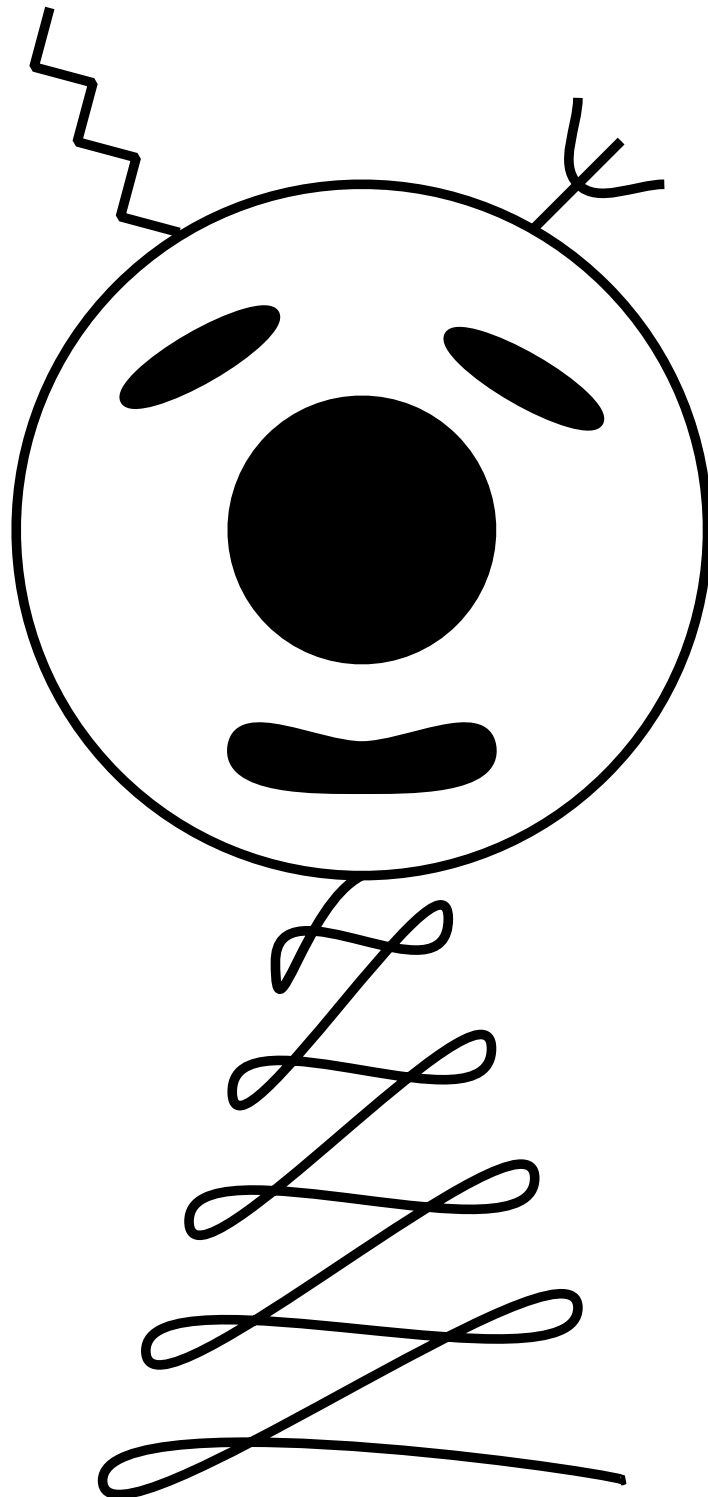


Grade Grabber

REVISION 2023



Grade Grabber 1

40 Mark Paper

Question 1

Ben Nevis, Scotland's highest mountain, is 4418 feet high

- (i) What “percentage of a mile high” is Ben Nevis ?

Use the fact that 1 mile = 5280 feet

[2 marks]

- (ii) Determine the height of Ben Nevis in metres

Use the facts that 1 foot = 12 inches, and 2.54 cm = 1 inch

[1 marks]

Question 2

The function f is such that

$$f(x) = \frac{18}{x - 5}$$

- (i) Find $f(8)$

[1 mark]

- (ii) State which value of x must be excluded from any domain of f

[1 mark]

The function g is such that

$$g(x) = x - 4$$

- (iii) Calculate $fg(18)$

[2 marks]

Question 3

- (i) Solve the following inequality

$$-5 < 3x + 1 \leq 13$$

[2 marks]

- (ii) Given that x is an integer, list the possible values of x

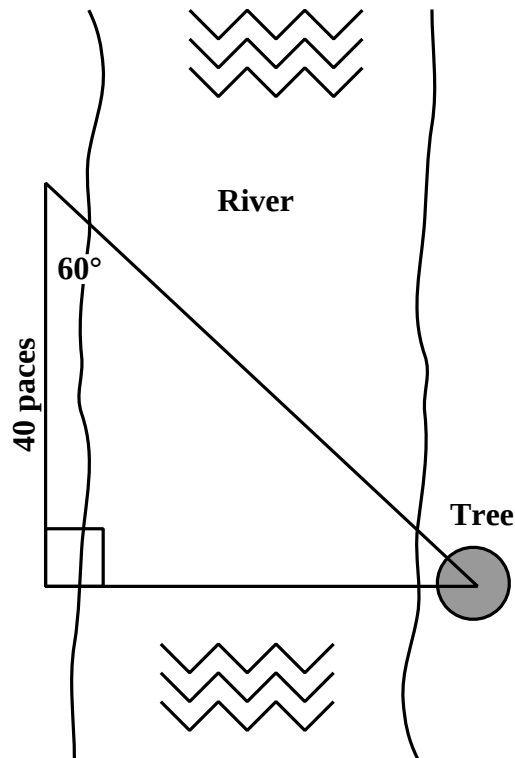
[1 marks]

Question 4

I stand on the bank of a river.

