THE BRITISH INTERNATIONAL SCHOOL ABU DHABI

A NORD ANGLIA EDUCATION SCHOOL

Year 9 Maths

Topic 10–11–12 Workbook

In the table below translate the key terms into your home language and write a short definition for each term [if needed visit www.mathsisfun.com/definitions/].

TOPIC 10 – INEQUALITIES		
Inequalities		
Number Line		
Interval		
Integer		
TOPIC 11 – TRANSFORMATION GEOMETRY		
Translation		
Reflection		
Rotation		
Enlargement		
Scale Factor		
TOPIC 12 - MEASURES		
Speed		
Distance		
Time		
Density		
Pressure		

Inequalities

1. Write down the inequality that represents each of the following statements.

n is less than 6 ..... n is greater than or equal to 6 .....

2. Safia is thinking of a number, S. It is between 20 and 30, but not equal to either.

Which of these inequalities does S satisfy? Circle your answer.

$20 < S < 30$ $20 \leq S < 30$ $20 < S \leq 30$ $20 \leq S \leq 30$

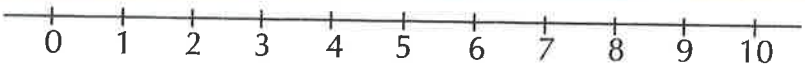
3. List all the positive integer values of p that satisfy these inequalities.

An integer is just any whole number.

$p \leq 4$ ..... $p < 6$ .....

$2 < p \leq 5$ ..... $1 \leq p \leq 3$ .....

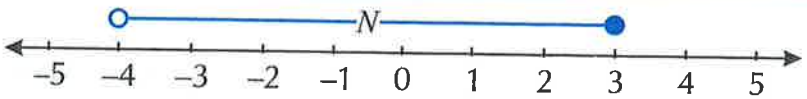
4. The value of x is a whole number. Use the number line below to answer these questions.



a) (i) Underline all values of x such that $x < 7$. (ii) Circle all values of x such that $x \geq 3$.

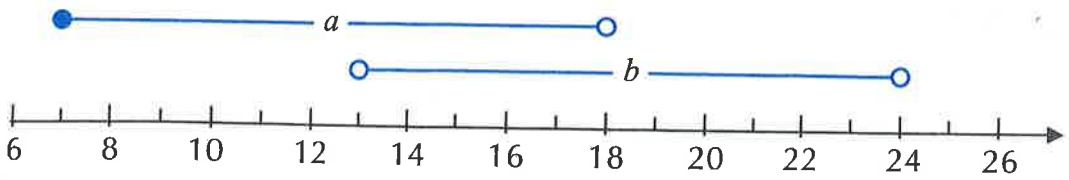
b) Write down an inequality for the values, x, that are both underlined and circled. .....

5. Fill in the boxes with the correct inequality signs to represent the interval shown below.



$-4 \square N \square 3$

6. For each of the intervals shown, write down the equivalent inequality.

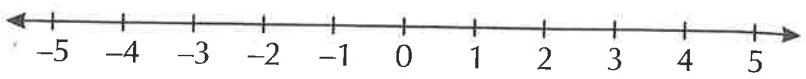


a: ..... b: .....

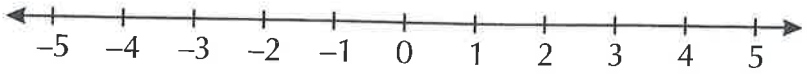
Inequalities

7. Show each of these inequalities on the number lines provided.

a) (i) $-2 \leq x < 3$



(ii) $-3 < x \leq 2$



b) Write down an inequality for the values, x, that satisfy both of the inequalities from part a). .....

8. Joey is thinking of a number, y. It is positive and less than 10.

0 is neither positive nor negative.

a) Write down an inequality to show the possible values of Joey's number. .....

b) Which of these could be Joey's number? Tick all possible answers.

☐ −2 ☐ 0 ☐ $\frac{1}{2}$ ☐ 9.99 ☐ 10

9. List all the positive integers, n, that satisfy the inequality $n + 2 < 7$.

.....

10. Solve these inequalities.

a) $w + 1 \leq 5$

.....

b) $6 - x > 5$

.....

c) $-5 < y - 1$

.....

d) $2z - 1 \geq 1$

.....

How did you do?

Inequalities are like equations — but they have a whole range of possible solutions. Before you move on, you should be able to:

- ☐ **Write inequalities to represent a range of values.**
- ☐ **Find the solutions to inequalities.**
- ☐ **Draw and interpret inequalities on number lines.**

Inequalities

Inequalities are a handy way of showing a range of values. Make sure you know what the symbols >, <, ≤ and ≥ mean — they're pretty important. Oh the joys of maths...

