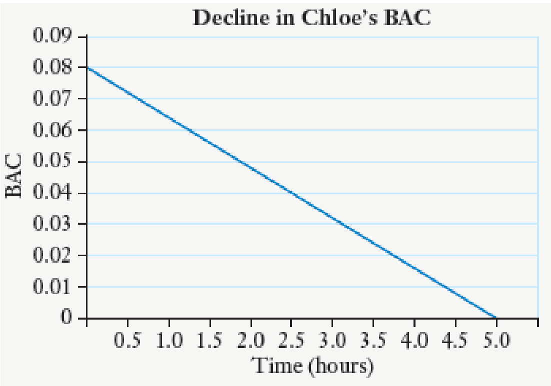
$\frac{0.06}{5} = 0.012$ per hour

Question 10

a

0	0.08
0.5	0.072
1	0.064
1.5	0.056
2	0.048
2.5	0.04
3	0.032
3.5	0.024
4	0.016
4.5	0.008
5	0

b



c **i** From graph ≈ 1 h 45 min

$\therefore$ Midnight + 1 h 45 min $= 1:45$ a.m. (approx)

ii From graph ≈ 5 h

$\therefore$ Midnight + 5 h $= 5$ a.m. (approx)

d Gradient $= \dfrac{\text{rise}}{\text{run}}$

$= \dfrac{0.08}{5}$

$= 0.016$, it is the rate at which the BAC is decreasing per hour.

Exercise 12.02 Accident statistics

Question 1

a $\frac{224}{440}=\frac{28}{55}$

b $\frac{273}{440}\times 100\% = 62.045...\%$

$\approx 62\%$

c Total No. drivers – No. drivers BAC over 0.05

$= 440 - 224$

$= 216$ drivers had a BAC of 0.05 or less

$\therefore \frac{216}{440}\times 100\% = 49.0909...\%$

$\approx 49\%$

Question 2

a **i** $307+248+223+107+183+33+39+10=1150$

ii $350+252+243+102+160+34+49+15=1205$

b $\frac{1150+1205}{2}=1177.5$

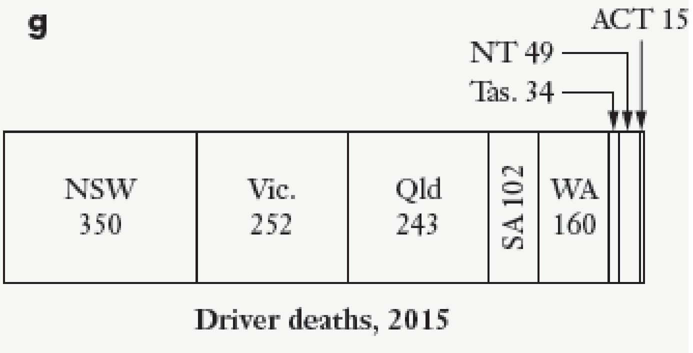
c ACT, has the smallest population.

d Tasmania

e SA and WA

f Numbers did not change much between 2014 and 2015, except for NSW, which showed a large increase.

g



Question 3

a $\text{Total} - (17 \text{ to } 24's) - (60+) = 100\% - 35\% - 9.6\%$

$$= 55.4\%$$

$$\therefore\ 55.4\% \text{ of } 18\,764 = \frac{55.4}{100} \times 18\,764$$
$$= 10\,395.256$$
$$\approx 10\,395$$

b $100\% - 70.2\% = 29.8\%$

$$\therefore 29.8\% \text{ of } 18\,764 = \frac{29.8}{100} \times 18\,764$$
$$= 5591.672$$
$$\approx 5592$$

c $100\% - 75.5\% = 24.5\%$

$$\therefore 24.5\% \text{ of } 18\,674 = \frac{24.5}{100} \times 18\,674$$
$$= 4597.18$$
$$\approx 4597$$

