Dalkeith High School

Maths

National 4

Expressions and Formulae

Revision Booklet

Contents

Practice Unit Assessment (1) Expressions and Formulae

1. Expand the brackets: $5(2m - 7)$

2. Factorise $4x + 32$.

3. Simplify $3m + 5n + 6m - 2n$.

4. **(a)** When $x = 2$ and $y = 3$, find the value of $5x - 3y$.

(b) Norrie is a plumber.

He calculates the cost of a job using the formula:

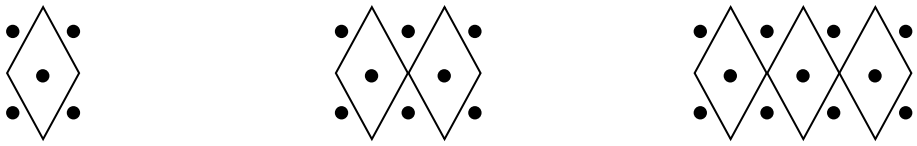
$$C = 26{\cdot}5H + 1{\cdot}5M$$

where C is the cost (in pounds), H is the number of hours he works, and M is the number of miles he travels to the job.

On one job he worked for 7 hours and travelled 32 miles.

Calculate how much Norrie charged for this particular job.

5. Milly bought a new top which has some coloured glass diamonds and beads round the neck. Here is how the pattern is built up.



Pattern 1
1 Diamond

Pattern 2
2 Diamonds

Pattern 3
3 Diamonds

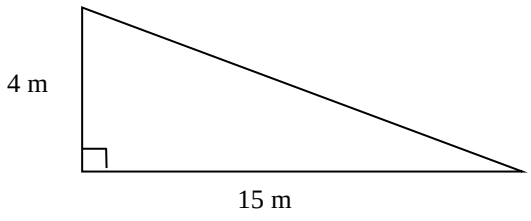
(a) Copy and complete the table for the number of diamonds (D) and number of beads (B) in other patterns.

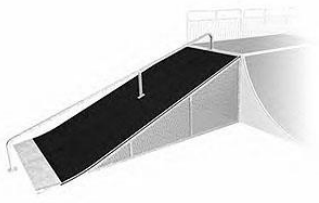
Number of Diamonds (D)	1	2	3	4	5		10
Number of Beads (B)	5	8					

(b) Write down a formula for calculating the number of beads (B) needed for any number of diamonds (D).

(c) A pattern has 50 beads. How many diamonds does it have?
You must show your working.

6. A skateboard ramp has been designed to have the following dimensions.





The ramp can only be used in competitions if the gradient of the slope is greater than 0·3.

(a) Calculate the gradient of the slope.

(b) Can this ramp be used in a competition? Give a reason for your answer.

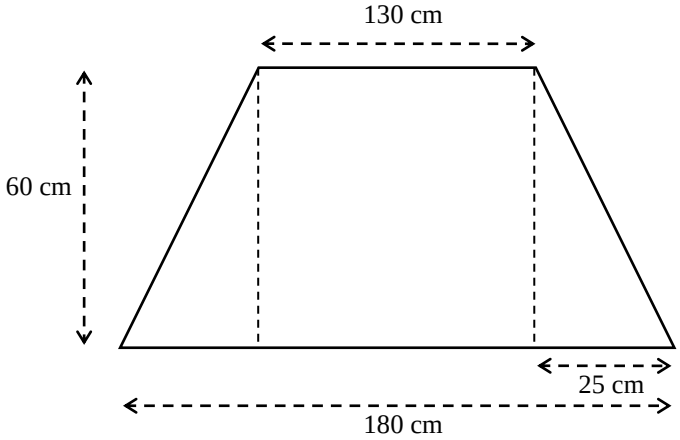
7. The speed limit outside schools is 20 miles per hour. The warning sign for this is shown below. The diameter of the sign is 30 cm.

(a) Calculate the circumference of the sign.

(b) Calculate the area of the sign.

8. A car windscreen is formed from a 'curved' trapezium.

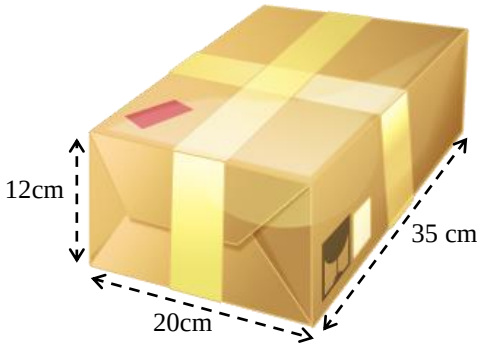
The trapezium is made up of a rectangle and two identical right-angled triangles, as shown in the diagram below.



