Sample Questions for the new GCSE in Mathematics
Foundation Tier (Grades 1-5)
Example 1
Liam, Sarah and Emily shared some money in the ratio 2 : 3 : 7
Emily got £80 more than Liam.
How much money did Sarah get? **(3 marks)**
Liam had 2 parts and Emily had 7 parts. The difference is 5 parts, so 5 parts equals £80. Hence 1 part = 80÷5 = 16.
Sarah had 3 parts, so she had 3 x 16 = **£48**

Example 2 (non-calculator)
Modelling the planet Mercury as a sphere, it has a radius of 2440 km.

(a) (i) Work out an estimate in square kilometres for the surface area of Mercury.
Surface area = $4\pi r^2 = 4\pi \times 2440^2 \approx 4 \times 3 \times 2000^2 =$ **$48\,000\,000$ km²**

(ii) Without carrying out a further calculation, give evidence to show whether your method gives you an underestimate or an overestimate for the surface area of Mercury.

If each value is rounded to 1 significant figure it is an underestimate, as the value of both pi and the radius have been reduced.

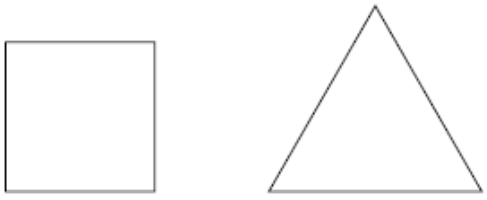
In July 2013, the spacecraft Messenger was near Mercury at a distance of 9.75×10^7 km from Earth.

Taking the speed of light to be 3×10^8 m/s,

(b) Work out how long it takes light to travel a distance of 9.75×10^7 km. (9.75×10^{10}m)
(6 marks)

Time = distance ÷ speed = $9.75 \times 10^7 \times 1000 \div (3 \times 10^8)$ = **325 seconds**

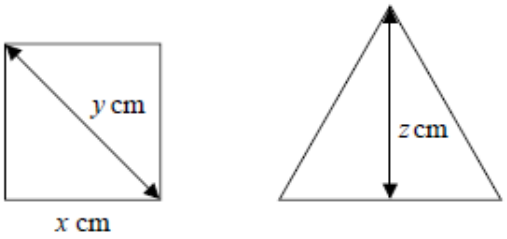
Example 3
Here are a square and an equilateral triangle.



The length of a side of the square is x cm.
The length of a side of the equilateral triangle is 2 cm more than the length of a side of the square.
The perimeter of the square is equal to the perimeter of the equilateral triangle.

(a) Work out the perimeter of the square.
Perimeter of square = 4x, perimeter of triangle = 3(x + 2)
These are equal, so 4x = 3(x + 2)
4x = 3x + 6
x = 6

Here are the same square and the same equilateral triangle.



The length of the diagonal of this square is y cm.
The height of this equilateral triangle is z cm.

(b) Which has the greater value, y or z? **(7 marks)**

Using Pythagoras' Theorem

$6^2 + 6^2 = y^2$ and $z^2 = 8^2 - 4^2$

$y^2 = 36 + 36 = 72$ and $z^2 = 64 - 16 = 48$ Hence **y is of greater value than z**

Sample Questions for the new GCSE in Mathematics
Higher Tier (Grades 4-9)

Example 1

A car has an initial speed of u m/s.
The car accelerates to a speed of $2u$ m/s in 12 seconds.

Using $v = u + at$

$2u = u + 12a$, $a = \frac{u}{12}$

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

$S = 12u + \frac{1}{2} \times \frac{u}{12} \times 12^2 = 12u + 6u = 18u$

The car then travels at a constant speed of $2u$ m/s for 10 seconds.

Using distance = speed x time = 2u x 10 = 20u

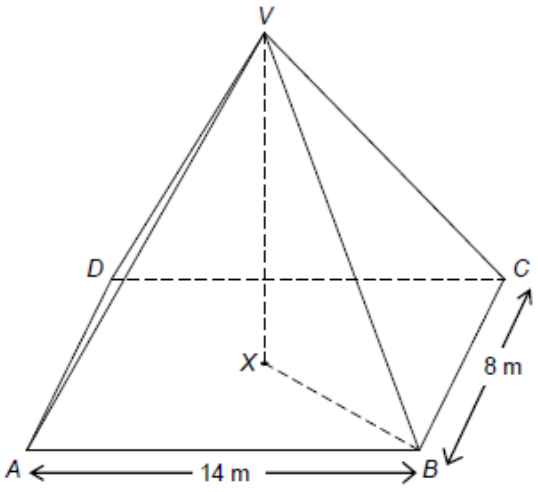
Assuming that the acceleration is constant, show that the total distance, in metres, travelled by the car is $38u$. **(4 marks)**

Total distance = 18u + 20u = **38u**

Example 2

The volume of a pyramid = $\frac{1}{3}$ x area of base x perpendicular height $336 = \frac{1}{3} \times 14 \times 8 \times h$, $h = 9$

$VABCD$ is a rectangular-based pyramid with volume 336 m^3
X is the centre of the base, directly below V.



Work out the angle between VB and the base.

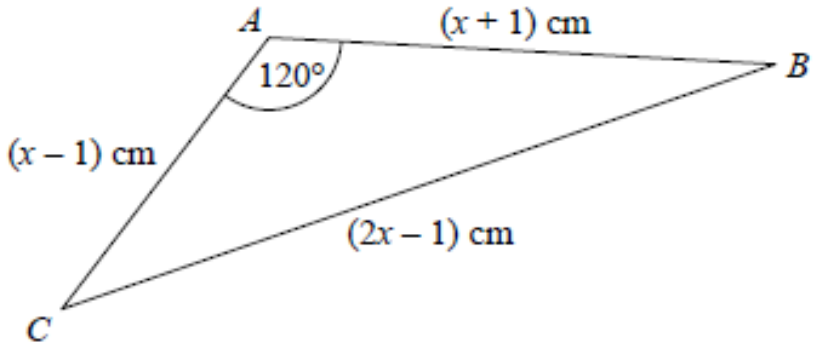
Using Pythagoras' Theorem, $BX^2 = 7^2 + 4^2$, $BX^2 = 49 + 16 = 65$, $BX = \sqrt{65}$

Using the tan ratio, $\tan(XBV) = \frac{9}{\sqrt{65}}$, angle required = tan-1 (1.116) = **48.1°**

(6 marks)

Example 4 (non-calculator)

The diagram shows triangle *ABC*.



The area of triangle *ABC* is $k\sqrt{3}$ cm^2.

Find the exact value of *k*. **(7 marks)**

Using the Cosine Rule

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

$(2x - 1)^2 = (x + 1)^2 + (x - 1)^2 - 2(x + 1)(x - 1)\cos 120$

$4x^2 - 4x + 1 = x^2 + 2x + 1 + x^2 - 2x + 1 - 2(x^2 - 1)\cos 120$

$4x^2 - 4x + 1 = 2x^2 + 2 - 2(x^2 - 1)\cos 120$

$2x^2 - 4x - 1 = -2(x^2 - 1) \times -\frac{1}{2}$

$2x^2 - 4x - 1 = (x^2 - 1)$

$2x^2 - 4x - 1 = x^2 - 1$

$x^2 - 4x = 0$

$x(x - 4) = 0$

$x = 0$ or 4

$x = 4$

Area of a triangle = $\frac{1}{2}$ ab sinC

$k\sqrt{3} = \frac{1}{2} \times 5 \times 3 \sin 120$

$k\sqrt{3} = 15 \times \frac{1}{2} \times \sqrt{3}/2$

k = 15/4