- 2D
  - 1. **scaffold to** write down the mathematical name of a polygon **scaffold is** reminder to count sides and look up table of number of sides and polygon names
  - 2. circle: recognise or count or write down the name
  - 3. triangle: recognise or count or write down the name
  - 4. square or rectangle: recognise or count or write down the name {NOT that square is special type of rectangle}
  - 5. pentagon or hexagon: recognise or count or write down the name
- 7. equilateral, isosceles, right, scalene: recognise or count or write down the name
- 10. mixed polygons: 5, 6, 8 or 10 sides: write down the name
- 11. parts of circles: centre, circumference, diameter, radius: write down the name

3D

- 1. use words: solid, flat, 2D and 3D to describe shapes or solids
- 2. cube: recognise or count or write down the name
- 3. cuboid or sphere: recognise or count or write down the name
- 4. cone or cylinder: recognise or count or write down the name
- 6. **scaffold to** name prism or pyramid **scaffold is** given one prism and one pyramid with similar base from similar view point
- 7. scaffold to work out the surface area of cuboid scaffold is given net
- 8. 3D solid: write down the mathematical name
- 9. 3D net: name solid
- 10. count the number of edges, faces, vertices and name e.g. the edge AB or the face ABCD
- 12. plan, side and front elevations: recognise solid from or draw or complete {for solids other than a cuboid}

angle

- 3. name these types of angle: acute, obtuse, reflex
- 4. use whole turn =  $360^{\circ}$ : to calculate a missing angle {and give reason}
- 5. use straight line =  $180^{\circ}$ : to calculate a missing angle {and give reason}
- 6. use angles in triangle =  $180^{\circ}$ : to calculate a missing angle {and give reason}
- 7. use angles in quadrilateral =  $360^{\circ}$ : to calculate a missing angle {and give reason}
- 8. use conventional angle naming e.g. ABC to solve missing angle problems {use skills from layers 4 to 7}

#### area

- 1. scaffold to state area shape {whole number of  $cm^2$ } scaffold is given example
- 2. scaffold to work out the area of rectangle scaffold is easy to count squares
- 3. work out the area of irregular shape {by counting squares}
- 4. **scaffold to** work out the area of rectangle **scaffold is** example which leads from systematically counting squares to using a multiplication table
- 5. scaffold to work out the area of rectangle scaffold is given multiplication table
- 6. work out the area of irregular shape or triangle {by counting squares and half squares}
- 7. work out the area of rectangle {partially obscured rectangle so hard to be accurate without using multiply}
- 8. work out the area of rectangle {width and height labelled, no square grid, so not possible to count squares}
- 10. work out the area of parallelogram
- 12. work out the area of right triangle {can't count 1/2 squares}

# changeUnits

- 1. **scaffold to** convert cm to mm **scaffold is** correctly aligned measuring stick marked in cm on one edge, the other edge has 10 mm marked on correctly
- 2. scaffold to convert e.g. 7 cm to mm {only whole number of cm} scaffold is proportional triangle, conversion stick and function diagram {encourage learners to use the scaffold they prefer}
- 3. scaffold to convert e.g. 7.2 cm to mm {not whole number of cm} scaffold is proportional triangle, conversion stick and function diagram {encourage learners to use the scaffold they prefer}
- 4. convert cm to mm
- 6. **scaffold to** recall metric conversion constants **scaffold is** blank proportional triangle, conversion stick and function diagram
- 8. convert m to cm
- 13. convert kg to grams or km to m or litres to ml
- 14. convert grams to kg, or m to km or millilitres to litres
- 15. convert mm to cm or mm to m or cm to m  $\,$

## coordinate

- 1. scaffold to plot coordinate at e.g. (3, 1) {only first quadrant} scaffold is coordinate labelled with x and y
- 2. scaffold to write down coordinate e.g. (3, 1) {only first quadrant} scaffold is ( , ) labelled with x and y
- 3. plot coordinate at e.g. (3, 1) {only first quadrant}
- 4. write down coordinate e.g. (3, 1) {only first quadrant}
- 5. plot and write down coordinate {only 2nd or 4th quadrants, i.e. only one negative}
- 7. plot coordinate {any except on x or y axis}
- 8. write down coordinate {any except on x or y axis}
- 9. plot and write down coordinate {only on x or y axis}
- 10. write down the midpoint between 2 coordinates {only first quadrant}

## enlarge

- 1. **scaffold to** enlarge shape {only rectangle} **scaffold is** enlarged edges calculated and 2 enlarged sides drawn
- 2. scaffold to enlarge shape {only rectangle} scaffold is example calculation and one side of enlarged shape drawn
- 3. scaffold to enlarge shape scaffold is formula edge × scale factor = EDGE and one vertex for enlarged shape drawn {for non rectangles hints on measuring or drawing sloping side}
- 4. enlarge shape {with only vertical and horizontal lines}
- 5. enlarge shape {has sloping sides}
- 6. describe transformation {always enlargement, scale factor is small positive integer}