Find the area of the windscreen.

9. A parcel is in the shape of a cuboid.

It is 35 centimetres long, 20 centimetres wide and 12 centimetres high, as shown below.

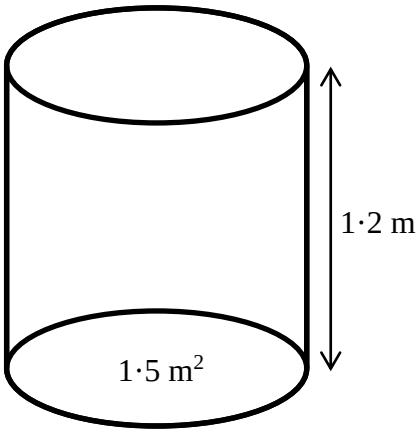


Find the surface area of the cuboid shown.

10. I have a large container in my garden for collecting water.

The area of the base of the container is 1·5 square metres.

The height of the container is 1·2 metres.

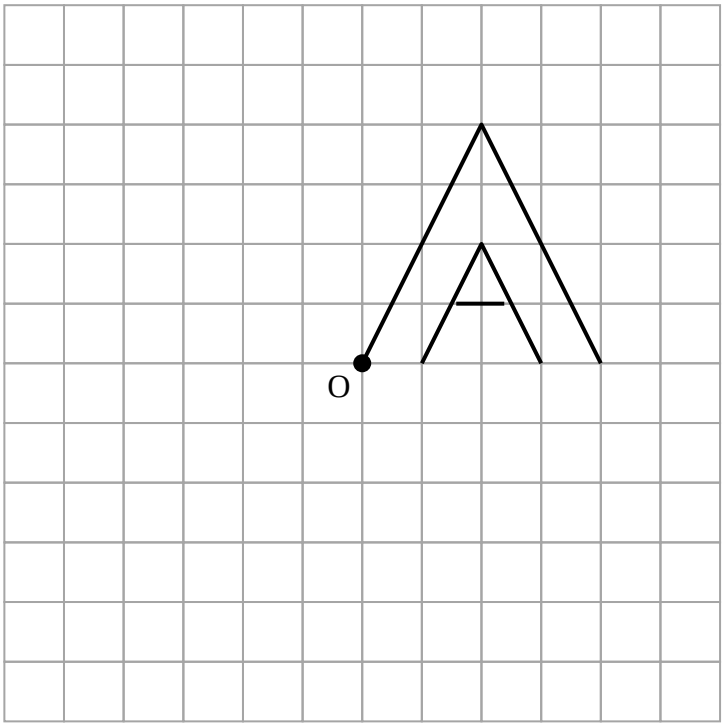


Calculate the volume of the container.

11. Andy's Autos have designed a new logo for their company.

Part of the design for the logo is shown below.

Copy and complete this shape so that it has rotational symmetry of order 4, about 0.



12. The number of visitors to an exhibition was recorded each day for two weeks.

The results are shown below.

77	93	87	71	90	98	100
78	84	91	97	88	102	107

Copy and complete the frequency table for these results.

Score	**Tally**	**Frequency**
70 – 79		
		Total =

13. Ten people were asked how long they had waited in a queue to get into an exhibition.
The time, in minutes, was recorded and the results are shown below.

14	23	21	15	12
22	26	22	17	16

(a) Calculate the mean time taken.

(b) Calculate the range.

The manager thought that these times were too long and introduced measures to cut the waiting times.
After this happened the mean waiting time was 15 minutes and the range 10.

(c) Write two comments comparing the results before and after these were introduced.

14. A group of sixty students were asked what there favourite 'soap' was.
The table below shows the results.

Soap	**No. of students**
Eastenders	15
Emmerdale	20
Corrie	25

Construct a pie chart to show this information.
To help you complete the pie chart, copy this table and fill in the blanks.

Soap	**No. of pupils**	**Angle at centre**
Eastenders	15	
Emmerdale	20	
Corrie	25	

Now complete the pie chart.

15. An octahedral die has eight faces numbered one to eight.

When it is thrown it comes to rest on one of its faces.

