



**MATHS QUEST** **8**  
for the Australian  
Curriculum

## 2

# Integers

- 2A Adding and subtracting integers
- 2B Multiplying integers
- 2C Dividing integers
- 2D Combined operations on integers

**WHAT DO YOU KNOW?**

- 1 List what you know about positive and negative integers. Create a concept map to show your list.
- 2 Share what you know with a partner and then with a small group.
- 3 As a class, create a large concept map that shows your class's knowledge of positive and negative integers.

**eBookplus****Digital doc**

Hungry brain activity  
Chapter 2  
doc-6386

**OPENING QUESTION**

A dolphin can leap up to 5 metres above the surface of the water. If a particular dolphin was swimming at a depth of  $-2.7$  metres, how many metres would the dolphin need to travel vertically to reach the maximum distance above the surface?

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**Digital doc**  
SkillSHEET 2.1  
doc-6387

- a 7                      b 4                      c 0

- c** 4 units away from 6.

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**Digital doc**  
SkillSHEET 2.2  
doc-6388

- c**  $65 + 518 + 2361$

eBook *plus*

**Digital doc**  
SkillsSHEET 2.3  
doc-6389

- b** descending order.

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**Digital doc**  
SkillsHEET 2.4  
doc-6390

- b** long multiplication.

## eBookplus

**Digital doc**  
SkillSHEET 2.5  
doc-6391

- c**  $21 \div 7$

## eBookplus

**Digital doc**  
SkillSHEET 2.6  
doc-6392

- f**  $(8 - 3)^2 + 8^2 - 3^2$

## 2A Adding and subtracting integers

### Integers

- Integers are positive whole numbers, negative whole numbers and zero.
- The group of integers is often referred to as the set  $Z$ .
- $Z = \{\dots -4, -3, -2, -1, 0, 1, 2, 3, 4, \dots\}$

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eLesson  
Directed  
numbers  
eles-0040

### Addition of integers

- A number line can be used to add integers.
- To add a positive integer, move to the right.
- To add a negative integer, move to the left.

#### WORKED EXAMPLE 1

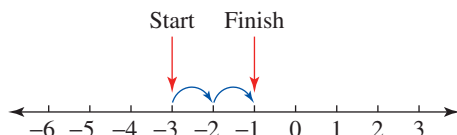
Calculate the value of each of the following.

a  $-3 + +2$

b  $-3 + -2$

#### THINK

- a 1 Start at  $-3$  and move 2 units to the right, as this is the addition of a positive integer.



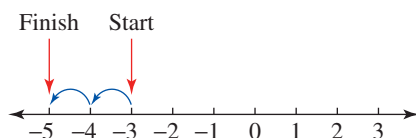
- 2 Write the answer.

#### WRITE

a  $-3 + +2$

$3 + +2 = -1$

- b 1 Start at  $-3$  and move 2 units to the left, as this is the addition of a negative integer.



- 2 Write the answer.

b  $-3 + -2$

$-3 + -2 = -5$

### Subtraction of integers

- Subtracting an integer gives the same result as adding its opposite.  
For example,  $-3 - 5 = -3 - +5 = -3 + -5 = -8$ .  
Note that  $+5$  and  $-5$  are opposites.
- By developing and extending a pattern, we can show that subtracting a negative has the same effect as adding a positive. Look at the pattern shown at right.  
It can be seen from the table that subtracting a negative is the same as adding its inverse. For example,  $8 - -4 = 8 + +4 = 12$ .

$8 - 3 =$	5
$8 - 2 =$	6
$8 - 1 =$	7
$8 - 0 =$	8
$8 - -1 =$	9
$8 - -2 =$	10
$8 - -3 =$	11

- In mathematics, a number without a positive or negative sign is considered to be positive. So  $8 + +4$  can be written as  $8 + 4$  and  $-5 - +1$  can be written as  $-5 - 1$ .

**WORKED EXAMPLE 2**

Calculate the value of each of the following.

**a**  $-7 - +1$

**b**  $-2 - -3$

**THINK**

- a**
- 1 Subtracting an integer gives the same result as adding its opposite.
  - 2 Using a number line, start at  $-7$  and move 1 unit to the left.
  - 3 Write the answer.
- b**
- 1 Subtracting an integer gives the same result as adding its opposite.
  - 2 Using a number line, start at  $-2$  and move 3 units to the right.
  - 3 Write the answer.

**WRITE**

**a**  $-7 - +1$

$$= -7 + -1$$

$$= -8$$

**b**  $-2 - -3$

$$= -2 + +3$$

$$= +1$$

**REMEMBER**

1. Integers are positive whole numbers, negative whole numbers and zero.
2. A number line can be used to add integers.
  - (a) To add a positive integer, move to the right.
  - (b) To add a negative integer, move to the left.
3. Subtracting an integer gives the same result as adding its opposite.  
For example,  $-3 - 5 = -3 - +5 = -3 + -5 = -8$ .
4. Opposite numbers are those with opposite signs. For example,  $+5$  and  $-5$  are opposites.
5. By developing and extending a pattern, we can show that subtracting a negative has the same effect as adding a positive.
6. In mathematics, a number without a positive or negative sign is considered to be positive.

**EXERCISE**
**2A Adding and subtracting integers**
**FLUENCY**

- 1 Which of the following numbers are integers?  
 $3, \frac{1}{2}, -4, 201, 20.1, -4.5, -62, -3\frac{2}{5}$
- 2 Copy and complete the following addition and subtraction number patterns by placing the correct integers in the boxes.
 

<p><b>a</b> <math>6, 4, 2, \square, \square, \square</math></p> <p><b>c</b> <math>\square, \square, \square, -1, -3, -5</math></p>	<p><b>b</b> <math>-5, -10, -15, \square, \square, \square</math></p> <p><b>d</b> <math>\square, \square, \square, -2, 0, 2</math></p>
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INDIVIDUAL  
PATHWAYS

eBookplus

## Activity 2-A-1

 The Game of  
Pirates — standard  
doc-6394

## Activity 2-A-2

 The Game of  
Pirates — variation 1  
doc-6395

## Activity 2-A-3

 The Game of  
Pirates — variation 2  
doc-6396

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## Interactivity

 Directed  
number target  
int-0074

 3 **WE1** Calculate the value of each of the following.

a  $-3 + 2$

b  $-7 + -3$

c  $6 + -7$

d  $-8 + -5$

e  $13 + +6$

f  $12 + -5$

g  $-25 + +10$

h  $16 + -16$

 4 **WE2** Calculate the value of each of the following.

