GCSE MATHEMATICS

S21-C300

Non-Calculator Assessment Resource R

Higher Tier

Formula list

Area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

Curved surface area of a cone = πrl

Surface area of a sphere = $4\pi r^2$

Volume of a sphere = $\frac{4}{3}\pi r^3$

Volume of a cone = $\frac{1}{3}\pi r^2 h$

Kinematics formulae

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

1. Work out $2\frac{3}{4} \div \frac{5}{8}$.

Give your answer as a mixed number in its simplest form. [3]

$2\frac{3}{4} = \frac{11}{4} = \frac{22}{8}$

$\frac{\frac{22}{8}}{\frac{5}{8}} = \frac{22}{5} \longrightarrow 4\frac{2}{5}$

2. *(a)* Simplify $18\pi \div 9\pi$. [1]

$\frac{18\pi}{9\pi} = 2$

(b) The diagram shows two circles, one inside the other.

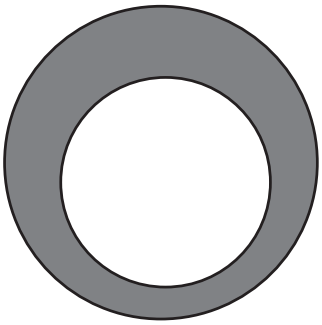


Diagram not drawn to scale

The radius of the outer circle is 6 cm.
The radius of the inner circle is 5 cm.

Work out the area of the shaded region.
Give your answer in terms of π. [3]

outer → $\pi r^2 = \pi 6^2 = 36\pi$

inner → $\pi r^2 = \pi 5^2 = 25\pi$

Shaded = $36\pi - 25\pi = 11\pi$

Area of shaded region = 11π cm^2

3. A line *L* has equation $y = 12 - 4x$.

Write down the equation of a different line that is parallel to *L*. [1]

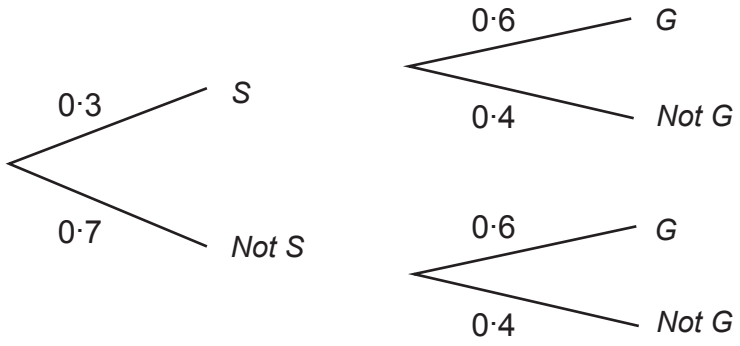
$y = 15 - 4x$

4. Jan's hobbies are sewing and gardening.

Each week the probability that she spends:
- Monday evening sewing (*S*) is 0·3,
- time gardening on Friday (*G*) is 0·6.

These events are independent.

The tree diagram shows this information.



Calculate the probability that, in a randomly selected week,

(a) Jan spends Monday evening sewing but does not spend time gardening on Friday, [2]

S Not S.

$0.3 \times 0.4 = 0.12$

(b) Jan does not spend Monday evening sewing but does spend time gardening on Friday. [2]

$0.7 \times 0.4 = 0.28$

5. *(a)* Find the next term of this sequence.

$\frac{3}{2}, \quad -\frac{9}{4}, \quad \frac{27}{8}, \quad -\frac{81}{16}, \quad \ldots$ [2]

$\times -\frac{3}{2} \qquad \times -\frac{3}{2}$

$\frac{81 \times 3}{16 \times 2} = \frac{243}{32}$

(b) The nth term of a sequence is $\left(2\sqrt{3}\right)^n$.

Find and simplify the 3rd term of this sequence. [2]

$(2\sqrt{3})^3$

$= 8(\sqrt{3})^3$

$= 8(3\sqrt{3})$

$= 24\sqrt{3}$

$\sqrt{3} \times \sqrt{3} \times \sqrt{3} = 3\sqrt{3}$

(c) Find the nth term of this sequence.

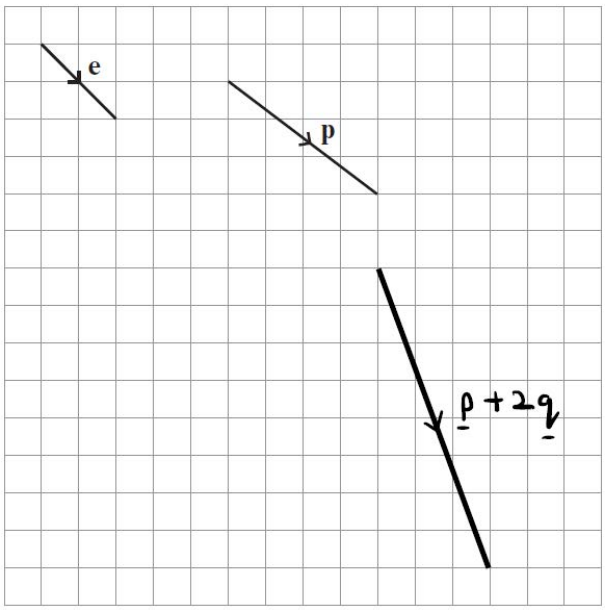
1·5, 3, 5·5, 9, 13·5, ... [2]

1·5 2·5 3·5 4·5

1 1 1

$= \frac{1}{2}n^2 + 1$

6. *(a)*



The grid shows the vector $\mathbf{e} = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$ and the vector $\mathbf{p}$.