What is the probability that it comes to rest on a number greater than 3?

End of Question Paper

Practice Unit Assessment (2) Expressions and Formulae

1. Expand the brackets: $4(2 - 3h)$

2. Factorise $6x - 54$.

3. Simplify $6a + 3b + b - 2a$.

4. **(a)** When $c = 4$ and $d = 7$, find the value of $2c + 3d$.

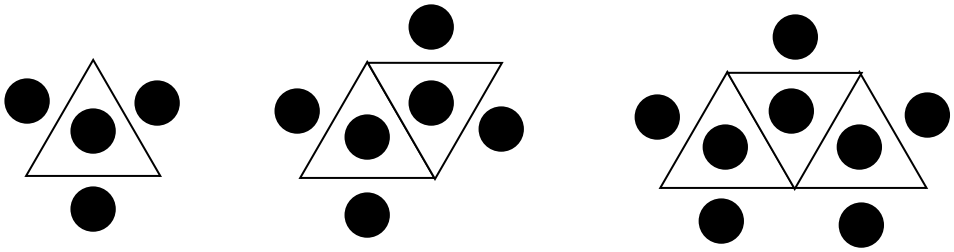
(b) The Pronto Parcels delivery company uses this formula to calculate the cost of delivering parcels.

$$C = 6{\cdot}5P + 0{\cdot}75M$$

where C is the cost (in pounds), P is the number of parcels delivered, and M is the number of miles travelled to make the delivery.

Calculate the cost of delivering 7 parcels to an address 140 miles away.

5. Carol is making a pattern with triangles and circles.
Here is how the pattern is built up.



Pattern 1
1 Triangle

Pattern 2
2 Triangles

Pattern 3
3 Triangles

(a) Copy and complete the table for the number of triangles and number of circles in other patterns.

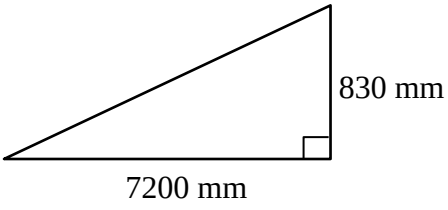
Number of Triangles (T)	1	2	3	4	5	6		10
Number of Circles (C)	4	6	8					

(b) Write down a rule for finding the number of circles (C) needed for any number of triangles (T).

(c) Another pattern has a total of 56 circles. How many triangles were there?

6. The manufacturer of a ramp for a shop entrance states that to be suitable for a wheelchair user the gradient of the ramp must lie between 0·1 and 0·15.

(a) Calculate the gradient of the slope.



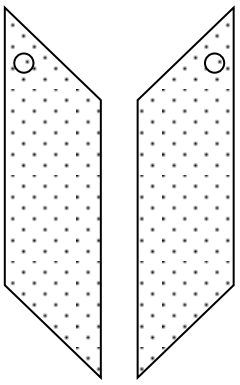
(b) Is this ramp suitable for wheelchair users?

7. Polly's Pizza Parlour sells pizzas with diameter 26cm.

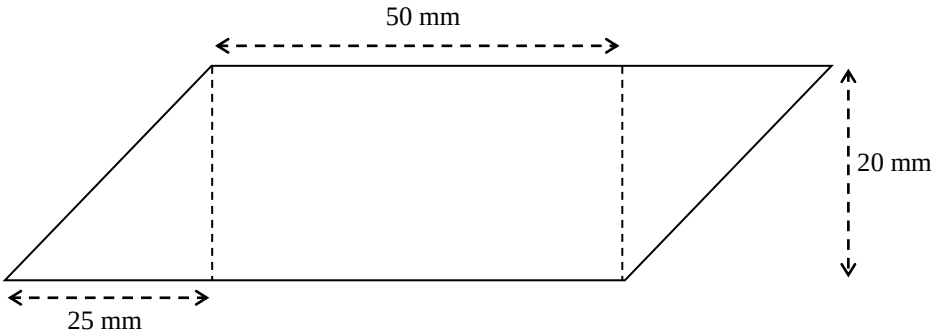
(a) Calculate the circumference of the pizza.

(b) Calculate the area of the pizza.