a  $7 + -2$

b  $-18 + -6$

c  $3 + -8$

d  $11 + -6$

e  $17 + -9$

f  $-28 + -12$

g  $14 + -8$

h  $-17 + -28$

5 Calculate the value of each of the following.

a  $-3 + -5$

b  $6 + -5$

c  $-17 + +3$

d  $-14 + -13$

e  $28 + -23$

f  $-48 + -3$

g  $-57 + -18$

h  $-32 + -40$

6 Simplify the following.

a  $-4 + -3$

b  $-6 + +3$

c  $5 + -2$

d  $17 + -5$

e  $-13 + -3$

f  $10 + -3$

g  $-26 + -14$

h  $25 + -7$

i  $32 + -5$

j  $-16 + +18$

k  $-26 + -15$

l  $124 + -26$

m  $-3 + -4 + -6$

n  $27 + -5 + -3$

o  $-10 + +3 + -6$

p  $23 + -15 + -14$

q  $15 + -4 + -10$

r  $-37 + -5 + -10$

## UNDERSTANDING

7 Copy and complete the following tables. For the subtraction table, subtract the number on the side from the number at the top.

a	+	-8	+25	-18	32
-6		$-8 + -6 = -14$			
-13					
-16					
-19					

b	-	+15	-17	-27	57
+7		$+15 + -7 = 8$			
-6					
-9					
+12					

c	+	-11		13	
		-16			
+17			36		
			18	12	
-28					-35

d	-	+9			42
		-17			
-14				-1	
			23		
+23			-2		

8 Design your own addition and subtraction of integers tables like those in question 7. Fill in all answers in your tables.

- 9 In a kitchen, some food is stored at  $-18^{\circ}\text{C}$  in a freezer and some at  $4^{\circ}\text{C}$  in the fridge. A roast is cooking in the oven at a temperature of  $180^{\circ}\text{C}$ .

Before answering each of the following questions, draw a number line to show the positions of the temperatures.

- What is the difference in temperature between the food stored in the freezer and the food stored in the fridge?  
(Hint: Difference = largest value – smallest value)
- What is the difference in temperature between the food stored in the fridge and the roast cooking in the oven?
- What is the difference in temperature between the food stored in the freezer and the roast cooking in the oven?



- 10 Calculate the difference between the two extreme temperatures recorded at Mawson Station in Antarctica in recent times.



- 11 Locate the button on your calculator that allows you to enter negative numbers. Use it to answer the following.
- $-458 + 157$
  - $-5487 - 476$
  - $-248 - -658 - -120$
  - $-42 + 57 - -68 + -11$
- 12 Write out these equations, filling in the missing numbers.
- $-7 + \square = 6$
  - $8 - \square = 12$
  - $-15 - \square = -26$
  - $42 - \square + -17 = 35$
  - $-7 - \square - -31 = -28$
  - $\square - 13 + 21 = 79$



- 13** The following is a homework sheet done by a student in Year 8. Correct her work for her and give her a mark out of six. Make sure you include the correct answer if her answer is wrong.

- a**  $-3 + -7 = -10$   
**b**  $-4 - -10 = -6$   
**c**  $-7 - 8 = 15$   
**d**  $9 - -8 + -7 = 10$   
**e**  $42 + 7 - -11 = 60$   
**f**  $-17 + 4 - 8 = 23$



### REASONING

- 14** Evaluate and compare the following pairs of expressions.  
**a**  $-4 + 1$  and  $+1 - 4$   
**b**  $-7 + 5$  and  $+5 - 7$   
**c**  $-8 + 3$  and  $+3 - 8$
- 15** What did you notice about the answers in question **14**? Use a number line to help you explain why this is the case.
- 16** Evaluate and compare the following pairs of expressions.  
**a**  $-2 + -5$  and  $-(2 + 5)$   
**b**  $-3 + -8$  and  $-(3 + 8)$   
**c**  $-7 + -6$  and  $-(7 + 6)$
- 17** What did you notice about the answers in question **16**? Explain why this is the case.

### REFLECTION

What strategy will you use to remember how to add and subtract integers?

## 2B Multiplying integers

- Patterns in the answers in multiplication tables can be used to determine the product when two directed numbers are multiplied. Consider the following patterns.

$3 \times 3 = 9$	$-3 \times 3 = -9$
$3 \times 2 = 6$	$-3 \times 2 = -6$
$3 \times 1 = 3$	$-3 \times 1 = -3$
$3 \times 0 = 0$	$-3 \times 0 = 0$
$3 \times -1 = -3$	$-3 \times -1 = 3$
$3 \times -2 = -6$	$-3 \times -2 = 6$
$3 \times -3 = -9$	$-3 \times -3 = 9$
Answers go down by 3.	Answers go up by 3.

- When multiplying two directed numbers:
- if their signs are the same, the answer is positive
  - if their signs are different, the answer is negative.

$+\times+=+$	$+\times-=-$
$-\times- = +$	$-\times+=-$



**WORKED EXAMPLE 3**

Evaluate each of the following.

**a**  $-3 \times +7$

**b**  $-8 \times -7$

**THINK**

- a** The two numbers have different signs, so the answer is negative ( $7 \times 3 = 21$ ).
- b** The two numbers have the same signs, so the answer is positive ( $8 \times 7 = 56$ ).

**WRITE**

**a**  $-3 \times +7$   
 $= -21$

**b**  $-8 \times -7$   
 $= 56$  (or  $+56$ )

## Powers and square roots of directed numbers

- Calculating powers of negative numbers uses the same process as calculating powers of positive numbers.
- There are two possible answers when you take the square root of a number. For example:

$$\begin{array}{lcl} 4^2 = 4 \times 4 & & (-4)^2 = (-4) \times (-4) \\ = 16 & & = 16 \end{array}$$

Therefore when asked to take the square root of 16, the answer could be  $\pm\sqrt{16}$ .  
 $\pm\sqrt{16} = -4$  or  $+4$ , which can also be written as  $\pm 4$  (positive or negative 4).

**WORKED EXAMPLE 4**

Evaluate each of the following.

**a**  $(-5)^3$

**b** The square root of 64

**THINK**

- a** **1** Write the question in expanded form.
- 2** Evaluate by working from left to right beginning with  $-5 \times -5 = +25$ .
- b** Look for the numbers that, when squared, result in 64 ( $8 \times 8 = 64$  and  $-8 \times -8 = 64$ ).

**WRITE**

**a**  $(-5)^3 = (-5) \times (-5) \times (-5)$   
 $= +25 \times (-5)$   
 $= -125$

**b**  $\pm\sqrt{64} = +8$  or  $-8$   
 $= \pm 8$

**REMEMBER**

- When multiplying two directed numbers:
  - if their signs are the same, the answer is positive
  - if their signs are different, the answer is negative.
- Calculating powers of negative numbers uses the same process as calculating powers of positive numbers.
- There are two possible answers when you take the square root of a number: a positive answer and a negative answer.

## EXERCISE

# 2B Multiplying integers

## INDIVIDUAL PATHWAYS

## eBookplus

**Activity 2-B-1**

 Integer multiplication  
doc-6397

**Activity 2-B-2**

 More integer  
multiplication  
doc-6398

**Activity 2-B-3**

 Advanced integer  
multiplication  
doc-6399

## FLUENCY

- 1 Copy and complete the following tables.

