

Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier Paper 1 Non-Calculator

Tuesday 19 May 2020

Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- mathematical instruments.

You must **not** use a calculator.



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



Please note that these worked solutions have neither been provided nor approved by AQA and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer **all** questions in the spaces provided.

1 Circle the fraction that is equivalent to 4.75

[1 mark]

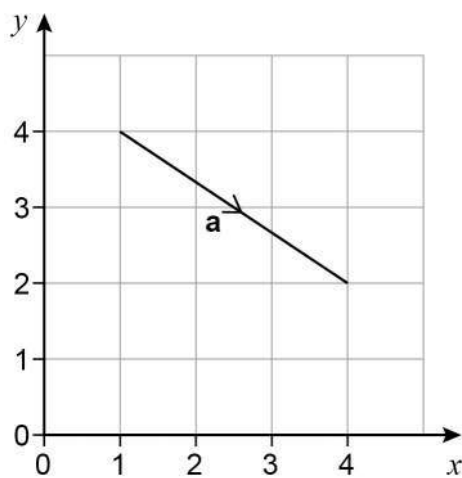
$\frac{15}{4}$

$\frac{19}{4}$

$\frac{21}{4}$

$\frac{23}{4}$

$$4 = 16/4. 0.75 = 3/4. 16/4 + 3/4 = 19/4$$

2 Here is vector **a**.Circle the column vector that represents **a**.

[1 mark]

$\begin{pmatrix} 3 \\ 2 \end{pmatrix}$

$\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

$\begin{pmatrix} 3 \\ -2 \end{pmatrix}$

$\begin{pmatrix} -3 \\ -2 \end{pmatrix}$

$$3 \text{ to the right, which is } 3 \text{ in the } x \text{ direction. } 2 \text{ down, which is } -2 \text{ in the } y \text{ direction}$$
3 Which one of these is a square number **and** a cube number?

Circle your answer.

[1 mark]

100

1000

10000

1000000

$$1000000 = 10^6. \text{ The power of } 6 \text{ can be divided by } 2 \text{ and by } 3 \text{ so therefore can be square rooted and cube rooted}$$


4 Circle the reciprocal of $\frac{5}{6}$

[1 mark]

$$\frac{6}{5}$$

$$\frac{1}{6}$$

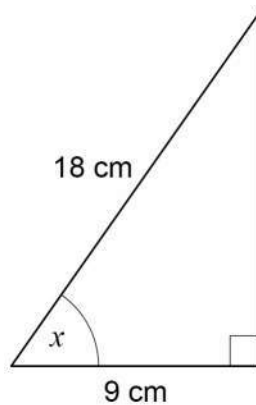
$$-\frac{1}{6}$$

$$-\frac{6}{5}$$

Reciprocal means 1 divided by. This flips fractions

5 Use trigonometry to work out the size of angle x .

Not drawn
accurately



[2 marks]

S^o H^o C^o A^o H^o T^o A^o

Listing SOH CAH TOA as formula triangles. Ticking A and H as we have the adjacent and hypotenuse

$$\frac{9}{18} = \frac{1}{2}$$

Two ticks on the CAH formula triangle means that this one can be used. By covering C in the formula triangle as this is the term involving the angle: $\cos(x) = \text{adjacent/hypotenuse} = 9/18$. This simplifies to $1/2$

Answer 60 degrees

0 30 45 60 90
 $\frac{\sqrt{4}}{2}$ $\frac{\sqrt{3}}{2}$ $\frac{\sqrt{2}}{2}$ $\frac{1}{2}$ $\frac{\sqrt{0}}{2}$

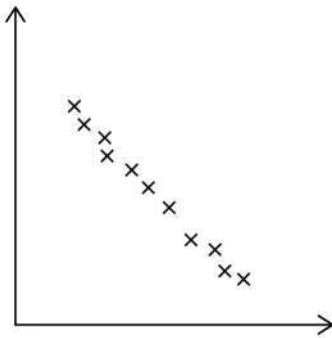
The angles we need to remember for the trig values are 0, 30, 45, 60 and 90. Listing these out in order. For the cos values list 4, 3, 2, 1, 0 under these, square root them all then put them over 2. $\sqrt{1}/2$ simplifies to $1/2$ so $\cos(60) = 1/2$. The angle must be 60



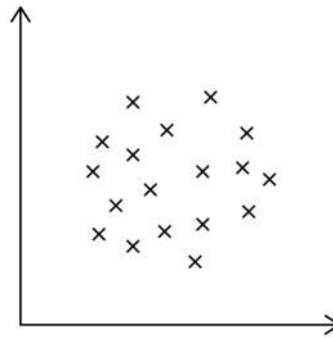
6

A and B are scatter graphs.