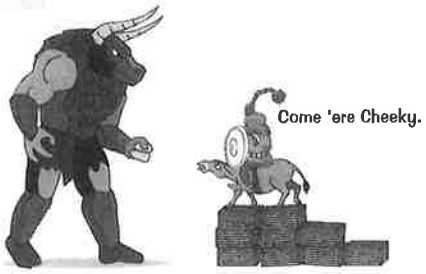
Q1 Write down all the possible values of x in the following inequalities.

a) x is a positive integer such that $x \leq 2$

b) x is a negative integer such that $x \geq -6$

c) x is a positive integer such that $x < 5$

d) x is a negative integer such that $x > -4$



Q2 If n is an integer, write down all the values of n that satisfy the following inequalities.

a) $2 < n < 7$

b) $2 \leq n \leq 7$

c) $2 < n \leq 7$

d) $21 \leq n \leq 25$

e) $8 < n < 9.5$

f) $-2 < n < 4$

g) $-3 < n < 2$

h) $-7 \leq n \leq -3$

Q3 Show on a number line all values of n that obey these inequalities.

a) $n < 4$

b) $n > 1$

c) $4 < n \leq 8$

d) $0 \leq n \leq 6$

e) $-1 < n \leq 5$

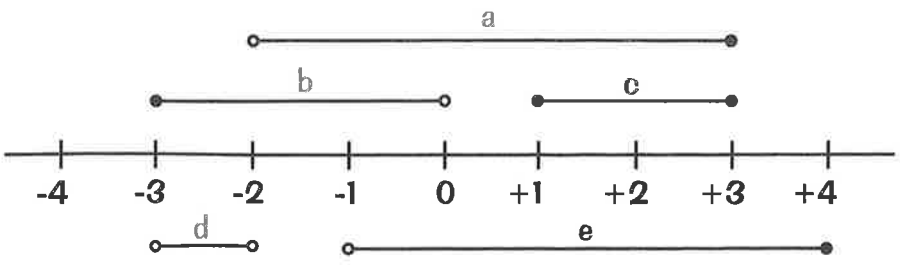
f) $0.1 < n < 1.7$

g) $-3.5 < n < 1.5$

h) $1234 < n \leq 1237$

Remember — use an open circle for < and a filled-in one for ≤.

Q4 Express using inequality signs, the range of values for each of the variables a, b, c, d, e, shown on this number line:



Q5 A boat can carry a legal maximum of 200 passengers. If fewer than 30 people turn up for a pleasure trip, a profit will not be made. If n is the number of passengers on a trip, write down an inequality statement for n, if the voyage is to be legal and profitable.

Inequalities

C **1** (a) $-3 < n \leqslant 2$

n is an integer.

Write down all the possible values of n.

Guided

n could be -2, ..., ..., ..., 2 **(2 marks)**

(b) Solve the inequality $4x - 3 > 21$

Exam questions similar to this have proved especially tricky – be prepared! ResultsPlus

Guided

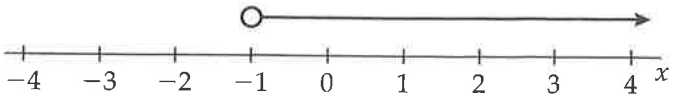
EXAM ALERT

$4x - 3 > 21$

$4x >$ .....

$x >$ ..... **(2 marks)**

B **2** (a) An inequality is shown on the number line.



Write down the inequality.

..... **(2 marks)**

(b) Solve the inequality $5x + 1 \leqslant 3x - 17$

..... **(2 marks)**

B **3** (a) Solve the inequality $2 - 4y > 12 - y$

Guided

$2 > 12$ ..... Add $4y$ to each side.

..... $>$ .....y Subtract 12 from each side.

..... $> y$ **(2 marks)**

(b) y is an integer.

Write down the largest value of y that satisfies $2 - 4y > 12 - y$

$y =$ ..... **(1 mark)**

A **4** Solve $-2 < \frac{3x}{5} < 7$

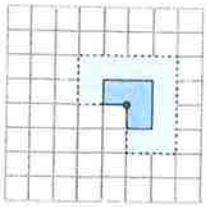
Solve the two equations $-2 < \frac{3x}{5}$ and $\frac{3x}{5} < 7$

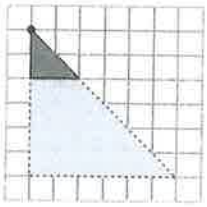
..... **(3 marks)**

Transformations

1. Each shape below has been enlarged from a centre of enlargement marked by a dot. The shapes with the dashed lines represent the enlarged shape.

Draw lines to match each enlargement with the correct scale factor.