$4 \times 4 =$ _____	$-5 \times 4 =$ _____	$-6 \times -4 =$ _____
$4 \times 3 =$ _____	$-5 \times 3 =$ _____	$-6 \times -3 =$ _____
$4 \times 2 =$ _____	$-5 \times 2 =$ _____	$-6 \times -2 =$ _____
$4 \times 1 =$ _____	$-5 \times 1 =$ _____	$-6 \times -1 =$ _____
$4 \times 0 =$ _____	$-5 \times 0 =$ _____	$-6 \times 0 =$ _____
$4 \times -1 =$ _____	$-5 \times -1 =$ _____	$-6 \times 1 =$ _____
$4 \times -2 =$ _____	$-5 \times -2 =$ _____	$-6 \times 2 =$ _____
$4 \times -3 =$ _____	$-5 \times -3 =$ _____	$-6 \times 3 =$ _____
$4 \times -4 =$ _____	$-5 \times -4 =$ _____	$-6 \times 4 =$ _____

- 2 **WE3** Evaluate each of the following.

<b>a</b> $-2 \times 5$	<b>b</b> $3 \times -8$	<b>c</b> $-6 \times -7$
<b>d</b> $2 \times -13$	<b>e</b> $-8 \times -6$	<b>f</b> $-7 \times 6$
<b>g</b> $-10 \times 75$	<b>h</b> $-115 \times -10$	<b>i</b> $-7 \times 9$
<b>j</b> $+9 \times -8$	<b>k</b> $-11 \times -5$	<b>l</b> $150 \times -2$

- 3 Use an appropriate method to evaluate the following.

<b>a</b> $-2 \times 5 \times -8 \times -10$	<b>b</b> $8 \times -1 \times 7 \times -2 \times 1$
<b>c</b> $8 \times -4 \times -1 \times -1 \times 6$	<b>d</b> $-3 \times -7 \times -2 \times -1 \times -1 \times -1$
<b>e</b> $-5 \times -8 \times -2 \times -2$	

- 4 Complete the following equations.

<b>a</b> $7 \times \underline{\hspace{1cm}} = -63$	<b>b</b> $-3 \times \underline{\hspace{1cm}} = 21$	<b>c</b> $16 \times \underline{\hspace{1cm}} = -32$
<b>d</b> $\underline{\hspace{1cm}} \times -3 = 36$	<b>e</b> $\underline{\hspace{1cm}} \times 7 = -42$	<b>f</b> $\underline{\hspace{1cm}} \times -9 = -72$
<b>g</b> $\underline{\hspace{1cm}} \times -4 = 80$	<b>h</b> $-10 \times \underline{\hspace{1cm}} = 60$	<b>i</b> $-11 \times \underline{\hspace{1cm}} = 121$

- 5 **WE4a** Evaluate each of the following.

<b>a</b> $(-2)^3$	<b>b</b> $(-3)^2$	<b>c</b> $(-2)^4$	<b>d</b> $(-3)^4$
<b>e</b> $(-2)^5$	<b>f</b> $(-4)^2$	<b>g</b> $(-5)^3$	<b>h</b> $(-4)^4$
<b>i</b> $(-5)^4$	<b>j</b> $(-6)^3$		

- 6 Use your answers to question 5 to help complete the following statements.

- a** If a negative number is raised to an even power the answer is (positive/negative).  
**b** If a negative number is raised to an odd power the answer is (positive/negative).

- 7 **WE4b** Evaluate the square root of the following numbers.

<b>a</b> 25	<b>b</b> 81	<b>c</b> 49	<b>d</b> 121	<b>e</b> 100
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- 8 If  $a = -2$ ,  $b = -6$ ,  $c = 4$  and  $d = -3$ , calculate the values of the following expressions.

<b>a</b> $a \times b \times c$	<b>b</b> $a \times -b \times -d$	<b>c</b> $b \times -c \times -d$
<b>d</b> $c \times -a \times -a$	<b>e</b> $d \times -(-c)$	<b>f</b> $a \times d \times b \times c^2$

## UNDERSTANDING

- 9 For each of the following, write three possible sets of integers that can be placed in the boxes to make the equation a true statement.

- a**  $\square \times \square \times \square = -12$   
**b**  $\square \times \square \times \square = 36$   
**c**  $\square \times \square \times \square \times \square = -36$

- 10 For each of the following, determine whether the result is a positive or negative value. You do not have to work out the value.

- a**  $-25 \times 54 \times -47$       **b**  $-56 \times -120 \times -145$       **c**  $-a \times -b \times -c \times -d \times -e$

- 11 What happens when a number is multiplied by  $-1$ ? Use some examples to illustrate your answer.

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 Digital doc  
WorkSHEET 2.1  
doc-6400

12 The notation  $-(-3)$  is a short way of writing  $-1 \times -3$ . Write the expression represented by each of the following and then use an appropriate method to determine the answer.

- a  $-(-2)$                       b  $-(+3)$   
 c  $-(-5)$                       d  $-(-(+5))$   
 e  $-(-(-7))$                   f  $-(-(+4))$

## REFLECTION

Can we find square roots, cube roots, fourth roots and so on for negative numbers?

## 2C Dividing integers

- Division is the inverse operation of multiplication. We can use the multiplication facts for directed numbers to discover the division facts for directed numbers.

Multiplication fact	Division fact	Pattern
$2 \times 3 = 6$	$6 \div 3 = 2$ or $\frac{6}{3} = 2$ and $6 \div 2 = 3$ or $\frac{6}{2} = 3$	$\frac{\text{positive}}{\text{positive}} = \text{positive}$
$-2 \times -3 = 6$	$6 \div -3 = -2$ or $\frac{6}{-3} = -2$ and $6 \div -2 = -3$ or $\frac{6}{-2} = -3$	$\frac{\text{positive}}{\text{negative}} = \text{negative}$
$-2 \times 3 = -6$	$-6 \div 3 = -2$ or $\frac{-6}{3} = -2$ and $-6 \div -2 = 3$ or $\frac{-6}{-2} = 3$	$\frac{\text{negative}}{\text{positive}} = \text{negative}$ and $\frac{\text{negative}}{\text{negative}} = \text{positive}$

- When dividing two directed numbers:
- if their signs are the same, the answer is positive
  - if their signs are different, the answer is negative.
- Remember that division statements can be written as fractions and then simplified.

For example,

$$\begin{aligned}
 -12 \div -4 &= \frac{-12}{-4} \\
 &= \frac{12 \times -1}{4 \times -1} \\
 &= 3
 \end{aligned}$$

$\frac{+}{+} = +$	$\frac{+}{-} = -$
$\frac{-}{-} = +$	$\frac{-}{+} = -$

### WORKED EXAMPLE 5

Evaluate each of the following.

a  $-56 \div 8$

b  $\frac{-36}{-9}$

## THINK

- a The two numbers have different signs, so the answer is negative ( $56 \div 8 = 7$ ).
- b Cancel the common factors  $(-1)$ . The two numbers have the same signs, so the answer is positive.

