NEW CENTURY MATHS 11
MATHEMATICS STANDARD (PATHWAY 2)

FULLY WORKED SOLUTIONS

Chapter 6

SkillCheck

Question 1

a 135 beats/min = 135 ÷ 60 beats/s
= 2.25 beats/s

b In half an hour = 135 beats/min × 30 min
= 4050 beats

Question 2

$78.65 = 7865 c

So, 55 L costs 7865 c
1 L costs 7865 c ÷ 55 = 143 c
∴ The cost is 143 c per litre.

Question 3

a 8.4 cm = 8.4 × 10 mm
= 84 mm

b 9600 mm = (9600 ÷ 1000) m
= 9.6 m

c 36 000 mL = (36 000 ÷ 1000) L
= 36 L

d 2610 L = (2610 ÷ 1000) kL
= 2.61 kL

e 5.2 m^3 = 5.2 × 1000 L
= 5200 L

f 660 s = 660 ÷ 60 min
= 11 min

Question 4

$$\begin{aligned}110\% \text{ of } \$423.85 &= 1.1 \times \$423.85 \\ &= \$466.235 \\ &\approx \$466.24\end{aligned}$$

$\therefore$ The electricity bill, including GST, is \$466.24.

Question 5

$$\begin{aligned}\text{Total days} &= \text{May} + \text{June} + \text{July} + \text{August} \\ &= 26 + 30 + 31 + 3 \\ &= 90 \text{ days}\end{aligned}$$

Question 6

$$\begin{aligned}\text{Total days} &= \text{Aug} + \text{Sept} + \text{Oct} + \text{Nov} \\ &= 26 + 30 + 31 + 9 \\ &= 96 \text{ days}\end{aligned}$$

$$\begin{aligned}\therefore \text{Average daily cost} &= \$468.24 \div 96 \\ &= \$4.8775 \\ &\approx \$4.88\end{aligned}$$

Question 7

a
$$\begin{aligned}\text{Cost} &= 74 \text{ c} \times 7 \\ &= 518 \text{ c} \\ &= \$5.18\end{aligned}$$

b
$$\begin{aligned}\text{Time} &= \$9.62 \div \$0.72 \\ &= 13.361... \text{ min} \\ &\approx 13 \text{ min}\end{aligned}$$

Exercise 6.01 Water usage in the home

Question 1

a $\mathbf{A} = 52.1 \times \$2.115$
$= \$110.1915$
$\approx \$110.19$

b $\mathbf{B} = \$41.39 + \$162.88 + \$110.19$
$= \$314.46$

Question 2

June has 30 days.

$$\begin{aligned}\text{Water use for June} &= 30 \times 425 \text{ L} \\ &= 12\,750 \text{ L} \\ &= 12\,750 \div 1000 \text{ kL} \\ &= 12.75 \text{ kL}\end{aligned}$$

$\therefore$ The correct answer is **B**.

Question 3

a Date of issue is 12/05/2018. Due date is 02/06/2018.
There are 19 + 2 = 21 days between the date of issue and payment date.

b The bill is paid quarterly: 1 April to 30 June.

c The fixed charges are for water service and sewerage service.
These charges amount to \$24.00 + \$118.75 = \$142.75.

d 18 kL of water were used in the period covered by this bill.

e Referring to the graph, the average daily water usage was less for this bill (205 kL) than for the previous bill (386 kL). A possible reason is that people have fewer showers in the colder months or it was not necessary to water plants.

f It is more useful to compare daily water usage for the same time of year because conditions will be the same and any seasonal factors do not affect the water usage.

g The total water usage in 88 days was 18 kL = 18 000 L.

$$\begin{aligned}\text{Litres per day} &= 18\,000 \div 88 \\ &= 204.54 \\ &\approx 205\end{aligned}$$

$\therefore$ The average daily usage is 205 L (as required).

h Cost is \$2.115/kL.

i $$\begin{aligned}\text{Water usage charge} &= 18 \times \$2.115 \\ &= \$38.07\end{aligned}$$

j $$\begin{aligned}\text{Cost for 40 kL} &= 40 \times \$2.115 \\ &= \$84.60\end{aligned}$$

Question 4

$$\begin{aligned}\text{Number of days} &= 31 + 30 + 31 \\ &= 92 \\ \text{Amount of water} &= 66.24 \text{ kL} \\ &= 66.24 \times 1000 \text{ L} \\ &= 66\,240 \text{ L} \\ \text{So, Water usage} &= 66\,240 \text{ L} \div 92 \text{ day} \\ &= 720 \text{ L/day}\end{aligned}$$

$\therefore$ The correct answer is **C**.

Question 5

a $24 \times \$2.115 = \$50.76$

b $\$32.57 \div 2.115 = 15.399...$

$\approx 15.4.$

$\therefore$ Hannah used approximately 15.4 kL.

c Total = \$32.57 + \$41.39 + \$232.88

= \$306.84

Question 6

a Total = 51.0 + 47.3 + 46.5 + 54.8

= 199.6 kL

b Average per quarter = 199.6 ÷ 4

= 49.9 kL

c Number of days = 31 + 28 + 31

= 90

Average daily water usage = 51.0 kL ÷ 90 days

≈ 0.567 kL/day

= 567 L/day

$\therefore$ The average water usage is 567 L/day.

d Number of days = 31 + 31 + 30

= 92

$\text{Volume} = 92 \times 2 \times 21$

$= 3864 \text{ L}$

$= 3.864 \text{ kL}$

e $\text{Percentage usage for dishwasher} = \frac{3.864}{46.5} \times 100\%$

$= 8.309...\%$

$\approx 8.3\%$

Question 7

Water usage = 8764 – 8112
= 652 kL

Cost = 652 × $2.115
= $1378.98

∴ The correct answer is **C**.

