



Powers and roots, transformations, constructions, Pythagoras and probability

Year 7 About 85 minutes Calculator allowed
86 marks

Name _____

Class _____

Date _____

A Before you start

Recall

You will need these in every question below.

- A1** Point P is at $(2, -1)$. Point Q is 4 units to the right of P and 3 units up from P . Write down the coordinates of Q . [1 mark]

Answer (.....,)

- A2** Write down the equation of the vertical line that passes through the point $(3, 5)$. [1 mark]

Answer

- A3** Work out 2.5×2.5 . [1 mark]

Answer

- A4** Write the fraction $\frac{18}{30}$ in its simplest form. [1 mark]

Answer

- A5** Work out $1 - \frac{3}{8}$ and $1 - 0.35$. [2 marks]

Answer and

Your teacher works through each example with you. Then try the one beside it on your own.

EXAMPLE 1

A right-angled triangle has shorter sides of 7 cm and 9 cm. Work out the length of the hypotenuse. Give your answer to 1 decimal place.

Hint Square the two shorter sides and add them. That gives the square of the hypotenuse, so take the square root at the end.

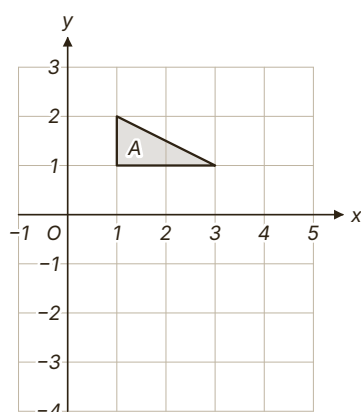
B1 A right-angled triangle has shorter sides of 6 cm and 11 cm. [3 marks]

Work out the length of the hypotenuse. Give your answer to 1 decimal place.

Answer

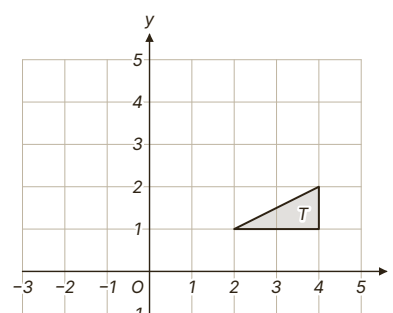
EXAMPLE 2

Rotate triangle *A* through 90° clockwise about the origin *O*. Write down the coordinates of the vertices of the image.



Hint Use tracing paper. Put your pencil on *O* and turn the paper a quarter turn clockwise. A point (x, y) moves to $(y, -x)$.

B2 Rotate triangle *T* through 90° anticlockwise about the origin *O*. Write down the coordinates of the vertices of the image. [2 marks]



Answer

EXAMPLE 3

A bag holds 5 red, 3 blue and 4 green counters. One counter is taken at random. Find the probability that it is not blue. Give your answer as a fraction in its simplest form.

Hint Count the counters that are not blue. Divide by the total number of counters.

B3 A bag holds 7 red, 2 white and 6 black counters. One counter is taken at random. Find the probability that it is not black. Give your answer as a fraction in its simplest form. [2 marks]

Answer

EXAMPLE 4

$\sqrt{60}$ lies between two whole numbers that are next to each other. Which two?

Hint List the square numbers until you pass 60. The square root lies between the roots of the two squares either side of 60.

B4 $\sqrt[3]{150}$ lies between two whole numbers that are next to each other. Which two? [2 marks]

Answer and

C Practice

Core

Each question asks for something different. Show your working.

C1 Answer both parts.

(a) Work out $3^4 - 4^3$. [2 marks]

Answer

(b) Write down both solutions of $x^2 = 324$. [1 mark]

Answer

Total for C1: 3 marks

C2 A is the point $(0, 0)$ and B is the point $(6, 0)$. A point P is exactly 5 units from A and exactly 5 units from B .

(a) P lies on the perpendicular bisector of AB . Write down the equation of this line. [1 mark]

Answer

(b) There are two possible points P . Find the coordinates of both. [2 marks]

Answer $(\dots, \dots)$ and $(\dots, \dots)$

Total for C2: 3 marks

C3 Point $A(-2, 3)$ is translated by the vector $\begin{pmatrix} 5 \\ -4 \end{pmatrix}$. Its image is A' .

