National Qualifications

# 2024 Mock Paper
# Mathematics
# Paper 2

**Duration – 1 hour 30 minutes**

**Fill in these boxes and read what is printed below.**

Full name of centre: Solutions

Town:

Forename(s):

Surname:

Number of seat:

Date of birth

Day | Month | Year

Scottish candidate number

**Total marks – 50**

Attempt ALL questions.

**You may use a calculator.**

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

**FORMULAE LIST**

The roots of $ax^2 + bx + c = 0$ are $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$ or $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$

Area of a triangle $A = \frac{1}{2}ab\sin C$

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

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

Volume of a pyramid $V = \frac{1}{3}Ah$

Standard deviation $s = \sqrt{\dfrac{\Sigma(x - \bar{x})^2}{n - 1}}$

or $s = \sqrt{\dfrac{\Sigma x^2 - \dfrac{(\Sigma x)^2}{n}}{n - 1}}$, where $n$ is the sample size.

**Total marks – 50**

**Attempt ALL questions**

DO NOT WRITE IN THIS MARGIN

**MARKS**

**1.** Find the equation of the line passing through the points (1,–3) and (–2,6).

Give your answer in its simplest form. **3**

$m = \frac{6-(-3)}{-2-1}$

$m = \frac{9}{-3}$ ✓1

$m = -3$

$y-(-3) = -3(x-1)$ ✓2

$y + 3 = -3x + 3$

$y = -3x.$ ✓3

**2.** In 2022, 868 school pupils sat the first ever Higher Applications of Mathematics exam.

This is expected to increase by 85% each year for the next three years.

Calculate the expected number of pupils who will sit the 2025 Higher Applications of Maths exam.

Give your answer correct to the nearest hundred. **3**

$865 \times 1.85^3$ ✓2 ✓1 $= 5476....$

$= 5500$ pupils. ✓3

**[Turn over**

**3.** The carbon dioxide ($CO_2$) concentration levels in 5 Maths classrooms are recorded at the start of the school day.

The $CO_2$ concentration levels, measured in parts per million (ppm), for the 6 classrooms are shown below.

634 850 721 983 1037

(a) Calculate the mean and standard deviation of the $CO_2$ concentration levels in the 5 Maths classrooms. **4**

$\bar{x} = \frac{4225}{5} = 845$ ✓1

| $x$ | $x - \bar{x}$ | $(x-\bar{x})^2$ |
|---|---|---|
| 634 | −211 | 44521 |
| 850 | 5 | 25 |
| 721 | −124 | 15376 ✓2 |
| 983 | 138 | 19044 |
| 1037 | 192 | 36864 |

$\Sigma(x-\bar{x})^2 = 115830$

$s.d = \sqrt{\frac{115830}{5-1}}$ ✓3

$s.d = 170.2$ ppm. ✓4

The $CO_2$ concentration levels in 5 English classrooms are also recorded at the start of the school day.

In these classrooms, the mean of the $CO_2$ concentration levels is 923 ppm and the standard deviation of the $CO_2$ concentration levels is 180 ppm.

(b) Make two valid comments comparing the $CO_2$ concentration levels in the Maths and English classrooms. **2**

On average, the $CO_2$ concentration levels in the English classrooms are higher. ✓5