Directly opposite me, on the other river bank is a tree.

I walk 40 paces upstream and the line from me to the tree is at an angle of 60° with my river bank.



- (i) How wide, in paces, is the river ?

[2 marks]

- (ii) If I know that 120 paces is 100 m, how wide is the river, in metres ?

[1 mark]

- (iii) Explain why it would be better to walk until the angle is 45°

[1 mark]

Question 5

- (i) Use the formula $m = \frac{\Delta y}{\Delta x}$ to calculate the gradient of the straight line between the points (5, 4) and (7, 10)

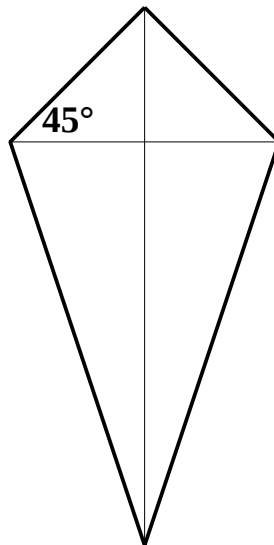
[2 marks]

- (ii) Hence work out the equation of the straight line between the two points.
Write your answer in the form $y = mx + c$

[3 marks]

Question 6

The kite shown below has a width of 4 cm and a height of 8 cm



Use the theorem of Pythagoras to help you find, correct to three significant figures, the perimeter of the kite.

[4 marks]

Question 7

The power loss, P , in an electrical cable is directly proportional to the square of the current, I , flowing in that cable.

In a certain cable I find that 100 watts of power is lost when a current of 5 amps flows.

(i) Write down a formula relating P and I for the cable.

[3 marks]

(ii) Use your formula to determine what power will be lost in the cable when a current of 12 amps flows.

[2 marks]

Question 8

Make sketches of

- (i) A hexagonal prism
- (ii) A pentagonal based pyramid

[4 marks]

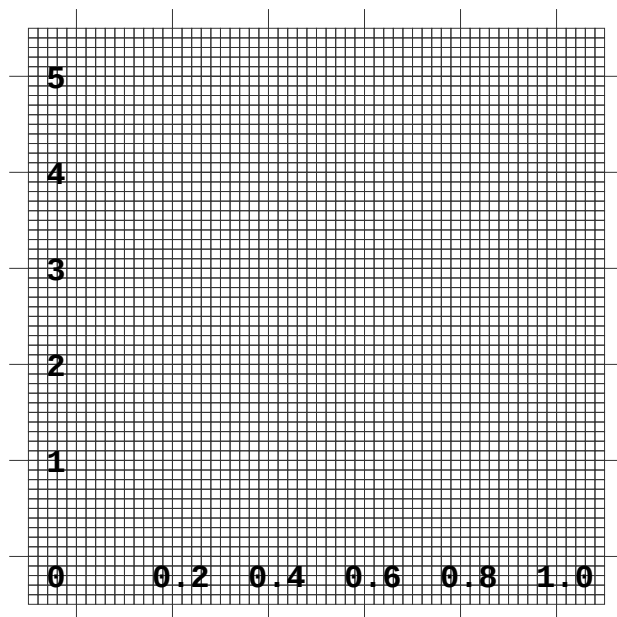
For each solid show that the number of Vertices plus the number of Faces minus the number of Edges is equal to 2.

[2 marks]

For Your Information: $V + F - E = 2$ is known as “Euler's Formula”
Google it to find out more.

Question 9

- (i) Plot the points, $(0.4, 0.2)$, $(0, 0.5)$, $(0.4, 1)$ and $(0.8, 0.5)$



[1 mark]

- (ii) Shade the quadrilateral thus formed.

[1 mark]

- (iii) A mathematical transformation known as “inversion” transforms points according to the rule,

$$(x, y) \rightarrow \left(x, \frac{1}{y} \right)$$

Transform each of the four points according to the rule for the inversion.

[2 marks]

- (iv) Plot the transformed points onto your graph and shade the resulting shape

[2 marks]

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Brief Answers to Grade Grabber 1

Answer 1

(i) $\frac{4418}{5280} \times 100 = 84\%$ of a mile high (ii) 1347 m

[2, 1 marks]

Answer 2

(i) 6

(ii) $x = 5$ must be excluded because it would cause a division by zero
Division by zero is undefined and a calculator will reject such a request

(iii) 2

[1, 1, 2 marks]

Answer 3

(i) $-2 < x \leq 4$

(ii) $x \in \{-1, 0, 1, 2, 3, 4\}$

[2, 1 marks]

Answer 4

(i) 69.3 paces

(ii) 58 m

(iii) The triangle would be isosceles with the number of paces walked being the same as the width of the river.
Yachts moving along a shore make use of this to work out their distance from the coast.

