

Mathematics
PAPER 3 (Calculator)
Higher Tier

You must have: Ruler graduated in centimetres and millimetres,
Total Marks protractor, pair of compasses, pen, HB pencil, eraser, calculator, Formulae Sheet (enclosed). Tracing paper may be used.

## Instructions

- Use black ink or ball-point pen.
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all questions.
- Answer the questions in the spaces provided - there may be more space than you need.
- You must show all your working.

- Diagrams are NOT accurately drawn, unless otherwise indicated.
- Calculators may be used.
- If your calculator does not have a $\pi$ button, take the value of $\pi$ to be 3.142 unless the question instructs otherwise.


## Information

- The total mark for this paper is 80
- The marks for each question are shown in brackets - use this as a guide as to how much time to spend on each question.


## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.



## MME.

 GCSE Revision - GCSE Maths

GCSE Maths Predicted Papers 2024


GCSE Maths
Revision Cards


GCSE Maths
Revision Guide


Course in a Box - GCSE Maths (Guaranteed Pass)

Answer ALL questions.
Write your answers in the spaces provided.
You must write down all the stages in your working.
1 Here is a right-angled triangle.


Work out the value of $x$.

$$
\text { Pythagoras: } \begin{aligned}
& 4^{2}+x^{2}=8.5^{2} \\
\Rightarrow & x=\sqrt{8.5^{2}-4^{2}} \\
x & =7.5 \mathrm{~cm}
\end{aligned}
$$

$$
x=7.5 \mathrm{~cm} .
$$

(Total for Question 1 is 2 marks)

$$
\begin{aligned}
& \text { mmerevise.co.uk } \\
& 2 T=4 m^{2}-11 \\
& \text { (a) Work out the value of } T \text { when } m=-3 \\
& T=4 \times(-3)^{2}-11 \\
& =4 \times 9-11=25 \text {. }
\end{aligned}
$$

$$
T=25
$$

(b) Make $p$ the subject of the formula $d=3 p+4$

(Total for Question 2 is $\mathbf{4}$ marks)
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3 Rick, Selma and Tony are playing a game with counters.
Rick has some counters.
Selma has twice as many counters as Rick.
Tony has 6 counters less than Selma.
In total they have 54 counters.
the number of counters Rick has: the number of counters Tony has $=1: p$
Work out the value of $p$.
Rick mas $r$ suety Selma, s, and Tony t.

$$
\begin{aligned}
& r+s+t=54 . \\
& s=2 r . \\
& t=s-6=2 r-6 . \\
& r+2 r+2 r-6=5 c . \\
& 5 r=60 \\
& r=12, s=24, t=18 . \\
& r: t=1: p \\
& 12: 18=1: p \\
& 1: \frac{18}{12}=1: p \\
& 1: 1.5=1: p \quad p=1.5 .
\end{aligned}
$$

4 Jo is going to buy 15 rolls of wallpaper.
Here is some information about the cost of rolls of wallpaper from each of two shops.

| Chic Decor |
| :---: |
| 3 rolls for $£ 36$ |


| Style Papers |
| :---: |
| Pack of 5 rolls |
| normal price $£ 70$ |
| $12 \%$ off the normal price |

Jo wants to buy the 15 rolls of wallpaper as cheaply as possible.
Should Jo buy the wallpaper from Chic Decor or from Style Papers?
You must show how you get your answer.
Chic Decor: 3 rolls for $\$ 36$

$$
\begin{aligned}
& 3 \text { rolls for } 5 \times 36=f 180 \text {. } \\
& 15 \text { rolls for } 5 \times 36
\end{aligned}
$$

Style Papers: 5 rolls for $£ 70$ normal price 5 rolls for $70 \times(1-0.12)=\neq 61.60$

$$
15 \text { rolls for } 3 \times 61.60=\hat{E} 184.80 \text {. }
$$

Chic Decor is cheaper at $\mathcal{L} 180$ than Style papers at $£ 184.80$, so Jo should chose Chic Decor.

5 The table gives information about the lengths, in cm , of some pieces of string.

| Length $(t \mathrm{~cm})$ | Frequency |
| :---: | :---: |
| $0<t \leqslant 10$ | 15 |
| $10<t \leqslant 20$ | 20 |
| $20<t \leqslant 30$ | 50 |
| $30<t \leqslant 40$ | 25 |
| $40<t \leqslant 50$ | 5 |

Amos draws a frequency polygon for the information in the table.


Write down two mistakes that $\Lambda$ mos has made.