The $CO_2$ concentration levels in the English classrooms are more varied ✓6

**4.** Solve the equation $5x^2 - 10x + 3 = 0$.

Give your answers correct to one decimal place. **4**

$b^2 - 4ac = (-10)^2 - 4(5)(3)$

$= 40$ ✓1

$x = \frac{10 \pm \sqrt{40}}{10}$ ✓2

$x = \frac{10 + \sqrt{40}}{10}$ $\qquad$ $x = \frac{10 - \sqrt{40}}{10}$

$x = 1.63...$ ✓3 $\qquad$ $x = 0.36...$

$x = 1.6$ ✓4 $\qquad$ $x = 0.4$

MARKS

DO NOT WRITE IN THIS MARGIN

**5.** Solve, algebraically, the inequation $3-2(x+1)<6x+5$. **3**

$3 - 2x - 2 < 6x + 5$ ✓1

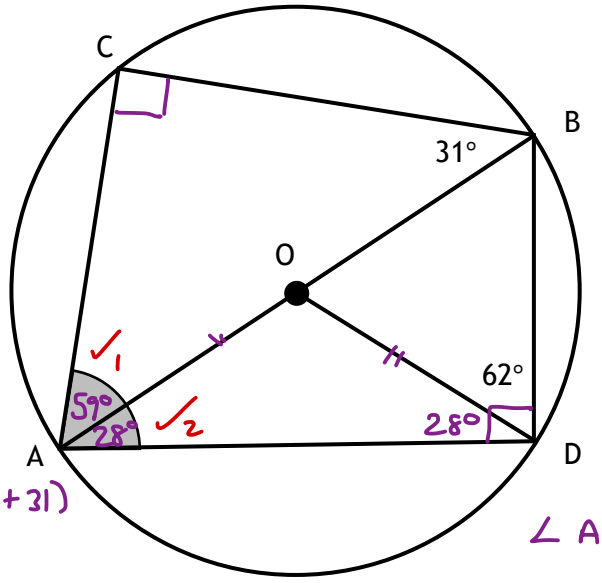
$1 - 2x < 6x + 5$

$-8x < 4$ ✓2

$x > -\frac{4}{8}$

$x > -\frac{1}{2}$ ✓3

**6.** The diagram below shows a circle, centre O.




$\angle ACB = 90°$

$\angle CAB = 180 - (90 + 31)$
$= 59°$

✓1 ✓2

$\angle ADO = 90 - 62$
$= 28°$

$\angle OAD = 28°$

- AB is a diameter of the circle
- Angle ABC is 31°
- Angle BDO is 62°

Calculate the size of angle CAD. **3**

$\angle CAD = 59 + 28$
$= 87°$ ✓3

7. A straight line has equation $2x-7y=3$.

Find the gradient of the line. 2

$2x-7y=3$

$-7y=-2x+3$

$(\times -1)$ $7y=2x-3$

$\div 7$ $y=\frac{2}{7}x-\frac{3}{7}$ ✓(1) $\rightarrow m=\frac{2}{7}$ ✓(2)

$y=mx+c$

8. Change the subject of the formula $y=(3x+4)^2$ to $x$. 3

$y=(3x+4)^2$

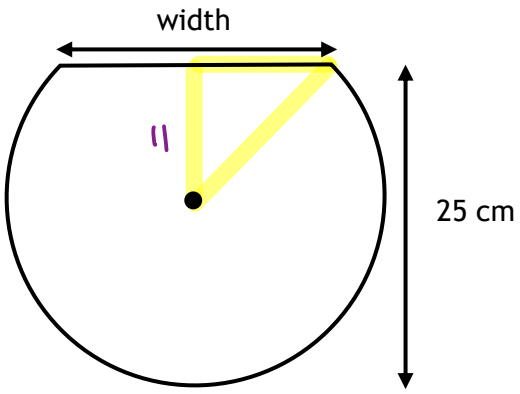
$(3x+4)^2=y$

$3x+4=\sqrt{y}$ ✓(1)

$3x=\sqrt{y}-4$ ✓(2)

$x=\frac{\sqrt{y}-4}{3}$ ✓(3)

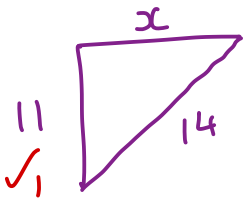
**9.** The shape below is part of a circle, centre C.




The height of the shape is 25 centimetres.

The radius of the circle is 14 centimetres.