8. Earrings are shaped like a parallelogram.



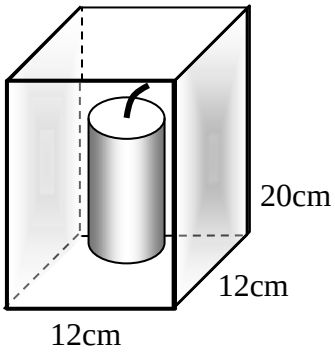
Each earring is made up of a rectangle and two identical right-angled triangles, as shown in the diagram below.



Find the area of one of the earrings.

9. As a safety measure, a candle is displayed in a glass case in the shape of a cuboid which is **open at the top.**

The base measures 12cm by 12cm and its height is 20cm.

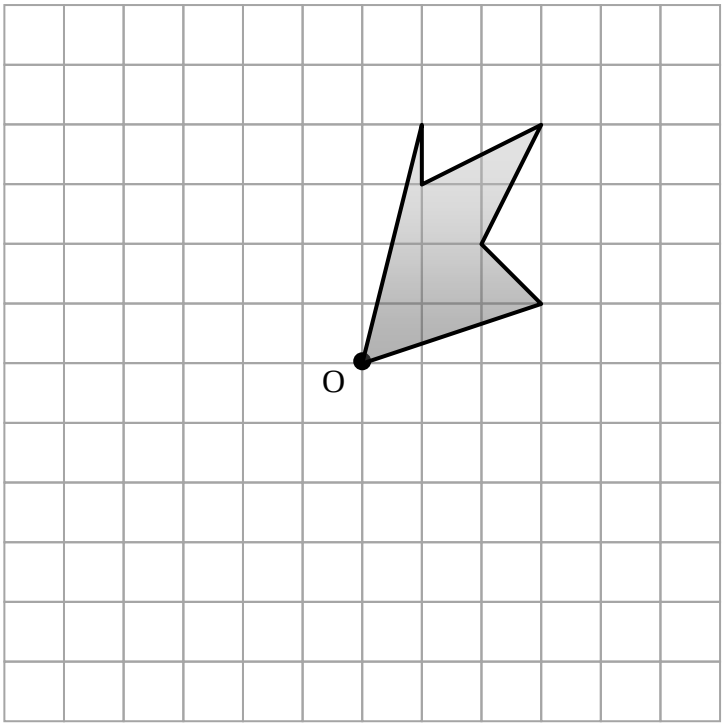


Calculate the amount of glass that would be need to used to make this case.

10. A heart – shaped chocolate box has a base area of 250 cm².
The depth of the box is 4·5 centimetres.

Calculate the volume of the chocolate box.

11. A textile company is designing a new cushion pattern which has rotational symmetry.
Part of the design is shown below.
Copy and complete this shape so that it has rotational symmetry of order 4, about 0.



12. The marks obtained (out of 30) in a test by a group of students are given in this list.

26	23	17	29	2	19	20
27	24	21	30	18	22	17

Complete the frequency table for these results.

Score	**Tally**	**Frequency**
1 – 6		
		Total =

13. Eight people were weighed at a slimming class before embarking on a healthy eating campaign. Their weights, in kilograms, are shown below.

84	75	61	65
72	86	64	77

(a) Calculate the mean weight.

(b) Calculate the range.

After two months on the healthy eating campaign they were weighed again and this time the mean was 70 kg with a range of 20. .

(c) Write two comments comparing the results before and after the healthy eating campaign.

14. One hundred and twenty people were asked in which season their birthday fell.
The table below shows the results:

Season	**No. of students**
Spring	30
Summer	35
Autumn	45
Winter	10

Construct a pie chart to show this information.
To help you complete the pie chart, copy this table and fill in the blanks.

Season	**No. of pupils**	**Angle at centre**
Spring	30	
Summer	35	
Autumn	45	
Winter	10	

Now complete the pie chart.

15. As people left a travel agent they were asked what kind of holiday they had booked. Here is what they said:

Package Holidays:	24
Cruise:	13
Camping:	6
Activity:	7

What is the probability that someone chosen at random will have booked a cruise?

Practice Unit Assessment (3) Expressions and Formulae

1. Expand the brackets: $2(5 - 4x)$

2. Factorise $72 - 6x$

3. Simplify $5g + 4h - 2h - g$.

4. **(a)** When $m = 5$ and $n = 7$, find the value of $4n - 3m$.