Question 8

$$\text{Charges} = \$9.37 + 12 \times \$1.93 + 20.2 \times \$2.115$$
$$= \$75.253$$
$$\approx \$75.25$$

Question 9

Total charge for recycled water = $11.58 + 39 × $1.70
= $77.88

∴ The correct answer is **B**.

Question 10

a From 1 January to 31 March = 31 + 28 + 31 = 90 days.

$$\text{Baskaran family water usage} = 560 \text{ L} \times 90$$
$$= 50\,400 \text{ L}$$
$$= 50.4 \text{ kL}$$
$$\text{Baskaran family water costs} = 50.4 \times \$2.115$$
$$= \$106.60$$
$$\text{Zhong family water usage} = 710 \text{ L} \times 90$$
$$= 63\,900 \text{ L}$$
$$= 63.9 \text{ kL}$$
$$\text{Zhong family water costs} = 63.9 \times \$2.115$$
$$= \$135.15$$

∴ The Zhong family pays more.

b Baskaran family water usage per person = 560 ÷ 4
= 140 L/day

Zhong family water usage per person = 710 ÷ 6
= 118.3 L/day

∴ The Baskaran family uses more water per person per day.

Exercise 6.02 Water tanks and dams

Question 1

a $r = 9.36 \div 2 = 4.68$ m

$V = \pi r^2 h$

$= \pi \times 4.68^2 \times 2.18$

$= 150.0023...$ m^3

≈ 150.00 m^3

$= 150.00$ kL

$\therefore$ The capacity of the tank is 150.00 kL.

b $V = l \times w \times h$

$= 2.4 \times 4.8 \times 1.2$

$= 13.824$ m^3

≈ 13.82 kL

$\therefore$ The capacity of the pool is 13.82 kL.

c $\text{Area} = \dfrac{\pi r^2}{2}$

$= \dfrac{\pi \times 1.2^2}{2}$

$= 2.2619...$ m^2

$V = Ah$

$= 2.2619... \times 0.4$

$= 0.9047...$ m^3

$= 0.9047...$ kL

≈ 0.90 kL

$\therefore$ The capacity of the pool is 0.90 kL.

Question 2

a 50 cm = 0.5 m

$V_{\text{tank}} = 2.5 \times 3 \times 0.5$

$= 3.75$ m^3

Combined volume $= 2 \times 3.75$

$= 7.5$ m^3

$\therefore$ Combined capacity = 7.5 kL

= 7500 L

b $\text{Number of days} = \dfrac{7500}{570}$

$= 13.157\ldots$

$\therefore$ It will take more than 13 days to use all the water, so the answer is 14 days.

Question 3

a 50 mm = 0.050 m

$$\begin{aligned} V &= 7.5 \times 4.8 \times 0.05 \\ &= 1.8 \text{ m}^3 \\ &= 1.8 \text{ kL} \\ &= 1800 \text{ L} \end{aligned}$$

$\therefore$ 1800 L of water are drained into the tank.

b Radius of cylinder = 60 cm = 0.6 m

Volume of water = 1.8 m^3

$$\begin{aligned} V &= \pi r^2 h \\ 1.8 &= \pi \times 0.6^2 \times h \\ 1.8 &= 1.130...h \\ h &= \frac{1.8}{1.130...} \\ &= 1.159 \\ &\approx 1.6 \text{ m} \end{aligned}$$

$\therefore$ The water level is 1.6 m.

c
$$\begin{aligned} V_{\text{tank}} &= \pi r^2 h \\ &= \pi \times 0.6^2 \times 2.4 \\ &= 2.7143... \text{ m}^3 \end{aligned}$$

So, to fill the tank the volume of water from the roof needs to be 2.714…

$$\begin{aligned} \text{So,} \quad V &= A_{\text{roof}} \times \text{height of water} \\ 2.7143... &= 7.5 \times 4.8 \times h \\ 2.7143... &= 36h \\ h &= \frac{2.7143...}{36} \\ &= 0.07539... \text{ m} \\ &= 0.07539... \times 1000 \text{ mm} \\ &= 75.39... \text{ mm} \\ &\approx 75.4 \text{ mm} \end{aligned}$$

$\therefore$ 75.4 mm of rain needs to fall onto the roof to completely fill the tank.

Question 4

a $A \approx \frac{h}{2}\left(d_f + d_l\right)$

$A \approx \frac{9}{2}(7 + 12.3) + \frac{9}{2}(12.3 + 10.5)$

$= 189.45 \text{ m}^2$

$\therefore$ The approximate surface area of the lake is 189.45 m^2.

b $V = Ah$

$= 189.45 \times 1.6$

$= 303.12 \text{ m}^3$

$= 303.12 \text{ kL}$

$= 303\,120 \text{ L}$

$\therefore$ The lake can hold 303 120 L when full.

Question 5

a July

b Level below capacity = full capacity – available storage

$= 2\,027\,000 - 1\,914\,444$

$= 112\,556 \text{ ML}$

c Available storage (A) = 96.5% of 2 027 000 ML

$= 0.965 \times 2\,027\,000 \text{ ML}$

$= 1\,956\,055 \text{ ML}$

d Available storage % (B) $= \frac{1\,943\,221}{2\,027\,000} \times 100\%$

$= 95.866...\%$

$\approx 95.9\ \%$

e Storage level rise = 2 008 362 – 1 768 468

= 239 894 ML

f Storage level decrease = 1 918 134 – 1 873 640

= 44 494 ML

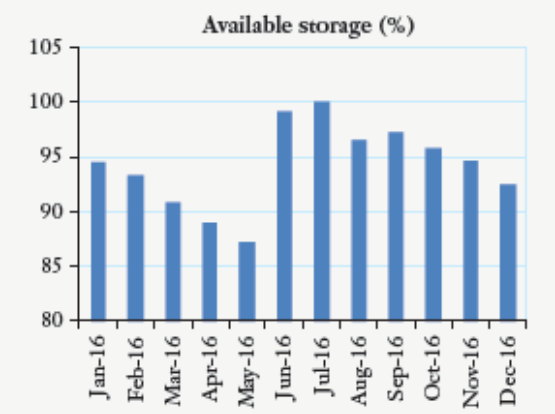
% decrease $= \frac{44\,494}{2\,027\,000} \times 100\%$

$= 2.195...\%$

$\approx 2.2\%$

g Lowest level means that the available storage is at its lowest.
∴ May

h



i Overall the available storage remained fairly constant over the 12 months almost to capacity (despite slight declines in available storage January to May 2016 and September to December 2016).