Scale factor 2

Scale factor 3

Scale factor 4

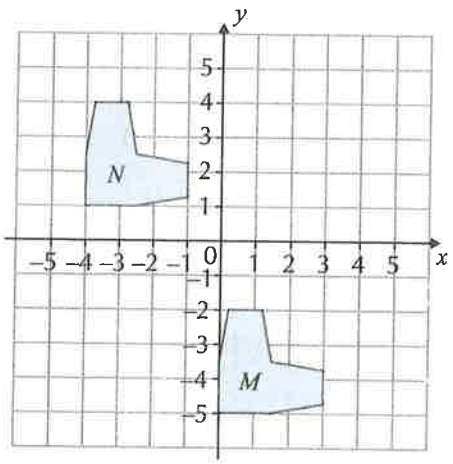
2. Write down the vector for the translations of:

a) M to N

.....

b) N to M

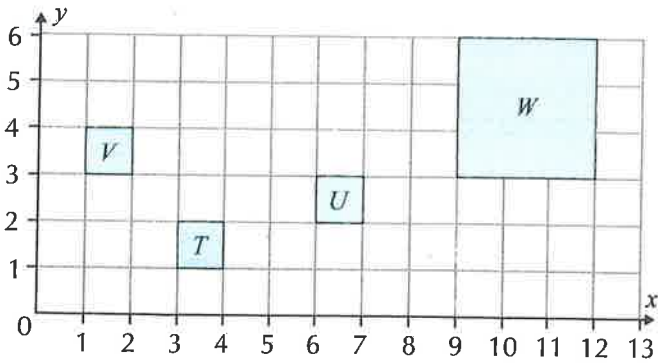
.....



3. Look at the grid on the right.

a) Square V is a reflection of square T. What is the equation of the mirror line for this reflection?

.....



b) Describe the rotation that would map square V onto square U. The coordinates of the centre of rotation are whole numbers.

.....

c) Describe the enlargement that would map square T onto square W.

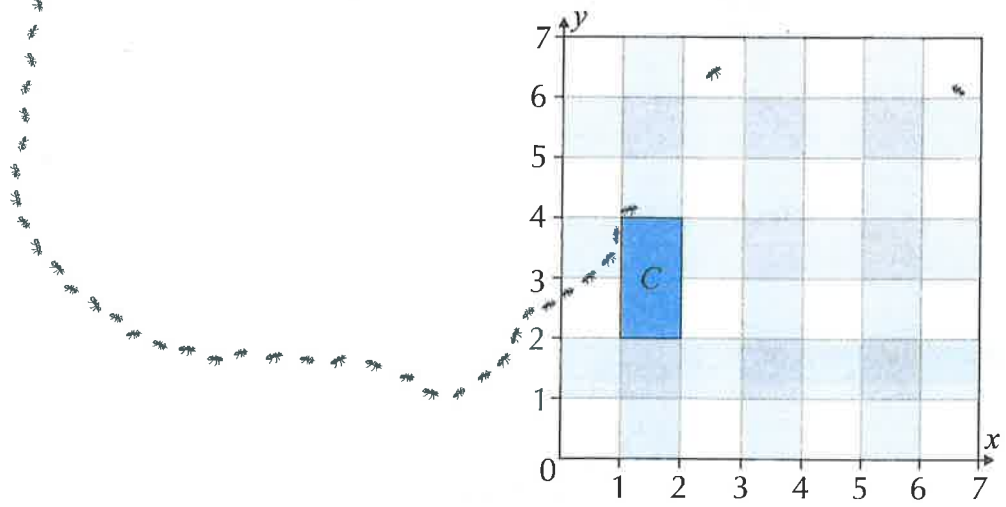
.....

Transformations

4. Amaya and Marshall are having a picnic on a chequered blanket when a trail of ants invades.

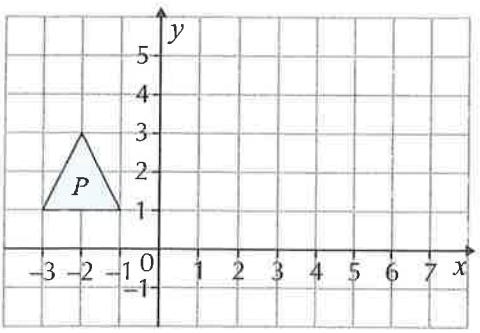
The ants move a box of cherries (C) so that, relative to the origin, it is translated by the vector $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$, and then by the vector $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$.

Draw the new position of the box on the grid below. Label it D.



5. Reflect triangle P in the line $x = 2$ on the grid below.

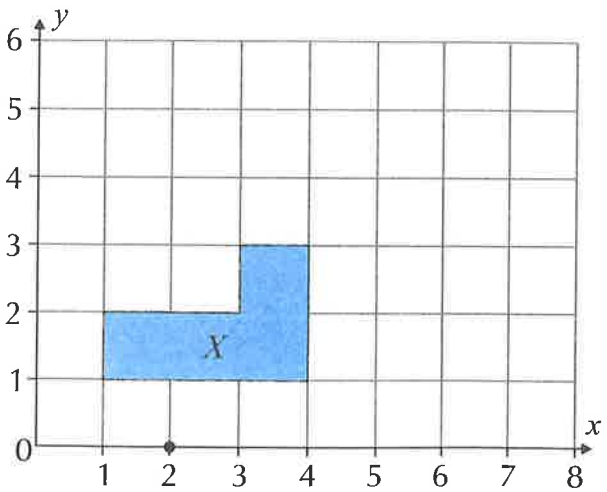
Label the new triangle Q.