## WRITE

a  $-56 \div 8$   
 $= -7$   
 b  $\frac{-36}{-9} = \frac{-1 \times 36}{-1 \times 9}$   
 $= \frac{36}{9}$   
 $= 4$

## WORKED EXAMPLE 6

Evaluate the following.

a  $234 \div -6$

b  $-182 \div -14$

## THINK

- a 1 Complete the division as if both numbers were positive numbers.
- 2 Determine the sign of the answer. A positive number divided by a negative number is a negative number.
- b 1 Complete the division as if both numbers were positive numbers.
- 2 Determine the sign of the answer. A negative number divided by a negative number is a positive number.

## WRITE

a 
$$\begin{array}{r} 39 \\ 6 \overline{)234} \end{array}$$

$$234 \div -6 = -39$$

b 
$$\begin{array}{r} 13 \\ 14 \overline{)182} \\ \underline{14} \phantom{0} \\ 42 \\ \underline{42} \\ 0 \end{array}$$

$$-182 \div -14 = 13$$

## REMEMBER

When dividing two directed numbers:

- if their signs are the same, the answer is positive
- if their signs are different, the answer is negative.

## EXERCISE

## 2C

## Dividing integers

## INDIVIDUAL PATHWAYS

## eBookplus

## Activity 2-C-1

 Integer division  
doc-6401

## Activity 2-C-2

 More integer division  
doc-6402

## Activity 2-C-3

 Advanced integer  
division  
doc-6403

## FLUENCY

1 WE5a Evaluate each of the following.

a  $-63 \div 9$

b  $8 \div -2$

c  $-8 \div 2$

d  $-6 \div -1$

e  $88 \div -11$

f  $0 \div -5$

g  $48 \div -3$

h  $-129 \div 3$

i  $-56 \div -7$

j  $+184 \div -4$

k  $-55 \div -11$

l  $304 \div -8$

2 WE5b Evaluate each of the following.

a  $\frac{-121}{-11}$

b  $\frac{-12}{3}$

c  $\frac{-36}{-12}$

d  $\frac{21}{-7}$

e  $\frac{-100}{-50}$

f  $-3 \times \frac{2}{-3}$

3 WE6 Evaluate the following.

a  $960 \div -8$

b  $-243 \div 9$

c  $-266 \div -7$

d  $-132 \div -4$

e  $-282 \div 6$

f  $1440 \div -9$

g  $324 \div -12$

h  $-3060 \div 17$

i  $-6000 \div -24$

j  $-2294 \div -37$

k  $4860 \div 15$

l  $-5876 \div -26$

## UNDERSTANDING

- 4 Write three different division statements, each of which has an answer of  $-8$ .
- 5 Copy and complete the following by placing the correct integer in the box.
- a  $-27 \div \square = -9$       b  $-68 \div \square = 34$   
 c  $72 \div \square = -8$       d  $-18 \div \square = -6$   
 e  $\square \div 7 = -5$       f  $\square \div -4 = -6$   
 g  $-132 \div \square = 11$       h  $-270 \div \square = 27$
- 6 Calculate the value of each of the following by working from left to right.
- a  $-30 \div 6 \div -5$       b  $-120 \div 4 \div -5$   
 c  $-800 \div -4 \div -5 \div 2$
- 7 If  $a = -12$ ,  $b = 3$ ,  $c = -4$  and  $d = -6$ , calculate the value of each of the following expressions.
- a  $a \div c$       b  $a \div b$   
 c  $a \div d$       d  $b \div c$   
 e  $b \div d$       f  $a \div b \div d$
- 8 If  $a = -24$ ,  $b = 2$ ,  $c = -4$  and  $d = -12$ , calculate the value of each of the following expressions.
- a  $a \div b \times c$       b  $d \times c \div b \div c$   
 c  $b \div c \div d \times a$       d  $c \times a \div d \div b$   
 e  $a \times b \div d \div d$       f  $a \div d \times c \div b$
- 9 Copy and complete the following tables:

a

$\times$			$-6$	$+8$
			18	
$-10$		$-40$		
	10		30	
$-7$				$-56$

b

$\times$			$-9$	
$+6$	30			$-42$
		36		
	$-55$		99	
		$-6$	$-18$	

- 10 Copy and complete the following tables. Divide the number on the top by the number on the side.

a

$\div$	4	$-10$	12	$-8$
$-2$				
7				
$-3$				
$-10$				

b

$\div$				$-4$
		$-2$		
$-8$	$-4$	3		
6			$-6$	
				1

## REFLECTION

Can you list 4 areas in real life where directed numbers are used?

## 2D Combined operations on integers

- The mathematical rules about order of operations apply when we work with directed numbers.
- BIDMAS helps us to remember the correct order in which we should perform the various operations. This means that we do brackets first; then powers or indices; then  $\times$  and  $\div$  (working from left to right); and finally  $+$  and  $-$  (working from left to right).

## WORKED EXAMPLE 7

Calculate the value of each of the following.

a  $54 \div -6 + 8 \times -9 \div -4$

b  $-8 \div 2 + (-2)^3$

## THINK

- a
- 1 Write the question.
  - 2 There are no brackets or powers, so, working from left to right, complete all multiplication and division, then the addition.
  - 3 Write the answer.
- b
- 1 Write the question.
  - 2 Simplify the cubed term.
  - 3 Complete the division.
  - 4 Write the answer.

## WRITE

a  $54 \div -6 + 8 \times -9 \div -4$   
 $= -9 + 18$

$$= 9$$

b  $-8 \div 2 + (-2)^3$   
 $= -8 \div 2 + -8$   
 $= -4 + -8$   
 $= -12$

## REMEMBER

1. The mathematical rules about order of operations apply when we work with directed numbers.
2. BIDMAS helps us to remember the correct order in which we should perform the various operations. This means that we do brackets first; then powers or indices; then  $\times$  and  $\div$  (working from left to right); and finally  $+$  and  $-$  (working from left to right).