Question 6

a An estimate of the available water storage (orange line) in January 2016 is 2 400 000 ML.

b 1998, 2012 or 2013.

c In January 2007 the available water storage was at its lowest of approximately 900 000 ML.

d Drought conditions

e The full operating storage (green line) in January 2016 is 2 600 000 ML.

f Shown by the blue line. So, 1 300 000 ML.

g 1998, 1999, 2001, 2002, 2011.

Question 7

a Dual flush toilets, as this column is higher in every year.

b Approximately 65% of households had water-efficient shower heads in 2010.

c 2004

d $\%\ \text{increase} = 65\% - 55\% = 10\%$

e The smallest increase was in 2013.

f $\%\ \text{increase} = 90\% - 65\% = 25\%$

g With the drought conditions around, there is a greater emphasis and education about saving water.

Exercise 6.03 Electricity usage in the home

Question 1

a Cooking = 6 %

$$= \frac{6}{100}$$

$$= \frac{3}{50}$$

b The 'Other' category could include anything that is not already included on the graph, for example: radio; charging mobile phones or electric cars; and beauty aids such as electric shavers or hair straighteners. It also includes 'standby' use, which refers to electricity used to keep appliances like televisions and computers on 'stand-by' ready to be turned on.

c TV, computers = 5% of \$562.37

$$= 0.05 \times \$562.37$$

$$= \$28.1185$$

$$\approx \$28.12$$

d Cost of lighting = \$0.67 × 90

= \$60.30.

The lighting cost is 6.4% of the total bill,

$$\text{So, } 4.7\% \text{ of Total bill} = \$60.30$$

$$1\% \text{ of Total bill} = \frac{\$60.30}{4.7}$$

$$100\% \text{ of Total bill} = \frac{\$60.30}{4.7} \times 100\%$$

$$= \$1282.978723$$

$$\approx \$1282.98$$

$\therefore$ The total electricity bill would be \$1282.98.

e 'Hot water' sector = 31.3% of 360°

= 112.68°

≈ 113°

Question 2

a $$\text{Heating} = \frac{\text{Length of 'Heating'}}{\text{Total length}}$$
$$= \frac{40 \text{ mm}}{100 \text{ mm}}$$
$$= \frac{2}{5}$$

b $$\text{Hot water \%} = \frac{\text{Length of 'Hot water'}}{\text{Total length}} \times 100\%$$
$$= \frac{43 \text{ mm}}{100 \text{ mm}} \times 100\%$$
$$= 43\%$$

c $$\text{Lighting} = \frac{\text{Length of 'Lighting'}}{\text{Total length}} \times 10\,000 \text{ kWh}$$
$$= \frac{3 \text{ mm}}{100 \text{ mm}} \times 10\,000 \text{ kWh}$$
$$= 300 \text{ kWh}$$

Question 3

a Move the decimal point to between the 5 and the 7. You have moved it six places left.
So, 5.7×10^6 MW

b Move the decimal point to between the 3 and the first 0. You have moved it six places left.
So, 3×10^6 kW

c Move the decimal point to between the first 4 and the 8. You have moved it nine places left.
So, 4.845×10^9 GW.

Question 4

Move the decimal point to between the first 4 and the 8. You have moved it six places left.
So, 6.84×10^6 MW.

Two significant figures: round the decimal section to 2 digits. So, 6.8×10^6 MW.
$\therefore$ The correct answer is **D**.

Question 5

a 1000 W = 1 kilowatt

So, $5600 \text{ W} = 5600 \div 1000 \text{ kW}$

$= 5.6 \text{ kW}$

b 1000 kW = 1 megawatt

So, $27\,500\,000 \text{ kW} = 27\,500\,000 \div 1000 \text{ MW}$

$= 27\,500 \text{ MW}$

c 1000 000 mW = 1 kilowatt

So, $3\,495\,000 \text{ mW} = 3\,495\,000 \div 1000\,000 \text{ kW}$

$= 3.495 \text{ kW}$

Question 6

1000 W = 1 kilowatt

So, $8\,450\,000 \text{ W} = 8\,450\,000 \div 1000 \text{ kW}$

$= 8\,450 \text{ kW}$

$\therefore$ The correct answer is **C**.

Question 7

a 1 gigawatt = 1000 MW

So, $2.35 \text{ GW} = 2.35 \times 1000 \text{ MW}$

$= 2350 \text{ MW}$

b 1 gigawatt = 1000 000 kW

So, $2.35 \text{ GW} = 2.35 \times 1000\,000 \text{ kW}$

$= 2\,350\,000 \text{ kW}$ (or 2.35×10^6)

(Alternatively, we can multiply the 2350 MW from part **a** by 1000.)

c 1 gigawatt = 1000 000 000 W

So, $2.35 \text{ GW} = 2.35 \times 1000\,000\,000 \text{ kW}$

$= 2\,350\,000\,000 \text{ W}$ (or 2.35×10^9)

(Alternatively, we can multiply the 2 350 000 kW from part **b** by 1000.)