6. Look at shape X on the right.

a) Enlarge shape X by scale factor 2 using the marked centre of enlargement at (2, 0). Label the new shape Y.

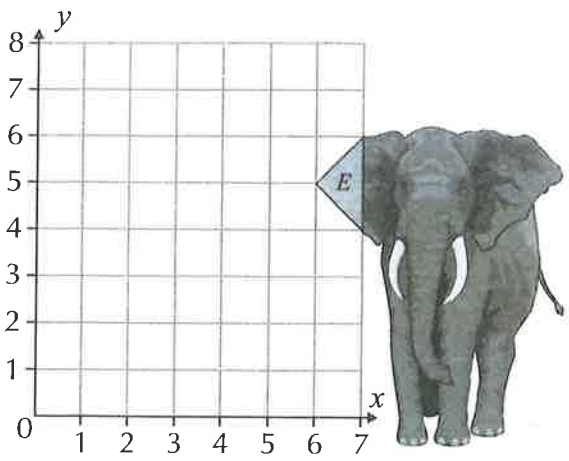
b) Translate shape X by the vector $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$. Label the new shape Z.



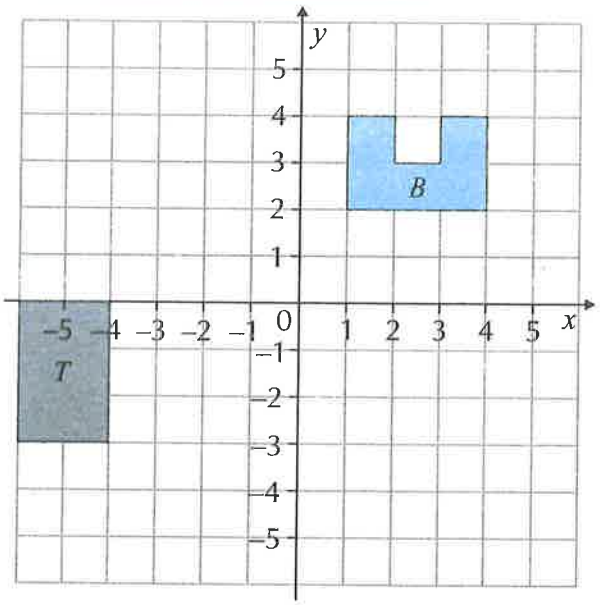
Transformations

7. The ear of the elephant below has been drawn on this grid.

Enlarge the elephant's ear, E, on the grid by scale factor 3 and with centre of enlargement (7, 6). Label the enlarged ear F.



8. Dr. Eve L. Genius is sitting in her office on her chair, B.



a) Dr. Genius rotates her chair 90° clockwise about the origin. Draw the chair after the rotation. Label it C.

b) She then pushes the rotated chair, C, so that it is translated by the vector $\begin{pmatrix} -7 \\ -1 \end{pmatrix}$. Does she collide with the table, T? Circle your answer.

Yes / No

How did you do?

What a transformational topic. Before you translate your knowledge onto the next page, rotate your head down and reflect on how you've enlarged your skills over these pages... Make sure you can:

- ☐ **Identify and describe translations, rotations, reflections and enlargements.**
- ☐ **Construct and carry out translations, rotations, reflections and enlargements.**

Transformations

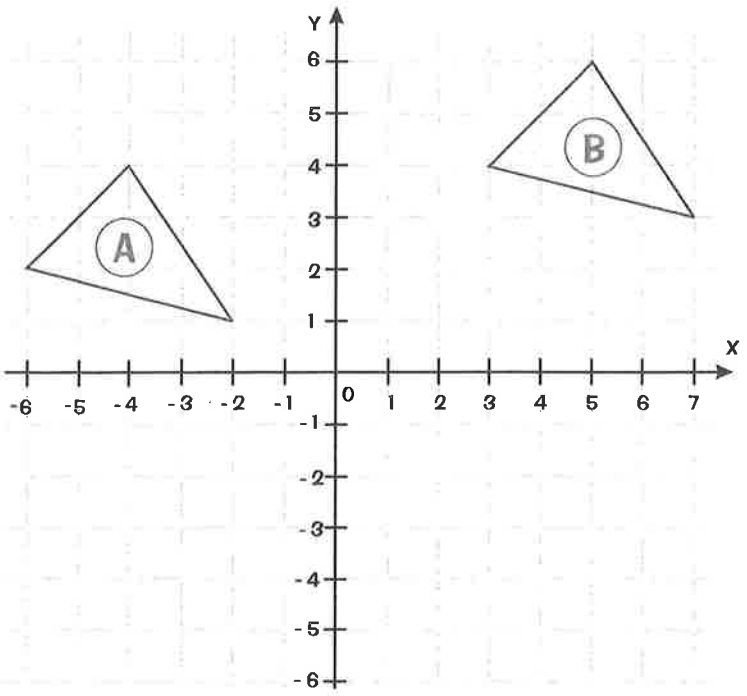
Transformations — the most fun you can have with a pencil and paper.
There are 4 different transformations — translation, reflection, rotation and enlargement.
You'll need to know them all, so practise, practise, practise...

