

Write your name here

Surname

Other Names

Mathematics

2022 Paper 3 (Calculator)

Higher Tier

Time: 1 hour 30 minutes

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

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.
- **Calculators may be used.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working.**



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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Higher Tier Formulae Sheet

Perimeter, area and volume

Where a and b are the lengths of the parallel sides and h is their perpendicular separation:

$$\text{Area of a trapezium} = \frac{1}{2}(a + b)h$$

Volume of a prism = area of cross section \times length

Where r is the radius and d is the diameter:

$$\text{Circumference of a circle} = 2\pi r = \pi d$$

$$\text{Area of a circle} = \pi r^2$$

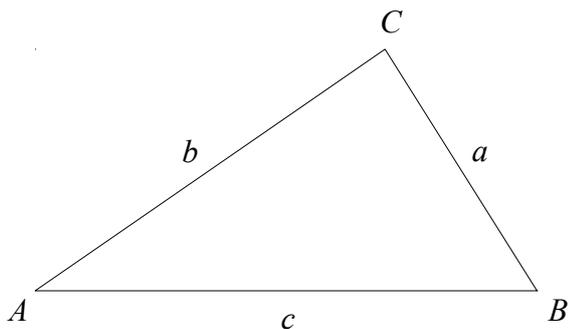
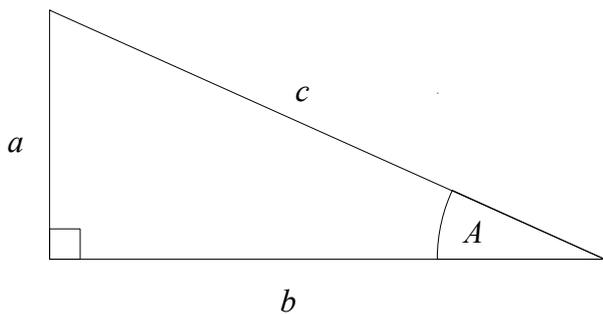
Quadratic formula

The solution of $ax^2 + bx + c = 0$

where $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Pythagoras' Theorem and Trigonometry



In any right-angled triangle where a , b and c are the length of the sides and c is the hypotenuse:

$$a^2 + b^2 = c^2$$

In any right-angled triangle ABC where a , b and c are the length of the sides and c is the hypotenuse:

$$\sin A = \frac{a}{c} \quad \cos A = \frac{b}{c} \quad \tan A = \frac{a}{b}$$

In any triangle ABC where a , b and c are the length of the sides:

$$\text{sine rule: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{cosine rule: } a^2 = b^2 + c^2 - 2bc \cos A$$

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

Compound Interest

Where P is the principal amount, r is the interest rate over a given period and n is number of times that the interest is compounded:

$$\text{Total accrued} = P \left(1 + \frac{r}{100} \right)^n$$

Probability

Where $P(A)$ is the probability of outcome A and $P(B)$ is the probability of outcome B :

