

GCSE Mathematics
Practice Booklet 2024
Paper 3 (Calculator)

Higher Tier



GCSE
Maths Tutor



How it all Works!

Work through the practice booklet,
scan the code, watch the live
tutorial and check your answers!

Try it out!

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Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages of your working.

1. Use your calculator to work out

$$\frac{\sqrt[3]{1.25^4 + \tan 30^\circ}}{9^{\frac{1}{2}}}$$

Give your answer correct to 3 significant figures.

.....
(2 marks)

2. Find the highest common factor (HCF) of 60 and 84.

.....
(2 marks)

3. There are 95 girls and 87 boys in Year 13 at a school.

One girl is going to be chosen for the role of Head Girl.

A different girl is going to be chosen for the role of Deputy Head Girl.

One boy is going to be chosen for the role of Head Boy.

A different boy is going to be chosen for the role of Deputy Head Boy.

Work out how many different ways this can be done.

.....
(3 marks)

4. a) Write 0.000068 in standard form.

.....
(1 marks)

$$T = \sqrt{\frac{w}{d^3}}$$

$$w = 5.6 \times 10^{-5}$$

$$d = 1.4 \times 10^{-4}$$

b) Work out the value of T .

Give your answer in standard form correct to 3 significant figures.

$T =$
(2 marks)

5. a) Write 4.5×10^5 as an ordinary number

.....
(1 mark)

b) Work out $4.2 \times 10^3 + 5.3 \times 10^2$

Give your answer in standard form.

.....
(2 marks)

6. $p = \sqrt{\frac{2e}{f}}$

$e = 6.8$ 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.

.....
(3 marks)

7. a) Expand and simplify $5(p + 3) - 2(1 - 2p)$

.....
(2 marks)

b) Factorise $a^2 - b^2$

.....
(1 mark)

c) Hence, or otherwise, simplify fully $(x^2 + 4)^2 - (x^2 - 2)^2$

.....
(3 marks)

8. Show that $\frac{6x^3}{(9x^2-144)} \div \frac{2x^4}{3(x-4)}$ can be written in the form $\frac{1}{x(x+r)}$ where r is an integer.

.....
(3 marks)

9. Show that $\frac{3x}{x+2} - \frac{2x+1}{x-2} - 1$ can be written in the form $\frac{ax+b}{x^2-4}$
where a and b are integers.

.....
(4 marks)

10. Prove algebraically that the difference between the squares of any two consecutive odd numbers is always a multiple of 8

.....
(3 marks)

11. $m = \sqrt{\frac{k^3+1}{4}}$

Make k the subject of the formula.

.....
(3 marks)

12. Make a the subject of $a + 3 = \frac{2a+7}{r}$

.....
(3 marks)

13. n is an integer greater than 1

Prove algebraically that $n^2 - 2 - (n - 2)^2$ is always an even number.

.....
(4 marks)

14. $f(x) = \frac{1}{x+2} + \frac{1}{x-3}$

a) Work out $f(5)$

Give your answer as a fraction.

.....
(2 marks)

b) Write down a value of x for which $f(x)$ is not defined.

Given that $f(x) = 4$

.....
(1 mark)

c) find the possible values of x .

Give your answer in the form $\frac{p \pm \sqrt{q}}{r}$ where p, q and r are positive integers.

.....
(5 marks)

15. The function f is such that

$$f(x) = 4x - 1$$

a) Find $f^{-1}(x)$

$$f^{-1}(x) = \dots\dots\dots$$

(2 marks)

The function g is such that

$$g(x) = kx^2 \text{ where } k \text{ is a constant.}$$

Given that $fg(2) = 12$

b) work out the value of k

.....

(2 marks)

16. Solve $6x^2 + 5x - 6 = 0$

.....

(3 marks)

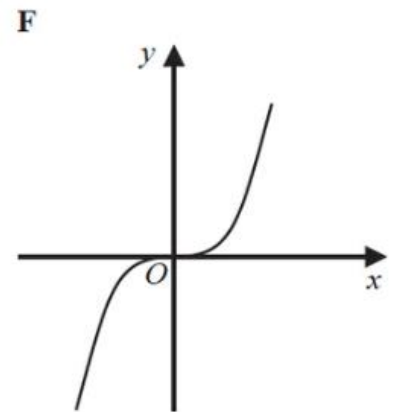
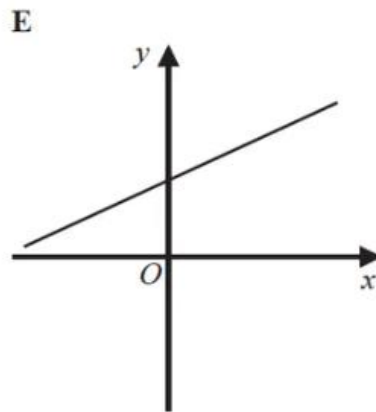
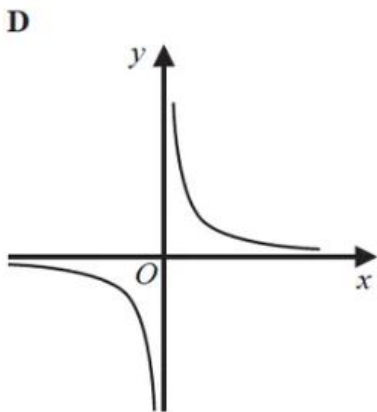
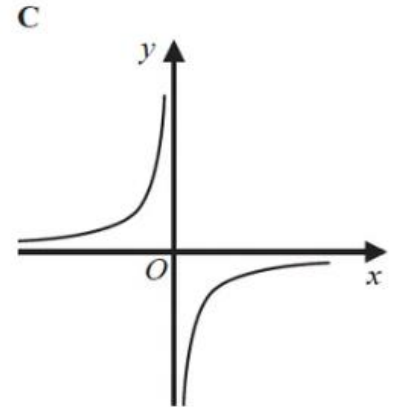
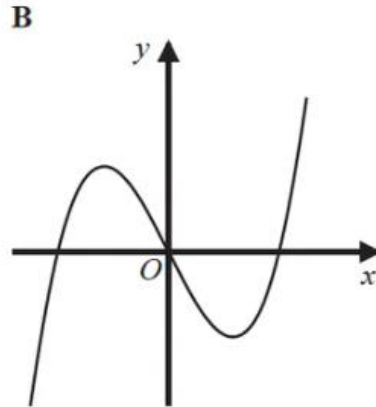
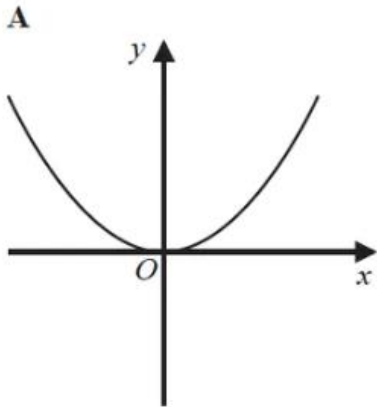
17. Solve algebraically the simultaneous equations

