Percentage Calculations

Solutions

Curriculum Ready

ACMNA: 157, 158, 187, 189

Mathletics

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Page 3 questions

Fractions and percentages

1 **a** $\frac{3}{100} = \boxed{3}\%$ **b** $\frac{41}{100} = \boxed{41}\%$ **c** $\frac{110}{100} = \boxed{110}\%$ **d** $\frac{200}{100} = \boxed{200}\%$

2 **a** $7\% = \frac{\boxed{7}}{\boxed{100}}$ **b** $89\% = \frac{\boxed{89}}{\boxed{100}}$ **c** $117\% = \frac{\boxed{117}}{\boxed{100}}$ **d** $336\% = \frac{\boxed{336}}{\boxed{100}}$

3 **a** $20\% = \frac{\boxed{20}}{\boxed{100}} = \frac{\boxed{1}}{\boxed{5}}$ Simplified **b** $15\% = \frac{\boxed{15}}{\boxed{100}} = \frac{\boxed{3}}{\boxed{20}}$ Simplified **c** $80\% = \frac{\boxed{80}}{\boxed{100}} = \frac{\boxed{4}}{\boxed{5}}$ Simplified

d $24\% = \frac{\boxed{24}}{\boxed{100}} = \frac{\boxed{6}}{\boxed{25}}$ Simplified **e** $42\% = \frac{\boxed{42}}{\boxed{100}} = \frac{\boxed{21}}{\boxed{50}}$ Simplified **f** $96\% = \frac{\boxed{96}}{\boxed{100}} = \frac{\boxed{24}}{\boxed{25}}$ Simplified

g $125\% = \frac{\boxed{125}}{\boxed{100}} = \frac{\boxed{5}}{\boxed{4}}$ Simplified improper **h** $180\% = \frac{\boxed{180}}{\boxed{100}} = \frac{\boxed{9}}{\boxed{5}}$ Simplified improper **i** $350\% = \frac{\boxed{350}}{\boxed{100}} = \frac{\boxed{7}}{\boxed{2}}$ Simplified improper

4 **a** $\frac{24}{300} = \frac{24 \div \boxed{3}}{300 \div \boxed{3}} = \frac{\boxed{8}}{\boxed{100}} = \boxed{8}\%$

b $\frac{48}{200} = \frac{48 \div \boxed{2}}{200 \div \boxed{2}} = \frac{\boxed{24}}{\boxed{100}} = \boxed{24}\%$

c $\frac{175}{500} = \frac{175 \div \boxed{5}}{500 \div \boxed{5}} = \frac{\boxed{35}}{\boxed{100}} = \boxed{35}\%$

Page 4 questions

Fractions and percentages

5 **a** $\frac{3}{10} = \frac{3 \times \boxed{10}}{10 \times \boxed{10}} = \frac{\boxed{30}}{\boxed{100}} = \boxed{30}\ \%$

b $\frac{12}{25} = \frac{12 \times \boxed{4}}{25 \times \boxed{4}} = \frac{\boxed{48}}{\boxed{100}} = \boxed{48}\ \%$

c $\frac{6}{5} = \frac{6 \times \boxed{20}}{5 \times \boxed{20}} = \frac{\boxed{120}}{\boxed{100}} = \boxed{120}\ \%$

6 **a** $3\frac{1}{2} = \frac{\boxed{7} \times \boxed{50}}{2 \times \boxed{50}} = \frac{\boxed{350}}{\boxed{100}} = \boxed{350}\ \%$

b $2\frac{1}{4} = \frac{\boxed{9} \times \boxed{25}}{4 \times \boxed{25}} = \frac{\boxed{225}}{\boxed{100}} = \boxed{225}\ \%$

c $1\frac{2}{5} = \frac{\boxed{7} \times \boxed{20}}{5 \times \boxed{20}} = \frac{\boxed{140}}{\boxed{100}} = \boxed{140}\ \%$

7 **a** $\frac{1}{2} = \boxed{50}\ \%$

b $\frac{1}{5} = \boxed{20}\ \%$

c $\frac{8}{25} = \boxed{32}\ \%$

d $\frac{13}{50} = \boxed{26}\ \%$

e $\frac{5}{2} = \boxed{250}\ \%$

f $\frac{15}{20} = \boxed{75}\ \%$

8 **a** $2\frac{2}{5} = \frac{\boxed{12}}{\boxed{5}} = \boxed{240}\ \%$

b $3\frac{3}{4} = \frac{\boxed{15}}{\boxed{4}} = \boxed{375}\ \%$

c $1\frac{7}{20} = \frac{\boxed{27}}{\boxed{20}} = \boxed{135}\ \%$

d $4\frac{9}{25} = \frac{\boxed{109}}{\boxed{25}} = \boxed{436}\ \%$

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Page 5 questions

Fractions and percentages

9 **a** $\frac{13}{500} = \frac{2.6}{100} = 2.6\% = 2\frac{3}{5}\%$

Decimal Mixed numeral

b $\frac{30}{800} = \frac{3.75}{100} = 3.75\% = 3\frac{3}{4}\%$

Decimal Mixed numeral

c $\frac{17}{400} = \frac{4.25}{100} = 4.25\% = 4\frac{1}{4}\%$

Decimal Mixed numeral

d $\frac{26}{500} = \frac{5.2}{100} = 5.2\% = 5\frac{1}{5}\%$

Decimal Mixed numeral

e $\frac{47}{500} = \frac{9.4}{100} = 9.4\% = 9\frac{2}{5}\%$

Decimal Mixed numeral

f $\frac{42}{400} = \frac{10.5}{100} = 10.5\% = 10\frac{1}{2}\%$

Decimal Mixed numeral

10 **a** $\frac{3}{200} = \frac{1.5}{100} = 1.5\% = \frac{3}{2}\%$

Decimal Improper fraction

b $\frac{7}{500} = \frac{1.4}{100} = 1.4\% = \frac{7}{5}\%$

Decimal Improper fraction

c $\frac{9}{800} = \frac{1.125}{100} = 1.125\% = \frac{9}{8}\%$

Decimal Improper fraction

d $\frac{9}{750} = \frac{1.2}{100} = 1.2\% = \frac{5}{4}\%$

Decimal Improper fraction

Page 7 questions

Decimals and percentages

1 a $15\% = 0.15$ b $20\% = 0.20$ c $4\% = 0.04$ d $9\% = 0.09$

e $125\% = 1.25$ f $250\% = 2.50$ g $110\% = 1.10$ h $305\% = 3.05$

2 a $0.03 = 3\%$ b $0.16 = 16\%$ c $1.12 = 112\%$ d $2.45 = 245\%$

e $0.125 = 12.5\%$ f $0.253 = 25.3\%$ g $0.018 = 1.8\%$ h $0.2225 = 22.25\%$

3 a $0.015 = 1.5\%$ (Decimal) $= \frac{3}{2}\%$ (Improper fraction)

b $0.185 = 18.5\%$ (Decimal) $= 18\frac{1}{2}\%$ (Mixed numeral)

c $0.012 = 1.2\%$ (Decimal) $= \frac{6}{5}\%$ (Improper fraction)

d $0.458 = 45.8\%$ (Decimal) $= 45\frac{4}{5}\%$ (Mixed numeral)