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

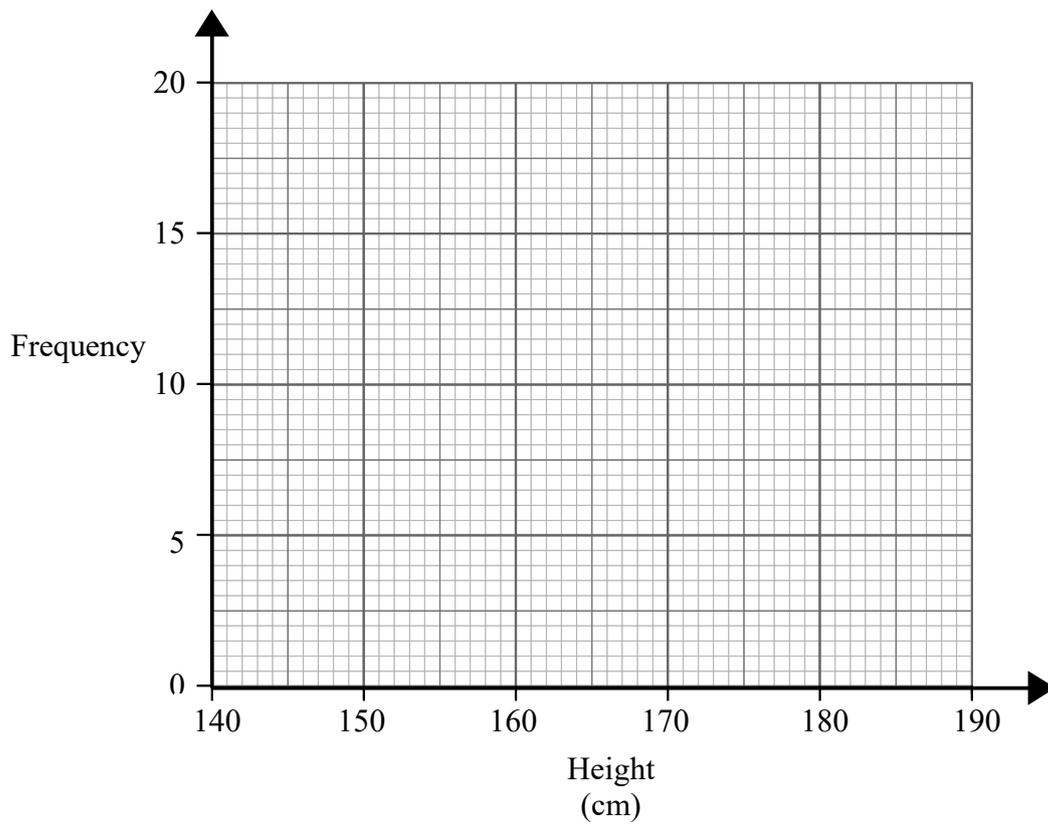
$$P(A \text{ and } B) = P(A \text{ given } B) P(B)$$

END OF EXAM AID

1 The frequency table shows the heights, in cm, of some tomato plants.

Height (cm)	Frequency
$140 < h \leq 150$	7
$150 < h \leq 160$	10
$160 < h \leq 170$	15
$170 < h \leq 180$	19
$180 < h \leq 190$	9

Draw a frequency polygon to show this information.



(Total for Question 1 is 2 marks)

2 Banana computers sold 19.3 million computers in 2017.

In 2018, they sold 18.2 million computers.

Work out the percentage decrease in the number of computers sold.

Give your answer to three significant figures.

..... %

(Total for Question 2 is 3 marks)

3 The value of a house increased by 6%.
The house then had a value of £265 000

Work out the value of the house before the increase.

£

(Total for Question 3 is 2 marks)

4 $s = ut + \frac{1}{2}at^2$

$u = -5$

$a = 4$

$t = 3$

(a) Work out the value of s .

$s = \dots\dots\dots$ (2)

(b) Make s the subject of $s = ut + \frac{1}{2}at^2$

$\dots\dots\dots$ (2)

(Total for Question 4 is 4 marks)

5 There are 120 people in a school canteen.
40% of the people in the canteen are in year 11 students.

The number of year 11 students in the canteen is three times the number of year 10 students.
The rest of the people in the canteen are year 9 students.

the number of year 9 students : the number of year 10 students = $n : 1$

Work out the value of n .
You must show how you get your answer.

$n = \dots\dots\dots$

(Total for Question 5 is 2 marks)

6 Amy drives 300 miles from London to Newcastle.
She drives the first 165 miles at an average speed of 60 mph.
From this point it takes Amy 3 hours and 5 minutes to complete her journey.

What was Amy's average speed for the whole journey?
Give your answer correct to 3 significant figures.

..... mph

(Total for Question 6 is 4 marks)

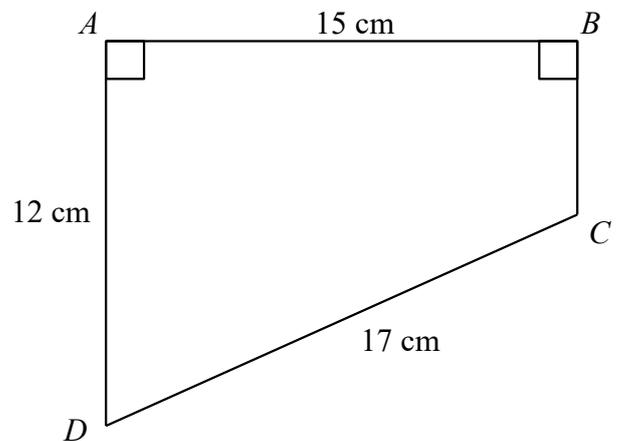
- 7 Potatoes cost £9 for a 12.5 kg bag at a farm shop.
The same type of potatoes cost £1.83 for a 2.5 kg bag at a supermarket.