The vector $\mathbf{q} = \begin{pmatrix} -0{\cdot}5 \\ -2{\cdot}5 \end{pmatrix}$.

Draw a diagram on the grid above to represent $\mathbf{p} + 2\mathbf{q}$. [2]

$p = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$

$p + 2q = \begin{pmatrix} 4 \\ -3 \end{pmatrix} + 2\begin{pmatrix} -0{\cdot}5 \\ -2{\cdot}5 \end{pmatrix} = \begin{pmatrix} 4 \\ -3 \end{pmatrix} + \begin{pmatrix} -1 \\ -5 \end{pmatrix} = \begin{pmatrix} 3 \\ -8 \end{pmatrix}$

(b)

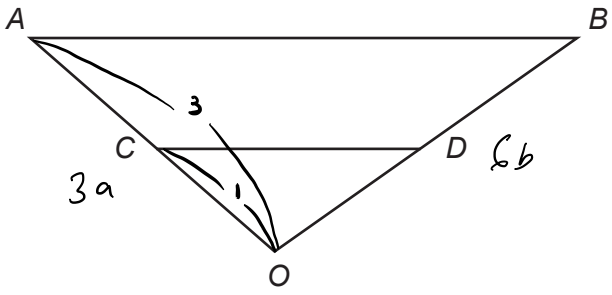


Diagram not drawn to scale

OA = 3**a** and **OB** = 6**b**.
The sides of triangles *OAB* and *OCD* are in the ratio 3 : 1.

By writing **AB** and **CD** in terms of **a** and **b**, decide whether *CD* is parallel to *AB*.

Parallel ☑ Not Parallel ☐

Show how you decide. [3]

if the sides are in the ratio 3:1

$\underline{OA} = 3\underline{a}$ and $\underline{OC} = \underline{a}$

and $\underline{OB} = 6\underline{b}$ and $\underline{OD} = 2\underline{b}$

$\therefore \quad \underline{AB} = 6\underline{b} - 3\underline{a}$

so $\underline{CD} = 2\underline{b} - \underline{a}$

which is a multiple of $\underline{AB} \rightarrow \underline{CD} = 3\underline{AB}$

so they are parallel

7. The diagram shows a sketch of a letter L.

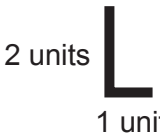
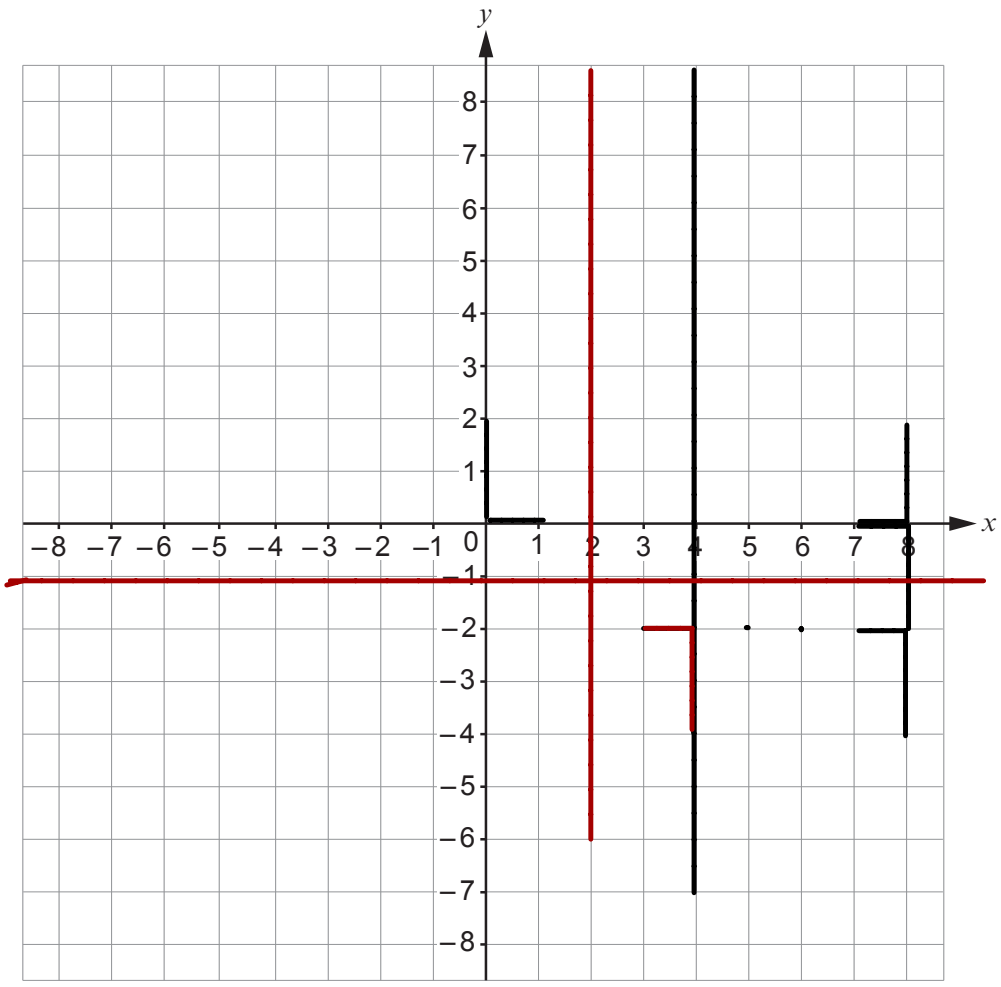