Q1 Triangle B is the translation of triangle A by the vector $\begin{pmatrix} 9 \\ 2 \end{pmatrix}$
(9 units in the positive x-direction, 2 units in the positive y-direction).

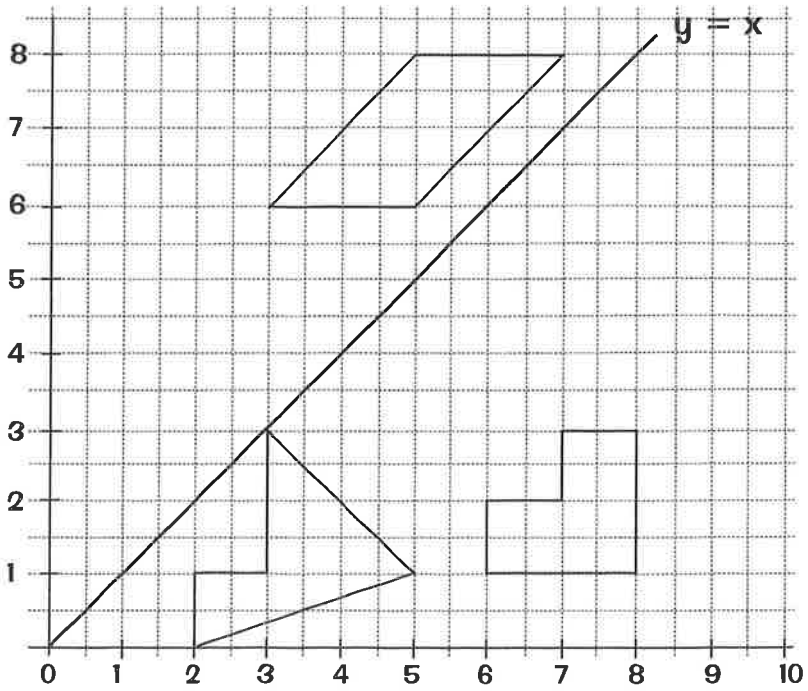
a) Translate A by the vector $\begin{pmatrix} 6 \\ -4 \end{pmatrix}$.
Label the result C.

b) Translate A now by the vector $\begin{pmatrix} 0 \\ -6 \end{pmatrix}$.
(This will be a movement parallel to the y-axis). Label the result D.

Make sure you get the vector numbers the right way round.



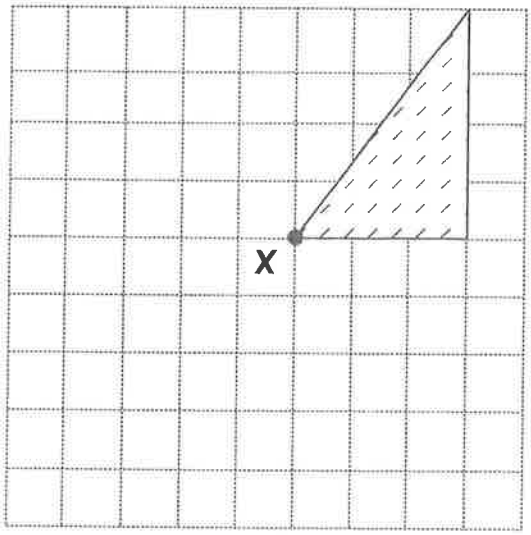
Q2 Reflect each shape in the line $y = x$.



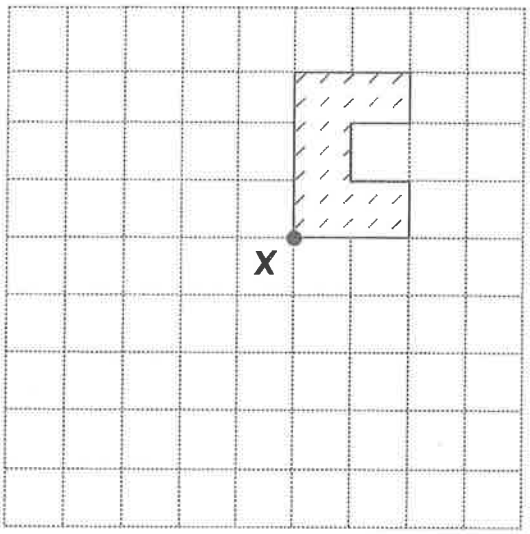
Transformations

Q3 The centre of rotation for each of these diagrams is X. Rotate each shape as asked then draw the new position of the shape onto each of the diagrams below.

a) 180° clockwise.