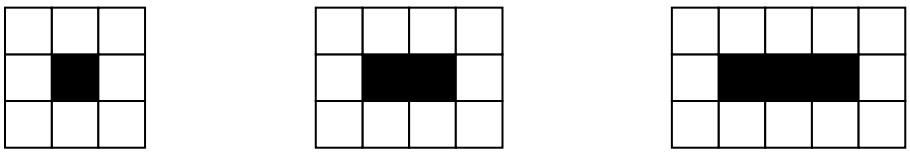
(b) A publishing company sends out flyers to customers to advertise its services. The cost to the company of doing this is calculated using this formula:

$C = 9{\cdot}15H + 0{\cdot}5S$

where C is the cost (in pounds), H is the number of hours someone is paid to prepare the flyers , and S is the number of stamps bought to post them.

Calculate the cost when it took Stewart 5 hours to prepare the flyers and 420 stamps were used.

5. A pattern of black and white tiles is made up as shown in these diagrams.



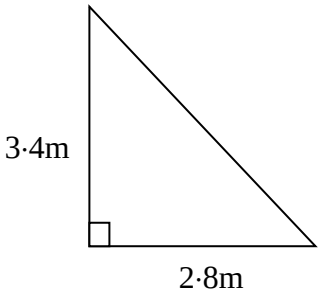
(a) Copy and complete the table for the number of black tiles and number of white tiles in other patterns.

Number of black tiles (B)	1	2	3	4	5	6		10
Number of white tiles (W)	8	10	12					

(b) Write down a rule for finding the number of white tiles (W) needed for any number of black tiles (B).

(c) Another pattern has a total of 46 white tiles. How many black tiles were there?

6. I have just had a new staircase fitted in my house. It has a height of 3.4m and is 2.8m horizontally.

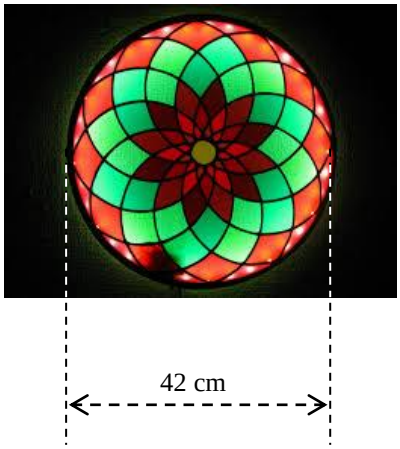


To be safe the gradient of the stairs has to be between 1·2 and 1·3.

(a) Calculate the gradient of the stairs.

(b) Is this staircase safe?

7. A decorative plaque in a church window is circular and has a diameter of 42cm.

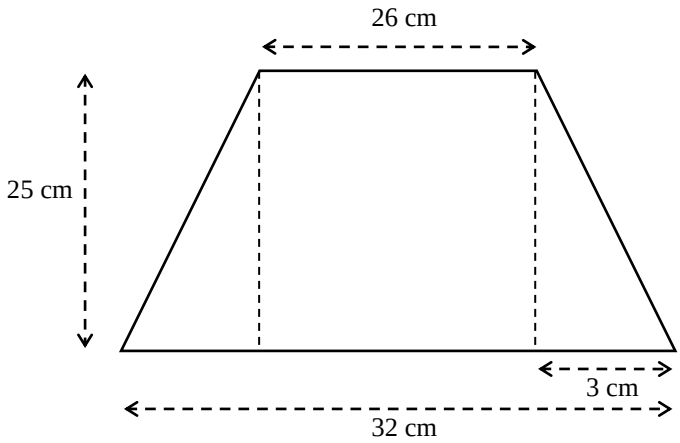


(a) Calculate the circumference of the plaque.

(b) Calculate the area of the area of the plaque.

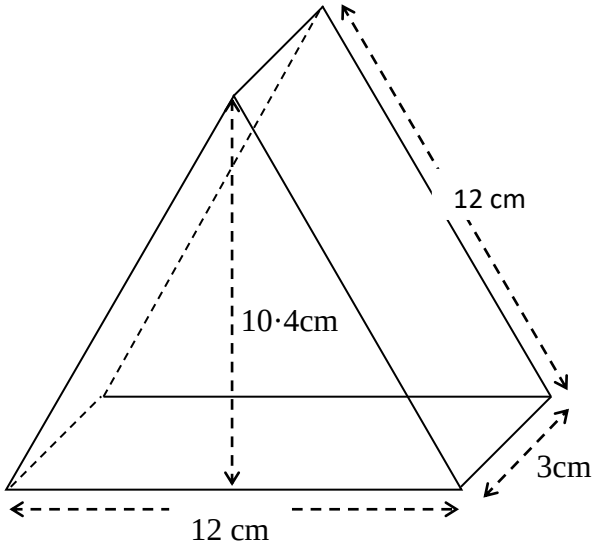
8. The front of a handbag is shaped like a trapezium.