$$x^2 - 4y^2 = 9$$

$$3x + 4y = 7$$

.....
(5 marks)

18. Here are 6 graphs



Write down the letter of the graph that could have the equation

a) $y = x^3$

.....
(1 mark)

b) $y = \frac{1}{x}$

.....
(1 mark)

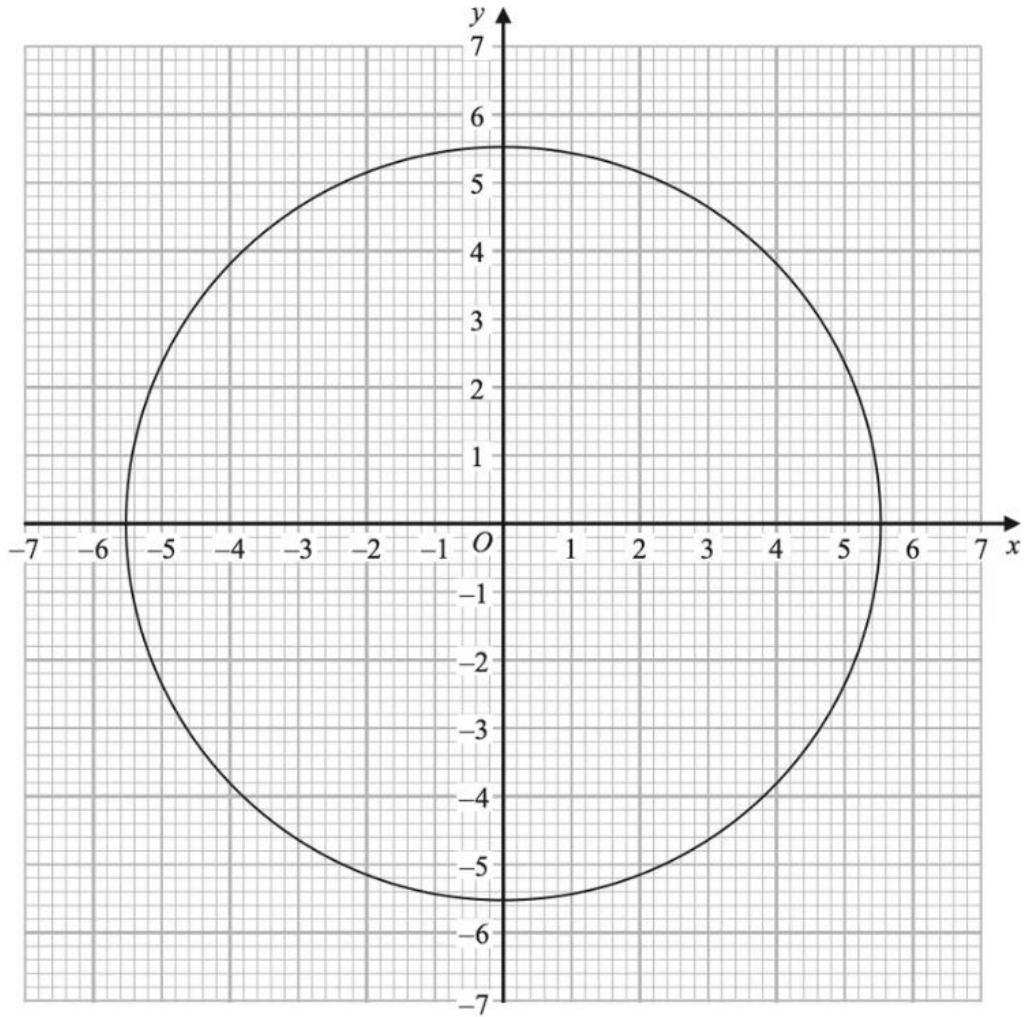
19. Here are the first 5 terms of a quadratic sequence.

1 3 7 13 21

Find an expression, in terms of n , for the n th term of this quadratic sequence.