Graph A



Graph B



What type of correlation is shown by each graph?

Choose from

Weak positive
Strong positive
Weak negative
Strong negative
No correlation

[2 marks]Graph A Strong negativeGraph B No correlation

If drawing a line of best fit, it would have a negative gradient and all the points would be quite close to it for Graph A so it has strong negative correlation. Graph B has no correlation as a suitable line of best fit cannot be drawn; there is no link between the two variables



7 Here is some information about 80 people who play in bands.

12 are singers but not guitar players.

30% are neither a singer nor a guitar player.

$\frac{1}{4}$ of the guitar players are also singers.

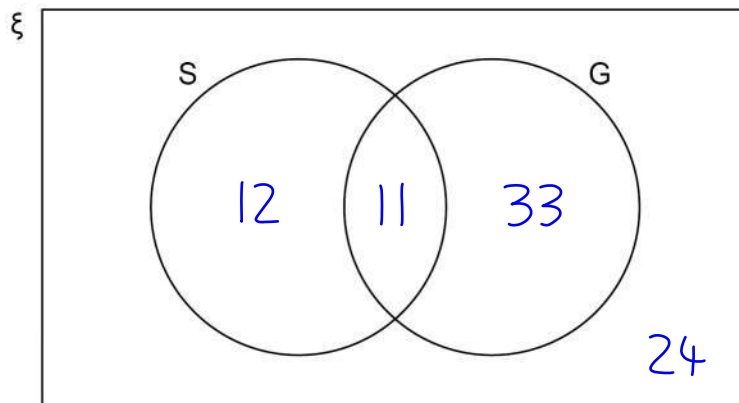
Complete this Venn diagram to represent the information.

[4 marks]

ξ = 80 people who play in bands

S = singers

G = guitar players



$$\frac{80}{10} \times 3$$

80/10 works out 10% of 80, which is 8. Multiplying this by 3 gives 30% so works out that 24 are neither a singer nor a guitar player

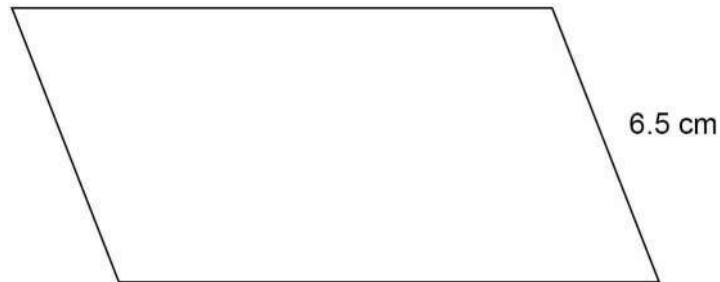
$$\begin{array}{r} 80 \\ -24 \\ \hline 44 \\ \div 4 \\ \hline 11 \\ -11 \\ \hline 33 \end{array}$$

Subtracting the 24 and 12 from 80 works out that 44 are guitar players. Dividing by 4 works out that 11 are also singers. Subtracting these 11 from the 44 works out that 33 are only guitar players



- 8 The shorter side of a parallelogram has length 6.5 cm

Not drawn
accurately



The length of the shorter side is $\frac{1}{9}$ of the perimeter.

Work out the length of the longer side.

[3 marks]

$$\begin{array}{r} 6.5 \\ \times 9 \\ \hline 58.5 \\ - 6.5 \\ \hline 45.5 \end{array}$$

Multiplying the shorter side by 9 works out the perimeter, which is 58.5cm. Subtracting both of the shorter sides leaves the total of both of the longer sides, which is 45.5

Dividing the total of both of the longer sides by 2 works out one of the longer sides, which is $45.5/2$. Multiplying both the numerator and denominator by 10 leaves a fraction with whole numbers

Answer $\frac{455}{20}$ cm



- 9 (a) All the terms of a **geometric** progression are positive.
The second and fourth terms are shown.

..... 4 16

Work out the first and third terms.