Question 4

a **i** $180°$

ii $19\% \text{ of } 360° = \frac{19}{100} \times 360$

$$= 68°$$

iii $2\% \text{ of } 360° = \frac{2}{100} \times 360$

$$= 7°$$

b **i** $19\% \text{ of } 443 = 0.19 \times 443$

$$= 84.17$$
$$\approx 84$$

ii $14\% \text{ of } 443 = 0.14 \times 443$

$$= 62.02$$
$$\approx 62$$

c $15\% = 68$

$$1\% = \frac{68}{15}$$

$$\therefore 50\% = \frac{68}{15} \times 50$$
$$= 226.66...$$
$$\approx 227 \text{ drivers}$$

Question 5

a $70+66+65+65+284+230+234+226=1240$

b $\frac{284}{1300}\times 100\% = 21.846...\%$

$\approx 21.8\%$

c $\%\ (26-39) \text{ in } 2015 - \%\ (26-39) \text{ in } 2014$

$= \frac{272}{1205}\times 100\% - \frac{252}{1150}\times 100\%$

$= 22.57...\% - 21.91...\%$

$= 0.65...$

$\approx 0.7\%$

d 2014

e 2015

Question 6

a Drivers in 2011

b $9315+9854+9884+10\ 667+10\ 671\ +11\ 351=61\ 742$

c
$$\begin{aligned}\text{Mean} &= (\text{Total No. motorcycles injuries}) \div (\text{No. years})\\ &= (2341+2576+...+2881)\div 6\\ &= 15\ 616...\div 6\\ &= 2602.66...\\ &\approx 2602.7\end{aligned}$$

d
$$\begin{aligned}\text{highest} - \text{lowest} &= 1060-943\\ &= 117\end{aligned}$$

e Put the data in ascending order

3360 3420 3421 | 3713 3773 3824

$$\begin{aligned}\text{So, median} &= \text{ average of the two middle scores}\\ &= \frac{(3421+3713)}{2}\\ &= 3567\end{aligned}$$

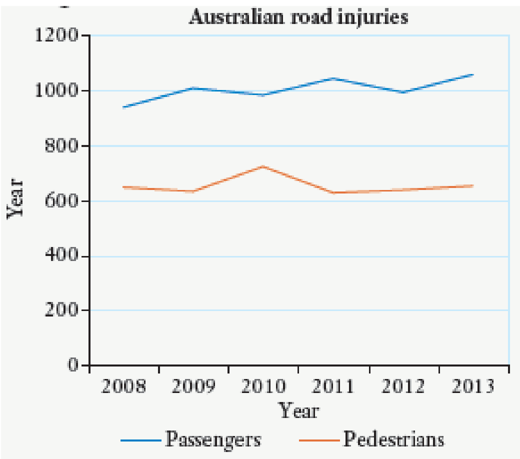
f Put the data in ascending order

1419 1723 1780 | 2017 2157 2517

$$\begin{aligned}Q_1 &= \text{ middle of the bottom half}\\ &= 1723\\ Q_3 &= \text{ middle of the top half}\\ &= 2157\end{aligned}$$

$$\begin{aligned}\text{So, IQR} &= Q_3 - Q_1\\ &= 2157-1723\\ &= 434\end{aligned}$$

g



Question 7

a **i** Mean $=(\text{Total No. motorcycles injuries})\div(\text{No. years})$

$$=(649+544+\ldots+491)\div 7$$
$$=3686\ldots\div 7$$
$$=526.57\ldots$$
$$\approx 526.6$$

ii Put the data in ascending order

463 491 504 515 520 544 649

So, median = middle score

= 515

iii highest – lowest = 649 – 463 = 186

iv Put the data in ascending order

463 491 504 515 520 544 649

Q_1 = middle of the bottom half

= 491

Q_3 = middle of the top half

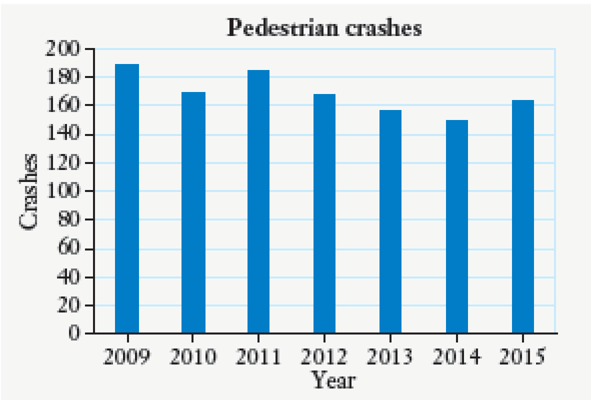
= 544

So, IQR $= Q_3 - Q_1$

$= 544 - 491$

$= 53$

b



c Decline in number of crashes perhaps due to road safety campaigns, more police presence, large fines for speeding, more cameras.

d Cars/vehicles are more likely to hit stationary objects such as trees, poles, walls than other vehicles.