[2, 1, 1 marks]

Answer 5

(i) $m = 3$ (ii) $y = 3x - 11$

[2, 3 marks]

Answer 6

Perimeter = 18.3 cm

The exact answer is $4(\sqrt{2} + \sqrt{10})$ cm

[4 marks]

Answer 7

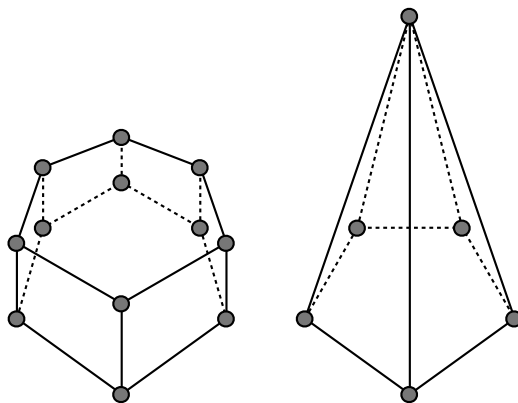
(i) $P = 4I^2$

(ii) 576 watts

[3, 2 marks]

Answer 8

(i)



[4 marks]

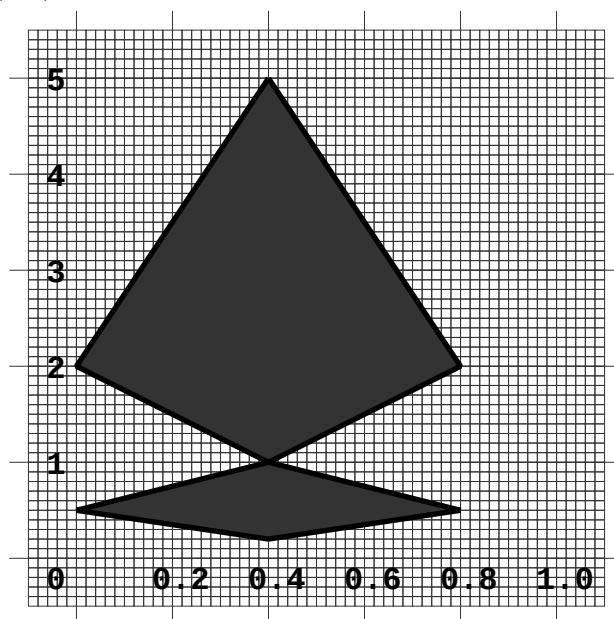
(ii) For the hexagonal based prism, $V + F - E = 12 + 8 - 18 = 2$

For the pentagonal based pyramid, $V + F - E = 6 + 6 - 10 = 2$

[2 marks]

Answer 9

(i), (ii) and (iv)



(iii) $(x, y) \rightarrow (x, \frac{1}{y}) :$ $(0.4, 0.2) \rightarrow (0.4, 5)$

$(0, 0.5) \rightarrow (0, 2)$

$(0.4, 1) \rightarrow (0.4, 1)$

$(0.8, 0.5) \rightarrow (0.8, 2)$

[1, 1, 2, 2 marks]

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Grade Grabber 2

40 Mark Paper

Question 1

Factorise completely

(i)

$$14x + 21$$

[1 mark]

(ii)

$$x^2 + 11x + 28$$

[2 marks]

(iii)

$$x^2 - 49$$

[2 marks]

Question 2

Solve the following simultaneous equations

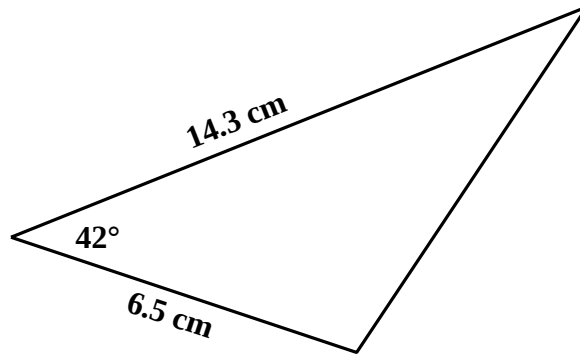
$$4x + 3y = 3$$

$$5x + 6y = 15$$

[4 marks]

Question 3

- (i) Archie has read that the formula $Area \Delta = \frac{1}{2} a b \sin C$ can calculate the area of a triangle. Write down how Archie should use the formula to calculate the area of the following triangle;



[2 marks]

- (ii) Also, write down how Archie could use the following formula

$$c^2 = a^2 + b^2 - 2ab \cos C$$

to calculate the length of the triangle's unknown side.

[2 marks]

Question 4

On 1st March 2021 it was reported on the Zoopla website that house prices in Shrewsbury had increased, on average, by 3.3 % in the past year.

What would this statistic predict that a house, which was bought for £380,000 on 1st March 2020, is worth on 1st March 2021 ?