4 a $155\% = 1.55 = 1\frac{11}{20} = \frac{31}{20}$

Decimal | Mixed numeral | Improper fraction

b $218\% = 2.18 = 2\frac{9}{50} = \frac{109}{50}$

Decimal | Mixed numeral | Improper fraction

c $100.5\% = 1.005 = 1\frac{1}{200} = \frac{201}{200}$

Decimal | Mixed numeral | Improper fraction

d $220.4\% = 2.204 = 2\frac{51}{250} = \frac{551}{250}$

Decimal | Mixed numeral | Improper fraction

e $375.20\% = 3.752 = 3\frac{94}{125} = \frac{469}{125}$

Decimal | Mixed numeral | Improper fraction

f $125.8\% = 1.258 = 1\frac{129}{500} = \frac{629}{500}$

Decimal | Mixed numeral | Improper fraction

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Page 8 questions

Decimals and percentages

5 a Simplified fraction $= \frac{1}{4}$

Decimal $= 0.25$

b Mixed numeral form $= 5\frac{1}{2}\%$

Improper fraction form $= \frac{11}{2}\%$

Simplified fraction $= \frac{11}{200}$

Decimal $= 0.055$

c Improper fraction form $= \frac{19}{4}\%$

Decimal form $= 4.75\%$

Simplified fraction $= \frac{19}{400}$

Decimal $= 0.0475$

d Improper fraction form $= \frac{17}{8}\%$

Decimal form $= 2.125\%$

Simplified fraction $= \frac{17}{800}$

Decimal $= 0.02125$

e Mixed numeral form $= 112\frac{1}{2}\%$

Improper fraction form $= \frac{225}{2}\%$

Simplified mixed numeral $= 1\frac{1}{8}$

Decimal $= 1.125$

f Mixed numeral form $= 237\frac{1}{5}\%$

Improper fraction form $= \frac{1186}{5}\%$

Simplified mixed numeral $= 2\frac{93}{250}$

Decimal $= 2.372$

g Mixed numeral form $= 17\frac{1}{4}\%$

Improper fraction form $= \frac{69}{4}\%$

Simplified fraction $= \frac{69}{400}$

Decimal $= 0.1725$

h Decimal form $= 7.1875\%$

Improper fraction form $= \frac{115}{16}\%$

Simplified fraction $= \frac{23}{320}$

Decimal $= 0.071875$

i Mixed numeral form $= 2\frac{3}{8}\%$

Improper fraction form $= \frac{19}{8}\%$

Simplified fraction $= \frac{19}{800}$

Decimal $= 0.02375$

j Decimal form $= 100.625\%$

Improper fraction form $= \frac{805}{8}\%$

Simplified mixed numeral $= 1\frac{1}{160}$

Decimal $= 1.00625$

Page 10 questions

Recurring decimals and percentages

1 **a** $0.\dot{1}\% = \frac{1}{9}\%$ **b** $0.\dot{5}\% = \frac{5}{9}\%$ **c** $0.0\dot{7}\% = \frac{7}{90}\%$ **d** $0.0\dot{6}\% = \frac{1}{15}\%$

2 **a** $0.1\dot{3}\% = \frac{1}{10} + \frac{3}{90}\% = \frac{2}{15}\%$ **b** $0.3\dot{8}\% = \frac{3}{10} + \frac{8}{90}\% = \frac{7}{18}\%$

c $0.08\dot{3} = \frac{8}{100} + \frac{3}{900}\% = \frac{1}{12}\%$ **d** $0.05\dot{7}\% = \frac{5}{100} + \frac{7}{900}\% = \frac{13}{225}\%$

3 **a** $23\frac{1}{3}\% =$ 23.3 (Decimal form) $\% =$ $0.2\dot{3}$ (Equivalent decimal) $= \frac{7}{30}$ (Fraction)

b $14\frac{4}{9}\% =$ 14.4 (Decimal form) $\% =$ $0.1\dot{4}$ (Equivalent decimal) $= \frac{13}{90}$ (Fraction)

c $5\frac{1}{9}\% =$ 5.1 (Decimal form) $\% =$ $0.05\dot{1}$ (Equivalent decimal) $= \frac{23}{450}$ (Fraction)

d $9\frac{2}{3}\% =$ 9.6 (Decimal form) $\% =$ $0.09\dot{6}$ (Equivalent decimal) $= \frac{29}{300}$ (Fraction)

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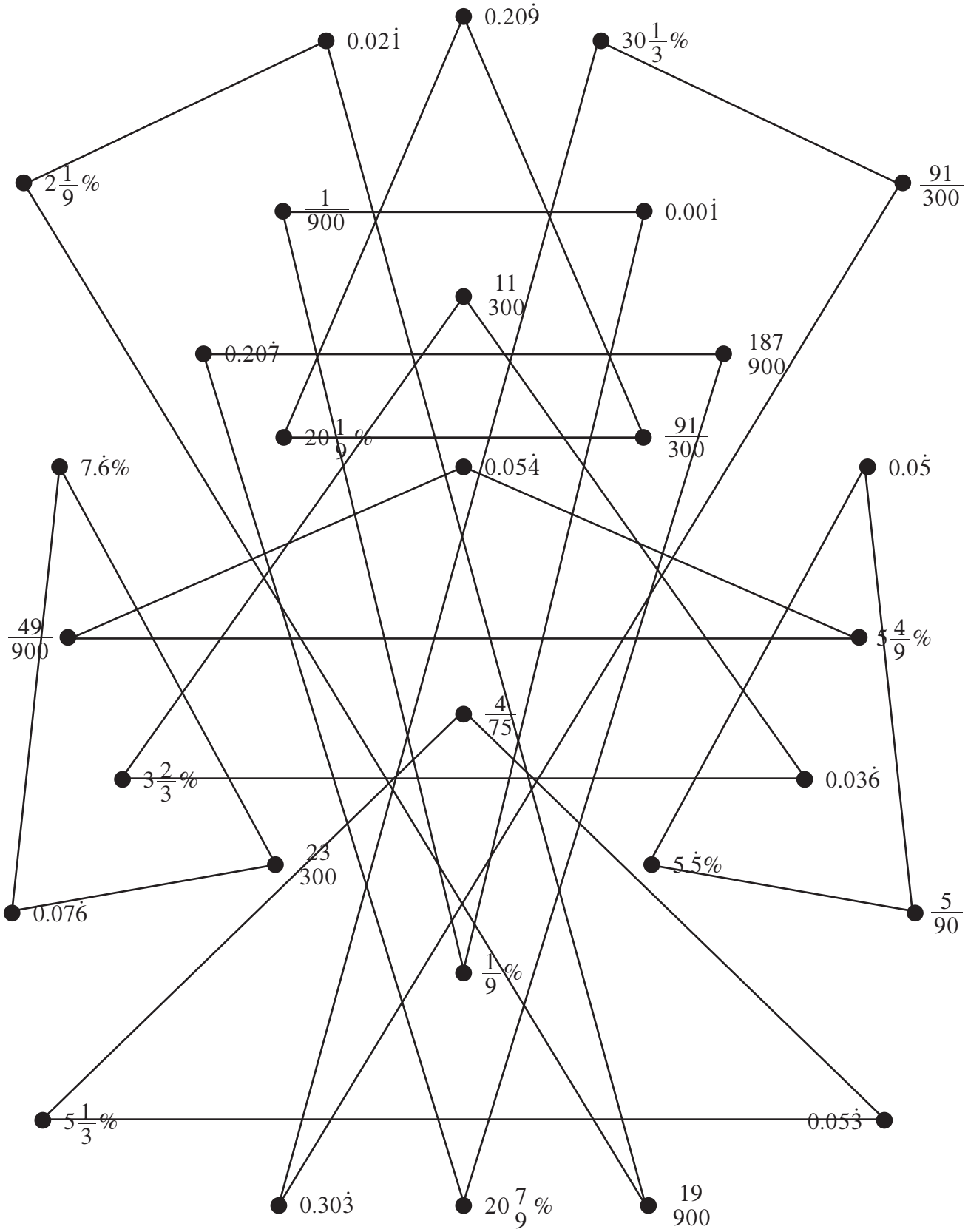
Page 11 questions