Question 8

a ≈ 850

b $\approx$ 350

c $\approx 850 + 350 = 1200$

d Number of deaths generally decreasing over the years, male deaths are more than double female deaths (about 2.5 times).

Question 9

a 4 p.m. – 5:59 p.m.; peak time when people leaving work or picking up children from school

b 2 a.m. – 3:59 a.m.; quietest time of day when fewest vehicles on roads (people still sleeping).

c Put the data in ascending order

270 429 447 752 1119 1404 | 1985 2080 2125 2135 2608 2918

i
$$\begin{aligned}\text{highest} - \text{lowest} &= 2918 - 270 \\ &= 2648\end{aligned}$$

ii
$$\begin{aligned}\text{Mean} &= (\text{Total casualties}) \div (\text{No. times day}) \\ &= (447 + 270 + ... + 752) \div 12 \\ &= 18\ 272 \div 12 \\ &= 1522.66... \\ &\approx 1522.7\end{aligned}$$

iii
$$\begin{aligned}\text{Median} &= \text{ average of the two middle scores} \\ &= \frac{(1404 + 1985)}{2} \\ &= 1694.5\end{aligned}$$

d **i** The day starts off with low casualties for 6 hours, at its minimum at 2 to 3:59 a.m. After 6 a.m., the number of casualties begins to rise, reaching a peak at 8 to 9:59 a.m. when people are going to work and school. It levels off between 10 a.m. and 2 p.m., then starts to increase as the afternoon peak time begins, at its maximum at 4 to 5:59 p.m. Then in the final 6 hours of the day until midnight, the number of casualties decreases.

ii Yes. The trend is for deaths to be lower in 2011 but still November is the month where most deaths occur in the year. Yes, because working hours and school hours have not changed. The numbers would be different on a weekend though.

Question 10

a $286+104=390$

b $150+125+71=346$

c $$\frac{\text{male }(17\text{ to }20)}{\text{Total }(17\text{ to }20)}\times 100\% = \frac{357}{(357+150)}\times 100\%$$
$$= \frac{357}{(507)}\times 100\%$$
$$= 70.41...\%$$
$$\approx 70.4\%$$

d $$\frac{\text{female }(17\text{ to }20)}{\text{Total }(\text{female})}\times 100\% = \frac{150}{(788)}\times 100\%$$
$$= 19.035...\%$$
$$\approx 19.04\%$$

e Male drivers are more than 2.5 the number of female drivers; males drive more aggressively and faster than females.

f Younger drivers (especially aged 17 – 20) are more likely to have accidents involving speed, the figures dip for ages 26 – 29, then they increase again for ages 30 – 39, then start to decrease again.

Exercise 12.03 Speed, distance and time

Question 1

$$\begin{aligned} s &= \frac{d}{t} \\ &= \frac{93 \text{ km}}{1\frac{1}{2} \text{ h}} \\ &= 62 \text{ km/h} \end{aligned}$$

$\therefore$ C

Question 2

$$\begin{aligned} t &= \frac{d}{s} \\ &= \frac{160 \text{ km}}{76 \text{ km/h}} \\ &= 2.105\ldots \text{ h} \\ &= 2 \text{ h } 6 \text{ min } 18.94 \text{s (using the } \boxed{\circ\ '\ ''} \text{ button)} \\ &\approx 2 \text{ h } 6 \text{ min} \end{aligned}$$