Question 8

a The bill period is from 16 Aug 2018 to 14 Nov 2018, so the bill is quarterly.

b In the snapshot box; 13.09 kWh.

c June/July – it is winter. More electricity is used for heating.

d In the 'Your electricity supply details' section it says that the kWh was 1191.

e In the 'Your electricity supply details' section it says that the days was 91.

f In the 'Your electricity supply details' section it says that the read date was 14 Nov 2018 and the end read was 58 335.

g The amount of the last bill appears as 'Previous Balance', which is \$415.69.
The current bill is \$385.44.
So, difference $= \$415.69 - \$385.44 = \$30.25$
$\therefore$ Decreased since last bill by \$30.25.

h Yes I think this house is running efficiently. In the 'compare with other homes in your area' this shows home usage is between people 2 and 3 people households.
Considering this is for a household of 4, then this house seems to be running efficiently.

i In the 'compare with other homes in your area' it says that they are homes with gas and no pool. These would help with the energy efficiency.

j 'Peak' is electricity used when most people use it (2 p.m. – 8 p.m.);
'Off Peak' is electricity used at low usage time (7 a.m. – 2 p.m., 8 p.m. – 10 p.m.).

Question 9

a $47\% \text{ of } 3022 = 0.47 \times 3022$
$= 1420.34 \text{ kWh}$

b **i** $1420.34 \times \$0.092\,800 = \$131.81$

ii Domestic usage = 53% of 3022
$= 0.53 \times 3022$
$= 1601.66 \text{ kWh}$

So, Cost $= 1601.66 \times \$0.265\,800$
$= \$425.72$

c Average daily cost $= \$425.72 \div 96 \text{ days}$
$= \$4.434... / \text{day}$
$\approx \$4.43 / \text{day}$

Question 10

a Read from the graphs. The average electricity usage over the period of the bill is written above the Aug column. 'Peak usage' was 7.9 kWh and 'off peak usage' was 4.9 kWh.

b June to August is highest because, in winter, heating uses a lot of electric power.

c The extra fee is a 'Daily supply Chg' of $0.94336/ day.

d The difference in the two off peak rates is that they are different times. Off Peak 1 is 10 p.m. – 7 a.m. Mon–Fri and Off Peak 2 (shoulder usage) is 7 a.m. – 2 p.m., 8 p.m. – 10 p.m.

e 2 p.m. – 8 p.m. Mon – Fri.

f Peak → Total usage = 718, Off Peak →Total usage = 437

$\therefore$ Uses more peak power.

g Looking at the graph for the usage in last Aug and this Aug:

$$\begin{aligned}\text{Peak difference} &= 7.9 - 8.5\\ &= -0.6\\ \text{Off Peak difference} &= 4.9 - 4.6\\ &= 0.3\end{aligned}$$

$\therefore$ The peak electricity usage has decreased by 0.6 kWh/day and the off peak electricity usage has increased by 0.3 kWh/day.

Question 11

$$\begin{aligned}\text{Off peak: } 984 \times 12.03719 &= 11\ 844.59...\text{ c}\\ &= \$118.4459...\end{aligned}$$

$$\begin{aligned}\text{Supply charge: } 90 \times 95.6494 &= 8608.446\text{ c}\\ &= \$86.08446\end{aligned}$$

$$\text{Domestic: } 1985 - 1750 = 235$$

$$\begin{aligned}\therefore 1750 \times 27.027 + 235 \times 20.46 &= 47\ 297.25 + 4808.1\\ &= 52\ 105.35\text{ c}\\ &= \$521.0535\end{aligned}$$

$$\begin{aligned}\therefore \text{Electricity Bill} &= \$118.4459... + \$86.08446 + \$521.0535\\ &= \$725.583...\\ &= \$725.58\end{aligned}$$

Exercise 6.04 Energy consumption and the costs of appliances

Question 1

a $100 \text{ W} \times 8 \text{ h} = 800 \text{ Wh}$
$= 800 \div 1000 \text{ kWh}$
$= 0.8 \text{ kWh}$

b $20 \text{ W} \times 8 \text{ h} = 160 \text{ Wh}$
$= 160 \div 1000 \text{ kWh}$
$= 0.16 \text{ kWh}$

c $12 \text{ W} \times 8 \text{ h} = 96 \text{ Wh}$
$= 96 \div 1000$
$= 0.096 \text{ kWh}$

d $50 \text{ W} \times 8 \text{ h} = 400 \text{ Wh}$
$= 400 \div 1000 \text{ kWh}$
$= 0.4 \text{ kWh}$

Question 2

$$\begin{aligned}2 \text{ min } 36 \text{ s} &= 120 + 36 \\ &= 156 \text{ seconds} \\ &= \frac{156}{60 \times 60} \text{ hours} \\ &= \frac{156}{3600} \text{ hours} \\ &= \frac{13}{300} \text{ hours}\end{aligned}$$

$$\begin{aligned}\text{Energy} &= 2200 \text{ W} \times \frac{13}{200} \\ &= 95.333... \text{ Wh} \\ &= 95.333... \div 1000 \text{ kWh} \\ &= 0.095333... \text{ kWh} \\ &\approx 0.09533 \text{ kWh}\end{aligned}$$

$\therefore$ The correct answer is **C**.

Question 3

$0.78 \text{ kW} \times 5 \text{ h} = 3.9 \text{ kWh}$

Question 4

a $\text{Energy per load} = 45 \text{ kWh} \div 250 \text{ loads} = 0.18 \text{ kWh}$

b $\text{Energy per load} = 547 \text{ kWh} \div 250 \text{ loads} = 2.188 \text{ kWh}$

Question 5

a Energy used = 1500 W × 0.5 h × 52

= 39 000 Wh $(\div 1000)$

= 39 kWh

b Cost = 39 × \$0.268 400

= \$10.4676

≈ \$10.47

Question 6

Energy used = 2400 W × 5 h × 92

= 1 104 000 Wh $(\div 1000)$

= 1104 kWh

∴ Cost = 1104 × \$0.288 200

= \$318.1728

≈ \$318.17

Question 7

Energy used = $2100 \text{ W} \times \frac{38}{60} \text{ h} \times 5 \times 52$

= 345 800 Wh $(\div 1000)$

= 345.8 kWh

∴ Total Cost = 345.8 × \$0.29821

= \$103.121...