[2 marks]

Question 5

Two functions, f and g , are defined as follows;

$$f(x) = 3x + 8$$

$$g(x) = 5x$$

(a) Evaluate

(i) $f(13)$

[1 mark]

(ii) $g(17)$

[1 mark]

(iii) $g g(4)$

[1 mark]

(iv) $f g(10)$

[2 marks]

(b) State the value of x for which $f(x) = 0$

[2 marks]

(c) Determine the inverse of the function $f(x)$

That is, find $f^{-1}(x)$

[2 marks]

Question 6

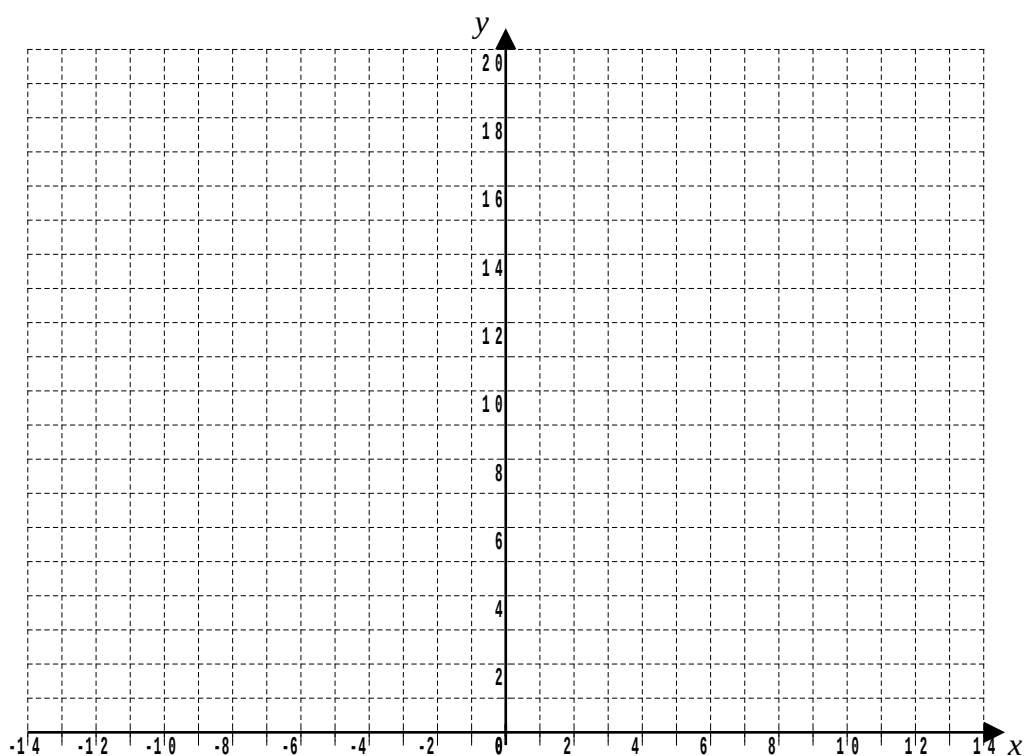
Below is a partly completed table for the graph of $y = 0.125x^2$

x	-12	-8	-4	-2	0	2	4	8	12
$y = 0.125x^2$		8							

(i) Complete the table by filling in the missing values of y

[2 marks]

(ii) Plot these points and join them with a smooth curve



[2 marks]

(iii) On your graph add the line $y = 10$

[1 mark]

(iv) From your graph, write down the approximate values of x where the line intersects the curve

[2 marks]

(v) Determine a more accurate answer to part (iv) by solving the equation

$$0.125x^2 = 10$$

[2 marks]

Question 7

- (a) Expand the brackets;

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

[2 marks]

- (b) The hypotenuse of a right angled triangle is of length $3x + 4$ cm
and the lengths of the other two sides are $3x + 3$ cm and x cm

- (i) Use the theorem of Pythagoras show that the relationship
between $3x + 4$, $3x + 3$ and x can be expressed as;

$$x^2 - 6x - 7 = 0$$

[3 marks]

- (ii) Solve your equation and hence state the lengths of each
of the three sides of the triangle.

[2 marks]

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Brief Answers to Grade Grabber 2

Answer 1

(i) $7 (2x + 3)$

(ii) $(x + 4) (x + 7)$

(iii) $(x + 7) (x - 7)$

By the difference of two squares

[1, 2, 2 marks]

Answer 2

$x = -3, y = 5$

[4 marks]

Answer 3

(i) 31.1 cm^2

(ii) 10.4 cm

[2, 2 marks]

Answer 4

£ 392 540

[2 marks]

Answer 5

(a) (i) 47

(ii) 85

(iii) 100

(iv) 158

[1, 1, 1, 2 marks]

(b)

$-\frac{8}{3}$

(c)

$f^{-1}(x) = \frac{x - 8}{3}$

[2, 2 marks]