## EXERCISE

## 2D

## Combined operations on integers

## INDIVIDUAL PATHWAYS

## eBookplus

## Activity 2-D-1

Match-'em Game A  
doc-6404

## Activity 2-D-2

Match-'em Game B  
doc-6405

## Activity 2-D-3

Match-'em Game C  
doc-6406

## FLUENCY

- 1 **WE7a** Calculate the values of the following expressions.

a  $-4 - 6 - 2$

c  $8 \div (2 - 4) + 1$

e  $6 \times (4 + 1)$

g  $-4 + 5 - 6 - 7$

i  $12 \div (2 - 4) - 6$

k  $7 \times (6 + 2)$

b  $-4 \times 2 + 1$

d  $7 - (3 - 1) + 4$

f  $-3 - 40 \div 8 + 2$

h  $-5 \times 12 + 2$

j  $13 - (4 - 6) + 2$

l  $-6 - 36 \div 9 + 3$

- 2 **WE7b** Evaluate each of the following.

a  $-7 + 6 \times -2$

c  $(-63 \div -7) \times -3 + -2$

e  $-5 \times -7 - [5 + (-8)^2]$

b  $-9 - 15 + 3$

d  $(-3)^3 - 3 \times -5$

f  $[(-48 \div 8)^2 \times 36] \div -4$

- 3 Calculate the values of the following expressions.

a  $-3 + 15 - 26 - 27$

c  $52 \div (-9 - 4) - 8$

e  $15 \times (-6 + 2)$

g  $-3 \times -4 \times -1 \times 5$

b  $-8 \times 11 + 12$

d  $23 - (16 - 4) + 7 - 3$

f  $-6 - 64 \div -16 + 8$

h  $-6 \times (-13 + 5) + -4 + 2$

# UNDERSTANDING

- 4 A class of year 8 students were given the following question to evaluate.

$$4 + 8 \div -(2)^2 - 7 \times 2$$

- a A number of different answers were obtained, including  $-8$ ,  $-12$  and  $-17$ . Which one of these is the correct answer?
- b Using only brackets, change the question in two ways so that the other two answers would be correct.
- 5 In a particular adventure video game, a player loses and gains points based on who or what they come in contact with during the game. See the list below right for the number of 'hit' points associated with each contact. Calculate the number of points a player has at the end of each round of the game below.



Round number	Points at the start of the round	Contacts during the round	Points at the end of the round
1	100	20 gnomes, 10 goblins and 3 healing potions	
2		3 gnomes, 5 goblins, 6 orcs and 5 healing potions	
3		3 orcs, 6 trolls and a cleric	
4		5 trolls, 1 balrog and a cleric	

Character	'Hit' points
Balrog	-100
Troll	-10
Orc	-5
Goblin	-2
Gnome	-1
Healing potion	+20
Cleric	+50

eBookplus

Digital doc  
WorkSHEET 2.2  
doc-6407

## REFLECTION

What effects do directed numbers have on order of operations?



# Summary

## Adding and subtracting integers

- Integers are positive whole numbers, negative whole numbers and zero.
- A number line can be used to add integers.
  - To add a positive integer, move to the right.
  - To add a negative integer, move to the left.
- Subtracting an integer gives the same result as adding its opposite.  
For example,  $-3 - 5 = -3 - + 5 = -3 + -5 = -8$ .
- Opposite numbers are those with opposite signs. For example,  $+5$  and  $-5$  are opposites.
- By developing and extending a pattern, we can show that subtracting a negative has the same effect as adding a positive.
- In mathematics, a number without a positive or negative sign is considered to be positive.

## Multiplying integers

- When multiplying two directed numbers:
  - if their signs are the same, the answer is positive
  - if their signs are different, the answer is negative.
- Calculating powers of negative numbers uses the same process as calculating powers of positive numbers.
- There are two possible answers when you take the square root of a number: a positive answer and a negative answer.

## Dividing integers

- When dividing two directed numbers:
  - if their signs are the same, the answer is positive
  - if their signs are different, the answer is negative.

## Combined operations on integers

- The mathematical rules about order of operations apply when we work with directed numbers.
- BIDMAS helps us to remember the correct order in which we should perform the various operations. This means that we do brackets first; then powers or indices; then  $\times$  and  $\div$  (working from left to right); and finally  $+$  and  $-$  (working from left to right).

## MAPPING YOUR UNDERSTANDING

Using terms from the summary, and other terms if you wish, construct a concept map that illustrates your understanding of the key concepts covered in this chapter. Compare your concept map with the one that you created in *What do you know?* on page 31.

Have you completed the two *Homework sheets*, the *Rich task* and two *Code puzzles* in your *Maths Quest 8 Homework Book*?



# Chapter review

## FLUENCY

- 1 True or false? The number  $-2.5$  is called an integer.
- 2 True or false?  $-6 < -2$
- 3 List the integers between  $-11$  and  $-7$ .
- 4 Arrange these numbers in ascending order:  $7, 0, -3, 10, -15$ .
- 5 Calculate the value of each of the following.
 

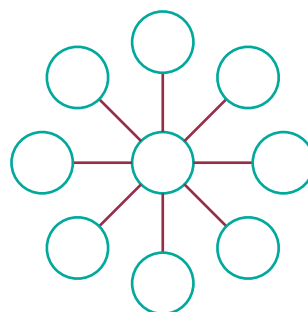
a $-6 + -8$	b $16 - -5$
c $-3 - +7 + -2$	d $-1 - -5 - +4$
- 6 Write out the following equations and fill in the missing numbers.
 

a $7 - \square = -14$	b $-19 + \square = 2$
c $\square - 13 - -12 = 10$	d $-28 - \square = -17$
- 7 **MC** Which of the following statements is true?
  - A Multiplying an even number of negative numbers together gives a negative answer.
  - B The square root of  $16$  is  $+4$ .
  - C Dividing a negative number by another negative number gives a positive answer.
  - D Adding two negative numbers together gives a positive answer.
- 8 Evaluate each of the following.
 

a $-12 \times -5$	b $-(-10) \times 3 \times -2$
c $-24 \div -3$	d $-48 \div -4 \div -3$
e $6 \times -3 \div -2$	f $-36 \div 3 \div -4 \times -9$
g $-8 \times -3 - (4 - -1) + -63 \div 7$	
h $-9 + -9 \div -9 \times -9 - -9$	

## PROBLEM SOLVING

- 1 Give an example of two numbers that fit each of the descriptions that follow. If no numbers fit the description, explain why.
  - a Both the sum and the product of two numbers are negative.
  - b The sum of two numbers is positive and the quotient is negative.
  - c The sum of two numbers is  $0$  and the product is positive.
- 2 On a test, each correct answer scores  $5$  points, each incorrect answer scores  $-2$  points and each question left unanswered scores  $0$  points.
  - a Suppose a student answers  $16$  questions correctly and  $3$  questions incorrectly, and does not answer  $1$  question. Write an expression for the student's score and find the score.
  - b Suppose you answered all  $20$  questions on the test. What is the greatest number of questions you can answer incorrectly and still get a positive score? Explain your reasoning.
- 3 Write each of the following problems as equations using directed numbers and then find the answer.
  - a You have  $\$25$  and you spend  $\$8$  on lollies. You then spend another  $\$6$  on lunch. A friend gives you  $\$5$  to buy lunch, which comes to only  $\$3.50$ . You then find another  $\$10$  in your pocket and buy an ice cream for  $\$3$ . How much money do you have left in total before you return your friend's change from lunch?
  - b Two friends are on holiday; one decides to go skydiving and the other decides to go scuba diving. If the skydiving plane climbs to  $4405$  m above sea level, and scuba diver goes to the ocean floor, which is  $26$  m below the surface, what is the vertical distance between the two friends?