$\therefore$ B

Question 3

a

$$\begin{aligned} s &= \frac{d}{t} \\ &= \frac{742 \text{ km}}{9\frac{1}{2} \text{ h}} \\ &= 78.105\ldots \text{ km/h} \\ &\approx 78 \text{ km/h} \end{aligned}$$

b

$$\begin{aligned} t &= \frac{d}{s} \\ &= \frac{1026 \text{ km}}{78.105\ldots \text{ km/h}} \\ &= 13.13\ldots \text{ h} \\ &\approx 13 \text{ h } 8 \text{ min (using the } \boxed{\circ\ '\ ''} \text{ button)} \end{aligned}$$

c

$$\begin{aligned} d &= s \times t \\ &= 78.105\ldots \times 3 \text{ h } 10 \text{ min} \\ &= 247.3\ldots \text{ km} \\ &\approx 247 \text{ km} \qquad \text{(use } \boxed{\circ\ '\ ''} \text{ to enter time)} \end{aligned}$$

Question 4

a $t = \dfrac{d}{s}$

$= \dfrac{507 \text{ km}}{57 \text{ km/h}}$

$= 8.897... \text{ h}$

$\approx 8 \text{ h } 54 \text{ min}$

b $t = \dfrac{d}{s}$

$= \dfrac{160 \text{ km}}{57 \text{ km/h}}$

$= 2.807... \text{ h}$

$\approx 2 \text{ h } 48 \text{ min}$

c $t = \dfrac{d}{s}$

$= \dfrac{440 \text{ km}}{57 \text{ km/h}}$

$= 7.719... \text{ h}$

$\approx 7 \text{ h } 43 \text{ min}$

Question 5

a Using $t = \dfrac{d}{s}$

There: $t = \dfrac{24}{16}$

$= 1\tfrac{1}{2}$ hours

Back: $t = \dfrac{24}{12}$

$= 2$ hours

$\therefore\ 3\tfrac{1}{2}$ hours

b $s = \dfrac{d}{t}$

$= \dfrac{48 \text{ km}}{3\tfrac{1}{2} \text{ h}}$

$= 13.714... \text{ km/h}$

$\approx 14 \text{ km/h}$

Question 6

a $9.5 \text{ m/s} = 0.0095 \text{ km/s}$

$= 0.0095 \times 60 \times 60$ (to convert to /h)

$= 34.2 \text{ km/h}$

b $d = s \times t$

$= 34.2 \times 9\tfrac{3}{4}$

$= 333.45 \text{ km}$

$= 333\,450 \text{ m}$

Question 7

$$\begin{aligned}0.1\text{ s} &= 0.1 \div 60 \div 60\text{ h}\\ &= 0.00002\dot{7}\text{ h}\\ &= \frac{1}{36\ 000}\text{h} \quad \text{(Need to use exact value)}\end{aligned}$$

a

$$\begin{aligned}d &= s \times t\\ &= 40\,000\text{ m/h} \times \frac{1}{36\ 000}\text{ h}\\ &= 1.11...\text{ m}\\ &\approx 1.1\text{ m}\end{aligned}$$

b

$$\begin{aligned}d &= s \times t\\ &= 60\,000\text{ m/h} \times \frac{1}{36\ 000}\text{ h}\\ &= 1.66...\text{ m}\\ &\approx 1.7\text{ m}\end{aligned}$$

c

$$\begin{aligned}d &= s \times t\\ &= 80\,000\text{ m/h} \times 0.00002\dot{7}\text{ h}\\ &= 2.22...\text{ m}\\ &\approx 2.2\text{ m}\end{aligned}$$

d

$$\begin{aligned}d &= s \times t\\ &= 100\,000\text{ m/h} \times 0.00002\dot{7}\text{ h}\\ &= 2.77...\text{ m}\\ &\approx 2.8\text{ m}\end{aligned}$$

Question 8

a

$$\begin{aligned}t &= \frac{d}{s}\\ &= \frac{402\text{ m}}{530\text{ km/h}}\\ &= \frac{0.402\text{ km}}{530\text{ km/h}}\\ &= 0.000758...\text{ h}\\ &\approx 3\text{ s}\end{aligned}$$

b

$$\begin{aligned}d &= s \times t\\ &= 530\text{ km/h} \times 10\text{ s}\\ &= 530\text{ km/h} \times \frac{10}{3600}\text{ h}\\ &= 1.4722...\text{ km}\\ &\approx 1472\text{ m}\end{aligned}$$