(a) Write down the coordinates of A' . [1 mark]

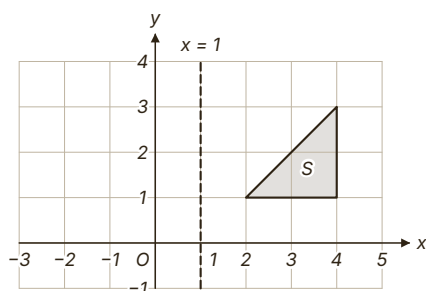
Answer $(\dots, \dots)$

(b) Write down the vector of the translation that takes A' back to A . [1 mark]

Answer

Total for C3: 2 marks

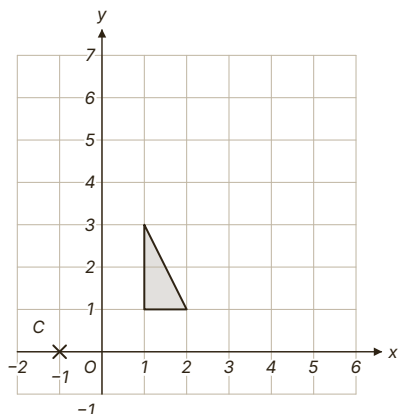
C4 Reflect shape S in the line $x = 1$. Write down the coordinates of the vertices of the image. [2 marks]



Answer

- C5** The shaded triangle is enlarged by scale factor 2, centre $C(-1, 0)$. Write down the coordinates of the vertices of the image.

[3 marks]



Answer

- C6** Ali uses compasses to construct the perpendicular bisector of a line AB . The line AB is 9 cm long.

- (a) The arcs he draws from A and from B must cross. The radius must be more than a certain length. What is that length? [1 mark]

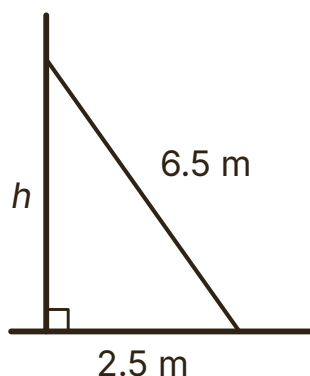
Answer

- (b) Point C is on the perpendicular bisector. $AC = 7.5$ cm. Write down the length of BC . [1 mark]

Answer

Total for C6: 2 marks

- C7** A ladder 6.5 m long leans against a vertical wall. The foot of the ladder is 2.5 m from the bottom of the wall, on level ground. How far up the wall does the ladder reach? [3 marks]



Not drawn accurately

Answer

- C8** A triangle has sides of 48 cm, 55 cm and 73 cm. Is the triangle right-angled? You must show your working. [2 marks]

Answer

- C9** A spinner is spun 80 times. It lands on red 28 times.

- (a) Work out the relative frequency of red. Give your answer as a decimal. [1 mark]

Answer

- (b) The spinner is spun 500 more times. Use your answer to part (a) to predict how many of these land on red. [1 mark]

Answer

Total for C9: 2 marks

D Test-style questions

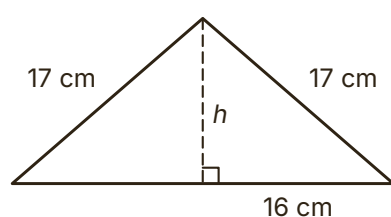
Stretch

Answer every question in the space given. Show your working: most of the marks are for method.

- D1** Sam says, " 2^5 and 5^2 are equal, because they both use a 2 and a 5." [2 marks]

Sam is wrong. Show that he is wrong.

- D2** An isosceles triangle has two sides of 17 cm and a base of 16 cm. The height h is drawn from the top to the middle of the base.



Not drawn accurately

- (a) Work out the height h . [3 marks]

Answer

- (b) Work out the area of the triangle. [1 mark]

Answer

- (c) A square has the same area as the triangle. Work out the perimeter of the square. [2 marks]
Give your answer to 1 decimal place.

Answer

Total for D2: 6 marks

D3 There are 60 people at a cinema. 35 are adults and the rest are children. 22 of the adults buy popcorn. 16 of the children do not buy popcorn.

- (a) One person is chosen at random. Find the probability that they are a child who buys popcorn. [2 marks]
Give your answer as a fraction in its simplest form.

Answer

- (b) One person is chosen at random. Find the probability that they buy popcorn. [1 mark]

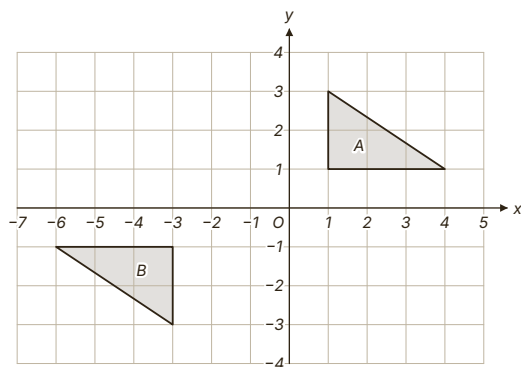
Answer

- (c) This time an adult is chosen at random. Find the probability that this adult does not buy popcorn. [2 marks]

Answer

Total for D3: 5 marks

D4 Describe fully the single transformation that maps triangle *A* onto triangle *B*. [3 marks]



Answer

D5 Point $P(7, 5)$ is enlarged with centre $(1, 2)$. Its image is $P'(3, 3)$.

(a) Work out the scale factor of the enlargement.

[2 marks]

Answer

(b) Point $Q(4, 11)$ is enlarged in the same way. Find the coordinates of its image.