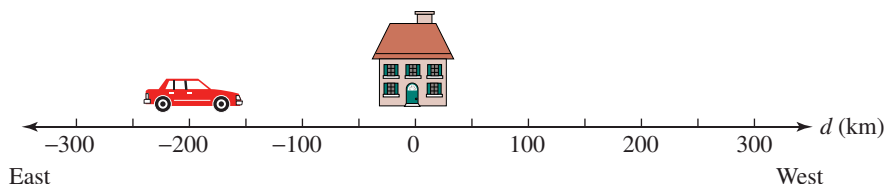
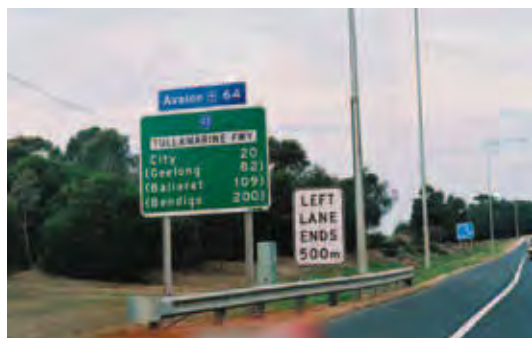
5 For each of the following:

- i represent the situation with a multiplication of directed numbers
  - ii solve the problem.
- a You receive several letters in the mail: two cheques worth \$100 each, three bills worth \$75 each and a voucher for \$20. How much money do you end up with?
  - b You earn \$150 each time you work at the local races. If you work at three race meetings in one month, how much do you earn that month?
  - c For your birthday, you get three cards with \$40 in each of them. As a present, your brother tears up the IOUs you gave him when he did your chores. There were four IOUs worth \$10 each. In total, how much more money do you have after your birthday?



In science, directed numbers are often used to describe a direction or an increase or decrease in a measurement.

6 Directed numbers can describe the distance of an object from a reference point (known as the *displacement, d*, of the object). For example, if we are 200 km east of a town, and east is defined as a negative direction, we are  $-200$  km from the town.



- a If a car travels 150 km in a westerly direction from  $-200$  km, describe the displacement of the car from the town.
  - b If a car travels from 300 km west of the town, describe the displacement of the car after it has travelled 450 km in a westerly direction.
- 7 Directed numbers can describe the direction that an object is travelling. For example, in question 6, travelling towards the west is travelling in a positive direction; towards the east is a negative direction. A car travelling east at 100 km/h goes at  $-100$  km/h. Scientists use the term *velocity, v*, to mean a speed in a particular direction.
- a If a car travels past the town at  $-100$  km/h, where will it be in 2 hours time?
  - b If a car goes past the town travelling at  $-100$  km/h, where was the car an hour ago?

eBookplus

#### Interactivities

Test yourself  
Chapter 2  
int-2722

Word search  
Chapter 2  
int-2724

Crossword  
Chapter 2  
int-2723

**Chapter opener****Digital doc** (page 31)

- Hungry brain activity Chapter 2 (doc-6386)

**Are you ready?****Digital docs** (page 32)

- SkillsSHEET 2.1 (doc-6387) Integers on the number line
- SkillsSHEET 2.2 (doc-6388) Adding and subtracting integers
- SkillsSHEET 2.3 (doc-6389) Arranging numbers in order
- SkillsSHEET 2.4 (doc-6390) Multiplying integers
- SkillsSHEET 2.5 (doc-6391) Dividing integers
- SkillsSHEET 2.6 (doc-6392) Order of operations and directed numbers

**2A Adding and subtracting integers****Digital docs** (page 35)

- Activity 2-A-1 (doc-6394) The Game of Pirates — standard
- Activity 2-A-2 (doc-6395) The Game of Pirates — variation 1
- Activity 2-A-3 (doc-6396) The Game of Pirates — variation 2

**eLesson** (page 33)

- Directed numbers (eles-0040)

**Interactivity** (page 35)

- Directed number target (int-0074)

**2B Multiplying integers****Digital docs** (page 39)

- Activity 2-B-1 (doc-6397) Integer multiplication
- Activity 2-B-2 (doc-6398) More integer multiplication
- Activity 2-B-3 (doc-6399) Advanced integer multiplication
- WorkSHEET 2.1 (doc-6400) (page 40)

**2C Dividing integers****Digital docs** (page 41)

- Activity 2-C-1 (doc-6401) Integer division
- Activity 2-C-2 (doc-6402) More integer division
- Activity 2-C-3 (doc-6403) Advanced integer division

**2D Combined operations on integers****Digital docs** (page 43)

- Activity 2-D-1 (doc-6404) Match-'em Game A
- Activity 2-D-2 (doc-6405) Match-'em Game B
- Activity 2-D-3 (doc-6406) Match-'em Game C
- WorkSHEET 2.2 (doc-6407) (page 44)

**Chapter review****Interactivities** (page 47)

- Test yourself Chapter 2 (int-2722) Take the end-of-chapter test to test your progress.
- Word search Chapter 2 (int-2724)
- Crossword Chapter 2 (int-2723)

**To access eBookPLUS activities, log on to**[www.jacplus.com.au](http://www.jacplus.com.au)

# Answers

## CHAPTER 1

### Numeracy

#### 1A Set 1A

- |                        |                  |                        |
|------------------------|------------------|------------------------|
| 1 D                    | 2 D              | 3 B                    |
| 4 A                    | 5 B              | 6 $31.25 \text{ cm}^2$ |
| 7 A                    | 8 $120^\circ$    | 9 A                    |
| 10 C                   | 11 B             | 12 C                   |
| 13 $5582 \text{ cm}^3$ | 14 D             | 15 B                   |
| 16 2.1 m               | 17 $\frac{1}{4}$ | 18 C                   |
| 19 B                   | 20 C             | 21 D                   |
| 22 A                   | 23 B             | 24 B                   |
| 25 C                   | 26 A             | 27 D                   |
| 28 C                   | 29 B             | 30 C                   |

#### 1B Set 1B

- |                |          |      |
|----------------|----------|------|
| 1 B            | 2 C      | 3 D  |
| 4 A            | 5 C      | 6 B  |
| 7 B            | 8 47.56s | 9 C  |
| 10 C           | 11 B     | 12 D |
| 13 B           | 14 D     | 15 C |
| 16 B           | 17 C     | 18 C |
| 19 C           | 20 D     | 21 D |
| 22 205         | 23 B     | 24 C |
| 25 $107^\circ$ | 26 40%   |      |
- 27 7 pegs in each yellow bucket; 18 pegs in each blue bucket.
- 28 B      29 D      30 B

#### 1C Set 1C

- |        |            |         |
|--------|------------|---------|
| 1 D    | 2 A        | 3 11 pm |
| 4 B    | 5 C        | 6 B     |
| 7 D    | 8 C        | 9 C     |
| 10 124 | 11 10 days | 12 B    |
| 13 A   | 14 B       | 15 B    |
| 16 A   | 17 D       | 18 A    |
| 19 B   | 20 58 cm   | 21 4    |
| 22 B   | 23 B       | 24 C    |
| 25 D   | 26 A       | 27 C    |
| 28 B   | 29 B       | 30 D    |