Recurring decimals and percentages

4



Page 12 questions

Recurring decimals and percentages

5 **a** $\frac{8}{11} = 8 \div 11$

$= 0.\dot{7}\dot{2}$ Recurring decimal

$= 0.\dot{7}\dot{2} \times 100\%$

$= 72.7\%$

Equivalent percentage to 1 d.p.

b $\frac{19}{12} = 19 \div 12$

$= 1.58\dot{3}$ Recurring decimal

$= 1.58\dot{3} \times 100\%$

$= 158.3\%$

Equivalent percentage to 1 d.p.

c $\frac{5}{6} = 0.83\dot{3}$

Recurring decimal

$= 83.3\%$

Percentage to 1 d.p.

d $\frac{2}{15} = 0.1\dot{3}$

Recurring decimal

$= 13.3\%$

Percentage to 1 d.p.

e $\frac{5}{18} = 0.2\dot{7}$

Recurring decimal

$= 27.8\%$

Percentage to 1 d.p.

f $\frac{9}{22} = 0.4\dot{0}\dot{9}$

Recurring decimal

$= 40.9\%$

Percentage to 1 d.p.

g $\frac{7}{12} = 0.58\dot{3}$

Recurring decimal

$= 58.3\%$

Percentage to 1 d.p.

h $\frac{13}{33} = 0.\dot{3}\dot{7}$

Recurring decimal

$= 39.4\%$

Percentage to 1 d.p.

i $\frac{12}{11} = 1.\dot{0}\dot{9}$

Recurring decimal

$= 109.1\%$

Percentage to 1 d.p.

j $\frac{17}{15} = 1.1\dot{3}$

Recurring decimal

$= 113.3\%$

Percentage to 1 d.p.

k $\frac{16}{12} = 1.\dot{3}$

Recurring decimal

$= 133.3\%$

Percentage to 1 d.p.

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Page 14 questions

Complementary percentages

1

a) 10%
Complement = 90 %

b) 25%
Complement = 75 %

c) 55%
Complement = 45 %

d) 37%
Complement = 63 %

e) 2%
Complement = 98 %

f) 99%
Complement = 1 %

2

a) 0.4
Complement = 0.6

b) 0.8
Complement = 0.2

c) 0.75
Complement = 0.25

d) 0.65
Complement = 0.35

e) 0.32
Complement = 0.68

f) 0.07
Complement = 0.93

g) $0.\dot{6}$
Complement = $0.\dot{3}$

h) $0.\dot{8}$
Complement = $0.\dot{1}$

i) $0.1\dot{4}$
Complement = $0.8\dot{5}$

3

a) $\frac{1}{3}$
Complement = $\frac{2}{3}$

b) $\frac{3}{4}$
Complement = $\frac{1}{4}$

c) $\frac{4}{5}$
Complement = $\frac{1}{5}$

d) $\frac{1}{2}$
Complement = $\frac{1}{2}$

e) $\frac{7}{10}$
Complement = $\frac{3}{10}$

f) $\frac{13}{25}$
Complement = $\frac{12}{25}$

4

a) 65.5%
Complement = 34.5 %

b) 0.5%
Complement = 99.5 %

c) 12.75%
Complement = 87.25 %

d) 30.15%
Complement = 68.85 %

e) 73.12%
Complement = 26.88 %

f) 90.99%
Complement = 9.01 %

g) $22\frac{1}{5}\%$
Complement = $77\frac{4}{5}$ %

h) $90\frac{5}{6}\%$
Complement = $9\frac{1}{6}$ %

i) $\frac{3}{20}\%$
Complement = $99\frac{17}{20}$ %

Page 16 questions

Percentages of an amount

1 **a** $15\% \text{ of } 40 = \frac{15}{100} \times 40$

$= 6$

b $28\% \text{ of } 75 = \frac{28}{100} \times 75$

$= 21$

c $65\% \text{ of } 60 = \{65 \times 100\} \times 60$

$= 0.65 \times 60$

$= 39$

d $22.5\% \text{ of } 280 = \{22.5 \div 100\} \times 280$

$= 0.225 \times 280$

$= 63$

2 **a** $\frac{20}{100} \times 65 = 0.2 \times 65$

$= 13$

b $\frac{60}{100} \times 35 = 0.6 \times 35$

$= 21$

c $\frac{22}{100} \times 25 = 0.22 \times 25$

$= 5.5$

d $\frac{15}{100} \times 30 = 0.15 \times 30$

$= 4.5$

e $\frac{67.5}{100} \times 48 = 0.675 \times 48$

$= 32.4$

f $\frac{34.5}{100} \times 14 = 0.345 \times 14$

$= 4.83$

g $\frac{125}{100} \times 12 = 1.25 \times 12$

$= 15$

h $\frac{220}{100} \times 40 = 2.20 \times 40$

$= 88$

i $\frac{150}{100} \times 15 = 1.5 \times 315$

$= 22.5$

j $\frac{175}{100} \times 79 = 1.75 \times 79$

$= 138.25$

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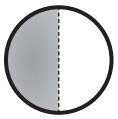
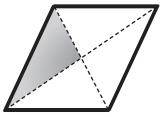
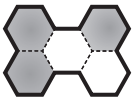
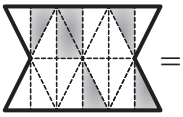
Page 17 questions