Where are the potatoes the better value, at the farm shop or at the supermarket?
You must show your working.

(Total for Question 7 is 3 marks)

- 8 $ABCD$ is a trapezium.

Calculate the area of $ABCD$.



.....cm²

(Total for Question 8 is 4 marks)

- 9 Given that $81 \times \sqrt{3} = 3^n$
Find the value n .

.....
(Total for Question 9 is 2 marks)

- 10 There are 5 starters, 6 main courses and x desserts in a restaurant.

Riley says there are 130 different ways of choosing a starter, a main course and a dessert.

Could Riley be correct?

You must show your working.

(Total for Question 10 is 2 marks)

11 The line AB passes through the points $A(-2, k)$ and $(4, 8)$.

The gradient of AB is -2 .

Work out the value of k .

$k = \dots\dots\dots$

(Total for Question 11 is 3 marks)

12 Expand and Simplify $(x + 5)(x - 3)(2x - 1)$

$\dots\dots\dots$

(Total for Question 12 is 3 marks)

13 $\mathbf{a} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$

(a) Write down as a column vector

(i) $\mathbf{a} + \mathbf{b}$

.....
(1)

(ii) $2\mathbf{a} - \mathbf{b}$

.....
(1)

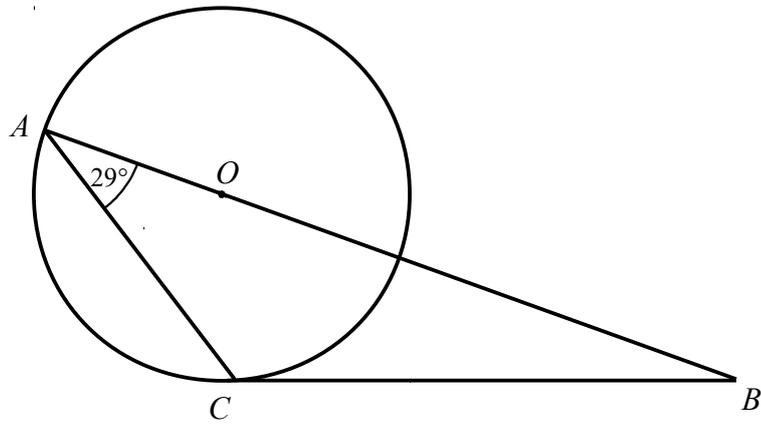
(Total for Question 13 is 2 marks)

14 A car's value is decreasing by $x\%$ each year.

The car's value will decrease by 60% in 6 years, work out the value of x .
Give your answer to 2 decimal places.

.....
(Total for Question 14 is 3 marks)

15



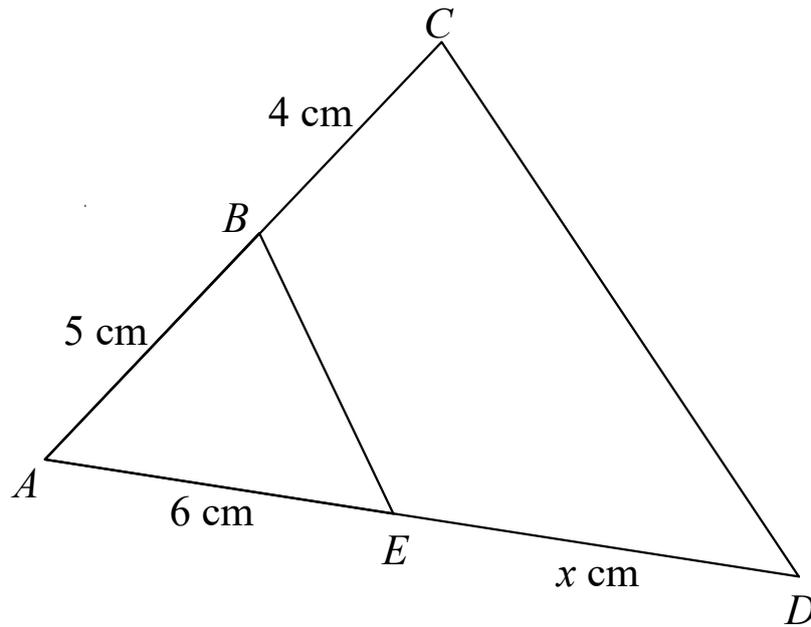
A and C are points on the circumference of a circle, centre O .
 BC is a tangent to the circle.