- The final point is plotted at length $=50 \mathrm{~cm}$, not the midpoint 45 cm .
${ }_{2}$ Vertical scale is not linear (frequency to is missing).
(Total for Question 5 is 2 marks)
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6 Jessica runs for 15 minutes at an average speed of 6 miles per hour.
She then runs for 40 minutes at an average speed of 9 miles per hour.
It takes Amy 45 minutes to run the same total distance that Jessica runs.
Work out Amy's average speed.
Give your answer in miles per hour.

$$
\text { distance }=S p e e d \times \text { time } \text {. }
$$

For Jessica first 15 minutes:
15 minutes $=0.25$ hours
dist ance $=0.25 \times 6=1.5$ miles.
For the next 40 minutes:
40 minutes $=\frac{40}{60}=\frac{2}{3}$ hours.
distance $=\frac{2}{3} \times 9=6$ miles.
Total distance $=7.5$ miles .
Average speed $=$ distance $\div$ time .
Amy rant in 45 minutes $=0.75$ hours.
Any average speed $775 \div 0.75$

$$
=10 \mathrm{mph} \text {. }
$$

7 The diagram shows rectangle STUV.
$T Q U$ and $S R V$ are straight lines.
All measurements are in cm .


The area of trapezium $Q U V R$ is $A \mathrm{~cm}^{2}$
Show that $A=2 x^{2}+20 x$
QUVR can be divided into a right angle with width RV and height uV.

$$
\begin{aligned}
\text { Rectangle area } & =5 \times 4 x=20 x \\
\text { Triangle area } & =\frac{1}{2} \times(3 x-2 x) \times 4 x \\
& =\frac{1}{2} \times 4 x^{2}=2 x^{2} .
\end{aligned}
$$

Total area QUVR: A

$$
=2 x^{2}+20 x .
$$

(Total for Question 7 is 3 marks)

8 An electricity company charges the same fixed amount for each unit of electricity used.
David uses this graph to work out the total cost of the electricity he has used.

(a) Work out the gradient of the straight line.

$$
\begin{aligned}
& \text { Using }(0,0) \text { and }(100,14) \\
& m=\frac{14-0}{100-0}=0.14 .
\end{aligned}
$$

(b) What does the gradient of this line represent?


9 (a) Express $\sqrt{\frac{10^{360}}{10^{150} \times 10^{90}}}$ as a power of 10

$$
\begin{aligned}
=\left(\frac{10^{360}}{10^{150+90}}\right)^{1 / 2} & =\left(\frac{10^{360}}{10^{240}}\right)^{1 / 2} \\
& =\left(10^{360-240}\right)^{1 / 2} \\
& =\left(10^{120}\right)^{1 / 2} \\
& =10^{\frac{1}{2} \times 120}=10^{60}
\end{aligned}
$$

Liam was asked to express $\left(12^{50}\right)^{2}$ as a power of 12
Liam wrote $\left(12^{50}\right)^{2}=12^{50^{2}}=12^{2500}$
Liam's method is wrong.
(b) Explain why.

$$
\left(12^{50}\right)^{2}=12^{2 \times 50}=12^{100}, \operatorname{not} 12^{50^{2}} \text {. }
$$

A power outside the bracket is mull pried by the pour inside.
(Total for Question 9 is 4 marks)
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10 Jane bought a new car three years ago.
At the end of the first year the value of the car had decreased by $12.5 \%$
The value of the car then decreased by $10 \%$ each year for the next two years.
At the end of the three years, the value of the car was $£ 17010$
Work out the value of the car when Jane bought it three years ago.
Let $x$ : the cars initial value.
After 1 year: $x \times(1-0.125)=0.873 x$ After 2 years: $0.875 x \times(1-0.1)=0.7875 x$ After 3 years: $0.7875 x \times(1-0.1)=0.70875 x$.
$0.70875 x=17,010$

$$
x=\frac{17010}{0.70875}=f 24,000 .
$$

$$
\pm 24,000
$$

(Total for Question 10 is $\mathbf{3}$ marks)
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11 Rayheem has
16 shirts
5 pairs of jeans
3 jackets
Rayheem chooses an outfit to wear.
An outfit is 1 shirt, 1 pair of jeans and 1 jacket.
Work out how many different outfits Rayheem can choose.

$$
16 \times 5 \times 3=240 \text { outfits. }
$$

(Total for Question 11 is 2 marks)
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$12 A B C$ and $A C D$ are right-angled triangles.