≈ \$103.12

Question 8

a Cooling: $2.5 \text{ kW} \times 240 \text{ h} = 600 \text{ kWh}$

Heating: $3.2 \text{ kW} \times 260 \text{ h} = 832 \text{ kWh}$

$\text{Total} = 600 + 832$

$= 1432 \text{ kWh}$

$\therefore \text{Cost} = 1432 \times 0.247\,793$

$= \$354.84$

b Cooling: $2.3 \text{ kW} \times 240 \text{ h} = 552 \text{ kWh}$

Heating: $3.0 \text{ kW} \times 260 \text{ h} = 780 \text{ kWh}$

$\text{Total} = 552 + 780$

$= 1332 \text{ kWh}$

$\therefore \text{Cost} = 1332 \times 0.247\,793$

$= \$330.06$

c Cooling: $7.1 \text{ kW} \times 240 \text{ h} = 1704 \text{ kWh}$

Heating: $8.0 \text{ kW} \times 260 \text{ h} = 2080 \text{ kWh}$

$\text{Total} = 1704 + 2080$

$= 3784 \text{ kWh}$

$\therefore \text{Cost} = 3784 \times 0.247\,793$

$= \$937.65$

Question 9

a $\text{Energy used} = 18 \times 4 \times 75 \times 365$

$= 1\,971\,000 \text{ W}$

$= 1971 \text{ kWh}$

$\therefore \text{ Cost} = 1971 \times \$0.2445$

$= \$481.9095$

$\approx \$481.91$

b $\text{Energy used} = 18 \times 4 \times 15 \times 365$

$= 394\,200 \text{ W}$

$= 394.2 \text{ kWh}$

$\therefore \text{ Cost} = 394.2 \times \$0.2445$

$= \$96.3819$

$\approx \$96.38$

c $\text{Energy used} = 18 \times 4 \times 12 \times 365$

$= 315\,360 \text{ W}$

$= 315.36 \text{ kWh}$

$\therefore \text{ Cost} = 315.36 \times \$0.2445$

$= \$77.10552$

$\approx \$77.11$

d $\text{Energy used} = 18 \times 4 \times 60 \times 365$

$= 1\,576\,800 \text{ Wh}$

$= 1576.8 \text{ kWh}$

$\therefore \text{ Cost} = 1576.8 \times \$0.2445$

$= \$385.5276$

$\approx \$385.53$

Question 10

$$\text{Cost of cold wash} = 123 \times \$0.2982$$
$$= \$36.6786$$
$$\text{Cost of hot wash} = 636 \times \$0.2982$$
$$= \$189.6552$$
$$\therefore \text{ Difference in cost} = \$189.6552 - \$36.6786$$
$$= \$152.9766$$
$$\approx \$152.98$$

Question 11

$$\text{Cost} = 259 \times \$0.298210$$
$$= \$77.23639$$
$$\approx \$77.24$$

Question 12

a Energy used = 20 × 18 × 6 × 365
= 788 400 Wh
= 788.4 kWh

Cost for the year = 788.4 × $0.30
= $236.52

b Energy used = 12 × 18 × 6 × 365
= 473 040 Wh
= 473.04 kWh

Cost for the year = 473.04 × $0.30
= $141.91

∴ Saving = $236.52 – $141.91
= $94.61

So, the cost for the year would be $141.91 and there would be a saving of $94.61.

Question 13

a

Refrigerator:	130 × \$0.30 = \$39
Freezer:	70 × \$0.30 = \$21
Washing machine:	10 × \$0.30 = \$3
Dishwasher:	92 × \$0.30 = \$27.60
Clothes dryer:	110 × \$0.30 = \$33
Television:	171 × \$0.30 = \$51.30
Computer:	216 × \$0.30 = \$64.80

b Total cost = \$39 + \$21 + \$3 + \$27.60 + \$33 + \$51.30 + \$64.80
= \$239.70

Question 14

a Energy used = 10 × 336
= 3360 kWh.

$$\text{Cost for the year} = 3360 \times \$0.30$$
$$= \$1008$$

b Energy used = 10 × 685
= 6850 kWh.

$$\text{Cost for the year} = 6850 \times \$0.30$$
$$= \$2055$$

c $\text{Energy used} = 10 \times (3.7 \times 280 + 3.5 \times 250)$
= 19 110 kWh.

$$\text{Cost for the year} = 19\ 110 \times \$0.30$$
$$= \$5733$$

Question 15

Assume the DVD recorder is continually on standby (24 hours a day, seven days a week).

Energy used = 5.4 W × (24 × 365) h
= 47 304 Wh
= 47.304 kWh

$$\text{Cost} = 47.304 \times \$0.2805$$
$$= \$13.268\ldots$$
$$\approx \$13.27$$

Question 16

a *Television (LCD)*:

$$\begin{aligned}\text{Energy used} &= 3.5 \times 24 \times 365 \\ &= 30\,660 \text{ Wh} \\ &= 30.66 \text{ kWh} \\ \therefore \text{Standby power cost} &= 30.66 \times \$0.26675 \\ &= \$8.178555 \\ &\approx \$8.18\end{aligned}$$

Computer notebook:

$$\begin{aligned}\text{Energy used} &= 8.9 \times 24 \times 365 \\ &= 77\,964 \text{ Wh} \\ &= 77.964 \text{ kWh} \\ \therefore \text{Standby power cost} &= 77.964 \times \$0.26675 \\ &= \$20.796... \\ &\approx \$20.80\end{aligned}$$

Inkjet printer:

$$\begin{aligned}\text{Energy used} &= 1.3 \times 24 \times 365 \\ &= 11\,388 \text{ Wh} \\ &= 11.388 \text{ kWh} \\ \therefore \text{Standby power cost} &= 11.388 \times \$0.26675 \\ &= \$3.037... \\ &\approx \$3.04\end{aligned}$$