Angle $CAB = 29^\circ$

Find the size of angle ABC .
You must show all your working.

.....
(Total for Question 15 is 4 marks)

16 The two triangles in the diagram are similar.



There are two possible values of x .

Work out each of these values.

State any assumptions you make in your working

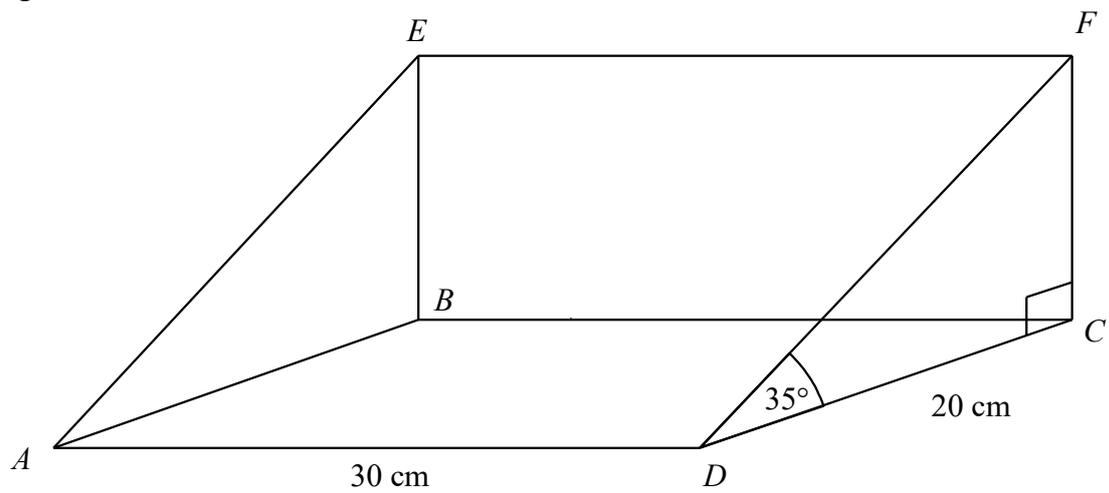
(Total for Question 16 is 5 marks)

17 Show that $3 + \left[(x+4) \div \frac{x^2 - 16}{x - 5} \right]$ simplifies to $\frac{ax - b}{cx - d}$ where a, b, c and d are integers.

(Total for Question 17 is 4 marks)

18 The diagram shows a triangular prism.

$CD = 20$ cm
 $AD = 30$ cm
Angle $FDC = 35^\circ$



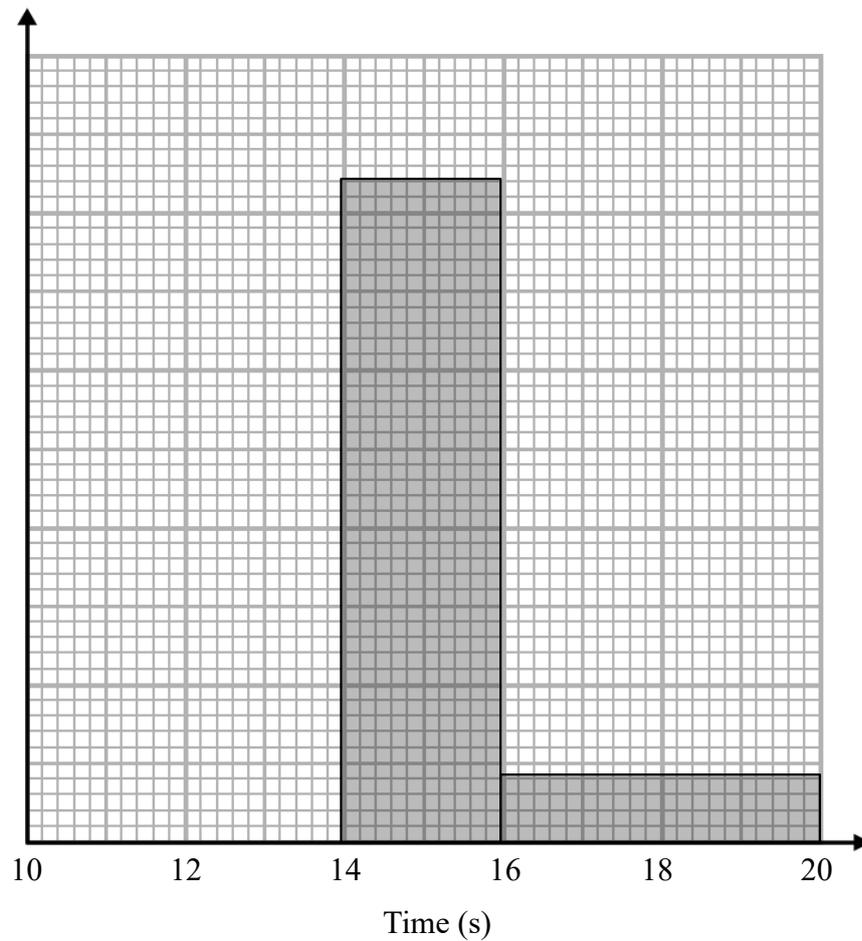
Calculate the size of the angle the line AF makes with the plane $ABCD$.
Give your answer correct to 3 significant figures.