$D C=8 \mathrm{~cm}$
Angle $A D C=45^{\circ}$
Angle $A B C=20^{\circ}$
Work out the length of $A B$.
Give your answer correct to 3 significant figures.

$$
\begin{aligned}
& \text { Give your answer correct to s siggnicant figures. } \\
& \angle D A C=180-90-45^{\circ}=4 .
\end{aligned}
$$

As $A D C$ is isocelos, $A C=8 \mathrm{~cm}$.
Now $S^{O} H C^{A} H T^{\circ}$ A.

$$
\begin{aligned}
& 8=\sin (20) \times A B . \\
& A B=\frac{8}{\sin (20)}
\end{aligned}=23.39 \ldots .
$$

mmerevise.co.uk
$13 \mathbf{a}$ and $\mathbf{b}$ are vectors such that

$$
\mathbf{a}=\binom{2}{-3} \quad \text { and } \quad 3 \mathbf{a}-2 \mathbf{b}=\binom{8}{-17}
$$

Find $\mathbf{b}$ as a column vector.

$$
\begin{aligned}
& 3 a-2 b=\binom{8}{-17} \\
& \begin{aligned}
2 b & =3 a-\binom{8}{-17} \\
& =3\binom{2}{-3}-\binom{8}{-17} \\
& =\binom{3 \times 2-8}{3 \times-3--17}=\binom{-2}{8}=2 b . \\
b & =\frac{1}{2} \times\binom{-2}{8}=\binom{-1}{4}
\end{aligned}
\end{aligned}
$$

14 (a) Factorise fully $4 p^{2}-36$

$$
=4\left(p^{2}-9\right)
$$

D: fference of 2 squame): $4(p-3)(p+3)$

$$
4(p-3)(p+3)
$$

(b) Show that $(m+4)(2 m-5)(3 m+1)$ can be written in the form $a m^{3}+b m^{2}+c m+d$ where $a, b, c$ and $d$ are integers

$$
\begin{aligned}
& (m+4)(2 m-5)(3 m+1) \\
& =(m+4)\left(6 m^{2}-13 m-5\right) \\
& =6 m^{3}-13 m^{2}-5 m+24 m^{2}-52 m-20 \\
& =6 m^{3}+11 m^{2}-57 m-20 \\
& a=6, b=11, c=-57, d=-20 .
\end{aligned}
$$

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$15 P, Q, R$ and $S$ are four points on a circle.

$P X R$ and $S X Q$ are straight lines.
Prove that triangle $P Q X$ and triangle $S R X$ are similar.
Angles at the circumference subtended from the same chord of a circle are equal so Angle $P Q X=$ Angle $S R X$ and Angle $Q P=$ Angle $R S X$.
And as vertically opposite angles are equal Angle $P X Q=$ Angle $S \times R$.
All three pairs of corresponding angles are equal the triangles are similar.
mmerevise.co.uk
$16 p=\sqrt{\frac{2 e}{f}}$
$e=6.8$ correct to 1 decimal place.
$f=0.05$ correct to 1 significant figure.

Work out the upper bound for the value of $p$.
Give your answer correct to 3 significant figures.
You must show all your working.
upper bound for $e=6.85$. Lower bound for $f=0.045$.
upper bound of $p=\sqrt{\frac{2 \times 6.85}{0.045}}$

$$
p=17.4(3 \mathrm{sf})
$$

17 The table gives information about the distances, in miles, that some Year 10 students live from school.

| Distance $(d$ miles) | Frequency | frequency dens. ty |
| :---: | :---: | :---: |
| $0<d \leqslant 1.0$ | 90 | 90 |
| $1.0<d \leqslant 1.5$ | 48 | 96 |
| $1.5<d \leqslant 2.0$ | 22 | 44 |
| $2.0<d \leqslant 3.0$ | 8 | 8 |
| $3.0<d \leqslant 5.0$ | 12 | 6. |

(a) On the grid, draw a histogram for this information.

 ebthlenta live home aelooni


The number of Year 11 students who live between 1 and 2 miles from school is $\pi$
(b) Find an expression, in terms of $n$, for the number of Year 11 students what o live between 3 and 5 miles from school.

$$
\begin{aligned}
& n: 3<d \leq 5=5 \cdot 2 \\
& 5 \text { parts }=n \\
& 2 \text { parts }=\frac{2 n}{5}-0.4 n
\end{aligned}
$$

18 Here is a prism $A B C D S P Q R$.


The base $A B C D$ of the prism is a square of side 14 cm $T$ is the point on $B C$ such that $B T: T C=4: 3$

The cross section of the prism is in the shape of a trapezium of area $147 \mathrm{~cm}^{2}$ $C R=12 \mathrm{~cm}$

Find the size of the angle between the line $S T$ and the base $A B C D$.
Give your answer correct to 1 decimal place.

$$
\begin{aligned}
& T C=\frac{3}{4+3} \times 14=6 \mathrm{~cm} \\
& T D=\sqrt{14^{2}+6^{2}}=2 \sqrt{58} .
\end{aligned}
$$