Microwave oven:

$$\begin{aligned}\text{Energy used} &= 3.1 \times 24 \times 365 \\ &= 27\,156 \text{ Wh} \\ &= 27.156 \text{ kWh} \\ \therefore \text{Standby power cost} &= 27.156 \times \$0.26675 \\ &= \$7.243... \\ &\approx \$7.24\end{aligned}$$

Dishwasher:

$$\begin{aligned}\text{Energy used} &= 2.7 \times 24 \times 365 \\ &= 23\,652 \text{ Wh} \\ &= 23.652 \text{ kWh} \\ \therefore \text{Standby power cost} &= 23.652 \times \$0.26675 \\ &= \$6.309... \\ &\approx \$6.31\end{aligned}$$

Set-top box (Pay TV):

$$\begin{aligned}\text{Energy used} &= 15.8 \times 24 \times 365 \\ &= 138\,408 \text{ Wh} \\ &= 138.408 \text{ kWh} \\ \therefore \text{Standby power cost} &= 138.408 \times \$0.26675 \\ &= \$36.920... \\ &\approx \$36.92\end{aligned}$$

Mobile phone charger:

$$\begin{aligned}\text{Energy used} &= 0.3 \times 24 \times 365 \\ &= 2628 \text{ Wh} \\ &= 2.628 \text{ kWh} \\ \therefore \text{Standby power cost} &= 2.628 \times \$0.26675 \\ &= \$0.701... \\ &\approx \$0.70\end{aligned}$$

b $\begin{aligned}\text{Total standby cost} &= \$8.18 + \$20.80 + ... + \$0.70 \\ &= \$83.19\end{aligned}$

Exercise 6.05 Food and energy consumption

Question 1

a $2350 \text{ kJ} = 2350 \times 1000$ (1 kJ = 1000 J)
$= 2\ 350\ 000 \text{ J}$

b $54 \text{ MJ} = 54 \times 1000$ (1 kJ = 1000 J)
$= 54\ 000 \text{ kJ}$

c $760 \text{ cal} = 760 \times 4.184$ (1 Cal = 4.184 kJ)
$= 3179.84 \text{ kJ}$

d $1475 \text{ kJ} = 1475 \div 1000$ (1000 kJ = 1 MJ)
$= 1.475 \text{ MJ}$

e $250 \text{ kJ} = 250 \div 4.184$ (4.184 kJ = 1 Cal)
$= 59.751... \text{ Cal}$
$\approx 59.75 \text{ Cal}$

f $0.9 \text{ MJ} = 0.9 \times 1000$ (1 MJ = 1000 kJ)
$= 900 \text{ kJ}$
$= 900 \div 4.184$ (4.184 kJ = 1 Cal)
$= 215.105... \text{ Cal}$
$\approx 215.11 \text{ Cal}$

Question 2

$400 \text{ kJ} = 400 \div 4.184$ (4.184 kJ = 1 Cal)
$= 95.602... \text{ Cal}$

$\therefore$ This is approximately 96 calories.

Question 3

a Total kilojoules in box $= 14.6 \times 37$
$= 540.2$

$\therefore$ There are 540.2 kJ in the box.

b One snack pack $= 540.2 \div 6$
$= 90.03...$
$\approx 90 \text{ kJ}$

$\therefore$ There are 90 kJ in one snack pack.

c $90.03... \text{ kJ} = 90.03... \div 4.184$
$= 21.518...$
$\approx 22 \text{ Cal}$

$\therefore$ There are 22 calories in one snack pack.

Question 4

a A 1 kg box is twenty 50 g serves.

$$\begin{aligned}\text{So, Total energy in box} &= 767 \text{ kJ} \times 20 \\ &= 15\,340 \text{ kJ} \\ &= 15.34 \text{ MJ}\end{aligned}$$

b $$\begin{aligned}\text{Total energy} &= 182 \times 20 \text{ Cal} \\ &= 3640 \text{ Cal}\end{aligned}$$

Question 5

a $$\begin{aligned}\text{Protein} &= 22\% \text{ of } 8700 \text{ kJ} \\ &= 0.22 \times 8700 \\ &= 1914 \text{ kJ}\end{aligned}$$

b $14 = 2 \times 7$

$$\begin{aligned}\therefore \text{ Total energy in packet} &= 7 \times 751 \\ &= 5257 \text{ kJ} \\ &= 5257 \div 4.184 \\ &= 1256.453... \text{ Cal} \\ &\approx 1256 \text{ Cal}\end{aligned}$$

Question 6

a $\text{Total energy} = 2120 + 744 + 1620 = 4484 \text{ kJ}$

b $$\begin{aligned}\%\text{ rec daily intake} &= \frac{4484}{8700} \times 100\% \\ &= 51.54...\% \\ &\approx 51.5\%\end{aligned}$$

Question 7

a $\text{Total energy} = 650 + 1280 + 300 + 429 + 64 + 645 + 2 \times 268 + 3 \times 80$

$= 4144 \text{ kJ}$

b From the table: Daily intake = 8400 kJ

$$\% \text{ rec daily intake} = \frac{4144}{8400} \times 100\%$$

$$= 49.33...\%$$

$$\approx 49.3\%$$

Question 8

a **i** Servings per package = 3

ii One serve = 150 g.

So, $150\,\text{g} \times 3 = 450 \text{ g}$

b $405 \text{ kJ} = 405 \div 4.184$

$= 96.79... \text{ Cal}$

$\approx 97 \text{ Cal}$

c **i** Carbohydrate total $= 17 \times 18.6 = 316.2 \text{ kJ}$

ii $\frac{316.2}{608} \times 100\% = 52.00...\% \approx 52\%$

$\therefore$ This represents 52% of the energy content per serving.