#### 1D Set 1D

- |      |       |                    |
|------|-------|--------------------|
| 1 B  | 2 C   | 3 D                |
| 4 D  | 5 C   | 6 A                |
| 7 D  | 8 A   | 9 B                |
| 10 D | 11 C  | 12 B               |
| 13 A | 14 B  | 15 $\frac{11}{15}$ |
| 16 A | 17 D  | 18 A               |
| 19 D | 20 D  | 21 C               |
| 22 C | 23 24 | 24 C               |
| 25 C | 26 B  | 27 B               |
| 28 A | 29 C  | 30 B               |

#### 1E Set 1E

- |      |      |          |
|------|------|----------|
| 1 A  | 2 B  | 3 B      |
| 4 D  | 5 C  | 6 160 km |
| 7 C  | 8 D  | 9 C      |
| 10 B | 11 B | 12 C     |
| 13 C | 14 D | 15 C     |

- |      |      |         |
|------|------|---------|
| 16 A | 17 C | 18 4 km |
| 19 C | 20 C | 21 5    |
| 22 C | 23 A | 24 C    |
| 25 D | 26 A | 27 C    |
| 28 D | 29 B | 30 C    |

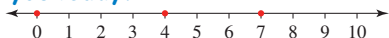
#### 1F Set 1F

- |            |      |         |
|------------|------|---------|
| 1 C        | 2 D  | 3 C     |
| 4 C        | 5 D  | 6 B     |
| 7 B        | 8 A  | 9 A     |
| 10 B       | 11 B | 12 B    |
| 13 276 800 | 14 C | 15 6    |
| 16 C       | 17 C | 18 32   |
| 19 9, 90   | 20 D | 21 True |
| 22 C       | 23 A | 24 A    |
| 25 35%     | 26 C | 27 220  |
| 28 B       | 29 B | 30 C    |

## CHAPTER 2

### Integers

#### Are you ready?

- 1 
- 2 a 2, 8      b 0, 4      c 2, 10
- 3 a 4869      b 635      c 2944
- 4 a 12, 17, 25, 29, 30, 39, 45, 56
- b 56, 45, 39, 30, 29, 25, 17, 12
- 5 41 384
- 6 34 776
- 7 a 3      b 12      c 3
- 8 a 11      b 28      c 5
- d 27      e 15      f 80

#### 2A Adding and subtracting integers

- 1 3, -4, 201, -62
- 2 a 0, -2, -4
- b -20, -25, -30
- c 5, 3, 1
- d -8, -6, -4
- 3 a -1      b -10      c -1      d -13
- e 19      f 7      g -15      h 0
- 4 a 5      b -24      c -5      d 5
- e 26      f -16      g 22      h 11
- 5 a -8      b 11      c -14      d -1
- e 51      f -51      g -39      h 8
- 6 a -7      b -9      c 3      d 12
- e -10      f 13      g -40      h 18
- i 27      j -34      k -11      l 150
- m -1      n 25      o -13      p 22
- 7 a 9      r -22

+	-8	25	-18	32
-6	-14	19	-24	26
-13	-21	12	-31	19
-16	-24	9	-34	16
-19	-27	6	-37	13

**b**

–	15	–17	–27	57
7	8	–24	–34	50
–6	21	–11	–21	63
–9	24	–8	–18	66
12	3	–29	–39	45

**c**

+	–11	19	13	–7
–5	–16	14	8	–12
17	6	36	30	10
–1	–12	18	12	–8
–28	–39	–9	–15	–35

**d**

–	9	21	–15	42
26	–17	–5	–41	16
–14	23	35	–1	56
–2	11	23	–13	44
23	–14	–2	–38	19

**8** Check with your teacher.

**9** **a** 22 °C      **b** 176 °C      **c** 198 °C

**10** 37 °C

**11** **a** –301      **b** –5963

**c** 530      **d** 72

**12** **a** 13      **b** –4      **c** 11

**d** –10      **e** 52      **f** 71

**13** **a** Correct      **b** Incorrect; 6

**c** Incorrect; –15      **d** Correct

**e** Correct      **f** Incorrect; –21

**14** **a** –3      **b** –2      **c** –5

**15** The answers are the same.

**16** **a** –7      **b** –11      **c** –13

**17** The answers are the same.

## 2B Multiplying integers

**1**  $4 \times 4 = 16$        $-5 \times 4 = -20$        $-6 \times -4 = 24$

$4 \times 3 = 12$        $-5 \times 3 = -15$        $-6 \times -3 = 18$

$4 \times 2 = 8$        $-5 \times 2 = -10$        $-6 \times -2 = 12$

$4 \times 1 = 4$        $-5 \times 1 = -5$        $-6 \times -1 = 6$

$4 \times 0 = 0$        $-5 \times 0 = 0$        $-6 \times 0 = 0$

$4 \times -1 = -4$        $-5 \times -1 = 5$        $-6 \times 1 = -6$

$4 \times -2 = -8$        $-5 \times -2 = 10$        $-6 \times 2 = -12$

$4 \times -3 = -12$        $-5 \times -3 = 15$        $-6 \times 3 = -18$

$4 \times -4 = -16$        $-5 \times -4 = 20$        $-6 \times 4 = -24$

**2** **a** –10      **b** –24      **c** 42      **d** –26

**e** 48      **f** –42      **g** –750      **h** 1150

**i** –63      **j** –72      **k** 55      **l** –300

**3** **a** –800      **b** 112      **c** –192

**d** 42      **e** 160

**4** **a** –9      **b** –7      **c** –2      **d** –12

**e** –6      **f** 8      **g** –20      **h** –6

**i** –11

**5** **a** –8      **b** 9      **c** 16      **d** 81

**e** –32      **f** 16      **g** –125      **h** 256

**i** 625      **j** –216

**6** **a** Positive      **b** Negative

**7** **a**  $\pm 5$       **b**  $\pm 9$       **c**  $\pm 7$

**d**  $\pm 11$       **e**  $\pm 10$

**8** **a** 48      **b** –36      **c** 72

**d** 16      **e** –12      **f** –576

**9** Check with your teacher.

**10** **a** Positive      **b** Negative      **c** Negative

**11** If a positive number is multiplied by –1, the number becomes negative.

If a negative number is multiplied by –1, the number becomes positive.