[2 marks]

$$4x^2 = 16$$

$$x^2 = 4$$

$$x = 2$$

Geometric means that each term is multiplied by the same amount to get the next term. Let x be the amount it multiplies by each time. 4 multiplied by x twice gives 16. Writing this as an equation then rearranging to find x . It must be 2 as it cannot be negative

First term _____ 2 _____

Third term _____ 8 _____

The sequence multiplies by 2 each term when going forward.
So going backward it must divide by 2. $16/2 = 8$. $4/2 = 2$

- 9 (b) The first two terms of an **arithmetic** progression are shown.

p $5p$ $9p$

The sequence is arithmetic so increases by the same amount between each term. It increases by $4p$ from p to $5p$ so must increase by $4p$ again to $9p$ for the third term

The sum of the first three terms is 90

Work out the value of p .

[3 marks]

$$15p = 90$$

The sum of p , $5p$ and $9p$ is $15p$. This must be equal to 90

15, 30, 45, 60, 75, 90

Dividing both sides by 15 gives p . Short division will not help much dividing 90 by 15 so counting up in 15s until it reaches 90

Answer _____ 6 _____

6 15s go into 90



10

The cost of a holiday is £2400

Rana pays a deposit followed by monthly payments, in the ratio

$$\text{deposit : total of the monthly payments} = 3 : 5$$

She makes 6 equal monthly payments.

Work out her monthly payment.

[4 marks]

$$\frac{2400}{8}$$

There is £2400 in total and 8 parts in the ratio in total. So 8 parts represent the £2400. Dividing 2400 by 8 works out what 1 part is worth

$$5 \times 300$$

5 parts represent the total of the monthly payments so multiplying 1 part by 5 works out the total of the monthly payments

Answer £

$$\begin{array}{r} 250 \\ 6 \overline{) 1500} \end{array}$$

Dividing the total of the monthly payments by the 6 months gives the monthly payment



11 As a decimal $\frac{11}{40} = 0.275$

Work out $\frac{33}{400}$ as a decimal.

[2 marks]

0.275

X 3

0.825

33 is 3 x 11 so first multiplying the decimal by 3

Dividing the result by 10 as 400 is 40 x 10. Having a denominator 10 times the size is equivalent to dividing by 10

Answer 0.0825

Turn over for the next question

Turn over ►



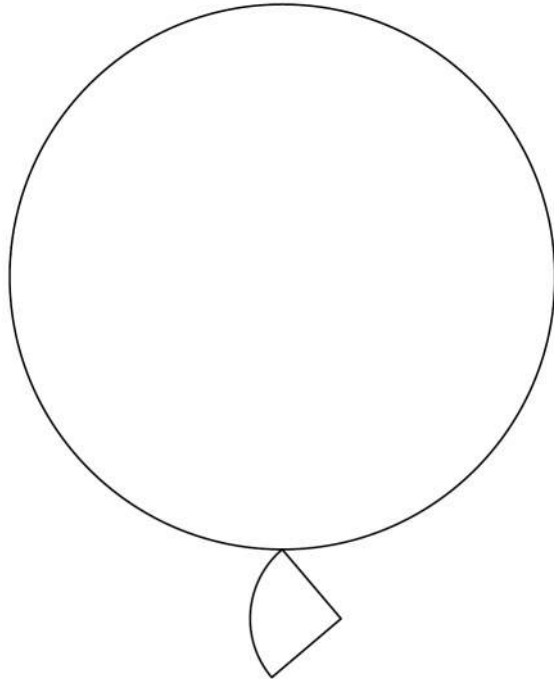
12 Two wire shapes make an earring.

The shapes are

a circle with radius 21 mm

and

a quarter circle.



Not drawn
accurately

radius of circle : radius of quarter circle = 7 : 2

12 (a) Show that the radius of the quarter circle is 6 mm

[1 mark]

$$\frac{21}{7} \times 2 = 6$$

7 parts of the ratio represent the radius of the circle which is 21mm. So dividing by 7 works out 1 part of the ratio. $21/7 = 3$. Then multiplying this by 2 works out the 2 parts which represents the radius of the quarter circle. $3 \times 2 = 6$



12 (b) Work out the **total** length of the wire in the earring.

Give your answer in the form $a\pi + b$ where a and b are integers.