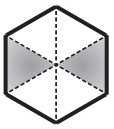
Percentages of an amount

3 a  = 50 %

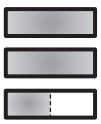
b  = 25 %

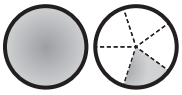
c  = 60 %

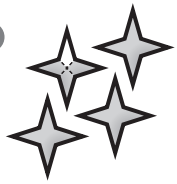
d  = 30 %

e  = $33.\dot{3}$ %

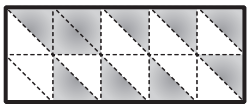
f  = 62.5 %

g  = 250 %

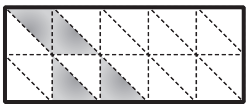
h  = 120 %

i  = 375 %

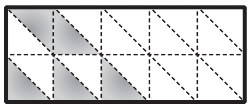
4 a 50%



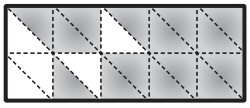
b 20%



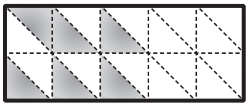
c 25%



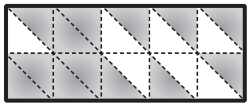
d 75%



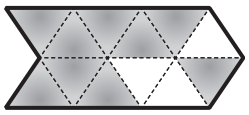
e 30%



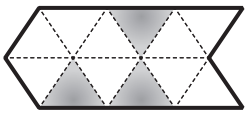
f 65%



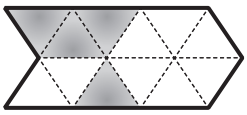
5 a 0.75



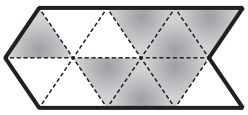
b 0.25



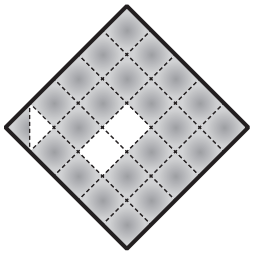
c $0.\dot{3}$



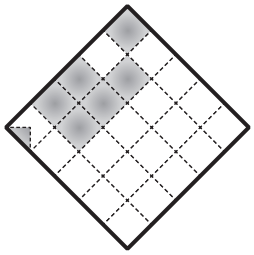
d $0.58\dot{3}$



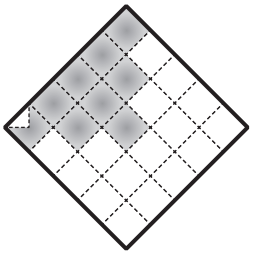
6 a 90%



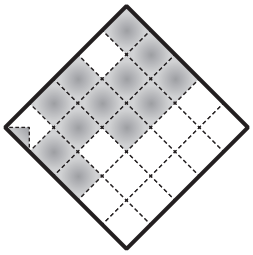
b 25%



c 35%



d 49%



Page 18 questions

Percentages of an amount

6 **a** 40% chose vegetarian course. $\therefore \frac{40}{100} \times 95 = 38$

$\therefore 38$ of the diners chose the vegetarian course.

b 30% of the time was in meetings. $\therefore \frac{30}{100} \times 8 = 2.4$ hours

$\therefore$ Mitch spent 2 hours and 24 minutes in meetings.

c 15.5% of the tickets still available. $\therefore \frac{15.5}{100} \times 12\,800 = 1984$ tickets

$\therefore$ There are 1984 tickets available after 1 hour.

d 42% of the time was right paddle. $\therefore \frac{42}{100} \times 3650 = 1533$

$\therefore$ The right paddle entered the water 1533 times.

7 40% of $75 \implies \frac{40}{100} \times 75 = 30$

75% of $40 \implies \frac{75}{100} \times 40 = 30$

This is true for all percentage calculations because both are the same calculation and are examples of the commutative law $(a \times b = b \times a)$.

$$40\% \text{ of } 75 = \frac{40}{100} \times 75 = \frac{40}{100} \times \frac{75}{1} = \frac{40 \times 75}{100} = \frac{75 \times 40}{100} = \frac{75}{100} \times \frac{40}{1} = \frac{75}{100} \times 40 = 75\% \text{ of } 40$$

Page 19 questions

Percentages of an amount

8 25% of the 64GB left. $\therefore \frac{25}{100} \times 64 = 16$

$\therefore$ There are 16GB left on the music device.

9 87.5% of the listed items in the shopping trolley. $\therefore \frac{87.5}{100} \times 96 = 84$

$\therefore$ There 84 of the listed items are in the shopping trolley.

10 0.57 of the pieces are left to complete the puzzle. $\therefore 0.57 \times 900 = 513$

$\therefore 513$ pieces still need to be placed to complete the jigsaw puzzle.

11 (i) The sled has $1 - 0.1\dot{5} = 0.8\dot{4}$ of the way down left to go.

(ii) $0.8\dot{4}$ of the way down the hill left. $\therefore 0.8\dot{4} \times 450 = 380$

Page 20 questions

Percentages of an amount

12 (i) $1 - \frac{1}{3} = \frac{2}{3} = 66.\dot{6}\%$

$\therefore 66.\dot{6}\%$ of the lightning strikes did not occur on the golf course.

(ii) $\frac{2}{3} \times 78 = 52$

$\therefore 52$ of the lightning strikes did not occur on the golf course.

13 $100\% - 83\frac{1}{3}\% = 16\frac{2}{3}\%$

$\therefore$ Number of surveys not returned $= \frac{16.\dot{6}}{100} \times 252 = 42$

$\therefore 42$ of the surveys posted out were not returned.

14 Total number of dots $= 6 + 5 + 4 + 3 + 2 + 1 = 21$

$100\% - 14\frac{2}{7}\% = 85\frac{5}{7}\%$

$\therefore$ Number of other non-centred dots $= \frac{85\frac{5}{7}}{100} \times 21 = 18$

$\therefore 18$ of the dots on a normal dice are not located at the centre of a side.

15 (i) $0.795\dot{3} \times 18 = 14.316$

$\therefore$ The water level is 14.3m from the top of the well accurate to 1 decimal place.

(ii) Water level $= 18 - 14.316 = 3.684\,\text{m}$

$\therefore$ The water level is $\frac{3.684}{18} \times 100 = 20\frac{7}{15}\%$ of the well is full.

$\therefore < 25\%$, so the water level indicates drought conditions.