.....
(3 marks)

20. The diagram shows the graph of $x^2 + y^2 = 30.25$



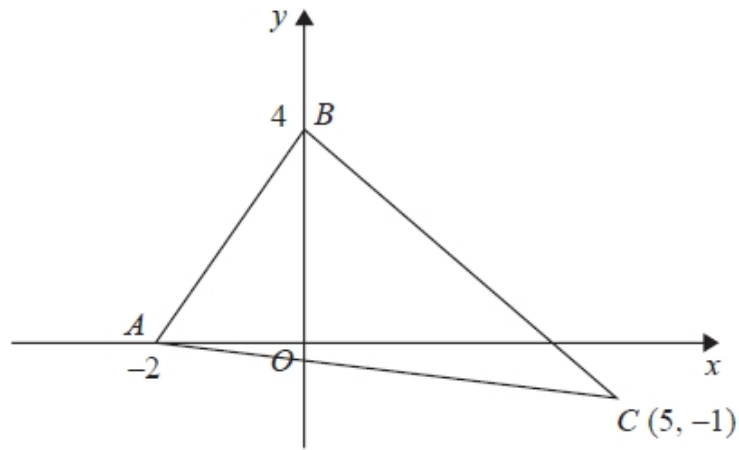
Use the graph to find estimates for the solutions of the simultaneous equations

$$x^2 + y^2 = 30.25$$

$$y - 2x = 1$$

.....
(3 marks)

21.



Find an equation of the line that passes through C and is perpendicular to AB.

.....
(4 marks)

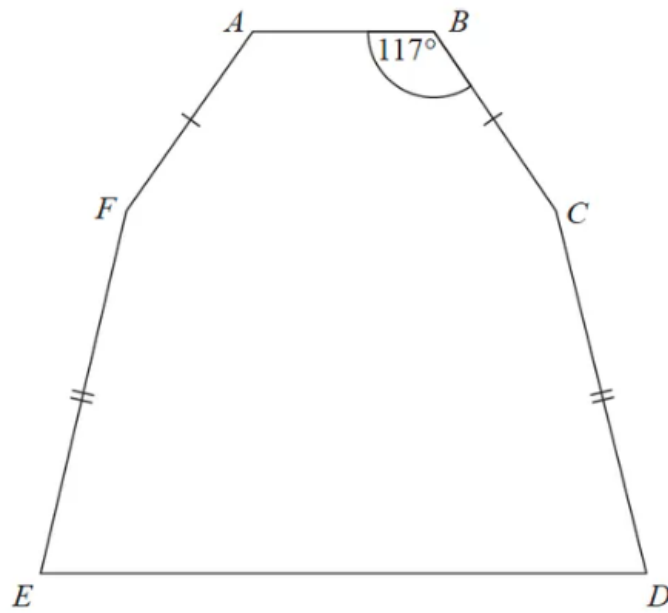
22. The equation of the line L_1 is $y = 3x - 2$
The equation of the line L_2 is $3y - 9x + 5 = 0$

Show that these two lines are parallel.

(2 marks)

23. The diagram shows a hexagon.

The hexagon has one line of symmetry.



Angle $BCD = 2 \times$ angle CDE

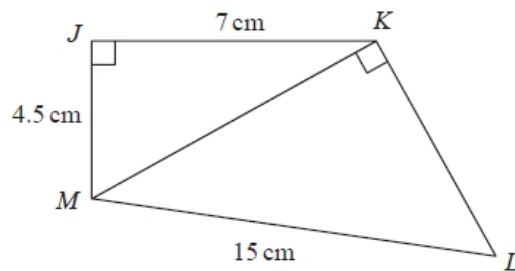
Work out the size of angle AFE .

You must show all your working.

.....

(4 marks)

24. The diagram shows a quadrilateral JKLM.

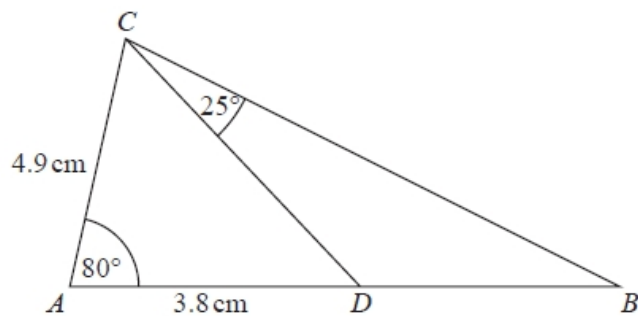


Work out the size of angle KLM.

Give your answer correct to 3 significant figures.

.....
(4 marks)

25.



ABC is a triangle.

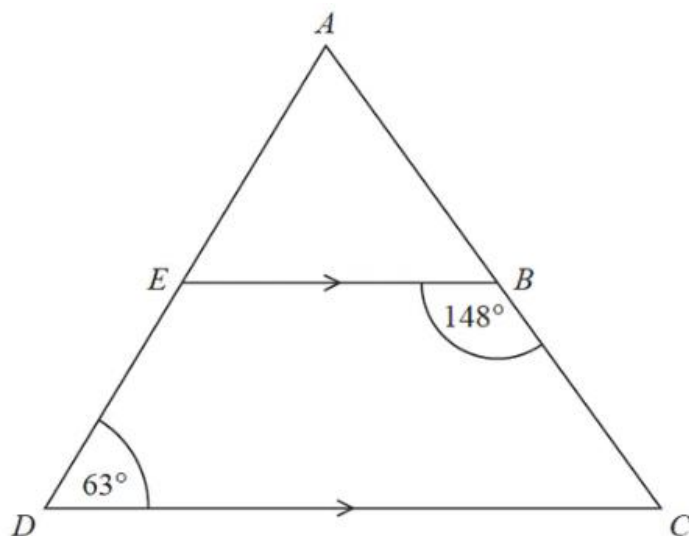
D is a point on AB.