Question 9

a Naming two that use more energy: touch football and running.

i
$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{2194}{1240} \times 30$$
$$= 53.08... \text{ min}$$
$$\approx 53 \text{ min}$$

ii
$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{1015}{1240} \times 30$$
$$= 24.55... \text{ min}$$
$$\approx 25 \text{ min}$$

b **i** Bacon and egg roll:

$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{2194}{1049} \times 30$$
$$= 62.74... \text{ min}$$
$$\approx 63 \text{ min}$$

Chicken teriyaki salad:

$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{1015}{1049} \times 30$$
$$= 29.02... \text{ min}$$
$$\approx 29 \text{ min}$$

ii Bacon and egg roll:

$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{2194}{918} \times 30$$
$$= 71.69... \text{ min}$$
$$\approx 72 \text{ min}$$

Chicken teriyaki salad:

$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{1015}{918} \times 30$$
$$= 33.16... \text{ min}$$
$$\approx 33 \text{ min}$$

iii Bacon and egg roll:

$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{2194}{787} \times 30$$
$$= 83.63... \text{ min}$$
$$\approx 84 \text{ min}$$

Chicken teriyaki salad:

$$\text{Time} = \frac{\text{Total kJ eaten}}{\text{kJ used in sport}} \times \text{duration of sport}$$
$$= \frac{1015}{787} \times 30$$
$$= 38.69... \text{ min}$$
$$\approx 39 \text{ min}$$

Exercise 6.06 Household budgeting

Question 1

a expense

b income

c expense

d expense

e income

f expense

g expense

h expense

i income

j expense

k income

l expense

m income

n income

o expense

Question 2

Fixed spending: a, f, g,
Discretionary spending: c, d, h, j, l, o

Question 3

a $\text{Casual job} = \text{Total} - \text{Youth allowance}$
$= \$621 - \$239.50$
$= \$381.50$

b It is a discretionary item.

$\text{Entertainment} = \text{Total} - \text{all other expenses}$
$= \$621 - (\$160 + \$56 + ... + \$60)$
$= \$78$

c Spend less on clothes, look for groceries specials, spend less on entertainment, try to walk or catch a lift with friends to reduce fares, etc.

Question 4

a Savings = Total Earnings – all expenses

$= \$615.40 - (\$40 + \$138 + ... + \$8)$

$= \$615.40 - \$504$

$= \$111.40$ per week

b Savings for year $= \$111.40 \times 52 = \$5792.80$

$\therefore$ Yes, she will easily have enough to pay for her trip in one year.

c Increase by 20% means 120% of cost

$= 1.2 \times \$2200$

$= \$2640$

$\therefore$ Yes, she will still have enough to pay the new price.

Question 5

a **Rogers Family Budget**

Income		**Expenses**	
Wages	$1901.77	Bills	$105.30
Part time job	$289.53	School fees	$85.80
		Entertainment	$295
Parenting allowance	$197.20	Health fund	$53.40
		Clothes	$132
		Home Maintenance	$184
		Groceries	$210.50
		Petrol	$85.40
		Fri night T/way	$46
		N'paper & mag	$26
		Home loan	$545.60
		Car loan	$184.22
		Savings	$435.28
Total:	**$2388.50**	**Total:**	**$2388.50**

b Savings = Total Earnings – all expenses

$= \$2388.50 - (\$105.30 + \$85.80 + ... + \$184.22)$

$= \$2388.50 - \$1953.22$

$= \$435.28$ per week

Question 6

a Zac's weekly income is $551.40.

b Electricity:

$$\begin{aligned}\$45.10 \text{ per quarter} &= \$45.10 \times 4 \text{ per year} \\ &= \$180.40 \text{ per year} \\ &= \$180.40 \div 52 \text{ per week} \\ &= \$3.469... \text{ per week} \\ &\approx \$3.47 \text{ per week}\end{aligned}$$

Phone Bill:

$$\begin{aligned}\$12.80 \text{ per two-monthly} &= \$12.80 \times 6 \text{ per year} \\ &= \$76.80 \text{ per year} \\ &= \$76.80 \div 52 \text{ per week} \\ &= \$1.476... \text{ per week} \\ &\approx \$1.48 \text{ per week}\end{aligned}$$

Chiropractor:

$$\begin{aligned}\$42 \text{ per month} &= \$42 \times 12 \text{ per year} \\ &= \$504 \text{ per year} \\ &= \$504 \div 52 \text{ per week} \\ &= \$9.692... \text{ per week} \\ &\approx \$9.69 \text{ per week}\end{aligned}$$

$$\begin{aligned}\text{Total expenses} &= \$110 + \$64 + \$46 + \$3.47 + \$1.48 + \$45 + \$9.69 \\ &= \$279.64\end{aligned}$$

c $$\begin{aligned}\text{Savings} &= \text{Total Earnings} - \text{all expenses} \\ &= \$551.40 - \$279.64 \\ &= \$271.76 \text{ per week}\end{aligned}$$

Sample HSC problem

a Amount of electricity generated $= 3 \times 2.09 \text{ kW} \times 365 \text{ per year}$

$= 2288.55 \text{ kW per year}$

b % household consumption from solar panels

$$= \frac{\text{solar panels}}{\text{Household consumption}} \times 100\%$$

$$= \frac{2288.55}{8764} \times 100\%$$

$$= 26.113...\%$$

$$\approx 26.11\%$$

c **i** Amount not generated by solar panels

$= 8764 - 2288.55$

$= 6475.45 \text{ kWh}$

ii Expected annual cost $= 6475.45 \times \$0.258100$

$= \$1671.313...$

$\approx \$1671.31$

Test yourself 6

Question 1

a $\text{Cost} = 21.6 \times \$2.115$
$= \$45.68$

$\therefore$ He will need to pay \$45.68.

b Bill total = \$45.68 + \$41.39 + \$162.88
= \$249.95

$\therefore$ The total of the bill is \$249.95.

