Higher Unit 18: Vectors and geometric proof

Numerical fluency

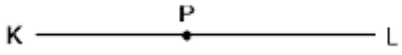
1 AB = $\frac{3}{4}$AC

Work out

a AB : AC ..... **b** AB : BC ..... **c** BC : AC .....

Let AC = 4 units
AB = ☐ units
BC = ☐ units

2 The point P divides the line KL in the ratio 3 : 4.
Complete



a KP = ... KL **b** PL = ... KL **c** KL = ... KP

3 parts + 4 parts = ☐ parts,
so KL = ☐ parts
KP = ☐ parts
PL = ☐ parts

3 Write each surd in its simplest form.

a $\sqrt{44} = \sqrt{2^2 \times 11} = \sqrt{2^2} \times \sqrt{11} =$ ..... $\sqrt{11}$ **b** $\sqrt{48}$ ..... **c** $\sqrt{175}$ .....

Algebraic fluency

4 Simplify

a $3a + 2b + 4a = 3a + 2b + 4a = 3a + 4a + 2b =$ .....

b $4p + 3c + 7p$ ..... **c** $3x + 6y + 5x + y$ .....

d $5x + 3y - x = 5x - x + 3y =$ ..... $x + 3y$ **e** $6p + 5q - 2p - 3q$ .....

Like terms contain the same letter (or contain no letter). For example, $5x$ and $7x$ are like terms, but $4x$ and $3y$ are not like terms. You can simplify an expression by collecting like terms.

5 Multiply out the brackets.

Multiply everything inside the brackets by 2.

a $2(4h + 3)$ ..... **b** $0.5(6t + 2)$ ..... **c** $2.5(2y - 4)$ .....

6 Expand and simplify

a $5(x + 3) + 2(x - 7) = 5x +$ ..... $+ 2x -$ ..... $= 7x +$ .....

b $3(a + 2) - 2(a + 5) = 3a +$ ..... $- 2a -$ ..... $= a -$ .....

c $3(y - 3) + 2(y + 5)$ ..... **d** $3(x + 2y) + 2(2x + y)$ .....

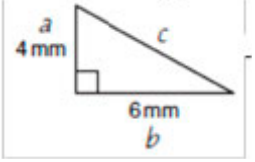
e $4(2p + q) + \frac{1}{2}(4p + 6q)$ ..... **f** $3(3c - 2d) + \frac{2}{3}(3c + 6d)$ .....

Expand the brackets, then collect like terms.

Geometrical fluency

7 Work out the length of the hypotenuse in each of these right-angled triangles, correct to the nearest mm.

a



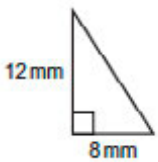
Label the hypotenuse c and the other sides a and b. Substitute $a = 4$ and $b = 6$ into the formula for Pythagoras' theorem, $c^2 = a^2 + b^2$. Then solve the equation.

$c^2 = a^2 + b^2 = 4^2 + 6^2$

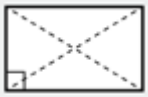
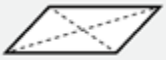
$= 16 +$ ..... $=$ .....

$c = \sqrt{.....} =$ ..... mm (to the nearest mm)

b



The properties of a shape are facts about its sides, angles, diagonals and symmetry.
Here are some of the properties of some well-known quadrilaterals.

Square 	• all sides are equal in length • opposite sides are parallel • all angles are 90° • diagonals bisect each other at 90°	Rectangle 	• opposite sides are equal in length • opposite sides are parallel • all angles are 90° • diagonals bisect each other
Rhombus 	• all sides are equal in length • opposite sides are parallel • opposite angles are equal • diagonals bisect each other at 90°	Parallelogram 	• opposite sides are equal in length • opposite sides are parallel • opposite angles are equal • diagonals bisect each other
Kite 	• 2 pairs of sides are equal in length • no parallel lines • 1 pair of equal angles • diagonals bisect each other at 90°	Trapezium 	• 1 pair of parallel sides
		Isosceles trapezium 	• 2 sides are equal in length • 1 pair of parallel sides • 2 pairs of equal angles

8 On each shape below:

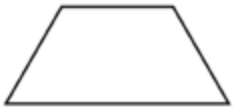
- Mark equal sides with dashes. Use double dashes for a second pair of equal sides.
- Mark equal angles with arcs. Use double arcs for a second pair of equal angles.
- Mark right angles.
- Mark parallel sides with arrows. Use double arrows for a second pair of parallel sides.
- Name the shape.

a 

b 

c 

d 

e 

f 

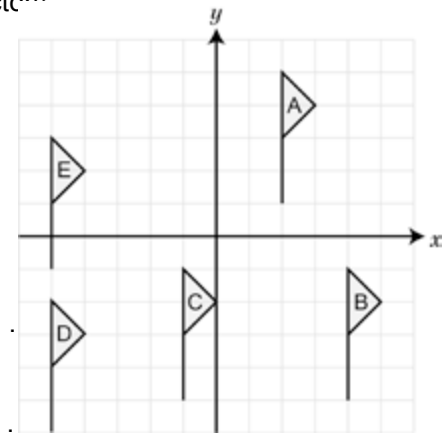
g 

.....

9 Describe these translations using column vectors.

a A to B $\begin{pmatrix} \cdots \\ \cdots \end{pmatrix}$ **b** B to C $\begin{pmatrix} \cdots \\ \cdots \end{pmatrix}$

c D to C $\begin{pmatrix} \cdots \\ \cdots \end{pmatrix}$ **d** E to C $\begin{pmatrix} \cdots \\ \cdots \end{pmatrix}$



10 On the grid in **Q9**

a Translate flag A by the column vector $\begin{pmatrix} -4 \\ 0 \end{pmatrix}$.
Label the image P.

b Translate flag E by the column vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.
Label the image Q.

You can describe a translation using a column vector.
The column vector for a translation 3 squares left,
2 squares up is $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$.
The top number in the column vector gives the horizontal movement.
The bottom number gives the vertical movement.

Higher Unit 18 answers

1 **a** 3 : 4

b 3 : 1

c 1 : 4

2 **a** $\frac{3}{7}$

b $\frac{4}{7}$

c $\frac{7}{3}$

3 **a** $2\sqrt{11}$

b $4\sqrt{3}$

c $5\sqrt{7}$

4 **a** $7a + 2b$

b $3c + 11p$

c $8x + 7y$

d $4x + 3y$

e $4p + 2q$

5 **a** $8h + 6$

b $3t + 1$

c $5y - 10$

6 **a** $7x + 1$

b $a - 4$

c $5y + 1$

d $7x + 8y$

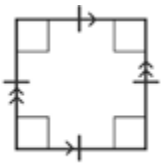
e $10p + 7q$

f $11c - 2d$

7 **a** 7 mm

b 14 mm

8 **a**



Square

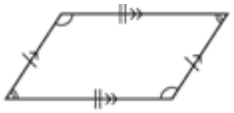
b

Kite/arrowhead

c

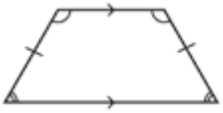
Rectangle

d



Parallelogram

e



Trapezium

f

Trapezium

g

Kite

9 **a** $\begin{pmatrix} 2 \\ -6 \end{pmatrix}$

b $\begin{pmatrix} -5 \\ 0 \end{pmatrix}$

c $\begin{pmatrix} 4 \\ 1 \end{pmatrix}$

d $\begin{pmatrix} 4 \\ -4 \end{pmatrix}$

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