Page 22 questions

One amount as a percentage of another

1 **a** $\frac{35}{50} \times 100\% = 70\%$

b $(3.2 \div 5) \times 100\% = 64\%$

2 **a** $(17 \div 22.5) \times 100\% = 75.\dot{5}\%$

$= 75\frac{5}{9}\%$

b $\left(\frac{1}{3} \div \frac{4}{5}\right) \times 100\% = 41.\dot{6}\%$

$= 41\frac{2}{3}\%$

3 **a** $(10.5 \div 83.4) \times 100\% = 12.58992806\ldots\%$

$\approx 12.59\%$ (to 2 d.p.)

b $(12.2\dot{5} \div 50) \times 100\% = 24.5\dot{1}\%$

$\approx 24.51\%$ (to 2 d.p.)

4 **a** $(15.3 \div 22.5) \times 100\% = 68\%$ — Pencil type: HB

b $(13.05 \div 22.5) \times 100\% = 58\%$ — Pencil type: 3H

c $(18.225 \div 22.5) \times 100\% = 81\%$ — Pencil type: 5B

d $(16.825 \div 22.5) \times 100\% = 75\%$ — Pencil type: 3B

5 $40 - 25 = 15$ vegetables do not get a nutritional report.

$\therefore (15 \div 40) \times 100\% = 37.5\%$

$\therefore 37.5\%$ of the vegetables do not get a nutritional report written about them.

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Page 23 questions

One amount as a percentage of another

6 $582 - 368 = 214$ birds wait for the first flock to leave.

$\therefore (214 \div 582) \times 100\% = 36.76975945\ldots\%$

$\therefore \approx 37\%$ of the migrating birds leave as part of the second flock.

7 a $(361130976 \div 510072000) \times 100\% = 70.8\%$

$\therefore 70.8\%$ of the Earth's surface is covered in salt water.

b 70.8% of $196\,935\,000$ square miles $= (70.8 \div 100) \times 196\,935\,000$

$= 139\,429\,980$ square miles

$\therefore 139\,429\,980$ square miles of the Earth's surface is covered in salt water.

8 First five minutes $= (980.24 \times 60 \times 5) = 294\,072$ hits.

$\therefore (294\,072 \div 1\,225\,300) \times 100\% = 24\%$

$\therefore 24\%$ of the hits occurred in the first five minutes.

9 Gallons left $= (125.75 - 70.8) = 54.95$ gallons remaining.

$\therefore (54.95 \div 125.75) \times 100\% = 43.67981312\ldots\%$

$\approx 43.70\%$ (to 2 d.p.)

$\therefore$ approximately 43.7% of the water remains in the tank.

Page 25 questions

Percentage change

1 **a** 10% increase = 100% [+] 10%

= [110] % of initial amount

∴ Increase of 10% = [1.1] × 25 = [27.5]

Decimal form

Other method:

Find 10% of 25 and add to 25

10% of 25 = [0.1] × 25

Decimal form

= [2.5]

∴ Increase of 10% = [2.5] + 25 = [27.5]

b 40% decrease = 100% [−] 40%

= [60] % of initial amount

∴ Decrease of 40% = [0.6] × 65 = [39]

Decimal form

Other method:

Find 40% of 65 and subtract from 65

40% of 65 = [0.4] × 65

Decimal form

= [26]

∴ Decrease of 40% = 65 − [26] = [39]

2 **a** A decrease of 30% = 100% − 30%

= 70% of original amount

∴ 70% of 50 = 0.70 × 50

= 35

b An increase of 25% = 100% + 25%

= 125% of original amount

∴ 125% of 76 = 1.25 × 76

= 95

c An increase of 5% = 100% + 5%

= 105% of original amount

∴ 105% of 6.2 = 1.05 × 6.2

= 6.51

Page 25 questions

Percentage change

2 **d** A reduction of $1.5\% = 100\% - 1.5\%$

$= 98.5\%$ of original amount

$\therefore 98.5\%$ of $8 = 0.985 \times 8$

$= 7.88$

e An increase of $33.\dot{3}\% = 100\% + 33.\dot{3}\%$

$= 133.\dot{3}\%$ of original amount

$\therefore 133.\dot{3}\%$ of $258 = 1.\dot{3} \times 258$

$= 344$

f An increase of $92\% = 100\% + 92\%$

$= 192\%$ of original amount

$\therefore 192\%$ of $12.8 = 1.92 \times 12.8$

$= 24.576$

3 **a** A decrease of $100\% = 100\% - 100\%$

$= 0\%$ of original amount

$\therefore 0\%$ of $50 = 0.00 \times 50$

$= 0$ cars

b No, because a decrease of more than 100% gives you a negative number of cars. Negative amounts of a physical quantity means you finish with less than zero cars, which is not possible.

Page 26 questions

Percentage change

4 **a** An increase of $100\% = 100\% + 100\%$

$= 200\%$ of original amount

$\therefore 200\%$ of $70 = 2.00 \times 70$

$= 140$

b An increase of 100% is the same as doubling. So an equivalent mathematical calculation is 2×70.

c An increase of $200\% = 100\% + 200\%$

$= 300\%$ of original amount

$\therefore 300\%$ of $70 = 3.00 \times 70$

$= 210$

d An increase of 200% is the same as tripling. So an equivalent mathematical calculation is 3×70.

e Let n be any positive counting number. An increase of $n \times 100\% = (n + 1) \times$ the original amount.

5 **a** An increase of $50\% = 100\% + 50\%$

$= 150\%$ of original amount

$\therefore 150\%$ of $\$20 = 1.50 \times \$20$

$= \$30$

b A decrease of $50\% = 100\% - 50\%$

$= 50\%$ of amount in part **a**

$\therefore 50\%$ of $\$30 = 0.50 \times \$30$

$= \$15$

c The increased amount is $\$30$ and the original amount is $\$20$, 50% of both values is different, so when decreasing the larger amount by a similar percentage, the actual amount it is reduced by is also larger.

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Page 26 questions

Percentage change

6 a An increase of $20\% = 100\% + 20\%$

$= 120\%$ of original amount

$\therefore 120\%$ of $80\text{m} = 1.20 \times 80\,\text{m}$

$= 96\,\text{m}$

A further increase of $25\% = 100\% + 25\%$

$= 125\%$ of new amount

$\therefore 125\%$ of $96\text{m} = 1.25 \times 96\,\text{m}$

$= 120\,\text{m}$

b No, because the whole 45% is calculated on the smaller initial value (increasing 80m by $45\% = 116\,\text{m}$). When split into two increases, the remaining 25% is calculated using a larger value, so therefore a larger increase.