Work out the area of triangle BCD.

Give your answer correct to 3 significant figures.

..... cm^2
(5 marks)

26. ADC is a triangle.
 AED and ABC are straight lines
 EB is parallel to DC .

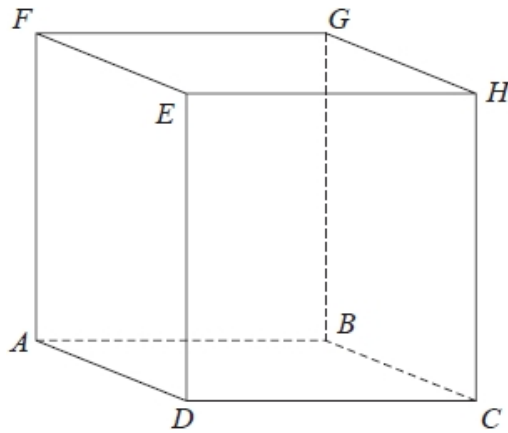


Work out the size of angle EAB .

You must give a reason for each stage of your working.

.....
(5 marks)

27. ABCDEFGH is a cuboid.



$AB = 7.3 \text{ cm}$

$CH = 8.1 \text{ cm}$

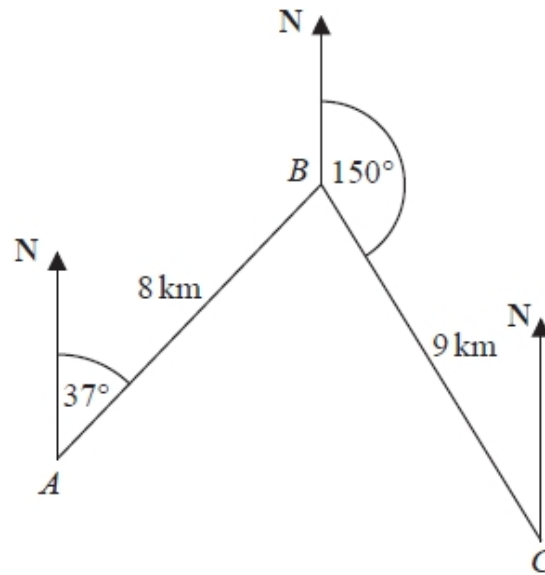
Angle $BCA = 48^\circ$

Find the size of the angle between AH and the plane ABCD.

Give your answer correct to 1 decimal place.

.....
(4 marks)

28. The diagram shows the positions of three towns, Acton, Barston and Chorlton.



Barston is 8 km from Acton on a bearing of 037°

Chorlton is 9 km from Barston on a bearing of 150°

Find the bearing of Chorlton from Acton.

Give your answer correct to 1 decimal place.

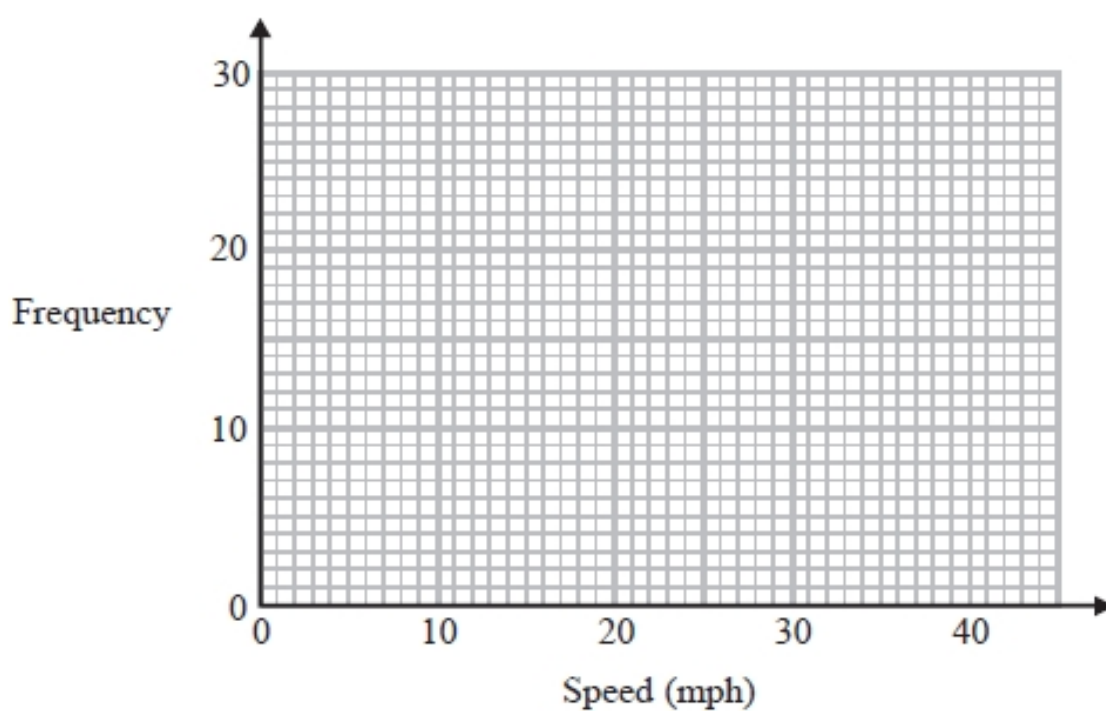
You must show all your working.