Question 2

$\text{Amount water used} = 8342 - 8145$
$= 197 \text{ kL}$

$\therefore \text{Water usage} = 197 \times \$2.115$
$= \$416.655$
$\approx \$416.66$

$\therefore$ B

Question 3

a $A \approx \frac{h}{2}\left(d_f + d_l\right)$

$A \approx \frac{10}{2}(5.2 + 11.3) + \frac{10}{2}(11.3 + 7.8)$
$= 178 \text{ m}^2$

$\therefore$ The approximate area of the lake is 178 m^2.

b $V = Ah$
$= 178 \times 3.1$
$= 551.8 \text{ m}^3$

$\therefore$ The volume of water in the lake is 551.8 m^3.

Question 4

a $16\,400 \text{ kW} = 16\,400 \div 1000$ (1000 kW = 1 MW)

$= 16.4 \text{ MW}$

b $7.15 \text{ GW} = 7.15 \times 1000$ (1 GW = 1000 MW)

$= 7150 \text{ MW}$

$= 7150 \times 1000 \text{ kW}$ (1 MW = 1000 kW)

$= 7\,150\,000 \text{ kW}$

c $26\,000\,000 \text{ mW} = 26\,000\,000 \div 1000$ (1000 mW = 1 W)

$= 26\,000 \text{ W}$

$= 26\,000 \div 1000$ (1000 W = 1 kW)

$= 26 \text{ kW}$

Question 5

Off peak:

$1087 \times 12.03719 \text{ c} = 13084.42553 \text{ c}$

$= \$130.844\,255\,3$

Domestic:

$2107 \times 29.5443 \text{c} = 62249.8401 \text{ c}$

$= \$622.498\,401$

Supply charge: $92 \times 95.6494 \text{ c} = 8799.7448 \text{ c}$

$= \$87.997488$

$\therefore \text{Electricity bill} = \$130.8442553 + \$622.498401 + \$87.997488$

$= \$841.3401443$

$\approx \$841.34$

Question 6

$\text{Time of showers} = 4 \text{ people} \times 2 \text{ showers} \times 8 \text{ min} = 64 \text{ min per day}$

$\text{Cost per day} = 3.6 \text{ kW} \times 27.5 \text{ c/kWh} \times \frac{64}{60} \text{ h}$

$= 105.6 \text{ c}$

$= \$1.056$

$\therefore \text{Cost per week} = \$1.056 \times 7$

$= \$7.392$

$\approx \$7.39$

$\therefore$ C

Question 7

$$\text{Power consumption} = \frac{15}{60}\ \text{h} \times 2400\ \text{W} \times 365\ \text{days}$$
$$= 219\,000\ \text{Wh} \qquad 1000\ \text{Wh} = 1\ \text{kWh}$$
$$= 219\,000 \div 1000$$
$$= 219\ \text{kWh}$$

$$\text{Annual cost} = 219 \times 24.25\text{c}$$
$$= 5310.75\text{c}$$
$$= \$53.11$$

$\therefore$ It will cost \$53.11 to use the kettle over one year.

Question 8

$$\text{Cold water cost} = 85 \times \$0.2834$$
$$= \$24.089$$

$$\text{Hot water cost} = 360 \times \$0.2834$$
$$= \$102.024$$

$$\text{Cost difference} = \$102.024 - \$24.089$$
$$= \$77.935$$
$$\approx \$77.94$$

$\therefore$ It is \$71.01 cheaper to wash in cold water instead of warm.

Question 9

a $4.65 \text{ kJ} = 4.65 \times 1000$ (1 kJ = 1000 J)
$= 4650 \text{ J}$

b $19 \text{ MJ} = 19 \times 1000$ (1 kJ = 1000 J)
$= 19\,000 \text{ kJ}$

c $7235 \text{ cal} = 7235 \times 4.184$ (1 Cal = 4.184 kJ)
$= 30\,271.24 \text{ kJ}$

d $108.5 \text{ kJ} = 108.5 \div 1000$ (1000 kJ = 1 MJ)
$= 0.1085 \text{ MJ}$

e $680 \text{ kJ} = 680 \div 4.184$ (4.184 kJ = 1 Cal)
$= 162.52... \text{ Cal}$
$\approx 162.5 \text{ Cal}$

f $0.4 \text{ MJ} = 0.4 \times 1000$ (1 MJ = 1000 kJ)
$= 400 \text{ kJ}$
$= 400 \div 4.184$ (4.184 kJ = 1 Cal)
$= 95.602... \text{ Cal}$
$\approx 95.6 \text{ Cal}$

Question 10

a 150 g means 150 ÷ 60 = 1.5 times the serve

$\therefore$ Amount energy $= 1.5 \times 870 \text{ kJ}$
$= 1305 \text{ kJ}$

b $1305 \text{ kJ} = 1305 \div 4.184$ (4.184 kJ = 1 Cal)
$= 311.9024... \text{ Cal}$
$\approx 311.9 \text{ Cal}$

Question 11

a Wage $= \$1654$ per fortnight
$= \$1654 \div 2$ per week
$= \$827$ per week

Rent $= \$1270$ per month
$= \$1270 \times 12$ per year
$= \$15\ 240$ per year
$= \$15\ 240 \div 52$ per week
$= \$293.076...$ per week
$\approx \$293.08$ per week

$\therefore$ Total weekly income $= \$827 + \$293.08$
$= \$1120.076...$
$= \$1120.08$

Income		**Expenses**	
Wages	$827	Groceries	$142
Rent	$293.08	Home Loan	$235
		Health Fund	$28.20
		Household bills	$43
		N'paper & mag	$18
		Takeaway meals	$32
		Petrol	$70
		Fares	$56.70
		Entertainment	$100
		Clothes	$100
		Savings	$295.18
Total:	**$1120.08**	**Total:**	**$1120.08**

b **Example of Chloe's Weekly Budget**

NOTE: Expenses minus the blanks equals $624.90. So, missing values can be anything if together they add up to $\$1120.08 - \$624.90 = \$495.18$.

c Cut down on takeaway meals, newspapers and magazines, spend less on clothes and/or entertainment, etc.