The trapezium is made up of a rectangle and two identical right-angled triangles, as shown in the diagram below.



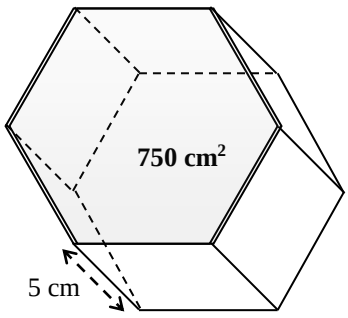
Find the area of the handbag.

9. A box is in the shape of a triangular prism with dimensions as shown in the diagram.



Calculate the surface area of the triangular prism.

10. A box of toiletries is a prism as shown in the diagram.
The area of the base is 750cm² and has height 5cm.

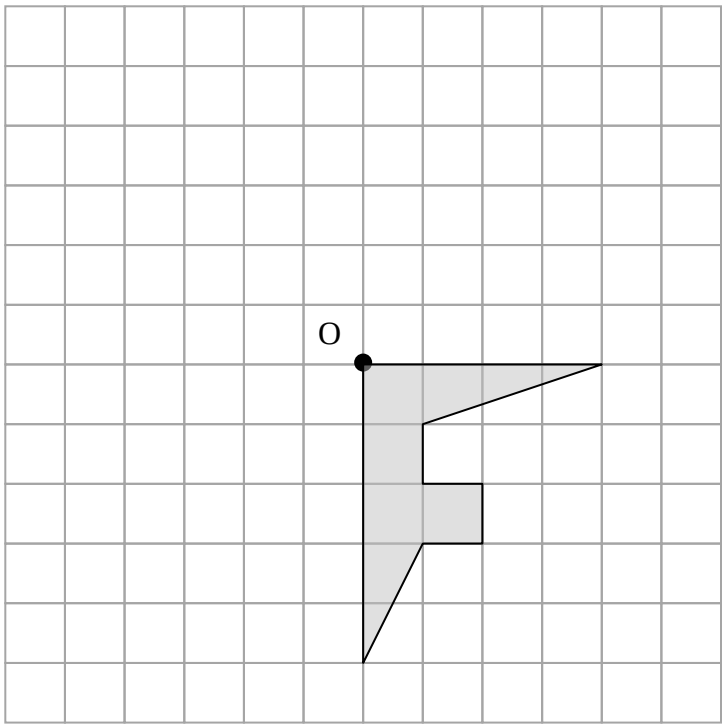


Calculate the volume of the box.

11. A company is designing a new logo.

Part of the design is shown below.

Copy and complete this shape so that it has rotational symmetry of order 4, about 0.



12. The number of people attending an emergency dental clinic over the course of three weeks was recorded. Here are the results

13	12	5	19	15	10	12	22
18	13	12	21	9	11	16	

Complete the frequency table for these results.

Score	**Tally**	**Frequency**
1 – 5		
		Total =

13. The tips received by a group of 8 waiters in a restaurant one Saturday evening are shown here.

£12	£24	£17	£22
£19	£20	£23	£15

(a) Calculate the mean amount earned in tips.

(b) Calculate the range.

The waiters went on a customer services course during the following week.
The next Saturday evening their tips gave a mean of £25 with a range of £9.

(c) Write two comments comparing the results before and after the course.

14. One hundred and sixty people were asked to say what sports they played.
. The table below shows the results.

Sport	**No. of students**
Indoor	40
Outdoor	72
Don’t play sport	48

Construct a pie chart to show this information.

To help you complete the pie chart, copy this table and fill in the blanks.

Sport	**No. of pupils**	**Angle at centre**
Indoor	40	
Outdoor	72	
Don’t play sport	48	

Now complete the pie chart.

15. A card is chosen from this set of cards.

What is the probability that it will **not** be a face card?

Practice Unit Assessment (1) for Expressions and Formulae: Marking Scheme

Points of reasoning are marked # in the table.