Calculate the width of the shape. **4**




$x^2 = 14^2 - 11^2$ ✓2

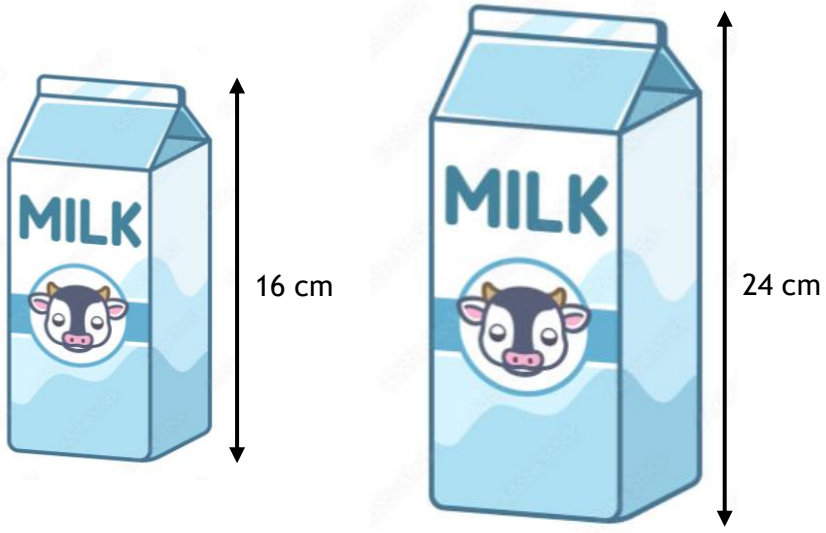
$x^2 = 75$

$x = 8.7\text{cm}$ ✓3

$\text{width} = 8.7 \times 2$

$= 17.4\text{ cm}$ ✓4

**10.** The two cartons of milk below are mathematically similar.




The smaller carton has a height of 16 centimetres and volume 650 millilitres.
The larger carton has a height of 24 centimetres.

Calculate the volume of the larger carton of milk. **3**

$LSF_e = \frac{24}{16} = 1.5$ ✓1

$VSF_e = 1.5^3$ ✓2

Volume of larger carton $= 650 \times 1.5^3 = 2193.75\,ml.$ ✓3

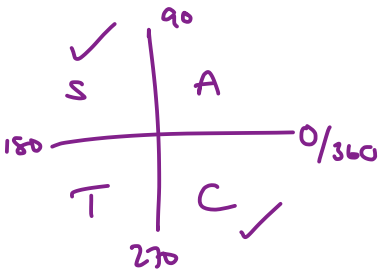
MARKS

DO NOT WRITE IN THIS MARGIN

**11.** Solve the equation $3\tan x° + 4 = 2$, for $0 \leq x \leq 360$. **3**

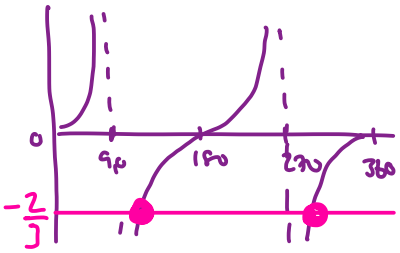
$3\tan x = -2$

$\tan x = -\frac{2}{3}$ ✓1




$x_1 = 180 - 34$ $\quad x_2 = 360 - 34$

$x_1 = 146°$ ✓2 $\quad x_2 = 326°$ ✓3




$\tan^{-1}\left(\frac{2}{3}\right) = 34°$

MARKS

DO NOT WRITE IN THIS MARGIN

**12.** Calculate $|\mathbf{v}|$, the magnitude of vector $\mathbf{v} = \begin{pmatrix} 3 \\ -4 \\ 5 \end{pmatrix}$. **2**