[2 marks]

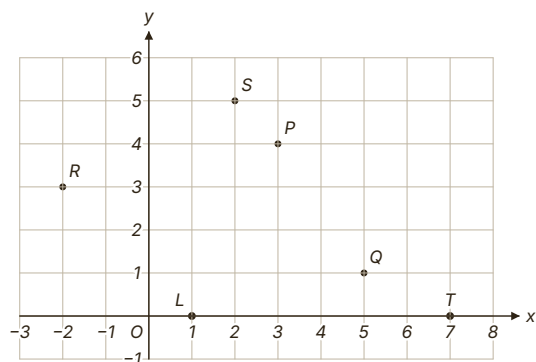
Answer (.....,)

Total for D5: 4 marks

D6 A garden is drawn on a grid. Each square is 1 m long. A lamp is at $L(1, 0)$ and a tree is at $T(7, 0)$. [4 marks]

A pond must be less than 5 m from the lamp, and closer to the lamp than to the tree.

Which of the points P , Q , R and S could be in the pond? You must show how you decide.



Answer

D7 Show that a triangle with sides of 3.6 cm, 7.7 cm and 8.5 cm is right-angled.

[2 marks]

D8 Jess rolls a six-sided dice 300 times. She gets a six 81 times.

(a) Work out the relative frequency of a six. Give your answer as a decimal.

[1 mark]

Answer

(b) If the dice were fair, how many sixes would you expect in 300 rolls?

[1 mark]

Answer

(c) Do you think the dice is fair? Give a reason.

[1 mark]

Answer

Total for D8: 3 marks

D9 A box is a cube. Its volume is 512 cm^3 . Work out the total area of its six faces.

[3 marks]

Answer

D10 A bag holds only red, blue and green counters. The probability of taking a red counter is 0.25. The probability of taking a blue counter is 0.4. There are 21 green counters in the bag.

[3 marks]

How many counters are in the bag altogether?

Answer

No route is given. Spend five minutes on a problem before you look at a hint. The hints are on the last page of the worksheet, and you can use one at a time.

- E1** Two square numbers are next to each other in the list of square numbers. Their difference is 37. What is the larger of the two square numbers? [3 marks]

Answer

- E2** A rectangle has a perimeter of 34 cm. Its diagonal is 13 cm long. What is the area of the rectangle? [4 marks]

Answer

- E3** A bag holds only red and blue counters. The probability of taking a red counter is $\frac{3}{7}$. Six more red counters are put in the bag. Now the probability of taking a red counter is $\frac{3}{5}$. [4 marks]
How many blue counters are in the bag?

Answer

- E4** A point P is reflected in the line $x = 3$. The image is then reflected in the line $y = 1$. [3 marks]
The final point is $(-4, 6)$. Find the coordinates of P .

Answer (.....,)

F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can work out squares, cubes, square roots and cube roots, and say which two whole numbers a root lies between.	☐	☐	☐
I can translate, reflect, rotate and enlarge a shape on a grid, and describe a transformation fully.	☐	☐	☐
I can use a perpendicular bisector and the distance from a point to decide where a locus or a region is.	☐	☐	☐
I can use Pythagoras' theorem to find a missing side and to test whether a triangle is right-angled.	☐	☐	☐
I can find a probability from counts or a two-way table, and use relative frequency to make a prediction.	☐	☐	☐

Extension hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

E1	Hint 1	Try some pairs of square numbers that are next to each other, such as 16 and 25, and look at their differences.
	Hint 2	The differences go 3, 5, 7, 9, ... The difference between n^2 and the square before it is $2n - 1$.
	Hint 3	$2n - 1 = 37$, so $n = 19$. The larger square is $19^2 = 361$.

E2	Hint 1	Call the sides a and b . Write down what the perimeter tells you, and what Pythagoras tells you about the diagonal.
	Hint 2	$a + b = 17$ and $a^2 + b^2 = 169$. Try whole numbers that add to 17.
	Hint 3	$5 + 12 = 17$ and $5^2 + 12^2 = 25 + 144 = 169$. So the sides are 5 cm and 12 cm, and the area is 60 cm^2 .

E3	Hint 1	The number of blue counters does not change. Write the first bag as $3k$ red and $4k$ blue.
	Hint 2	After adding 6 red, the bag has $3k + 6$ red out of $7k + 6$ counters, and this fraction equals $\frac{3}{5}$.
	Hint 3	$5(3k + 6) = 3(7k + 6)$ gives $15k + 30 = 21k + 18$, so $k = 2$. There are $4k = 8$ blue counters. Check: $\frac{12}{20} = \frac{3}{5}$.

E4	Hint 1	Work backwards from the final point, undoing the last reflection first.
	Hint 2	Reflecting $(-4, 6)$ in $y = 1$ gives $(-4, -4)$, since 6 is 5 above the line.
	Hint 3	Reflecting $(-4, -4)$ in $x = 3$ gives $(10, -4)$, since -4 is 7 to the left of the line. So P is $(10, -4)$.