Diagram not drawn to scale

This letter is first, reflected in the line $x = 4$, then reflected in the x-axis and finally translated through $\begin{pmatrix} -4 \\ -2 \end{pmatrix}$.

Describe the **single** transformation that is equivalent to these 3 transformations. [3]

You may use this grid to help you.



a rotation of 180° about (2, -1)

8. *(a)*

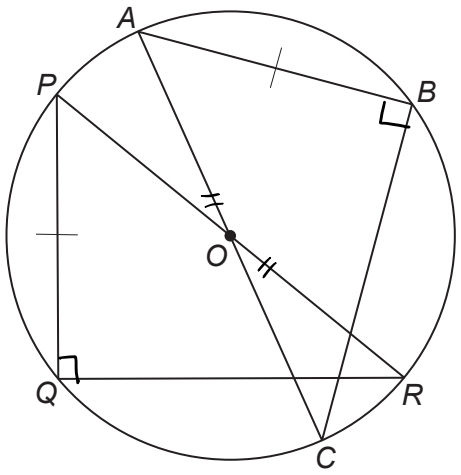


Diagram not drawn to scale

Points *A*, *B*, *C*, *P*, *Q* and *R* lie on the circumference of the circle, centre *O*.

Show that triangle *ABC* is congruent to triangle *PQR*.
Give a reason for each step of your answer. [3]

Triangle ABC	Triangle PQR
$AC = OA + OC$	$PR = OP + OR$
$= 2r = d$	$= 2r = d$
$A\hat{B}C = 90°$	$P\hat{Q}R = 90$
$PQ = BA$	$PQ = BA$

∴ these triangles are RHS ✓ congruent as they both have a right angle, equal hypotenuse ✓ (which is the diameter) and equal side

(AC = PR) (PQ = BA)

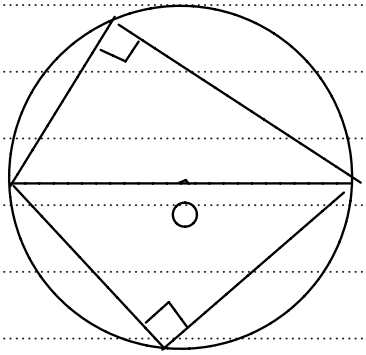
(b) William says,

"It is possible to draw one circle through the four vertices of any kite that has two opposite angles that are right angles."

Is William correct?

Yes ☑ No ☐

Show how you decide. [1]



9.

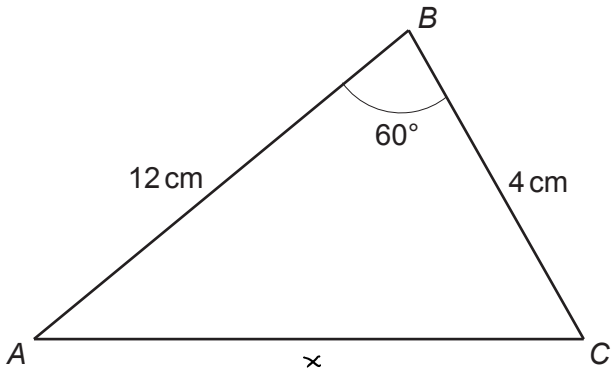


Diagram not drawn to scale

Calculate the length of *AC*.
Give your answer as a surd in its simplest form. [5]

$a^2 = b^2 + c^2 - 2bc \cos A$

$a^2 = 12^2 + 4^2 - 2(12)(4)\cos 60$

$a^2 = 144 + 16 - 96\cos 60$

$a^2 = 144 + 16 - 48$

$a^2 = 96 + 16$

$a^2 = 112$

$a = \sqrt{112}$

$a = \sqrt{16 \times 7}$

$a = 4\sqrt{7}$

$7\overline{)1'1^{4}2}$ 01 6

10. *(a)* Write the expression $x^2+8x+18$ in the form $(x+a)^2+b$, where a and b are integers. [3]

$(x+4)^2 - 16 + 18$

$(x+4)^2 + 2$

$a = 4$

$b = 2$

(b) Write down the coordinates of the turning point of the curve $y = x^2+8x$. [2]

$(x+4)^2 - 16$

Turning point = (-4 , -16)