Question 9

a

$$\begin{aligned}s &= \frac{d}{t}\\ &= \frac{460\text{ m}}{6.011\text{ s}}\\ &= 76.526...\text{ m/s}\\ &\approx 76.5\text{ m/s}\end{aligned}$$

b

$$\begin{aligned}t &= \frac{d}{s}\\ &= \frac{58\text{ km}}{76.5\text{ m/s}}\\ &= \frac{58\,000\text{ m}}{76.5\text{ m/s}}\\ &= 758.169...\text{ s}\\ &= 758.169... \div 60\text{ min}\\ &= 12.636...\text{ min}\\ &\approx 12.6\text{ min}\end{aligned}$$

Question 10

a
$$\begin{aligned} t &= \frac{d}{s} \\ &= \frac{60.72 \text{ km}}{208.33 \text{ km/h}} \\ &= 0.2914\ldots \text{ h} \\ &= 0.2914\ldots \times 60 \text{ min} \\ &= 17.4876\ldots \text{ min} \\ &\approx 17.5 \text{ min} \end{aligned}$$

b
$$\begin{aligned} s &= \frac{d}{t} \\ &= \frac{72.4 \text{ km}}{17.5 \text{ min}} \\ &= 4.137\ldots \text{ km/min} \\ &= 4.137\ldots \times 60 \text{ km/h} \\ &= 248.22\ldots \text{ km/h} \\ &\approx 248 \text{ km/h} \end{aligned}$$

Question 11

Using $t = \frac{d}{s}$

Shellie:
$$\begin{aligned} t &= \frac{11.5 \text{ km}}{32 \text{ km/h}} \\ &= 0.3593 \text{ h} \\ &\approx 21 \text{ min } 34 \text{ s} \end{aligned}$$

Roxy :
$$\begin{aligned} t &= \frac{11.5 \text{ km}}{11 \text{ km/h}} \\ &= 1.045\ldots \text{ h} \\ &\approx 1 \text{ h } 2 \text{ min } 44 \text{ s} \end{aligned}$$

$$\begin{aligned} \therefore \text{Difference} &= 41 \text{ min } 10 \text{ s} \\ &\approx 41 \text{ minutes head start.} \end{aligned}$$

Question 12

$$\begin{aligned} d &= s \times t \\ &= \frac{75\,000 \text{ m}}{3600 \text{ s}} \times 5 \text{ s} \\ &= 104.166\ldots \text{ m} \\ &\approx 104.2 \text{ m} \end{aligned}$$

Question 13

$$\begin{aligned} s &= \frac{d}{t} \\ &= \frac{20.7 \text{ m}}{1.2 \text{ s}} \\ &= 17.25 \text{ m/s} \\ &= 0.01725 \text{ km/s} \qquad (\times 3600 \text{ to convert to h}) \\ &= 62.1 \text{ km/h} \end{aligned}$$

Exercise 12.04 Stopping distance

Question 1

$80-51=29\text{ m}$
$\therefore\ \text{A}$

Question 2

$118.4+79.3=197.7\text{ m}$

Question 3

$15.6-9.8=5.8\text{ m}$

Question 4

a $\text{A}=33.6-19.7=13.9$
$\text{B}=23.7-11.1=12.6$
$\text{C}=45.0-16.7=28.3$
$\text{D}=27.8+78.7=106.5$

b **i** $78.7-19.7=59\text{ m}$

$$\begin{aligned}\therefore\ \frac{59}{19.7}\times 100\% &= 299.49...\% \\ &\approx 299\%\end{aligned}$$

ii $106.5-33.6=72.9\text{ m}$

$$\begin{aligned}\therefore\ \frac{72.9}{33.6}\times 100\% &= 216.96...\% \\ &\approx 217\%\end{aligned}$$

c Yes. It is 110 m ahead, but he only takes 106.5 m to stop.

Question 5

a 7.9 m

b 11.1 m

c Both would stop in time. Hanna in 30.1 m and Fran in $11.1+7.9=19$ m.