Page 27 questions

Percentage change

7 a An increase of $33.\dot{3}\% = 100\% + 33.\dot{3}\%$

$= 133.\dot{3}\%$ of original amount

$\therefore 133.\dot{3}\%$ of $60 = 1.\dot{3} \times 60$

$= 80$

A further decrease of $20\% = 100\% - 20\%$

$= 80\%$ of new amount

$\therefore 80\%$ of $80 = 0.80 \times 80$

$= 64$

Page 27 questions

Percentage change

7 b A reduction of $25\% = 100\% - 25\%$

$= 75\%$ of original amount

$\therefore 75\%$ of $200 = 0.75 \times 200$

$= 150$

A further reduction of $70.5\% = 100\% - 70.5\%$

$= 29.5\%$ of new amount

$\therefore 29.5\%$ of $150 = 0.295 \times 150$

$= 44.25$

c A decrease of $12\% = 100\% - 12\%$

$= 88\%$ of original amount

$\therefore 88\%$ of $\$55 = 0.88 \times \$55$

$= \$48.40$

A further increase of $16\% = 100\% + 16\%$

$= 116\%$ of new amount

$\therefore 116\%$ of $\$48.40 = 1.16 \times \$48.40$

$= \$56.14$

d An inflation of $5.25\% = 100\% + 5.25\%$

$= 105.25\%$ of original amount

$\therefore 105.25\%$ of $\$90 = 1.0525 \times \$90$

$= \$94.725$

A further reduction of $0.6\% = 100\% - 0.6\%$

$= 99.4\%$ of new amount

$\therefore 99.4\%$ of $\$94.725 = 0.994 \times \$94.725$

$= \$94.16$

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Page 27 questions

Percentage change

8 **a**

An increase of $45\% = 100\% + 45\%$

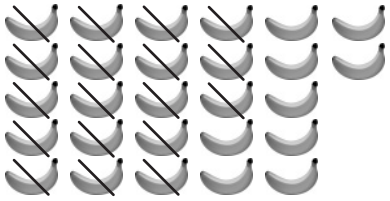
$= 145\%$ of original amount

$\therefore 145\%$ of $20 = 1.45 \times 20$

$= 29$ triangles

$\therefore$ need to add 9 same-sized triangles to the diagram.

b



A reduction of $66.\dot{6}\% = 100\% - 66.\dot{6}\%$

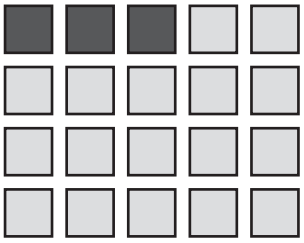
$= 33.\dot{3}\%$ of original amount

$\therefore 33.\dot{3}\%$ of $27 = 0.\dot{3} \times 27$

$= 9$ bananas

$\therefore$ need cross off 18 bananas to leave only 9.

c



60% of 20 squares $= 0.6 \times 20$

$= 12$ shaded

A decrease of $75\% = 100\% - 75\%$

$= 25\%$ of 12 squares

$\therefore 25\%$ of $12 = 0.25 \times 12$

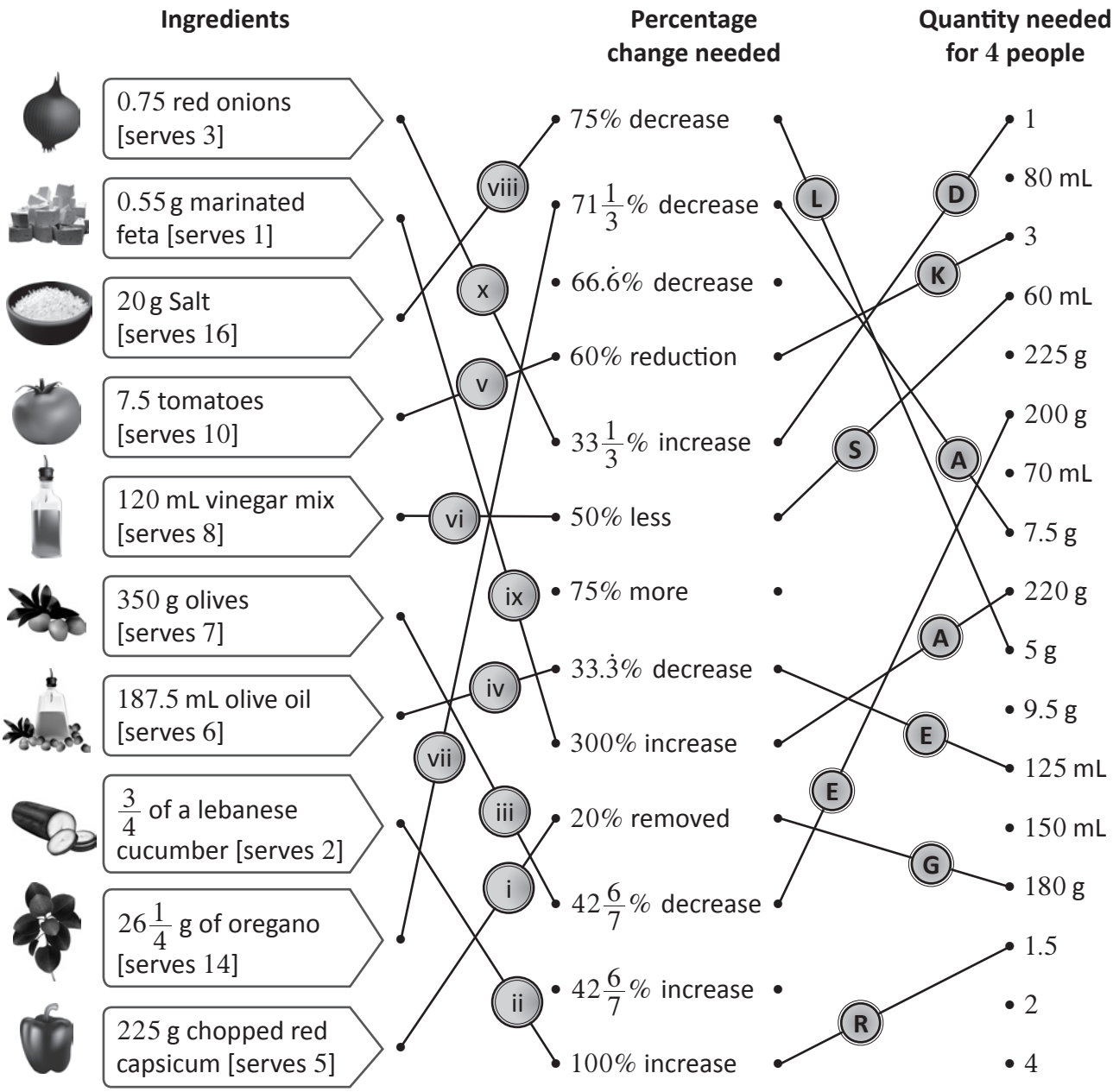
$= 3$ squares

$\therefore$ only 3 squares remain shaded.