[4 marks]

$$\pi \times 2 \times 21 + \frac{1}{4} \times \pi \times 2 \times 6 + 2 \times 6$$

Adding the wire used for the circle and quarter circle give the total length of wire

The length of wire used in the circle.
Circumference = $\pi \times$ diameter
Diameter = $2 \times$ radius

The length of wire used in the quarter circle.
Arc length = $1/4$ of the circumference
Circumference = $\pi \times$ diameter
Diameter = $2 \times$ radius
Then adding 2 lots of the radius

Answer $45\pi + 12$ mm

$\pi \times 2 \times 21 = 42\pi$. $1/4 \times \pi \times 2 \times 6 = 3\pi$. $2 \times 6 = 12$.
Then adding all these together

Turn over for the next question

Turn over ►



- 13 (a) s and t are **positive** integers.

$(x + s)(x - t)$ is expanded and simplified.

The answer is $x^2 + kx - 40$ where k is a positive integer.

Work out the **smallest** possible value of k .

[2 marks]

$$\begin{aligned} x^2 - tx + sx - st \\ x^2 + (s-t)x - st \end{aligned}$$

Expanding out the brackets and factorising the two middle x terms to express in the same form as the answer

$$1, 40$$

$$2, 20$$

$$4, 10$$

$$5, 8$$

By equating the coefficients of the expansion and the answer, $st = 40$ and $s - t = k$. Listing out the possible factor pairs of 40 to work out what s and t could be. As k is positive, s must be larger than t

The smallest positive value of $s - t$ is $8 - 5 = 3$

Answer

3

- 13 (b) Faisal tries to solve $(x + 2)(x - 7) = 0$

Here is his working.

$$\begin{array}{l} (x + 2) = 0 \quad \text{or} \quad (x - 7) = 0 \\ \text{Answer} \quad x = 2 \quad \text{or} \quad x = 7 \end{array}$$

Give a reason why his answer is wrong.

[1 mark]

$$x = -2$$

Subtracting 2 from both sides in the equation $x + 2 = 0$ gives $x = -2$

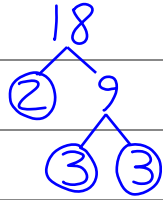


14 (a) $c = 2^{10} \times 3 \times 5^6$

Work out $18c$.

Give your answer as a product of prime factors in index form.

[2 marks]



Finding 18 as a product of primes by doing a factor tree. So $18 = 2 \times 3^2$. $18c = 2 \times 3^2 \times 2^{10} \times 3 \times 5^6$.
Multiplication can be done in any order and $a^x \times a^y = a^{x+y}$

Answer $2^{11} \times 3^3 \times 5^6$

14 (b) Work out $\sqrt[3]{\frac{2^7 \times 11^3}{2}}$

Give your answer as an integer.

[2 marks]

$\sqrt[3]{2^6 \times 11^3}$
 $2^2 \times 11$

$a^x/a^y = a^{x-y}$ so $2^7/2 = 2^6$

Cube rooting divides the powers by 3 and applies to both parts of the term

Answer 44



15

$$3x = \frac{1}{2}y$$

Circle the ratio $x : y$

[1 mark]

6 : 1

1 : 6

3 : 2

2 : 3

Multiplying both sides by 2 eliminates the fraction and gives $6x = y$. So x could be 1 and y could be 6

16

A sequence of numbers is formed by the iterative process

$$u_{n+1} = \frac{4}{u_n - 1} \quad u_1 = 9$$

Work out the values of u_2 and u_3

[2 marks]

$$u_2 = \frac{4}{9-1}$$

To find u_2 , $u_{n+1} = u_2$ so $n + 1 = 2$, $n = 1$ therefore $u_n = u_1$. Substituting in u_1 gives u_2

$$u_3 = \frac{4}{\frac{4}{8} - \frac{8}{8}} = 4 \times \frac{8}{4}$$

To find u_3 , $u_{n+1} = u_3$ so $n + 1 = 3$, $n = 2$ therefore $u_n = u_2$. Substituting in u_2 gives u_3 . Changing 1 into $\frac{8}{8}$ so it can be subtracted from $\frac{4}{8}$. $\frac{4}{8} - \frac{8}{8} = -\frac{4}{8}$. To divide by a fraction, keep the first number, change the sign to multiplication and flip the second number