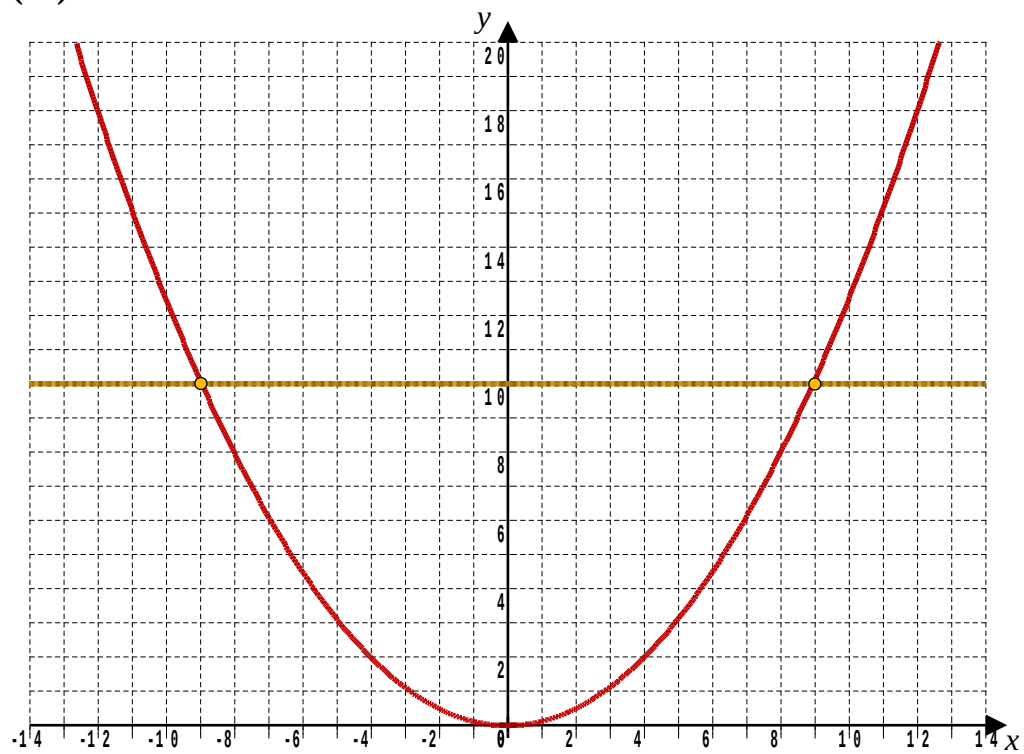
Answer 6

(i)

x	-12	-8	-4	-2	0	2	4	8	12
$y = 0.125x^2$	18	8	2	0.5	0	0.5	2	8	18

[2 marks]

(ii)



[2 marks]

(iii) Gold line added to graph

[1 mark]

(iv) About $(-9, 10)$ and $(9, 10)$

[2 marks]

(v) Exact answers are $(-4\sqrt{5}, 10)$, $(4\sqrt{5}, 10)$

This is, more approximately, $(\pm 8.94, 10)$

[2 marks]

Answer 7

(a) $9x^2 + 24x + 16$

[2 marks]

(b)

$$\begin{aligned}(3x + 4)^2 &= (3x + 3)^2 + x^2 \\ 9x^2 + 24x + 16 &= 9x^2 + 18x + 9 + x^2 \\ x^2 - 6x - 7 &= 0\end{aligned}$$

[3 marks]

(c) $x = 7$ which means the sides are 25 cm, 24 cm and 7 cm

[2 marks]

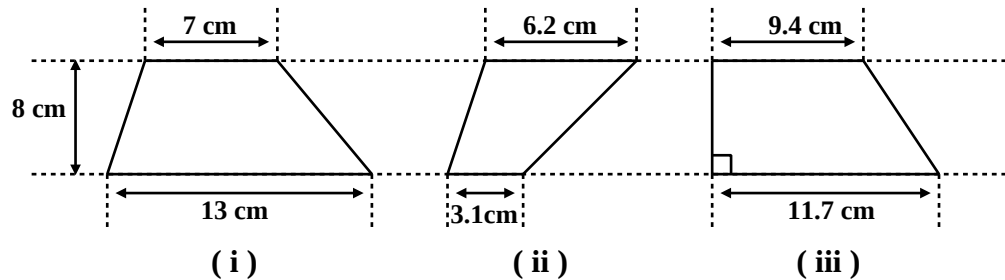
Grade Grabber 3

40 Mark Paper

Question 1

The area of a trapezium may be found by remembering that it is “*half the sum of the parallel sides times the (perpendicular) distance in between*”.

Below are sketched three trapezia,



Calculate the area of each trapezium.

[3 marks]

Question 2

A yacht with a displacement hull has a theoretical maximum speed given by;

$$Speed_{max} = 1.34 \times \sqrt{\text{Waterline length}}$$

where the speed is in knots and the waterline length is in feet.



The yacht, Farida, pictured, has a waterline length of 28 feet.
What is its maximum speed ?

[1 mark]

Question 3

The area of the floor of a room is 25 m^2

- (i) Assuming the floor is square, what is the length of a each side of the floor in metres ?

[1 mark]

- (ii) What is the length of each side in centimetres ?

[1 mark]

- (iii) Use your part (ii) answer to determine the area of the floor in cm^2

[1 mark]

- (iv) If the room were rectangular rather than square, but still of area 25 m^2 , would your part (iii) answer be different ?