Page 28 questions

Percentage change

9



G	R	E	E	K
(i)	(ii)	(iii)	(iv)	(v)

S	A	L	A	D
(vi)	(vii)	(viii)	(ix)	(x)

Page 30 questions

Unitary method

1 **a** 25% of the amount = 40

$\therefore$ 1% of the amount = 40 ÷ 25

= 1.6

$\therefore$ 100% of the amount = 1.6 × 100

= 160

b 112% of the amount = 84

$\therefore$ 1% of the amount = 84 ÷ 112

= 0.75

$\therefore$ 100% of the amount = 0.75 × 100

= 75

2 **a** $55\% = 220$

$\therefore 1\% = 220 \div 55$

$= 4$

$\therefore 100\% = 4 \times 100$

$= 400$

b $325\% = 487.5$

$\therefore 1\% = 487.5 \div 325$

$= 1.5$

$\therefore 100\% = 1.5 \times 100$

$= 150$

c $34.2\% = 282.15$

$\therefore 1\% = 282.15 \div 34.2$

$= 8.25$

$\therefore 100\% = 8.25 \times 100$

$= 825$

d $115\frac{3}{8}\% = 1269\frac{1}{8}$

$\therefore 1\% = 1269\frac{1}{8} \div 115\frac{3}{8}$

$= 11$

$\therefore 100\% = 11 \times 100$

$= 1100$

e $286\% = 16\,094$

$\therefore 1\% = 16\,094 \div 286$

$= 56.\dot{2}\dot{7}$

$\therefore 100\% = 56.\dot{2}\dot{7} \times 100$

$= 5627.\dot{2}\dot{7}$

f $14\frac{2}{3}\% = 7.1\dot{6}$

$\therefore 1\% = 7.1\dot{6} \div 14\frac{2}{3}$

$= 0.488636363$

$= 0.4886\dot{3}\dot{6}...$

$\therefore 100\% = 0.488\,6\dot{3}\dot{6} \times 100$

$= 48.8\,6\dot{3}\dot{6}$

Page 31 questions

Unitary method

3 **a** $65\% = 390$

$\therefore 1\% = 390 \div 65$

$= 6$

$\therefore 32\% = 6 \times 32$

$= 192$ units

b $12\% = 46\text{g}$

$\therefore 1\% = 46 \div 12$

$= 3.8\dot{3}\text{g}$

$\therefore 30\% = 3.8\dot{3} \times 30$

$= 115\text{g}$

c $110\% = 5\text{kg}$

$\therefore 1\% = 5 \div 110$

$= 0.0\dot{4}\dot{5}\text{kg}$

$\therefore 44\% = 0.0\dot{4}\dot{5} \times 44$

$= 2\text{kg}$

d $290\% = 4096$

$\therefore 1\% = 4096 \div 290$

$= 14.12413793\ldots$

$\therefore 72.5\% = 14.124137\,93 \times 72.5$

$= 1024$ amoeba

4 **a** $35\% = 56\text{kg}$

$\therefore 1\% = 56 \div 35$

$= 1.6$

$\therefore 100\% = 1.6 \times 100$

$= 160\text{kg}$

b $87.5\% = 8575$ termites

$\therefore 1\% = 8575 \div 87.5$

$= 98$ termites

$\therefore 11.5\% = 11.5 \times 98$

$= 1127$ soldier termites

c $\frac{2}{5} \times 41\,250 = 16\,500$ people

$60\% = 16\,500$ people

$\therefore 1\% = 16\,500 \div 60$

$= 275$ people

$\therefore 100\% = 275 \times 100$

$= 27\,500$ people

Page 32 questions

Unitary method

5 a $\frac{100}{35} \times 16 = 45.71428571\ldots$

$= 45.71$ (to 2 d.p.)

b $\frac{100}{450} \times 96 = 21.\dot{3}$

$= 21.33$ (to 2 d.p.)

c $\frac{45}{71} \times 121 = 76.69014085\ldots$

$= 76.69$ (to 2 d.p.)

d $\frac{50}{128} \times 245.8 = 96.015625\ldots$

$= 96.02$ (to 2 d.p.)

e $\frac{140}{30} \times \frac{5}{8} = 2.91\dot{6}$

$= 2.92$ (to 2 d.p.)

f $\frac{10\frac{3}{7}}{5\frac{1}{3}} \times 2130 = 4164.910714\ldots$

$= 4164.91$ seconds (to 2 d.p.)

6 a $\frac{70}{2.5} \times 8 = 224$

b $\frac{70}{2.5} \times 7 = 196$

c $\frac{70}{2.5} \times 3.5 = 98$

Page 34 questions

Profit and loss

1 a Cost price = \$25
Sale price = \$22

$\therefore$ \$3 ☐ Profit ☒ Loss

b Cost price = \$45.00
Sale price = \$63.50

$\therefore$ \$18.50 ☒ Profit ☐ Loss

c Cost price = \$104.25
Sale price = \$140.75

$\therefore$ \$36.50 ☒ Profit ☐ Loss

2 a Cost price = \$18.00
Sale price = \$22.50 → \$4.50 ☒ Profit ☐ Loss

$\therefore$ (\$4.50 ÷ \$18.00) × 100%

= 25 % ☒ Profit of the cost price ☐ Loss of the cost price

b Cost price = \$5.20
Sale price = \$4.16 → \$1.04 ☐ Profit ☒ Loss

$\therefore$ (\$1.04 ÷ \$5.20) × 100%

= 20 % ☐ Profit of the cost price ☒ Loss of the cost price

Page 34 questions

Profit and loss

3 **a** Cost price = \$34.56
Sale price = \$25.60
→ \$8.96 ☐ Profit ☒ Loss

$\therefore \left(\$8.96 \div \$25.60 \right) \times 100\%$

$\approx$ 35 % ☐ Profit of the sale price ☒ Loss of the sale price

b Cost price = \$49.66
Sale price = \$124.15
→ \$74.49 ☒ Profit ☐ Loss

$\therefore \left(\$12.76 \div \$124.15 \right) \times 100\%$

$\approx$ 60 % ☒ Profit of the sale price ☐ Loss of the sale price

4 **a** Cost price = \$20.50
Sale price = \$11.45
→ \$9.05 ☐ Profit ☒ Loss

= 44.1 % ☐ Profit of the cost price ☒ Loss of the cost price

= 79.0 % ☐ Profit of the cost price ☒ Loss of the cost price

b Cost price = \$59.40
Sale price = \$84.95
→ \$25.55 ☒ Profit ☐ Loss

= 43.0 % ☒ Profit of the cost price ☐ Loss of the cost price

= 30.1 % ☒ Profit of the cost price ☐ Loss of the cost price

Page 35 questions

Profit and loss

5 **a** \$24 marked up $25\% = 1.25 \times \$24$
$= \$30$
Marked price = \$ 30.00

b \$32.50 marked up $46\% = 1.46 \times \$32.50$
$= \$47.45$
Marked price = \$ 47.45

c \$230 marked up $12.5\% = 1.125 \times \$230$
$= \$258.75$
Marked price = \$ 258.75

6 **a** 40% discount on $\$157 = 0.60 \times \$157$
$= \$94.20$
Discounted price = \$ 94.20

b 40% discount on $\$78.50 = 0.60 \times \$78.50$
$= \$47.10$
Discounted price = \$ 47.10

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Page 35 questions

Profit and loss

7 **a** $\$210$ marked up $50\% = 1.50 \times \$210$
$= \$315$

5 tables sold for $\$315$ = total sales of $\$1575$.
5 tables cost at $\$210$ each = $\$1050$.
Therefore, profit = $\$1575 - \$1050$
$= \$525$ profit.

b Profit as a percentage of the cost price:
$= (\$525 \div \$1050) \times 100\%$
$= 50\%$ profit.