$|v| = \sqrt{3^2 + (-4)^2 + 5^2}$ ✓1

$|v| = 5\sqrt{2}$ or $7.1$. ✓2

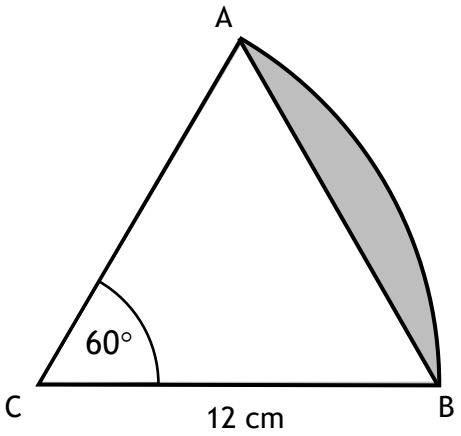
**13.** Express $\frac{2x+18}{5} \times \frac{1}{x+9}$ as a single fraction in its simplest form. **2**

$\frac{2x+18}{5(x+9)}$ ✓1 $= \frac{2(x+9)}{5(x+9)}$

$= \frac{2}{5}$ ✓2

**[Turn over**

**14.** The diagram shows a sector of a circle with centre C.
Angle ABC is 60°.




The radius of the circle is 12 centimetres.

AB splits the sector into triangle ABC and the shaded segment.

Calculate the area of the shaded segment. **5**

triangle

$A = \frac{1}{2} \times 12 \times 12 \times \sin 60$ ✓1

$A = 62.4 cm^2$ ✓2

sector

$A = \frac{60}{360} \times \pi \times 12^2$ ✓3

$A = 75.4 cm^2$ ✓4

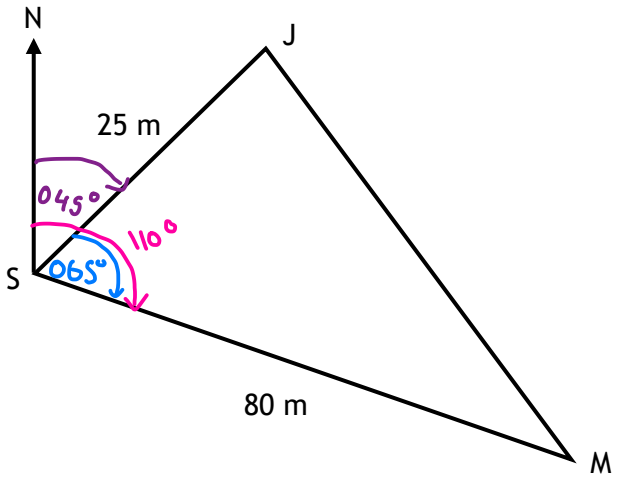
Shaded area $= 75.4 - 62.4$

$= 13 cm^2$ ✓5

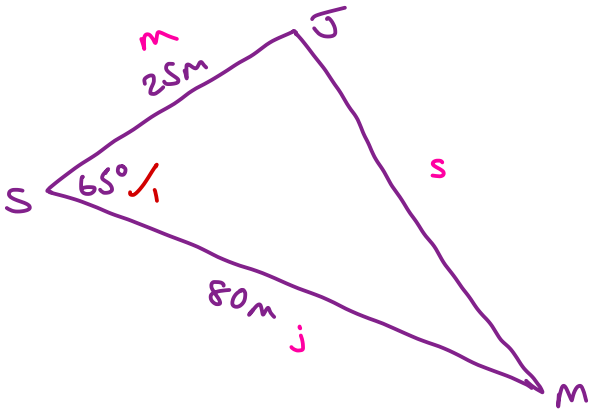
**15.** Julian and Michael are testing out their new drones together at point S.

From the starting point:

- Julian's drone (J) travels 25 metres on a bearing of 045°
- Michael's drone (M) travels 80 metres on a bearing of 110°




Calculate the distance between the two drones. **4**




$s^2 = 80^2 + 25^2 - 2 \times 80 \times 25 \times \cos 65$ ✓2

$s^2 = 5334.5$ ✓3

$s = 73$ metres. ✓4

**[END OF QUESTION PAPER]**