[1 mark]

Question 4

Differentiate :

$$y = 5x^4 + x^2 + 1$$

[2 marks]

Question 5

Joyce thinks of a number, adds on 5, and squares the result.

As a result, in her mind, right now, is the number 1.

- (i) By calling Joyce's original number, x , write down an equation that captures the above information.

[1 mark]

- (ii) Solve your equation to determine the two possible values of Joyce's original number.

[2 marks]

Question 6

From a point, P , a *Shrewsbury School Rover* walks on a bearing of 020° for a distance of 400 metres to a second point, Q .
He then walks due South until he is at a third point, R .
 R is due East of P

- (i) Sketch a diagram to show the relative positions of P , Q and R and mark a right angle on your diagram.

[2 marks]

- (ii) Determine the distance from R to P .
Give your answer correct to one decimal place.

[2 marks]

Question 7

Rationalise the denominator and simplify your answer;

$$\frac{\sqrt{3}}{3 - \sqrt{3}}$$

[3 marks]

Question 8

In a “build a Lego Tower” competition the height, h , of 100 towers were;

Height, h (in cm)	$120 < h \leq 130$	$130 < h \leq 140$	$140 < h \leq 150$	$150 < h \leq 160$
Number of Towers	12	33	38	17

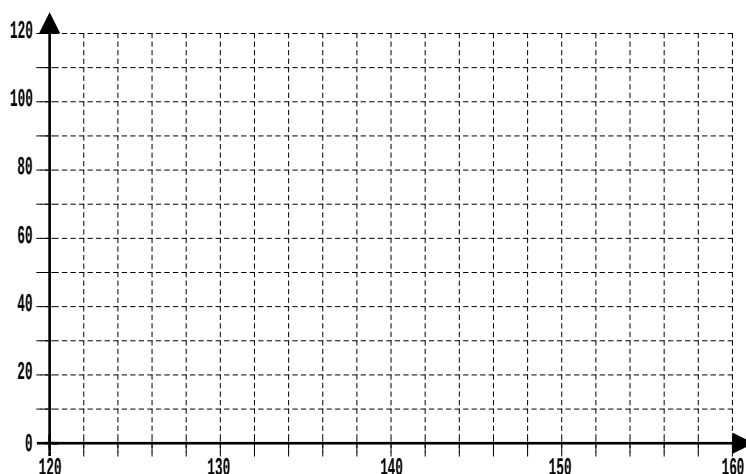
(i) Estimate the mean height of the towers.

[3 marks]

(ii) Explain why your answer to part (i) is an “estimate”.

[1 mark]

(iii) Draw a cumulative frequency graph on the grid below,



[2 marks]

(iv) Use your graph to find the median and the interquartile range.

[3 marks]

(v) If a tower is selected at random, what is the probability that it is *taller* than 145cm.

[1 mark]

Question 9

$$f(x) = \sqrt{x - 11}, \quad x \geq 11$$

- (i) Evaluate $f(60)$

[1 mark]

- (ii) Explain the need for the condition on the domain that $x \geq 11$

[2 marks]

- (iii) Determine the inverse of the function $f(x)$

That is, find $f^{-1}(x)$

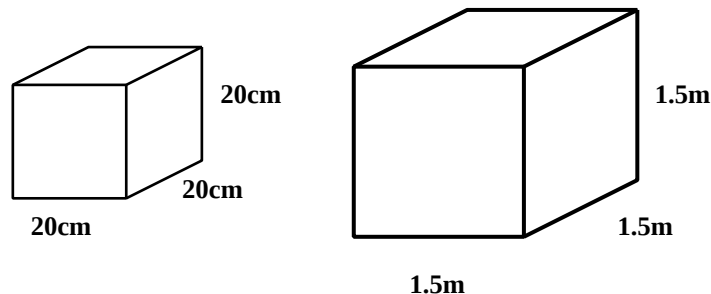
[2 marks]

- (iv) Determine $f^{-1}(3)$

[1 mark]

Question 10

- (i) Find the volume of the two cubes drawn below.
Give your first answer in cm^3 and your second in m^3 .



[2 marks]

- (ii) Explain why 400 cm^3 is a very different amount of volume to 4 m^3 , even although it is true that $100 \text{ cm} = 1 \text{ m}$

[1 mark]

- (iii) Which cube has the greater volume ?

[1 mark]

Brief Answers to Grade Grabber 3

Answer 1

- (i) 80 cm^2
- (ii) 37.2 cm^2
- (iii) 84.4 cm^2

Answer 2

7.1 knots

Answer 3

- (i) 5 m
- (ii) 500 cm
- (iii) 250000 cm^2
- (iv) No

[3, 1, 4 marks]

Answer 4

$$\frac{dy}{dx} = 20x^3 + 2x$$

[2 marks]