Area of trapezium:

$$
\begin{aligned}
& 147=\frac{1}{2} \times(S D+12) \times 14 \\
& \Rightarrow S D+12=21 \Rightarrow S D=9 \mathrm{~cm} . \\
& \text { Now } S^{\circ} H C^{A} H T^{\circ} A \\
& \tan (\angle D T S)=\frac{9}{2 \sqrt{58}} \\
& \angle D T S=\tan ^{-1}\left(\frac{9 / 2 \sqrt{58})}{}\right)=30.577 \\
& \\
& \angle D 0.6^{\circ}\left(1 d_{p}\right)
\end{aligned}
$$

(Total for Question 18 is 5 marks)
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19 Show that $\frac{3 x}{x+2}-\frac{2 x+1}{x-2}-1$ can be written in the form $\frac{a x+b}{x^{2}-4}$
where $a$ and $b$ are integers.

$$
\begin{aligned}
& =\frac{3 x}{x+2}-\frac{2 x+1}{x-2}-1=\frac{3 x(x-2)}{(x+2)(x-2)}-\frac{(2 x+1)(x+2)}{(x+2)(x-2)}-\frac{(x+2)(x-2)}{(x+2)(x-2)} \\
& =\frac{3 x(x-2)-(2 x+1)(x+2)-(x+2)(x-2)}{(x+2)(x-2)} \\
& =\frac{3 x^{2}-6 x-2 x^{2}-5 x-2-x^{2}+4}{(x+2)(x-2)} \\
& =\frac{-11 x+2}{x^{2}-4} \\
& a=-11, b=2 .
\end{aligned}
$$

20 The profit made by a shop increases each year.
The profit made by the shop in year $n$ is $£ P_{n}$
Given that the profit made by the shop in the next year is $£ P_{n+1}$ then

$$
P_{n+1}=a P_{n}+800 \text { where } a \text { is a constant. }
$$

The table shows the profit made by the shop in 2018 and in 2019

| Year | 2018 | 2019 |
| :--- | :---: | :---: |
| Profit | $£ 24000$ | $£ 29600$ |

Work out the profit predicted to be made by the shop in 2021

$$
\begin{gathered}
P_{2019}=a \times 24000+800=29600 \\
a \times 24000=28800 \\
a=\frac{28800}{24000}=1.2 .
\end{gathered}
$$

$$
\begin{aligned}
P_{220} & =1.2 \times 29600+800 \\
& =\{36,320 \\
P_{2021} & =1.2 \times 36320+800 \\
& = \pm 44384 .
\end{aligned}
$$

21 Ray has nine cards numbered 1 to 9

Ray takes at random three of these cards.
He works out the sum of the numbers on the three cards and records the result.
Work out the probability that the result is an even number.
There are four ways the sum could be aneven number: $E, E, E, \& O, O, E \& O, E, O \& E, O, O$

$$
\begin{aligned}
& P(E, E, E)=\frac{4}{9} \times \frac{3}{8} \times \frac{2}{7}=\frac{1}{21} \\
& P(O, O, E)=\frac{5}{9} \times \frac{4}{8} \times \frac{4}{7}=\frac{10}{63} \\
& P(O, E, O)=\frac{5}{9} \times \frac{4}{8} \times \frac{4}{7}=\frac{10}{63} \\
& P(E, O, O)=\frac{4}{9} \times \frac{5}{8} \times \frac{4}{7}=\frac{10}{63} \\
& \begin{aligned}
P(\text { Sumis even }) & =\frac{1}{21}+\frac{10}{63}+\frac{10}{63}+\frac{10}{63} \\
& =\frac{11}{23} .
\end{aligned}
\end{aligned}
$$

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22 L is the straight line with equation $y=2 x-5$
C is a graph with equation $y^{2}=6 x^{2}-25 x-8$
Using algebra, find the coordinates of the points of intersection of $\mathbf{L}$ and $\mathbf{C}$.
You must show all your working.
For $L: y^{2}=(2 x-5)^{2}=4 x^{2}-20 x+25$. Where Land $C$ meet:

$$
\begin{aligned}
& 4 x^{2}-20 x+25=6 x^{2}-25 x-8 . \\
& \Rightarrow \quad 2 x^{2}-5 x-33=0 . \\
&(2 x-11)(x+3)=0 \\
& x=11 / 2 \text { or } x=-3 .
\end{aligned}
$$

To find $y$ values

$$
\begin{array}{ll}
y=2 x(11 / 2)-5 & \text { and } \begin{array}{ll}
y & =2 x(-3)-5 \\
y & =6
\end{array} \\
y & =-11
\end{array}
$$

Points of intersection are $(5 \cdot 5,6)$ and
$(-3,-11)$

$$
\begin{aligned}
& (5-5,6) \\
& (-3,-11)
\end{aligned}
$$

(Total for Question 22 is 5 marks)