Question	Main Points of expected responses	
1(a)	●[1] multiply out brackets	●[1] $10m - 35$
2	●[1] identify common factor	●[1] 4
	●[2] factorise expression	●[2] $4(x + 8)$
3	●[1] collect like terms	●[1] $9m + 3n$
4(a)	●[1] substitute into expression	●[1] $5 \times 2 - 3 \times 3$
	●[2] evaluate expression	●[2] 1
(b)	●[3] substitute into expression	●[3] $26{\cdot}5 \times 7 + 1{\cdot}5 \times 32$
	●[4] evaluate expression	●[4] £233.50
5(a)	●[1] extend sequence	●[1] 11, 14, 17
	●[2] complete table	●[2] 32
(b)	●[3] begin to find formula	●[3] $\times 3$
	●[4] correct formula	●[4] $B = 3D + 2$
(c)	#2.1 valid strategy	#2.1 $50 = 3D + 2$
	●[5] correct solution	●[5] 16
6(a)	●[1] calculate gradient	●[1] $\frac{4}{15} = 0{\cdot}2666\ldots\ldots$
(b)	#2.2 correct conclusion with reason	#2.2 no as $0{\cdot}2666 < 3$
7(a)	●[1] circumference of circle	●[1] $\pi \times 30$
	●[2] calculate circumference	●[2] 94·2 cm
(b)	●[3] area of circle	●[3] $\pi \times 15^2$
	●[4] calculate area of circle	●[4] $706{\cdot}5\text{cm}^2$
8	●[1] areas of rectangle and triangle	●[1] $130 \times 60 = 7800$
	●[2] area of trapezium	$\frac{1}{2} \times 25 \times 60 = 750$
		●[2] 9300 cm²
9	●[1] calculate all 3 areas	●[1] 240, 700, 420
	●[2] find total area	●[2] 2720 cm²
10	●[1] volume of cylinder	●[1] $1{\cdot}5 \times 1{\cdot}2$

	●[2] correct answer	●[2] 1·8 m³
11	#2.1 correct strategy	#2.1 three further shapes drawn at least two of which are correct
12	●[1] correct intervals and tally marks ●[2] all frequencies correct	●[1] 70 – 79 (3), 80 – 89 (3), 90 – 99 (5), 100 – 109 (3) ●[2] 3, 3, 5, 3
13	●[1] calculate total time ●[2] calculate mean ●[3] find range #2.1 compare mean compare range	●[1] 188 minutes ●[2] 18·8 minutes ●[3] 14 #2.1 on average the waiting time was reduced after measures The difference between the longest and shortest time was less after measures
14	●[1] calculates angles in a pie chart ●[2] construct pie chart ●[3] label sections	●[1] 90°, 120°, 150° ●[2] pie chart drawn correct angles correct to±2 degrees ●[3] appropriate labels
15	●[1] state probability	●[1] $\frac{5}{8}$

Practice Unit Assessment (2) for Expressions and Formulae: Marking Scheme

Points of reasoning are marked # in the table.

Question	**Main Points of expected responses**	
1(a)	●[1] multiply out brackets	●[1] $8 - 12h$

2	●[1] identify common factor ●[2] factorise expression	●[1] 6 ●[2] $6(x-9)$
3	●[1] collect like terms	●[1] $4a + 4b$
4(a) **(b)**	●[1] substitute into expression ●[2] evaluate expression ●[3] substitute into expression ●[4] evaluate expression	●[1] $2 \times 4 + 3 \times 7$ ●[2] 29 ●[3] $6{\cdot}5 \times 7 + 0{\cdot}75 \times 140$ ●[4] £150.50
5(a) **(b)** **(c)**	●[1] extend sequence ●[2] complete table ●[3] begin to find formula ●[4] correct formula #2.1 valid strategy ●[5] correct solution	●[1] 10, 12, 14 ●[2] 22 ●[3] $\times 2$ ●[4] $C = 2T + 2$ #2.1 $56 = 2D + 2$ ●[5] 27
6(a) **(b)**	●[1] calculate gradient #2.2 correct conclusion with reason	●[1] $\frac{830}{7200} = 0{\cdot}11527\ldots\ldots$ #2.2 yes since $0{\cdot}1 < 0{\cdot}12 < 0{\cdot}15$
7(a) **(b)**	●[1] circumference of circle ●[2] calculate circumference ●[3] area of circle ●[4] calculate area of circle	●[1] $\pi \times 26$ ●[2] 81·64 cm ●[3] $\pi \times 13^2$ ●[4] 530·66 cm²
8	●[1] areas of rectangle and triangle ●[2] area of parallelogram	●[1] $50 \times 20 = 1000$ $\frac{1}{2} \times 25 \times 20 = 250$ ●[2] 1500 mm²
9	●[1] calculate both areas ●[2] find total area	●[1] 144, 240 ●[2] 1104 cm²
10	●[1] volume of box ●[2] correct answer	●[1] $250 \times 4{\cdot}5$ ●[2] 1125 cm³
11	#2.1 correct strategy	#2.1 three further shapes drawn