$$u_2 = \frac{4}{8}$$

$$u_3 = -8$$

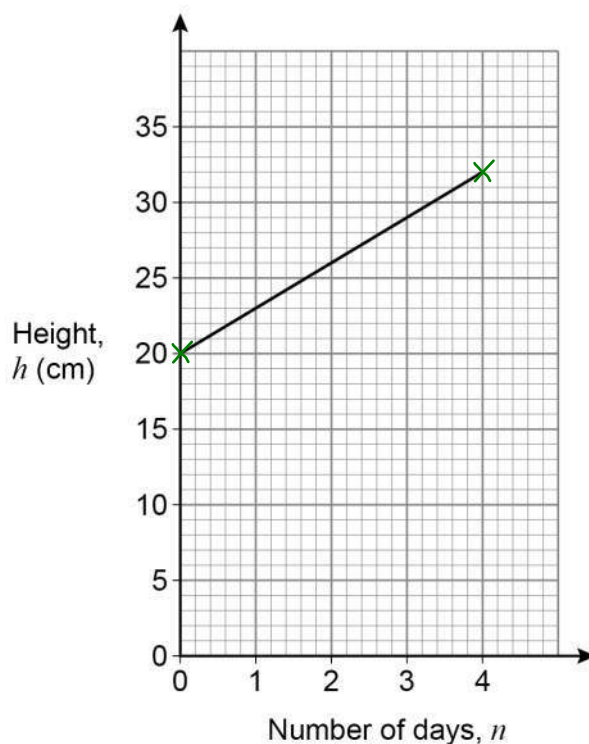
To multiply by a fraction, divide by the denominator then multiply by the numerator. $4/-4 = -1$. $-1 \times 8 = -8$



17

Jim buys a plant of height 20 cm

The graph shows how the height of the plant changes during the next 4 days.

Work out a formula for h in terms of n .**[3 marks]**

$$\frac{12}{4}$$

Gradient = (change in y)/(change in x). From the point on the left to the point on the right, y has changed by 12 and x has changed by 4

Answer

$$h = 3n + 20$$

The general equation of a straight line is $y = mx + c$, where m is the gradient and c is the y -intercept. The gradient is 3 and the y intercept, the y coordinate where it crosses the y axis, is 20. Writing h instead of y as h is on the y axis and n instead of x as n is on the x axis



18

Solve the simultaneous equations

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

$$2y = 4x - 7$$

[4 marks]

$$y = 2x - \frac{7}{2}$$

Dividing both sides of the second equation by 2 to make y the subject

$$4\left(2x - \frac{7}{2}\right)$$

Expressing 4y in terms of x by substituting y for $2x - \frac{7}{2}$

$$2x + 8x - 14 = -9$$

Expanding the bracket and substituting for 4y in the first equation

$$10x = 5$$

Collecting the x terms and adding 14 to both sides to get them on their own

$$y = 2\left(\frac{5}{10}\right) - \frac{7}{2}$$

Substituting x for $\frac{5}{10}$ in $y = 2x - \frac{7}{2}$

$$= \frac{2}{2} - \frac{7}{2}$$

 $2 \times \frac{5}{10} = \frac{10}{10}$. Simplifying it to $\frac{2}{2}$ so the $\frac{7}{2}$ can be subtracted

$$x = \frac{5}{10} \quad y = -\frac{5}{2}$$

 $10x = 5$. Dividing both
sides by 10 gives x


19 Circle the expression that is equivalent to $\frac{x}{5} + \frac{x}{10}$

[1 mark]

$$\frac{3x}{10}$$

$$\frac{2x}{15}$$

$$\frac{x}{25}$$

$$\frac{x^2}{50}$$

The fractions can be added if the denominators are the same. 10 is a common multiple of 5 and 10. Multiplying both the numerator and denominator of $x/5$ by 2 gives $2x/10$, which when added to $x/10$ gives $3x/10$

20 (a) Write down the value of 7^0

[1 mark]

Answer _____

|

Anything to the power of 0 is 1

20 (b) Work out the value of $32^{-\frac{3}{5}}$

[2 marks]

Answer _____

 $\frac{1}{8}$

The denominator of 5 as a power means 5th root. $2^5 = 32$ so the 5th root of 32 is 2. The numerator of 3 as a power means to cube. $2^3 = 8$. The negative as a power means reciprocal. The reciprocal of 8 is $1/8$

Turn over for the next question



21

Write these numbers in order of size.

15.6

 $3\sqrt{23}$ 2.1^4 $\frac{47}{3}$

Start with the smallest.