**12** **a** 2      **b** –3      **c** 5

**d** 5      **e** –7      **f** 4

## 2C Dividing integers

**1** **a** –7      **b** –4      **c** –4      **d** 6

**e** –8      **f** 0      **g** –16      **h** –43

**i** 8      **j** –46      **k** 5      **l** –38

**2** **a** 11      **b** –4      **c** 3

**d** –3      **e** 2      **f** 2

**3** **a** –120      **b** –27      **c** 38

**d** 33      **e** –47      **f** –160

**g** –27      **h** –180      **i** 250

**j** 62      **k** 324      **l** 226

**4** Check with your teacher.

**5** **a** 3      **b** –2      **c** –9

**d** 3      **e** –35      **f** 24

**g** –12      **h** –10

**6** **a** 1      **b** 6      **c** –20

**7** **a** 3      **b** –4      **c** 2

**d**  $-\frac{3}{4}$       **e**  $-\frac{1}{2}$       **f**  $\frac{2}{3}$

**8** **a** 48      **b** –6      **c** –1

**d** –4      **e**  $-\frac{1}{3}$       **f** –4

**9** **a**

×	–2	4	–6	8
–3	6	–12	18	–24
–10	20	–40	60	–80
–5	10	–20	30	–40
–7	14	–28	42	–56

**b**

×	5	–3	–9	–7
6	30	–18	–54	–42
–12	–60	36	108	84
–11	–55	33	99	77
2	10	–6	–18	–14

**10** **a**

÷	4	–10	12	–8
–2	–2	5	–6	4
7	$\frac{4}{7}$	$-\frac{10}{7}$	$\frac{12}{7}$	$-\frac{8}{7}$
–3	$-\frac{4}{3}$	$\frac{10}{3}$	–4	$\frac{8}{3}$
–10	$-\frac{2}{5}$	1	$-\frac{6}{5}$	$\frac{4}{5}$

**b**

÷	32	–24	–36	–4
12	$\frac{8}{3}$	–2	–3	$-\frac{1}{3}$
–8	–4	3	$\frac{9}{2}$	$\frac{1}{2}$
6	$\frac{16}{3}$	–4	–6	$-\frac{2}{3}$
–4	–8	6	9	1

## 2D Combined operations on integers

- 1 a -12 b -7 c -3 d 9  
 e 30 f -6 g -12 h -58  
 i -12 j 17 k 56 l -7  
 2 a -19 b -21 c -29 d -12  
 e -34 f -324  
 3 a -41 b -76 c -12 d 15  
 e -60 f 6 g -60 h 46  
 4 a -12  
 b  $(4 + 8) \div -(2)^2 - 7 \times 2 = -17$   
 $4 + 8 \div -(2)^2 - 7 \times 2 = -8$

Round number	Points at the start of the round	Contacts during the round	Points at the end of the round
1	100	20 gnomes, 10 goblins and 3 healing potions	120
2	120	3 gnomes, 5 goblins, 6 orcs and 5 healing potions	177
3	177	3 orcs, 6 trolls and a cleric	152
4	152	5 trolls, 1 balrog and a cleric	52

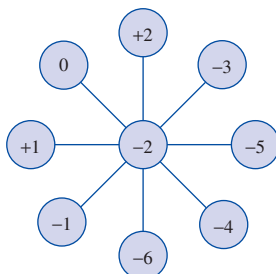
## Chapter review

### Fluency

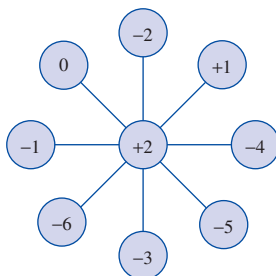
- 1 False  
 2 True  
 3 -10, -9, -8  
 4 -15, -3, 0, 7, 10  
 5 a -14 b 21 c -12 d 0  
 6 a 21 b 21 c 11 d -11  
 7 C  
 8 a 60 b -60 c 8 d -4  
 e 9 f -27 g 10 h -9

### Problem solving

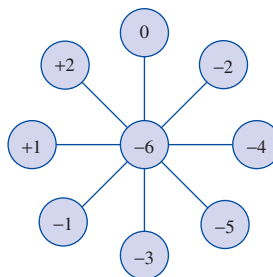
- 1 Check with your teacher.  
 2 a 74 b 14  
 3 a \$19.50 b 4431 m  
 4 a



b



c



- 5 a i  $2 \times 100 - 3 \times 75 + 20$  ii -\$5  
 b i  $3 \times 150$  ii \$450  
 c i  $3 \times 40 + 4 \times 10$  ii \$160  
 6 a -50 km b 750 km  
 7 a -200 km b 100 km

## CHAPTER 3

### Index laws

#### Are you ready?

- 1 a  $32 = 2 \times 2 \times 2 \times 2 \times 2$  b  $81 = 3 \times 3 \times 3 \times 3$   
 c  $1000 = 2 \times 2 \times 2 \times 5 \times 5 \times 5$   
 2 a 36 b 121 c 2500  
 3 a  $\frac{1}{3}$  b  $\frac{2}{5}$  c  $\frac{3}{4}$   
 4 a  $6abc$  b  $6zw$  c  $20l^2$   
 5 a a b  $\frac{m^2}{3}$  c  $2k$

### 3A Review of index form

- 1 a Base = 8, power = 4  
 b Base = 7, power = 10  
 c Base = 20, power = 11  
 d Base = 19, power = 0  
 e Base = 78, power = 12  
 f Base = 3, power = 100  
 g Base =  $m$ , power = 5  
 h Base =  $c$ , power = 24  
 i Base =  $n$ , power = 36  
 j Base =  $d$ , power = 42  
 2 a  $2^6$  b  $4^4$  c  $x^5$   
 d  $9^3$  e  $11l^7$  f  $44m^5$   
 3 a  $4 \times 4$  b  $5 \times 5 \times 5 \times 5$   
 c  $7 \times 7 \times 7 \times 7 \times 7$  d  $6 \times 6 \times 6$   
 e  $3 \times 3 \times 3 \times 3 \times 3 \times 3$  f  $n \times n \times n \times n \times n \times n \times n$   
 g  $a \times a \times a \times a$   
 h  $k \times k \times k \times k \times k \times k \times k \times k \times k \times k$   
 4 a 243 b 256 c 256  
 d 1331 e 2401 f 216  
 g 1 h 625  
 5 a B b D  
 6 a  $2^2 \times 4^4 \times 6$  b  $3^4 \times 7^4$  c  $2^3 \times 19^5$   
 d  $4^4 \times 13^2$  e  $66p^2m^5s^2$  f  $378n^2i^3r^3$   
 g  $192ke^3p^2$  h  $99j^5p^2l$   
 7 a  $15 \times f \times f \times f \times f \times j \times j \times j \times j$   
 b  $7 \times k \times k \times k \times k \times k \times k \times k \times s \times s$   
 c  $4 \times b \times b \times b \times c \times c \times c \times c \times c$   
 d  $19 \times a \times a \times a \times a \times n \times n \times n \times n \times m$   
 e  $8 \times r \times r \times r \times l \times l \times l \times l \times t \times t$   
 8 a  $64 = 2^6$  b  $40 = 2^3 \times 5$  c  $36 = 2^2 \times 3^2$   
 d  $400 = 2^4 \times 5^2$  e  $225 = 3^2 \times 5^2$  f  $2000 = 2^4 \times 5^3$