## perimeter

- 2. write down perimeter of rectangle {on cm grid}
- 4. write down perimeter of rectangle {width and height labelled no square grid, so not possible to count}
- 6. write down perimeter of odd shape {on cm grid}
- 7. write down perimeter of rectangle {width and/or height a decimal no square grid, so not possible to count}
- 8. write down perimeter of square {given length of one side}

reflect

- 1. **scaffold to** reflect shape {mirror line is horizontal or vertical and along one edge of shape} **scaffold is** instructions on how to use tracing paper
- 2. reflect shape {mirror line is horizontal or vertical and along one edge of shape}
- 3. scaffold to draw a line of symmetry on each shape {there may be more than one} scaffold is reminder that some shapes do not have a line of symmetry
- 4. reflect shape {mirror line is horizontal or vertical but NOT on an edge of the shape}
- 5. draw on **all** lines of symmetry {polygons but not hard ones e.g. parallelogram or rectangle}
- 6. reflect shape {mirror line is diagonal}
- 7. reflect shape in **x** or **y** axis
- 8. scaffold to draw only correct lines of symmetry on parallelogram or rectangle scaffold is to reflect/think about reflecting 2 sides of a parallelogram or rectangle in line which is not a line of symmetry
- 9. draw on all lines of symmetry or state number of lines of symmetry or choose the shapes with a given number of lines of symmetry {including rectangle and parallelogram}
- 10. complete a pattern by shading triangles or squares for the requested number of lines of symmetry {easier as no choice of lines of symmetry}
- 11. reflect a shape in e.g. the line x = 3 or y = -2 or x = 0 or y = 0
- 12. reflect a shape in line y = x or y = -x

rotate

- 1. **scaffold to** complete a shape/shading on a shape with given rotational order of symmetry **scaffold is** instructions to use tracing paper
- 2. complete a shape/shading on a shape with given rotational order of symmetry
- 3. rotate a shape 90 anti/clockwise about a symbol
- 4. scaffold to write down order of rotational symmetry of a shape scaffold is worked example
- 6. rotate a shape 90/180/270 anti/clockwise about a coordinate {which is on the vertex of the shape}
- 8. rotate a shape 90/180/270 anti/clockwise about a coordinate {which is **not** on the vertex of the shape on edge or away from shape}

### scaleInterpret

- 1. **scaffold to** measure length of line {whole number of cm} **scaffold is** cm only ruler placed correctly
- 2. scaffold to measure length of line, {whole number of cm} scaffold is ruler placed correctly
- 3. scaffold to measure length in cm and mm scaffold is pictures of 2 correctly aligned rulers one marked in cm and one marked in mm
- 4. scaffold to use ruler correctly scaffold is to explain why Name is incorrect {ONLY use when errors in layer 5}
- 5. measure length in cm {horizontal line}
- 6. measure length in cm {line not horizontal and/or part of a shape}
- 8. scaffold to measure bearing {only 100 to 359} scaffold is correctly aligned angle measurer and instructions
- 9. scaffold to measure bearing {includes 0 to 99} scaffold is correctly aligned angle measurer and instructions
- 11. measure bearing
- 12. scaffold to measure angle {only from horizontal} scaffold is correctly aligned angle measurer given
- 13. measure angle {only from horizontal}
- 14. measure bearing and interpret length given scale {1 cm represents 1 km or 1m or 100 km or 10 km or 100m or 10m}

shapeProblemNC

- 1. find missing length in a composite rectangle {requires subtraction only}
- 2. find radius/diameter given pattern of touching circles and radius/diameter clue
- 3. find area of shape given area clue in pattern {requires multiply or divide}
- 4. find missing coordinate vertex {use properties of e.g. rhombus}
- 8. draw a rectangle of a given area {paper not large enough for 1  $\times$  width or sometimes 2  $\times$  width}

### translateANDvector

- 1. **scaffold to** describe translation {whole number of cm in horizontal direction} **scaffold is** e.g. translate ? to the left
- 2. translate a shape{in horizontal or vertical direction} description given in words
- 3. translate a shape{in horizontal and vertical direction} description given in words
- 5. scaffold to translate a shape by a column vector scaffold is no negatives in column vector
- 7. write a column vector given a diagram
- 8. translate a shape by a column vector
- 9. write down the column vector e.g.  $2\mathbf{a}$  or  $3\mathbf{b}$  given  $\mathbf{a}$  and  $\mathbf{b}$  as column vectors
- 10. write down a vector {shown in diagram} in terms of vectors  $\mathbf{a}$  or  $\mathbf{b}$  {shown in diagram} e.g.  $2\mathbf{a}$  or  $3\mathbf{b}$  {but not e.g  $-2\mathbf{a}$ }
- 11. write down the vector  $\mathbf{a} + \mathbf{b}$  as a column vector given column vectors  $\mathbf{a}$  and  $\mathbf{b}$
- 12. write down the vector e.g. 3a + 2b {but not e.g 3a 2b} as a column vector given column vectors a and b

### volume

- 1. scaffold to find volume of cuboid:  $\{1 \times 1 \times n\}$  scaffold is one example given with alternate cubes shaded
- 2. find volume of cuboid:  $\{1 \times 1 \times n\}$
- 3. find volume of cuboid:  $\{w \times d \times 1\}$
- 4. scaffold to find the volume of cuboid  $\{w \times d \times h\}$  scaffold is alternate layers shaded and asked to complete number of cubes on top layer = ... and number of layers = ...
- 5. find the volume of cuboid  $\{w \times d \times h, \text{ individual cubes shown}\}$
- 6. find the volume of cuboid  $\{1 \times m \times n, \text{ individual cubes shown, either width or depth} = 1\}$ FYI: for some learners this is a trivial extension of layer 3, other learners need to develop their ability to see in 3D
- 7. scaffold to find the volume of odd shape prism {cross section may be counted} scaffold is 1 dimension of prism = 1 cm
- 8. find the volume of odd shape prism {cross section may be counted}
- 9. find the volume of cuboid  $\{w \times d \times h, \text{ individual cubes NOT shown}\}$