Question 6

a 44.4 m

b 17.7 m

c Mark : 51 m

Sanjay: $44.4\text{ m} + 7.9\text{ m} = 52.3\text{ m}$

$\therefore$ Sanjay has the greatest stopping distance.

Question 7

a

$$\begin{aligned} d &= kv^2 \\ 62 &= k \times 80^2 \\ k &= \frac{62}{80^2} \\ &= 0.0096875 \\ &\approx 0.0097 \end{aligned}$$

b

$$\begin{aligned} d &= kv^2 \\ &= 0.0097 \times 105^2 \\ &= 106.9425 \\ &\approx 106.9\text{ m} \end{aligned}$$

c

$$\begin{aligned} d &= kv^2 \\ 75 &= 0.0097v^2 \\ v^2 &= \frac{75}{0.0097} \\ v^2 &= 7731.95... \\ v &= \sqrt{7731.95...} \\ &= 87.93... \\ &\approx 88\text{ km/h} \end{aligned}$$

d **i**

$$80\text{ km/h} = \frac{80\,000\text{ m}}{3600\text{ s}}$$

$\therefore$ in 1.6 s, $80\text{ km/h} \times 1.6\text{ s}$

$$\begin{aligned} &= \frac{80\,000\text{ m}}{3600\text{ s}} \times 1.6\text{ s} \\ &= 35.555...\text{ m} \\ &\approx 35.6\text{ m} \end{aligned}$$

$$\begin{aligned} \therefore \text{stopping distance} &= 62 + 35.6 \\ &= 97.6\text{ m} \end{aligned}$$

ii

$$105\text{ km/h} = \frac{105\,000\text{ m}}{3600\text{ s}}$$

$\therefore$ in 1.6 s, $105\text{ km/h} \times 1.6\text{ s}$

$$\begin{aligned} &= \frac{105\,000\text{ m}}{3600\text{ s}} \times 1.6\text{ s} \\ &= 46.66...\text{ m} \\ &\approx 46.7\text{ m} \end{aligned}$$

$$\begin{aligned} \therefore \text{stopping distance} &= 106.9 + 46.7 \\ &= 153.6\text{ m} \end{aligned}$$

Question 8

a

$$d = kv^2$$
$$89.6 = k \times 115^2$$
$$\frac{89.6}{115^2} = k$$
$$k = 0.006775...$$
$$\approx 0.00678$$

b

$$d = kv^2$$
$$= 0.006775... \times v^2$$
$$= 0.006775... \times 95^2$$
$$= 61.14...$$
$$\approx 61.1 \text{ m}$$

c

$$d = 89.6$$

Reaction time: 115 km/h $= \dfrac{115\ 000 \text{ m}}{3600 \text{ s}}$

$$\therefore \text{In 2s} = \frac{115\ 000 \text{ m}}{3600 \text{ s}} \times 2$$
$$= 63.888... \text{ m}$$
$$\approx 63.9 \text{ m}$$

$\therefore$ Stopping distance $= 89.6 + 63.9$

$$= 153.5 \text{ m}$$

Question 9

a

$$d = 0.02754 \times 35^2$$
$$= 33.7365$$
$$\approx 33.7 \text{ m}$$

b

$$d = 0.02754 \times 61^2$$
$$= 102.476...$$
$$\approx 102 \text{ m}$$

c

$$d = 0.02754 \times 112^2$$
$$= 345.46...$$
$$\approx 345 \text{ m}$$

d

$$d = 0.02754 \times 93^2$$
$$= 238.19...$$
$$\approx 238 \text{ m}$$

Question 10

a

$$t = \frac{d}{s}$$
$$= \frac{41.8 \text{ m}}{80 \text{ km/h}}$$
$$= \frac{41.8 \text{ m}}{\frac{80\,000 \text{ m}}{3600 \text{ s}}}$$
$$= 1.881 \text{ s}$$
$$\approx 1.88 \text{ s}$$