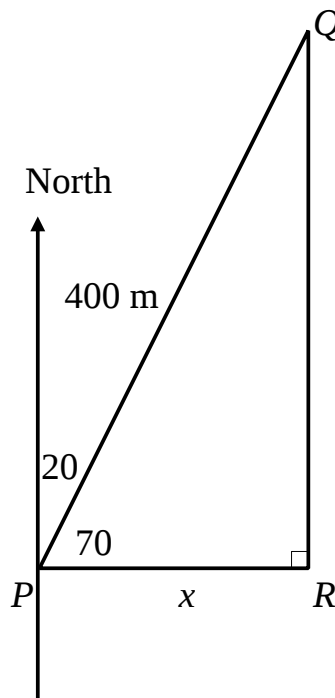
Answer 5

- (i) $(x + 5)^2 = 1$
- (ii) -4 or -6

[1, 2 marks]

Answer 6

- (i)



[2 marks]

- (ii) 136.8 m

[2 marks]

Answer 7

$$\frac{\sqrt{3}}{3 - \sqrt{3}} \times \frac{3 + \sqrt{3}}{3 + \sqrt{3}} = \frac{3\sqrt{3} + 3}{6} \times \frac{1 + \sqrt{3}}{2}$$

[3 marks]

Answer 8

(i) 141 cm

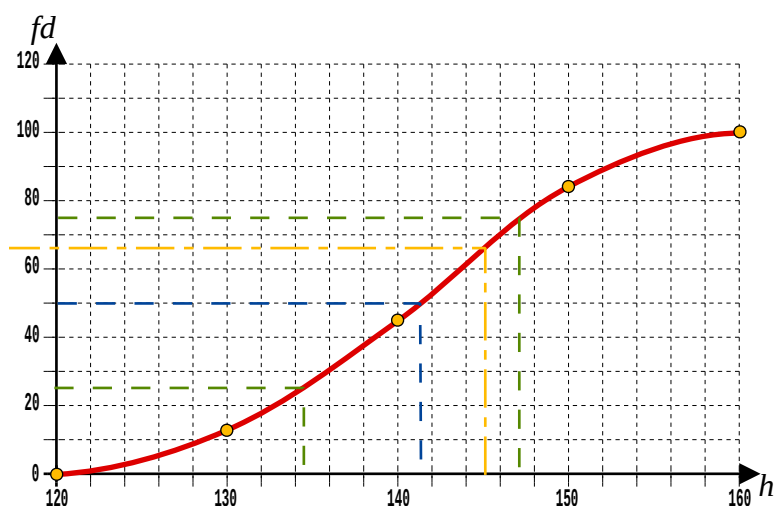
[3 marks]

(ii) Data is grouped, so exact heights of towers lost

[1 mark]

(iii) Points to plot are at END OF INTERVALS

(120, 0) $\rightarrow$ (130, 12) $\rightarrow$ (140, 45) $\rightarrow$ (150, 83) $\rightarrow$ (160, 100)



[2 marks]

(iv) Median is 140 - 142 cm (Blue broken line on the graph)

IQR = 11 - 14 cm (Green broken lines on the graph)

[3 marks]

$$(v) \quad \frac{0.5 \times 38 + 17}{100} = 0.36$$

[1 mark]

Answer 9

(i) 7

(ii) To prevent the taking of the square root of a negative number

$$(iii) \quad f^{-1}(x) = x^2 + 11$$

(iv) 20

[1, 2, 2, 1 marks]

Answer 10

(i) 8000 cm³ 3.375 m³

(ii) 1 m³ $\equiv$ 1000000 cm³

(iii) The cube with side length 1.5 m has the greater volume

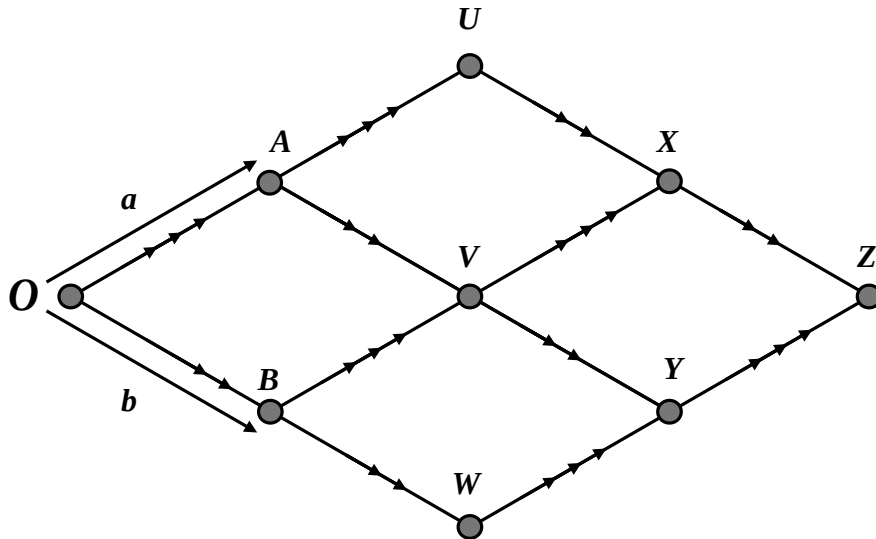
[2, 1, 1 marks]

Grade Grabber 4

Marks Available: 40

Question 1

In the diagram below four congruent rhombuses are shown.