.....^o
(5 marks)

29. The table gives information about the speeds of 70 cars.

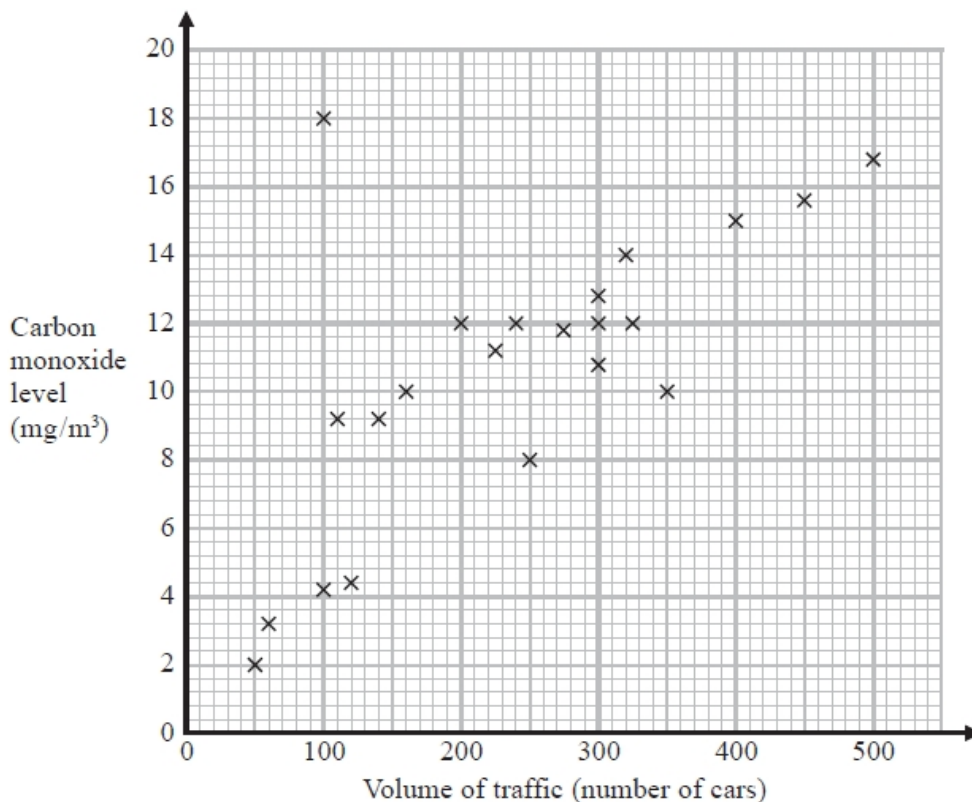
Speed (s mph)	Frequency
$0 < s \leq 10$	14
$10 < s \leq 20$	18
$20 < s \leq 30$	26
$30 < s \leq 40$	12

Draw a frequency polygon for this information.



(2 marks)

30. The scatter graph shows information about the volume of traffic and the carbon monoxide level at a point on a road each day for 22 days.



One point is an outlier.

(a) Write down the coordinates of this point. (..... ,) (1 mark)

For another day, 370 cars pass the point on the road.

(b) Estimate the carbon monoxide level for this day.
 mg/m³ (2 marks)

Alfie says,

"Because there is an outlier, there is no correlation."

(c) Is Alfie correct? You must give a reason for your answer.

.....

.....

(1 mark)

31. The table shows some information about the foot lengths of 40 adults.

Foot length (f cm)	Number of adults
$16 \leq f < 18$	3
$18 \leq f < 20$	6
$20 \leq f < 22$	10
$22 \leq f < 24$	12
$24 \leq f < 26$	9

(a) Write down the modal class interval.

.....

(1 marks)

(b) Calculate an estimate for the mean foot length.

.....

(3 marks)

32. Each person in a fitness club is going to get a free gift. Sam is going to order the gifts. Sam takes a sample of 50 people in the fitness club. He asks each person to tell him the gift they would like. The table shows information about his results.

Gift	Number of people
sports bag	17
gym towel	7
headphones	11
voucher	15

There are 700 people in the fitness club.

a) Work out how many sports bags Sam should order.

.....

(2 marks)

b) Write down any assumption you made and explain how this could affect your answer.

.....

.....

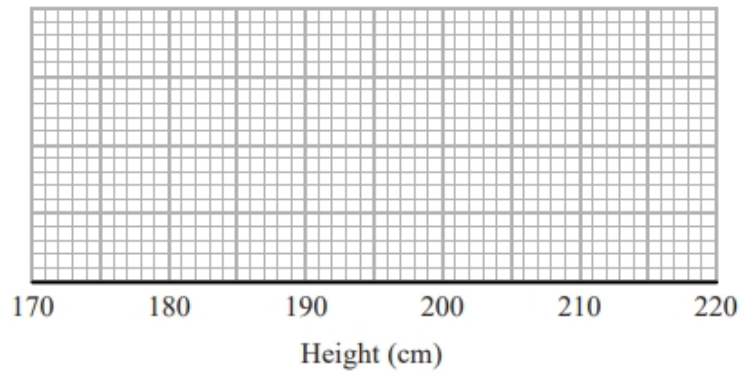
(1 mark)

33. The stem and leaf diagram shows information about the heights, in cm, of 23 flowers.

17	3	4	9				
18	6	8	8				
19	0	0	1	4	6	7	8
20	1	4	7	7	9	9	
21	4	8	8	9			

Key: 17|3 represents 173 cm

On the grid, draw a box plot for this information.