		at least two of which are correct
12	●[1] correct intervals and tally marks ●[2] all frequencies correct	●[1] 1 – 6 (1), 7 – 12 (0), 13 – 18 (3), 19 – 24 (6), 25 – 30 (4) ●[2] 1, 0, 3, 6, 4
13	●[1] calculate total weight ●[2] calculate mean ●[3] find range #2.1 compare mean compare range	●[1] 584 kilograms ●[2] 73 kilograms ●[3] 25 #2.1 on average the weight was reduced after healthy eating The difference between the longest and shortest time was less after healthy eating
14	●[1] calculates angles in a pie chart ●[2] construct pie chart ●[3] label sections	●[1] 90^o, 105^o, 135^o, 30^o ●[2] pie chart drawn correct angles correct to±2 degrees ●[3] appropriate labels
15	●[1] state probability	●[1] $\frac{13}{50}$

Practice Unit Assessment (3) for Expressions and Formulae: Marking Scheme

Points of reasoning are marked # in the table.

Question	**Main Points of expected responses**	
1(a)	●[1] multiply out brackets	●[1] $10 - 8x$
2	●[1] identify common factor ●[2] factorise expression	●[1] 6 ●[2] $6(12 - x)$

3	●[1] collect like terms	●[1] $4g + 2h$
4(a)	●[1] substitute into expression	●[1] $4 \times 7 - 3 \times 5$
	●[2] evaluate expression	●[2] 13
(b)	●[3] substitute into expression	●[3] $9{\cdot}15 \times 5 + 0{\cdot}5 \times 420$
	●[4] evaluate expression	●[4] £255.75
5(a)	●[1] extend sequence	●[1] 14, 16, 18
	●[2] complete table	●[2] 26
(b)	●[3] begin to find formula	●[3] $\times 2$
	●[4] correct formula	●[4] $W = 2B + 6$
(c)	#2.1 valid strategy	#2.1 $46 = 2B + 6$
	●[5] correct solution	●[5] 20
6(a)	●[1] calculate gradient	●[1] $\frac{3 \cdot 4}{2 \cdot 8} = 1 \cdot 214.....$
(b)	#2.2 correct conclusion with reason	#2.2 yes since $1.2 < 1.21 < 1.3$
7(a)	●[1] circumference of circle	●[1] $\pi \times 42$
	●[2] calculate circumference	●[2] 132 cm
(b)	●[3] area of circle	●[3] $\pi \times 21^2$
	●[4] calculate area of circle	●[4] 1385 cm²
8	●[1] areas of rectangle and triangle	●[1] $26 \times 25 = 650$
	●[2] area of trapezium	$\frac{1}{2} \times 25 \times 3 = 37{\cdot}5$ ●[2] 725 cm²
9	●[1] calculate both areas	●[1] $62{\cdot}4$, 36
	●[2] find total area	●[2] $232{\cdot}8$ cm²
10	●[1] volume of box	●[1] 750×5
	●[2] correct answer	●[2] 3750 cm³
11	#2.1 correct strategy	#2.1 three further shapes drawn at least two of which are correct
12	●[1] correct intervals and tally marks	●[1] 1 – 5 (1), 6 – 10 (2), 11 – 15 (7), 16 – 20 (3), 21 – 25

	●^{2} all frequencies correct	(2) ●^{2} 1, 2, 7, 3, 2
13	●^{1} calculate total weight ●^{2} calculate mean ●^{3} find range #2.1 compare mean compare range	●^{1} £152 ●^{2} £19 ●^{3} £12 #2.1 On average the tips went up. The difference between the highest and smallest tip was less after the course.
14	●^{1} calculates angles in a pie chart ●^{2} construct pie chart ●^{3} label sections	●^{1} 90º, 162º, 108º ●^{2} pie chart drawn correct angles correct to±2 degrees ●^{3} appropriate labels
15	●^{1} state probability	●^{1} $\frac{2}{5}$