b

$$57.2 + 41.8 = 99 \text{ m}$$

Question 11

$d = 0.00435v^2$

$$v^2 = \frac{d}{0.00435}$$

$$v = \sqrt{\frac{d}{0.00435}}$$

a $v = \sqrt{\frac{142}{0.00435}}$
$= 180.67...$
≈ 181 km/h

b $v = \sqrt{\frac{91.2}{0.00435}}$
$= 144.79...$
≈ 145 km/h

c $v = \sqrt{\frac{101.4}{0.00435}}$
$= 152.67...$
≈ 153 km/h

d $v = \sqrt{\frac{68.9}{0.00435}}$
$= 125.85...$
≈ 126 km/h

Question 12

a $d = kv^2$

$84.3 = k \times 106.3^2$

$k = \frac{84.3}{106.3^2}$

$k = 0.007460...$

≈ 0.00746

b $d = 0.00746 \times 110^2$
$= 90.266$
≈ 90.3 m

c Reaction distance $= 110$ km/h $\times 2$ s
$= \frac{110\,000 \text{ m}}{3600 \text{ s}} \times 2$ s
$= 61.11...$ m
≈ 61.1 m

$\therefore$ Stopping distance $= 90.3 + 61.1$
≈ 151 m

Question 13

a $d = \frac{1}{2} \times 100^2 + 5 \times 100 = 5500$ m

b $d = \frac{1}{2} \times 250^2 + 5 \times 250 = 32\,500$ m

c $d = \frac{1}{2} \times 300^2 + 5 \times 300 = 46\,500$ m

Question 14

a 160 m

b **i** 108 m

ii 133 m

iii 190 m

c

Road	Reaction time	Stopping distance
Dry	1	78
Dry	2	105
Dry	4	160
Wet	1	105
Wet	2	135
Wet	4	190

d You can see exact values in a table but a graph gives a good visual overall picture of the situation.

Sample HSC problem

a 0.15

b 4

c 10

d

$$\begin{aligned}\text{Gradient} &= \frac{\text{rise}}{\text{run}}\\ &= \frac{(0.15-0.03)}{(5-1)}\\ &= \frac{0.12}{4}\\ &= 0.03\end{aligned}$$

$\therefore 0.03$, rate at which BAC is increasing with each drink consumed.

e

$$\begin{aligned}h &= \frac{BAC}{0.015}\\ &= \frac{0.24}{0.015}\\ &= 16\text{ h}\end{aligned}$$

Test yourself 12

Question 1

a

$$\begin{aligned} BAC &= \frac{10N - 7.5H}{5.5M} \\ &= \frac{10 \times 4\frac{1}{2} - 7.5 \times 3}{5.5 \times 56} \\ &= 0.0730... \\ &\approx 0.073 \end{aligned}$$

b

$$\begin{aligned} \text{Time} &= \frac{BAC}{0.015} \\ &= \frac{0.073}{0.015} \\ &= 4.866... \\ &\approx 4 \text{ h } 52 \text{ min} \end{aligned}$$

c

$$\begin{aligned} BAC &= \frac{10N - 7.5H}{5.5M} \\ &= \frac{10 \times 3 - 7.5 \times 3}{5.5 \times 56} \\ &= 0.02435... \\ &\approx 0.024 \end{aligned}$$

Question 2

a **i** 0

ii 0.07

iii $0.1 + 0.07 = 0.17$

b

$$\begin{aligned} \frac{0.17}{0.018} &= 9.44... \\ &\approx 9 \text{ h } 27 \text{ min} \end{aligned}$$

Question 3

a Heavier people have more blood and water in their bodies to dilute alcohol.

b Females tend to be lighter than males.

Question 4

a $\text{Mean} = (495 + 521 + ... + 424) \div 8$

$= 3570 \div 8$

$= 446.25$

b $\text{highest} - \text{lowest} = 148 - 102$

$= 46$

c $\frac{\text{Male in 2015}}{\text{Total in 2015}} \times 100\% = \frac{424}{(424 + 131)} \times 100\%$

$= \frac{424}{555} \times 100\%$

$= 76.39...\%$

$\approx 76.4\%$

d $\frac{\text{female drivers 2015}}{\text{Total females in 2015}} \times 100\% = \frac{131}{(131 + 132)} \times 100\%$

$= \frac{131}{263} \times 100\%$

$= 49.80...\%$

$\approx 49.8\%$

e More drivers are killed than passengers. There are more drivers than passengers in cars overall (many cars have no passengers), drivers sit in the car where they are more likely to be injured.

f Put the data in ascending order

131 146 146 151 | 164 166 175 186

Median = average of the two middle scores

$= \frac{(151 + 164)}{2}$

$= 157.5$

g Generally decreasing (despite increasing populations). Better road safety campaigns, more policing, safer cars and roads.