(3 marks)

34. Emily buys a pack of 12 bottles of water.
 The pack costs £5.64
 Emily sells all 12 bottles for 50p each.
 Work out Emily's percentage profit.
 Give your answer correct to 1 decimal place.

..... %
 (3 marks)

35. There are four types of cards in a game.

Each card has a black or white circle or a black or white triangle.

The number of cards with a black shape : number of cards with a white shape = 3 : 5

The number of cards with a circle : number of cards with a triangle = 2 : 7

Express the total number of cards with a black shape as a fraction of the total number of cards with a triangle.

.....
(3 marks)

36. Jack bought a new boat for £12 500

The value, $\pounds V$, of Jack's boat at the end of n years is given by the formula

$$V = 12\,500 \times (0.85)^n$$

At the end of how many years was the value of Jack's boat first less than 50% of the value of the boat when it was new?

.....
(2 marks)

37. Charlie invests $\pounds x$ in Better Investments for 3 years.
Sadie invests $\pounds x$ in County Bank for 3 years.

Better Investments
Compound Interest
2.5% per annum

County Bank
Compound Interest
2% per annum for the first two years
3.5% per annum for each extra year

At the end of the 3 years, the value of Charlie's investment is $\pounds 344,605$
Work out the value of Sadie's investment at the end of the 3 years.

\pounds
(4 marks)

38. Natasha invests $\pounds 6000$ for 5 years.
The investment gets compound interest of $x\%$ per annum.
At the end of 5 years the investment is worth $\pounds 8029.35$
Work out the value of x .

.....
(3 marks)

39. In London, 1 litre of petrol costs 108.9p
In New York, 1 US gallon of petrol costs \$2.83
1 US gallon = 3.785 litres
£1 = \$1.46
In which city is petrol better value for money, London or New York?
You must show your working.

(3 marks)

40. A box in the shape of a cuboid is placed on a horizontal floor.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

The box exerts a force of 180 newtons on the floor.

The box exerts a pressure of 187.5 newtons/m² on the floor.

The face in contact with the floor is a rectangle of length 1.2 metres and width x metres.

Work out the value of x .

$x = \dots\dots\dots$

(3 marks)

41. 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.

..... mph
(4 marks)

42. The density of ethanol is 1.09 g/cm^3
The density of propylene is 0.97 g/cm^3

60 litres of ethanol are mixed with 128 litres of propylene to make 188 litres of antifreeze.

Work out the density of the antifreeze.
Give your answer correct to 2 decimal places.

..... g/cm^3
(4 marks)

43. The functions f and g are such that

$$f(x) = 3x - 1 \text{ and } g(x) = x^2 + 4$$

(a) Find $f^{-1}(x)$

$f^{-1}(x)$
(2 marks)

Given that $fg(x) = 2gf(x)$,

(b) show that $15x^2 - 12x - 1 = 0$

(5 marks)

44. The number of rabbits on a farm at the end of month n is P_n
The number of rabbits at the end of the next month is given by $P_{n+1} = 1.2P_n - 50$

At the end of March there are 200 rabbits on the farm.

Work out how many rabbits there will be on the farm at the end of June.

.....
(3 marks)

45. Sylvia wants to find an estimate for the number of birds in a reserve.

On Monday, she catches 90 of the birds.
She puts a ring on each of the birds and returns them to the reserve.

On Tuesday, she catches 120 of the birds.
She find that 20 of the birds have rings on them.

a) Work out an estimate for the total number of birds in the reserve.

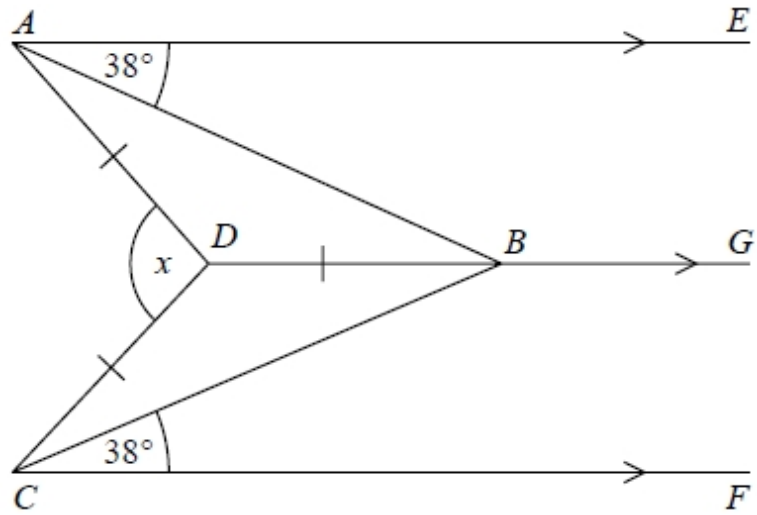
.....
(3 marks)

Sylvia assumes that none of the rings have fallen off between Monday and Tuesday.

b) If Sylvia's assumption is wrong, explain what effect this would have on your answer to part (a).

.....
.....
.....
(1 mark)

46.



AE, DBG and CF are parallel.

DA = DB = DC.