[2 marks]

$$\begin{array}{r} 15.6 \\ 3 \overline{)47.0} \end{array}$$

$$\sqrt{25} = 5 \text{ so } \sqrt{23} < 5, 3\sqrt{23} < 15, 2.1^4 = 16 \text{ so } 2.1^4 > 16$$

Smallest

 $3\sqrt{23}$

15.6

 $\frac{47}{3}$

Largest

 2.1^4 

22 (a) y is directly proportional to x^3

$$y = 17 \quad \text{when} \quad x = 4$$

Work out an equation connecting y and x .

[3 marks]

$$y = kx^3$$

x^3 can be multiplied by anything and still be directly proportional to y . So using k to represent what x^3 is multiplied by

$$k = \frac{17}{4^3}$$

Rearranged to make k the subject and substituted in the values of y and x given

Substituted for k back in the original equation. $4^3 = 4 \times 4 \times 4 = 64$

Answer $y = \frac{17}{64}x^3$

22 (b) m is inversely proportional to \sqrt{r}

The value of r is multiplied by 4

Circle what happens to the value of m .

[1 mark]

$\times 2$

$\times 16$

$\div 2$

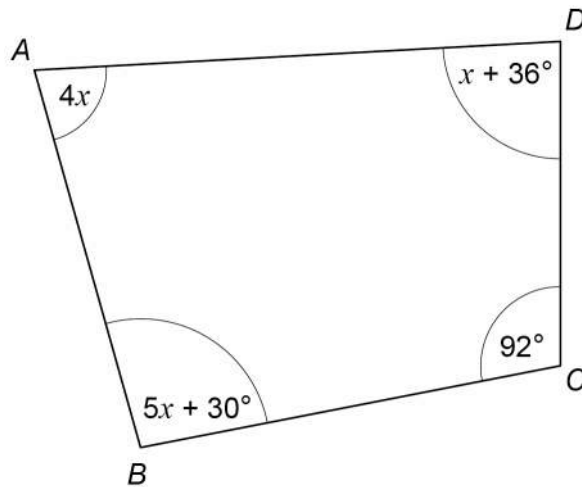
$\div 16$

Inversely proportional means that the opposite effect happens to m so if r is multiplied, m will be divided. As r is square rooted, the square root of 4 will be what m is divided by

Turn over for the next question



23

 $ABCD$ is a quadrilateral.Not drawn
accuratelyProve that $ABCD$ is **not** a cyclic quadrilateral.

[4 marks]

$$4x + 92 = 180$$

Assuming that it is a cyclic quadrilateral, opposite angles will add to 180. Adding angles BAD and BCD and setting it equal to 180

$$x = \frac{180 - 92}{4}$$

$$\begin{array}{r} 180 \\ - 92 \\ \hline 88 \end{array} \quad \begin{array}{r} 22 \\ 4 \overline{) 88} \\ \underline{88} \\ 0 \end{array}$$

Rearranged to find x , which is 22

$$5(22) + 30 + 22 + 36$$

Adding angles ABC and ADC while substituting x for 22

$$\begin{array}{r} 22 \quad 110 \\ \times 5 + 30 \\ \hline 110 + 22 \\ \quad + 36 \\ \hline 198 \end{array}$$

Should be 180

The sum of angles ABC and ADC is 198, which is not 180 as it should be if they are opposite angles in a cyclic quadrilateral

Both pairs of opposite angles cannot add up to 180 at the same time so it cannot be a cyclic quadrilateral