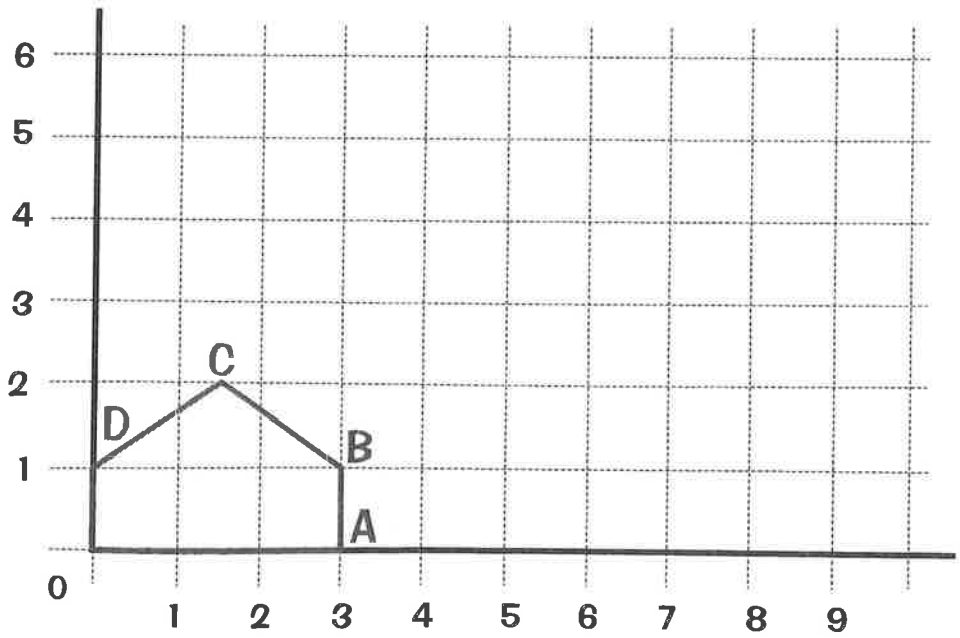
b) 270° anticlockwise.

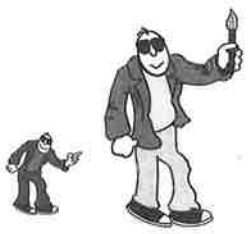


Q4 Using the origin (0, 0) as the centre of enlargement:

a) Enlarge shape ABCD by a scale factor of 2, and label the new shape A′B′C′D′.

b) Enlarge shape ABCD by a scale factor of 3, and label the new shape A″B″C″D″.





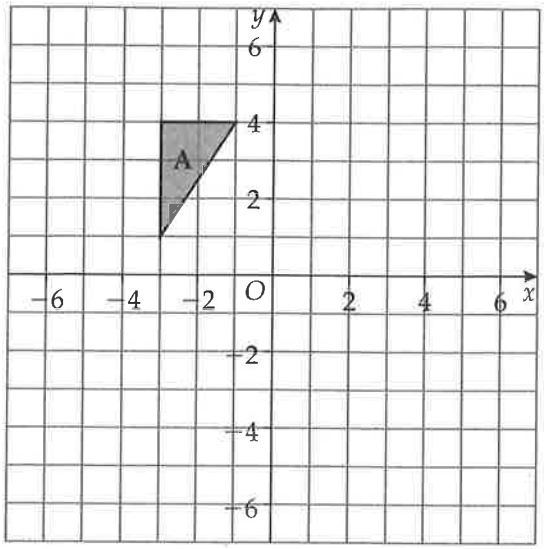
Remember — a scale factor of 2 means each point on the new shape is twice as far from the centre of enlargement as the same point on the original shape.

Translations, reflections and rotations

C 1 (a) On the grid, translate triangle **A** by $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$.
Label the new triangle **B**.

$\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ means 4 units to the right and 3 units down.

(2 marks)



(b) On the grid, rotate triangle **A** 180° about (0, 0).
Label the new triangle **C**.

Use tracing paper to help with the rotation.

(2 marks)

C 2 (a) Describe fully the single transformation that will map triangle **A** onto triangle **B**.

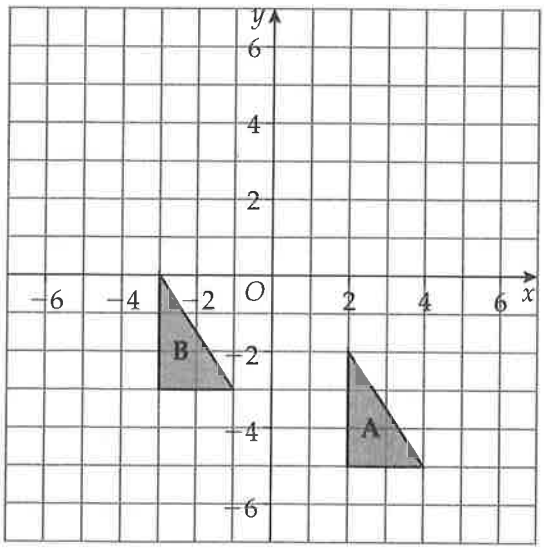
EXAM ALERT

Exam questions similar to this have proved especially tricky – be prepared! ResultsPlus

.....

.....

(2 marks)



(b) On the grid, rotate triangle **A** 180° about (1, 0).
Label the new triangle **C**.