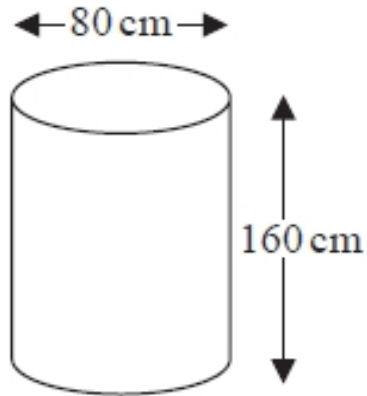
Angle EAB = angle BCF = 38°

Work out the size of the angle marked x .

You must show your working.

.....^o
(3 marks)

47. Karina has 4 tanks on her tractor.
Each tank is a cylinder with diameter 80 cm and height 160 cm.



The 4 tanks are to be filled completely with a mixture of fertiliser and water.

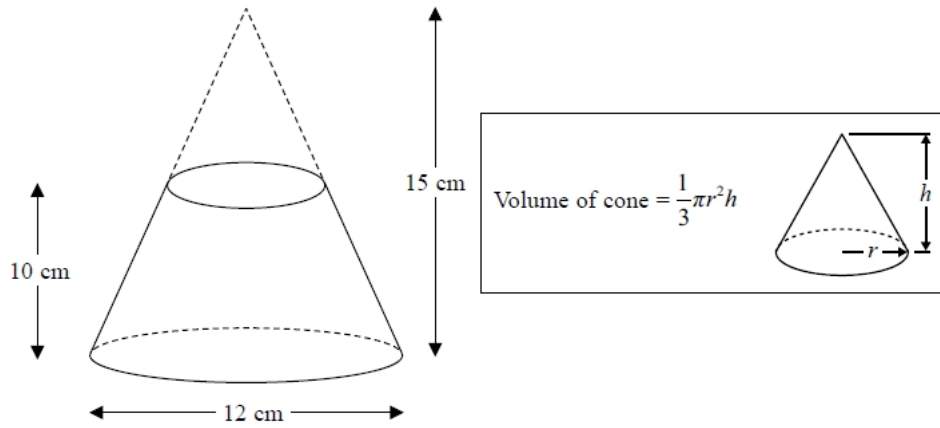
The fertiliser has to be mixed with water in the ratio 1 : 100 by volume.
Karina has 32 litres of fertiliser.

$$1 \text{ litre} = 1000 \text{ cm}^3$$

Has Karina enough fertiliser for the 4 tanks?
You must show how you get your answer.

(4 marks)

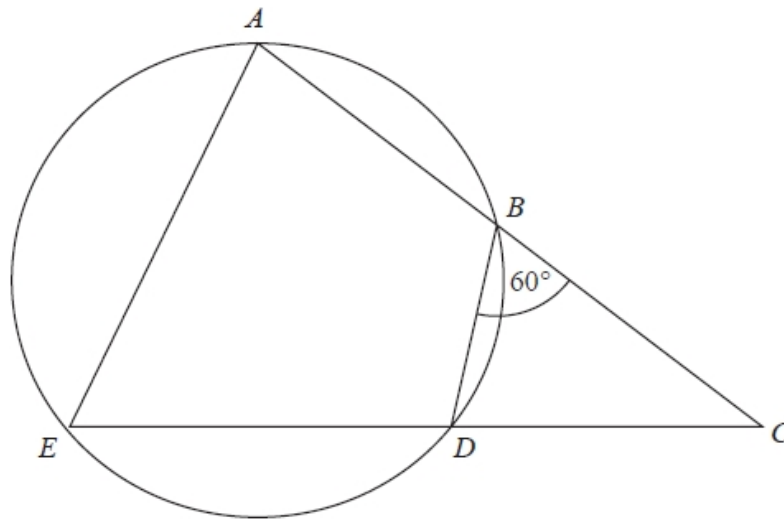
48. A frustum is made by removing a small cone from a large cone as shown in the diagram.



The frustum is made from glass.
The glass has a density of 2.5 g / cm^3
Work out the mass of the frustum.
Give your answer to an appropriate degree of accuracy.

..... g
(5 marks)

49.



ABDE is a cyclic quadrilateral.
ABC and EDC are straight lines.
Angle DBC = 60°

Given that

size of angle EAB : size of angle BCD = 2 : 1

work out the size of angle BCD.

You must show all your working.

.....^o
(4 marks)

50. a) Show that the equation $x^3 + x = 7$ has a solution between 1 and 2

(2 marks)

b) Show that the equation $x^3 + x = 7$ can be rearranged to give $x = \sqrt[3]{7 - x}$