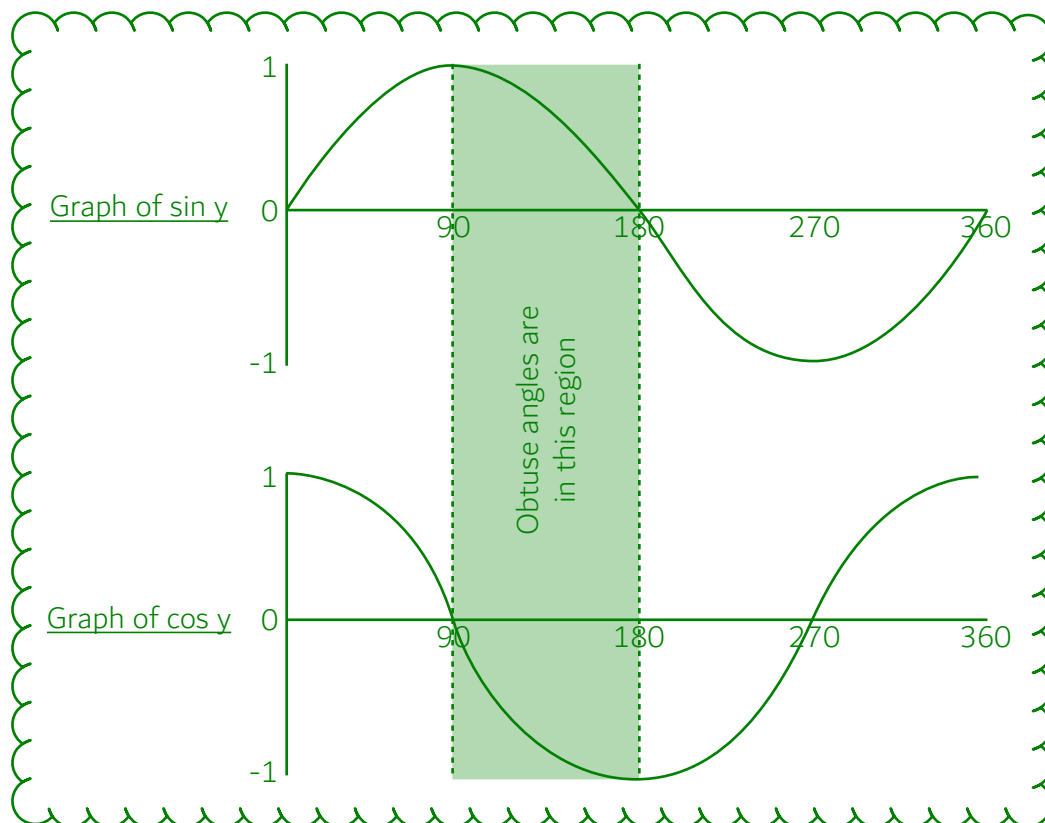
24

 y is an obtuse angle.

Which statement is true?

Tick **one** box.

[1 mark]

 $\sin y > 0$ and $\cos y > 0$ $\sin y > 0$ and $\cos y < 0$ $\sin y < 0$ and $\cos y > 0$ $\sin y < 0$ and $\cos y < 0$ 

Turn over for the next question

Turn over ►

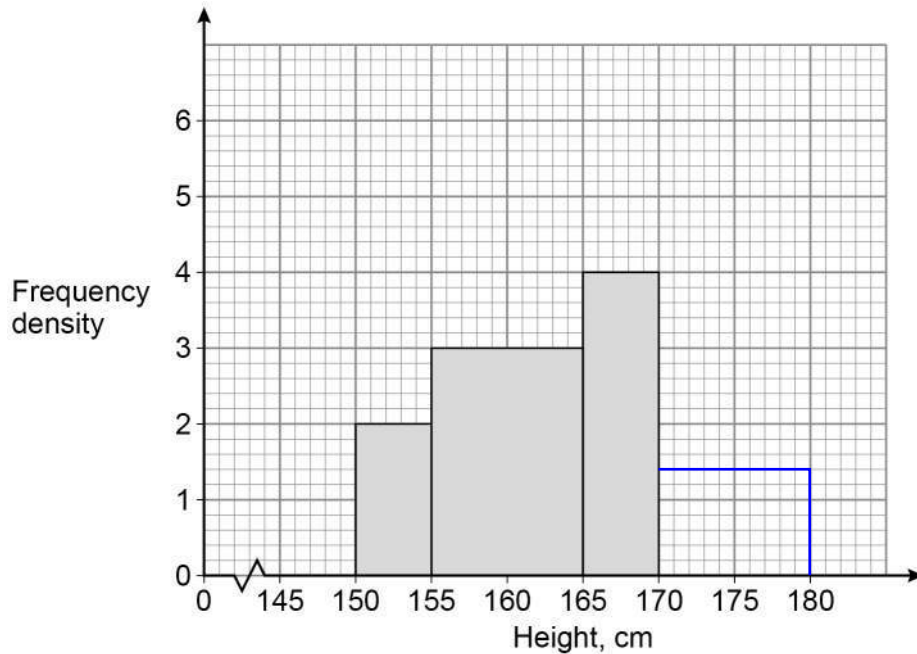


25

A histogram is drawn to represent the heights of a sample of women.

Three of the four bars are shown.