Or simply, since the markup was 50% on all of them and they were sold at this price, then the profit is 50%!

c Discount of $40\% = 0.60 \times \$315$
$= \$189$

d Total sales of the tables:
$= 5 \times \$315 + 5 \times \$189$
$= \$2520$

Total cost of the tables was $10 \times \$210 = \$2100$
Sale price $>$ Cost price, so in profit
$\therefore$ Profit $= \$2520 - \$2100 = \$420$

Page 36 questions

Profit and loss

8 **a** Percentage discount = 30%

Discount of 30% = 70% of original value
$\therefore 70\% = \$3150$
$\therefore 1\% = \$3150 \div 70$
$= \$45$
$\therefore 100\% = \$45 \times 100$
$= \$4500$
$\therefore$ Marked price = $\$4500$

b Percentage discount = 70%

Discount of 70% = 30% of original value
$\therefore 30\% = \$55.80$
$\therefore 1\% = \$55.80 \div 30$
$= \$1.86$
$\therefore 100\% = \$1.86 \times 100$
$= \$186$
$\therefore$ Marked price = $\$186$

Page 36 questions

Profit and loss

8 **c** Percentage discount = 50%

Discount of $50\% = 50\%$ of original value

$\therefore 50\% = \$97.50$

$\therefore 1\% = \$97.50 \div 50$

$= \$1.95$

$\therefore 100\% = \$1.95 \times 100$

$= \$195$

$\therefore$ Marked price = $195.00

d Percentage discount = 20%

Discount of $20\% = 80\%$ of original value

$\therefore 80\% = \$455.60$

$\therefore 1\% = \$455.60 \div 80$

$= \$5.695$

$\therefore 100\% = \$5.695 \times 100$

$= \$569.50$

$\therefore$ Marked price = $569.50

9 Markup of $20\% = 1.2 \times \$40$

$= \$48.00$

A following discount of $15\% = 0.85 \times \$48.00$

$= \$40.80$

$\therefore$ sale price $= \$40.80$, so the retailer made a profit of $\$0.80$.

Page 37 questions

Profit and loss

10 **a** Markup of $38\% = 1.38 \times \$200$

$= \$276.00$

$\therefore$ marked price $= \$276.00$

b Discount $= \$76$

$\therefore$ Percentage discount $= (\$76 \div \$276) \times 100\%$

$\approx 27.5\%$ (to 1 d.p.)

11 **a** Cost price $= 1.125 \times \$890$

$= \$1001.25$

$\therefore \$1001.25 - \$890$

$= \$111.25$ loss on the sale

b Labelled price $= 1.2 \times \$1001.25$

$= \$1201.50$

c Discount $= \$1201.50 - \$890$

$= \$311.50$

$\therefore (\$311.50 \div \$1001.25) \times 100\%$

$= 31.1\%$ (to 1 d.p.)

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Page 37 questions

Profit and loss

12 **a** Marked price $= 1.36\dot{3} \times \$72.50$

$= \$98.84\dot{1}6$

$= \$98.84$ (to 2 d.p.)

b Minimum sale price $= 1.1725 \times \$72.50$

$= \$85.00625$

$= \$85$ (nearest whole dollar)

c Minimum discount $= (\$98.84 - \$85)$

$= \$13.84$

Maximum percentage discount $= (\$13.84 \div \$98.84) \times 100\% = 14.002\,42817 \approx 14\%$

Page 38 questions

More applications of percentage calculations

1 **a** Protein per $100\text{g} = 8.0\,\text{g}$

$\therefore 8\%$ protein

b Protein recommended $= (70 \times 0.8)$

$= 56\,\text{g}$

c $56\text{g} \div 0.4\text{g} = 140$ servings!

d $140 \times 3.8\text{g} = 532\,\text{g}$

e For Protein, minimum daily requirement should account for 32%.

$\therefore 32\% = 56\text{g}$

$= 56\text{g}$

$\therefore$ recommended amount of Carbohydrates eaten $= \frac{50}{32} \times 56\text{g} = 87.5\,\text{g}$

This is not a healthy option as it means the person consumes approximately 6 times the recommended daily intake of carbohydrates.

2 $24\frac{3}{4}\% = 145$ days

$\therefore 1\% = 145 \div 24.6$ days

$= 5.894308943$ days

$\therefore 200\% = 5.894308943 \times 200$ days

$= 1178.861789\ldots$ days

≈ 1179 days

Page 39 questions

More applications of percentage calculations

3 **a** Tree height after 1 year $= 1.2025 \times 14\,\text{m}$

$= 16.835\,\text{m}$

b Tree height after 2 years $= 1.2025 \times 16.835\,\text{m}$

$= 20.2440875\,\text{m}$

$\therefore 20.2440875 - 16.835 = 3.4090875\,\text{m}$

$\approx 3.41\,\text{m}$ (to 2 d.p.)

c Percentage growth after 2 years $= (3.41 \div 14) \times 100\%$

$= 24.357\,142\,86$

$= 24.4\%$ (to 1 d.p.)

d Total growth 3 years from now $= 1.2025 \times 20.2440875\,\text{m}$

$= 24.34351522\,\text{m}$

$< 25\,\text{m}$ so no, the tree will not be cut down in 3 years time.

e The tree height is increasing each year, so 20.25% of the height is also increasing, so after four years it is more than a 100% increase, even though $4 \times 20.25\%$ only $= 81\%$.

4 Intially $50\,\text{m}$

After first burst of hot air, height above ground $= 1.31 \times 50 = 65.5\,\text{m}$

After a further 20 minutes, height above ground $= 65.5\text{m} - 17\text{m} = 48.5\,\text{m}$

After second burst of hot air, height above ground $= 1.288\dot{3} \times 48.5 = 62.48416667\ldots\text{m}$

$\therefore$ Overall change in height $= 62.48416667 - 50 = 12.48\,\text{m}$ (to 2 d.p.)

$\therefore$ Overall percentage change $= (12.48 \div 50) \times 100\% = 25\%$ (nearest whole percentage)

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