.....
(Total for Question 18 is 4 marks)

19 The table shows information about the time, in seconds, taken for some people to run a 100m race.

Time (s)	Frequency
$10 < t \leq 12$	6
$12 < t \leq 13$	21
$13 < t \leq 14$	23
$14 < t \leq 16$	
$16 < t \leq 20$	8

(a) Use the information on the table to complete the histogram.



(b) Use the histogram to complete the table.

(Total for Question 19 is 4 marks)

20

$$f = \frac{\sqrt{g}}{h}$$

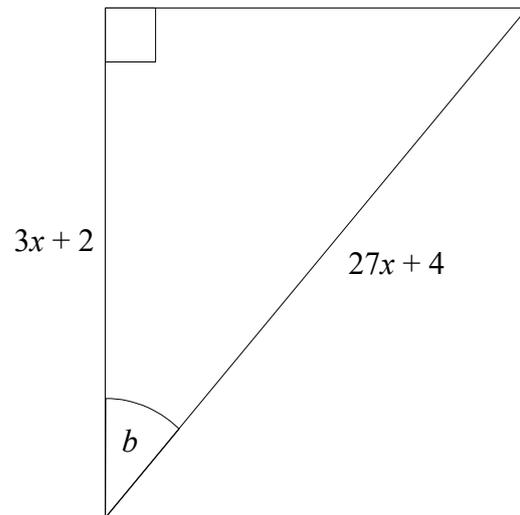
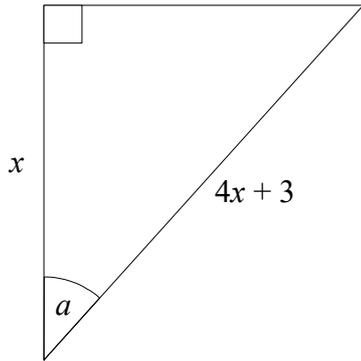
$g = 12.7$ correct to 3 significant figures

$h = 9.294$ correct to 3 decimal places

By considering bounds, work out the value of f to a suitable degree of accuracy.
Give a reason for your answer.

.....
(Total for Question 20 is 5 marks)

21 Here are two right angled triangles.



Given that

$$\cos a = \cos b$$

find the value of x .

You must show all your working.

.....
(Total for Question 21 is 5 marks)

22 Solve algebraically the simultaneous equations

$$x^2 - 3y^2 = 13$$

$$2x + 3y = 4$$

(Total for Question 22 is 5 marks)

23 There are some red counters and some blue counters in a bag.

The ratio of red counters to blue counters is 3:1.

Two counters are removed at random.

The probability that both the counters taken are blue is $\frac{1}{20}$

Work how many counters were in the bag before any counters were removed.

.....
(Total for Question 23 is 5 marks)

Extra Question

The number of people living in a town t years from now is P_t where

$$P_0 = 55000$$

$$P_{t+1} = 1.03(P_t - 800)$$

Work out the number of people in the town 3 years from now.

.....
(Total for Extra Question is 3 marks)