The bar for $170 \text{ cm} \leq \text{height} < 180 \text{ cm}$ is missing.



There are 74 women in the sample.

Complete the histogram.

[4 marks]

$$\begin{array}{r} 74 \\ -10 \\ -30 \\ -20 \\ \hline 14 \div 10 \end{array}$$

Frequency = class width \times frequency density.

Frequency for first bar = $5 \times 2 = 10$.

Frequency for second bar = $10 \times 3 = 30$.

Frequency for third bar = $5 \times 4 = 20$.

Subtracting these frequencies from 74 leaves
the frequency for the fourth bar.

Frequency density = frequency/class width.

Frequency density for fourth bar = $14/10 = 1.4$



26 (a) Show that $\frac{14}{\sqrt{7}}$ can be written in the form $a\sqrt{b}$ where a and b are integers.

[2 marks]

$$\frac{14}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}}$$

Rationalising the denominator

$$\frac{14\sqrt{7}}{7}$$

Multiplying the fractions by multiplying the numerators and denominators. $\sqrt{7} \times \sqrt{7} = 7$

$$2\sqrt{7}$$

Dividing the 14 on the numerator by the 7 on the denominator simplifies the fraction and gets the desired form

26 (b) Work out $2\sqrt{10} \times \sqrt{80} \times \sqrt{18}$
Give your answer as an integer.

$$\sqrt{ab} = \sqrt{a} \times \sqrt{b}$$

This can be used to simplify surds if one of a or b are a square number

[3 marks]

$$2 \times \sqrt{10} \times \sqrt{4} \times \sqrt{4} \times \sqrt{5} \times \sqrt{9} \times \sqrt{2}$$

 $\sqrt{10}$ does not simplify as there are no square number factors of 10 apart from 1

$\sqrt{18}$ simplifies to $\sqrt{9} \times \sqrt{2}$

$\sqrt{80}$ simplifies to $\sqrt{4} \times \sqrt{20}$.
 $\sqrt{20}$ simplifies to $\sqrt{4} \times \sqrt{5}$

$$24\sqrt{100}$$

 $\sqrt{4} = 2$. $\sqrt{9} = 3$. Multiplication can be done in any order so the whole numbers can be multiplied separately to the surds. $2 \times 2 \times 2 \times 3 = 24$. $\sqrt{10} \times \sqrt{5} \times \sqrt{2} = \sqrt{100}$

Answer

$$240$$

$\sqrt{100} = 10$. $24 \times 10 = 240$

Turn over for the next question

Turn over ►



27

A and B are similar solid cylinders.

$$\text{base area of A : base area of B} = 9 : 25$$

Complete these ratios.

[2 marks]

$$\text{curved surface area of A : curved surface area of B} = \underline{9} : \underline{25}$$

$$\text{height of A : height of B} = \underline{3} : \underline{5}$$

The ratio of the area is the same for all of the faces. Square rooting both sides of the ratio gives the ratio of the lengths and height is a length

28

Factorise fully $144 - 4x^2$ **[2 marks]**

$$\underline{(12 + 2x)(12 - 2x)}$$

It can be factorised using difference of two squares: $A^2 - B^2 = (A + B)(A - B)$

It can be factorised further as 2 is a common factor to both terms in both brackets. Bringing out two 2s as factors gives 4 outside the brackets

$$\text{Answer } \underline{4(6+x)(6-x)}$$



29

The graph of $y = x^3 + 6$ is translated 4 units to the right.

The translated graph has equation $y = f(x)$

Work out $f(x)$.

Give your answer in the form $x^3 + ax^2 + bx + c$ where a , b and c are integers.

[4 marks]

$$(x-4)(x-4)(x-4)$$

Subtracting 4 from all of the x translates it 4 to the right as the same values are got to 4 later. Ignoring the +6 for now and writing out the $(x-4)^3$

$$x^2 - 4x - 4x + 16$$

Expanding out the first two brackets

$$(x^2 - 8x + 16)(x-4)$$

Simplifying the expansion and writing it multiplied by the third bracket

$$x^3 - 4x^2 - 8x^2 + 32x + 16x - 64 + 6$$

Expanding out these two brackets and now dealing with the +6 which was ignored earlier

$$\begin{array}{r} 16 \\ \times 4 \\ \hline 64 \end{array}$$

Collecting the like terms and simplifying

Answer $x^3 - 12x^2 + 48x - 58$

END OF QUESTIONS