(2 marks)

(c) On the grid, reflect triangle A in the line $y = 1$
Label the new triangle **D**.

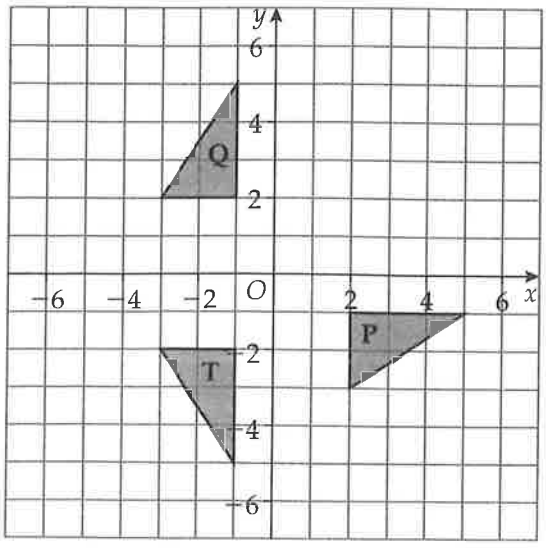
(2 marks)

C 3 (a) Describe fully the single transformation that will map triangle **P** onto triangle **Q**.

.....

.....

(2 marks)



(b) Describe fully the single transformation that will map triangle **P** onto triangle **T**.

.....

.....

(3 marks)

Speed

1. A footballer sprints down the length of a 90 m pitch in 18 seconds.

Circle their speed in m/s.

7 m/s 5 mph 0.2 m/s 2 mph 5 m/s

2. An otter swims at a speed of 0.4 m/s.

a) How far can it swim in 45 seconds?

..... m

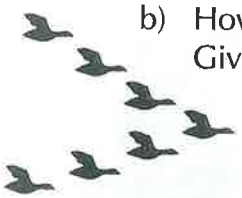
b) How far can it swim in 5 minutes?

..... m

3. It takes a gaggle of geese 2 hours and 15 minutes to fly 99 miles.

a) What was the average speed of the geese in mph?

..... mph



b) How long would it take for the geese to fly 70 miles at the same speed?
Give your answer to the nearest minute.

..... minutes

4. Yvette wants to catch a bus that leaves at 8:20 pm.

She sets off from her friend's house at 8:07 pm and walks at an average speed of 6.6 km/h.
Her friend lives 1650 metres from the bus stop.

a) How long does it take Yvette to reach the bus stop?

..... minutes

b) Does she reach the bus stop in time to catch the bus?
Circle the correct answer.

Yes / No

How did you do?

"Gary, I don't think we're going the right way..."
Oh Gary — he does this every year. By now you should:

☐ **Know the formula that links speed, distance and time.**

☐ **Be able to substitute values into the formula to solve speed problems.**

 ☐  ☐  ☐

Speed

Whoever came up with formula triangles was a genius — they make questions like these really easy... just cover up the thing you want and the triangle tells you what do.

Q1 Calculate the average speeds in the following cases, being careful to give appropriate units with your answer:

a) a car going 180 miles in 4 hours .....

b) a hiker walking 24 miles in 6 hours .....

c) a train going 770 km in 7 hours .....

d) a plane flying 3300 km in 6 hours .....

e) a spaceship going 525 000 miles in 3 hours .....

Q2 Calculate the distance travelled in the following cases:

a) a soggy pea moving at 6 m/s for 5 seconds .....

b) a snail moving at 0.5 cm/s for 120 seconds (give your answer in metres) .....

c) a dolphin swimming at 4.5 m/s for 15 minutes .....

This is easier if you convert the minutes into seconds first.

Q3 Calculate the time required for following journeys:

a) 120 miles by train from London to Bristol, at an average speed of 80 mph.

.....

b) 49 km by car from Worcester to Birmingham, at an average speed of 70 km/h.

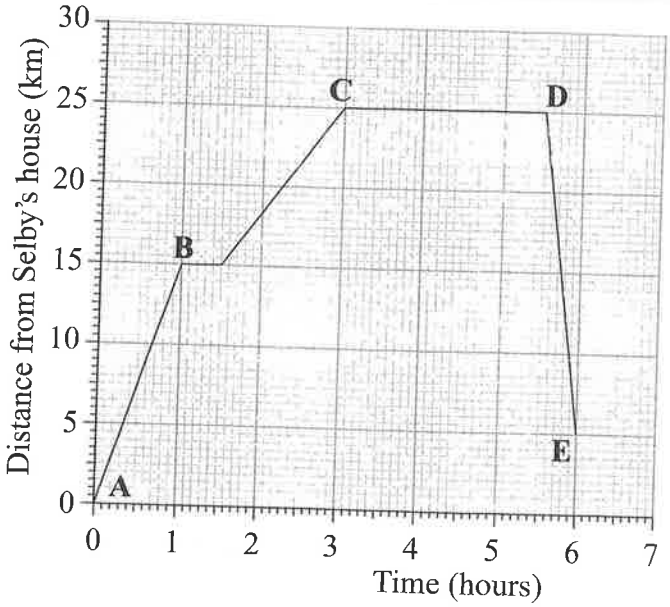
.....

c) 4200 miles from Europe to America by plane at 600 mph.