Question 5

a Single vehicle

b $$\frac{\text{Pedestrian in 2015}}{\text{Total in 2015}} \times 100\% = \frac{163}{1101} \times 100\%$$
$$= 14.80...\%$$
$$\approx 14.8\%$$

c Single vehicle crashes $= 649 + 544 + ... + 491$
$= 3686$

Multiple vehicle crashes $= 509 + 520 + ... + 447$
$= 3310$

$\therefore$ True

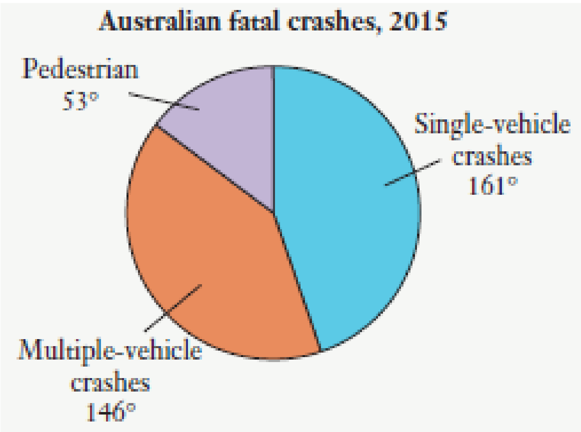
d **i** 2010

ii 2009

e $$\frac{491 - 463}{463} = \frac{28}{463} = 0.060...$$

6% increase

f



Question 6

a

$$\begin{aligned} s &= \frac{d}{t} \\ &= \frac{200 \text{ km}}{2\frac{3}{4} \text{ h}} \\ &= 72.72... \text{ km/h} \\ &\approx 73 \text{ km/h} \end{aligned}$$

b

$$\begin{aligned} t &= \frac{d}{s} \\ &= \frac{430 \text{ km}}{72.72... \text{ km/h}} \\ &= 5.9125 \text{ h} \\ &= 5 \text{ h } 54 \text{ min } 45 \text{ s} \\ &\approx 5 \text{ h } 55 \text{ min} \end{aligned}$$

c

$$\begin{aligned} d &= s \times t \\ &= 72.72... \text{ km/h} \times 5 \text{ h} \\ &= 363.63... \text{ km} \\ &\approx 364 \text{ km} \end{aligned}$$

Question 7

Using $d = s \times t$,

$$\begin{aligned} \text{Reaction distance} &= 150 \text{ km/h} \times 3 \text{ s} \\ &= \frac{150\,000 \text{ m}}{3600 \text{ s}} \times 3 \text{ s} \\ &= 125 \text{ m} \\ \text{So, total distance} &= 125 + 810 \\ &= 935 \text{ m} \end{aligned}$$

Question 8

Using $d = s \times t$,

$$\begin{aligned} \text{Reaction distance} &= 65 \text{ km/h} \times 1.2 \text{ s} \\ &= \frac{65\,000 \text{ m}}{3600 \text{ s}} \times 1.2 \text{ s} \\ &= 21.66... \text{ m} \\ &\approx 21.7 \text{ m} \end{aligned}$$

$\therefore$ No, he travels 21.7 m before he applies the brakes so his stopping distance is $21.7 \text{ m} + 24 \text{ m} = 45.7 \text{ m}$.

Question 9

a same

b increases as reaction time increases

c A = 23.7 B = 34.8 C = 57

d No, he needs 57 m to stop.

e Drive slower than the speed limit, get someone else to drive you.

Question 10

a $50-12=38\text{ m}$ difference in braking distance.

b $28-18=10\text{ m}$ further on a wet road.

c 100 km/h

d 50 km/h

e It takes much longer to stop on a wet road. If the speed is double, the distance is much more than doubled. For example, at 100 km/h on a wet road it takes 4 times as long as it does on at 50 km/h.