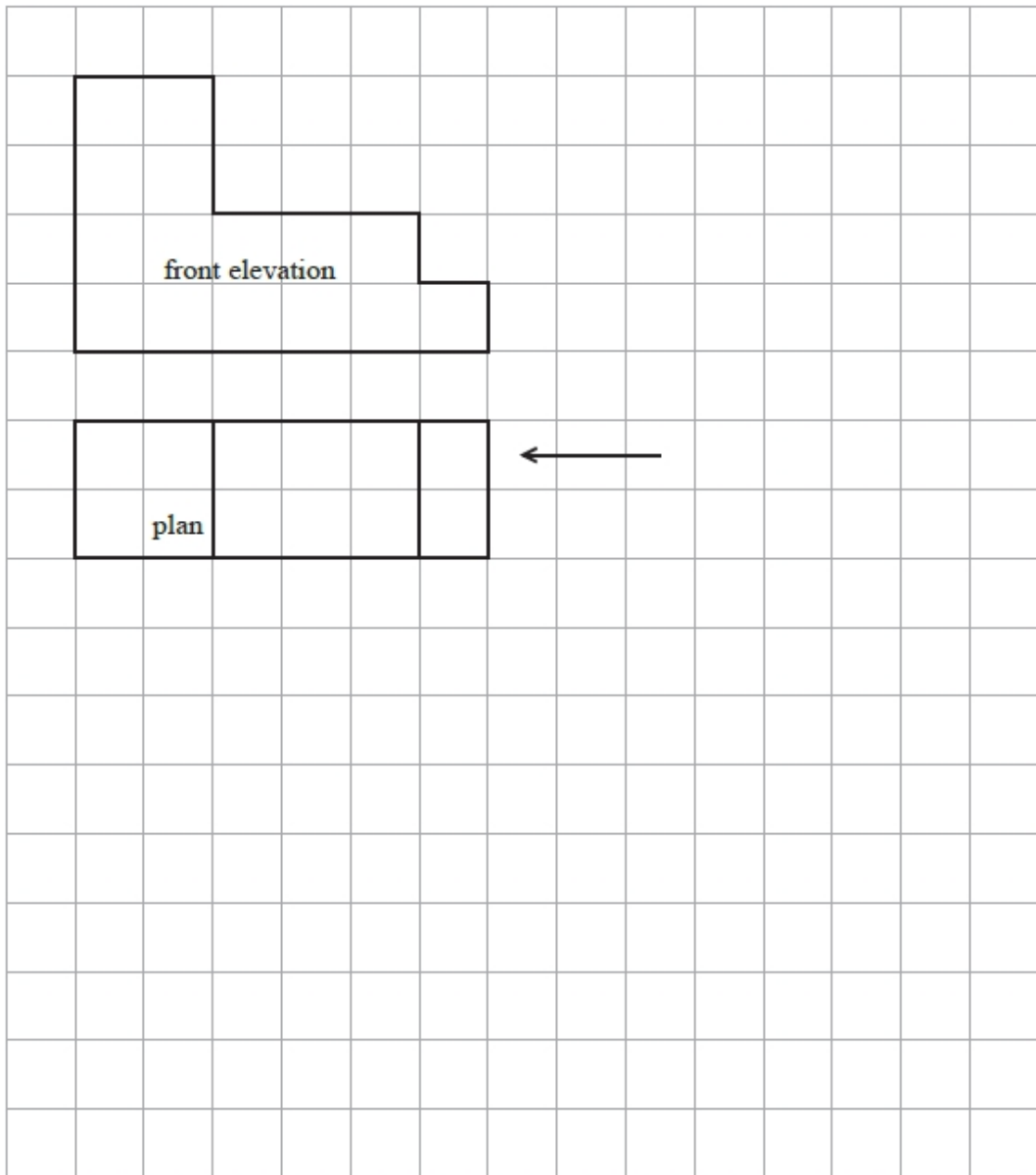
(1 mark)

c) Starting with $x_0 = 2$

use the iteration formula $x_{n+1} = \sqrt[3]{7 - x_n}$ three times to find an estimate for a solution of $x^3 + x = 7$

.....
(3 marks)

51. The front elevation and plan of a solid are shown on the grid.
On the grid, draw the side elevation from the direction of the arrow.



(2 marks)

52. Jackson is trying to find the density, in g/cm^3 , of a block of wood. The block of wood is in the shape of a cuboid.

He measures

the length as 13.2 cm, correct to the nearest mm

the width as 16.0 cm, correct to the nearest mm

the height as 21.7 cm, correct to the nearest mm

He measures the mass as 1970 g, correct to the nearest 5 g.

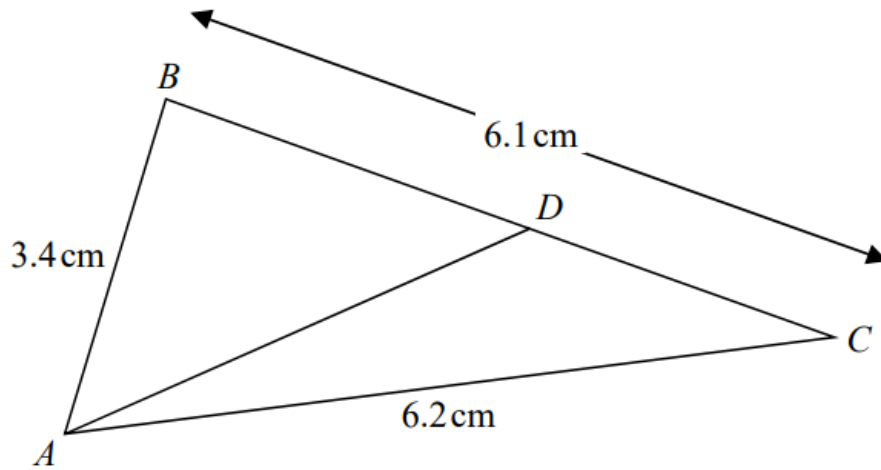
By considering bounds, work out the density of the wood.

Give your answer to a suitable degree of accuracy.

You must show all your working and give a reason for your final answer.

(5 marks)

53. The diagram shows triangle ABC.



AB = 3.4 cm AC = 6.2 cm BC = 6.1 cm

D is the point on BC such that

$$\text{size of angle DAC} = \frac{2}{5} \times \text{size of angle BCA}$$

Calculate the length DC.

Give your answer correct to 3 significant figures.

You must show all your working.

..... cm
(5 marks)