.....

Distance-Time Graphs

1 The distance/time graph below shows Selby's bike ride from his house (**A**) to the zoo (**C**), which is 25 km away. (D)



a) After one hour Selby stops at a bench (**B**) to get his breath back. Find the gradient of the line between point **A** and point **B**.

.....

[2]

b) What does the gradient of the line between point **A** and point **B** represent?

.....

[1]

c) How long was Selby's journey to the zoo (**C**) from home (**A**)?

..... hours

[1]

d) How long did Selby spend at the zoo?

..... hours

[1]

e) After the zoo, Selby stopped at the shops (**E**) for 30 minutes before cycling straight home. Given that he arrived home 7 hours after he first left, complete the graph above.

[2]

f) How many hours did Selby spend cycling in total during the day?

..... hours

[1]

[Total 8 marks]

Score: ☐ / **8**

Density

On this page, you'll need the formula density = $\frac{\text{mass}}{\text{volume}}$.

1. The density of cork is 0.24 g/cm^3.

If a cork stopper from a bottle has a volume of 19.6 cm^3, what is its mass in grams to 1 d.p.?

..... g

2. An iron bar has a mass of 7500 g and a density of 7.87 g/cm^3.

What is the volume of the iron bar in cm^3 to 2 s.f.?

..... cm^3

3. A paddling pool can be filled with up to 1.28 m^3 of water. When completely full, the total mass of the pool and the water is 1285 kg. When empty, the pool has a mass of 5 kg.

a) Use this information to find the density of water.

Start by working out the mass of the water in the pool.

..... kg/m^3

b) The pool is partially filled so that the volume of water in the pool is 0.95 m^3. What is the mass of the water?

..... kg

4. A sculpture is being built out of steel and concrete.

a) The steel frame of the sculpture is built with a volume of 0.2 m^3. Steel has a density of 8050 kg/m^3. Calculate the mass of the steel frame.

..... kg

b) Concrete is then added and fixed around the frame. The mass of the concrete is 4800 kg and its density is 2400 kg/m^3.

(i) Calculate the volume of the concrete.

..... m^3

(ii) What is the total volume of the sculpture?

..... m^3

How did you do?

This page shouldn't make you feel dense... You can use the formula triangle to help you remember the formula for density — just like you do for speed. Right, make sure that you:

- ☐ **Know the formula that links density, mass and volume.**
- ☐ **Can substitute values into the formula to solve density problems.**

Density and Speed

Whoever came up with formula triangles was a genius — they make questions like these really easy... just cover up the thing you want and the triangle tells you what to do.

Q1 Calculate the average speeds in the following cases, being careful to give the answer in appropriate units:

a) a car going 180 miles in 4 hours

b) a hiker walking 26 miles in 8 hours

c) a train going 725 km in 5.8 hours

d) a plane flying 3500 km in 5.6 hours

e) a rocket going 240 km in 30 seconds

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Q2 Calculate the time required for the following journeys:

a) by train from London to Bristol, 118 miles, at an average speed of 92 mph (2 d.p.)

b) by car from Worcester to Birmingham, 49 km, at an average speed of 60 km/h (2 d.p.)

c) 3500 miles from Europe to America by plane at 560 mph.

Q3 Calculate the distance travelled in the following cases:

a) a soggy pea moving at 25 m/s for 18.5 seconds

b) a snail moving at 0.3 cm/s for 2 minutes (give answer in metres.)

c) a river flowing at 4.5 m/s for 24 hours (give answer in km.)

Q4 Use the density formula triangle to answer the following:

a) A small block of silver has a volume of 4.5 cm^3 and a mass of 47.25 g. Calculate the density of the silver.

b) Mercury has a density of 13.6 g per cm^3. Calculate the mass of 6.5 cm^3 of mercury.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

c) The density of gold is 19.3 g/cm^3. Find the volume of a lump of gold with mass 57.9 g.

d) The average density of a type of quartz (a crystalline rock) is 2.6 g per cm^3. What will be the mass of a lump of quartz of volume 64 cm^3?

e) Ice has a density of about 0.9 g per cm^3. What volume of ice will be produced when 810 ml of water freezes? (Take 1 ml = 1 cm^3 and the density of water as 1 g per cm^3.)

Q5 The mean density of the Earth is about 5.52 g per cm^3. That of the Moon is only 3.34 g per cm^3.

a) If the Earth had the same volume as the Moon, how many times heavier than the Moon would it be? Give your answer to 2 sf.

You haven't been given the volume, so just call it V and it'll cancel out later on. It will, trust me.

b) In fact, the Earth has a volume about 49 times that of the Moon. How many times heavier is the Earth compared with the Moon? Give your answer to 2 sf.

This time, call the volume of the Moon V and the volume of the Earth 49V... the V still cancels out nicely.