If the vectors $\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$ write down in terms of $\mathbf{a}$ and $\mathbf{b}$ the vectors:

(i) $\vec{OZ}$

[1 mark]

(ii) $\vec{UB}$

[1 mark]

(iii) $\vec{XA}$

[1 mark]

(iv) Given that $\vec{OZ} = k \vec{XA}$ state the value of the constant k

[2 marks]

(v) What does your part (iv) result tell you about $\vec{OZ}$ and $\vec{XA}$?

[1 mark]

Question 2

Lead is one of the most dense metals with a density of 11340 kg m^{-3}
Blocks of it are used to shield nuclear reactors in power stations.

- (i) Find the volume in m^3 of a block of lead measuring $1.5 \text{ m} \times 1.5 \text{ m} \times 0.2 \text{ m}$

[1 mark]

- (iii) Use the formula

$$\text{Mass} = \text{Density} \times \text{Volume}$$

to find the mass of the block of lead, in kg

[1 mark]

- (iv) As $1000 \text{ kg} = 1 \text{ tonne}$, give the mass of the block in tonnes

[1 mark]

- (v) Could you lift this block of lead ?

[1 mark]

Question 3

$$A = \{ \text{factors of } 16 \}$$

$$B = \{ \text{factors of } 20 \}$$

List the elements of :

- (i) A

[1 mark]

- (ii) B

[1 mark]

- (iii) $A \cap B$

[1 mark]

- (iv) $A \cup B$

[1 mark]

- (v) $A' \cap B$

[1 mark]

- (vi) $A \cap B'$

[1 mark]

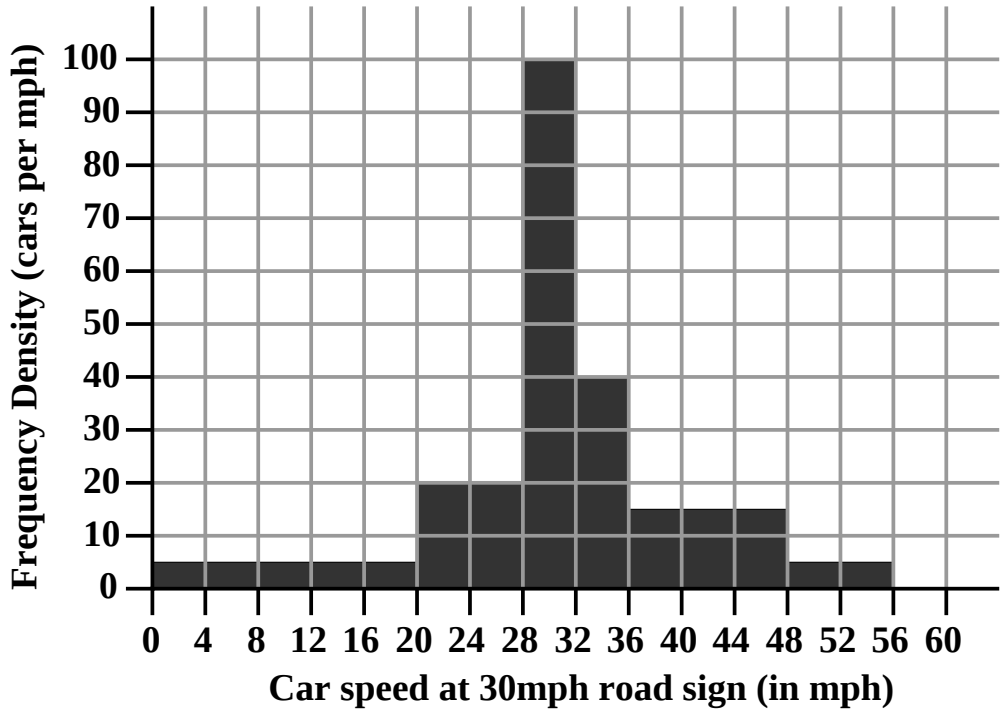
- (vii) $(A' \cap B) \cap (A \cap B')$

[1 mark]

Question 4

In trying to decide if a speed camera is required in the town of Numberville, a consultant provides the following histogram which shows the distribution of car speeds as cars pass the 30 mph sign heading into Numberville.

A histogram to show the distribution of car speeds at a 30mph road sign



(i) Use the histogram to complete the following table :

Car speed (miles per hour, mph)	Number of cars Frequency = Area	Width	Height
$0 \leq m < 20$			
$20 \leq m < 28$			
$28 \leq m < 32$			
$32 \leq m < 36$			
$36 \leq m < 48$			
$48 \leq m < 56$			

[3 marks]

(ii) How many cars in total had their speed recorded entering Numberville ?

[2 marks]

(iii) What percentage of cars were travelling within 2mph of the speed limit ?

[2 marks]

Question 5

An iPad costs £320 *after* a discount of 20% has been applied.
What was its price *before* the discount was applied ?

[2 marks]

Question 6

Differentiate :

$$y = 4x^3 + 5\sqrt{x}$$

[3 marks]

Question 7

Simplify;

$$\frac{x^2 - 2x - 24}{x^2 - 36}$$

[2 marks]

Question 8

A circle has equation;

$$x^2 + y^2 = 100$$

and a line has equation;

$$x = 3y - 10$$

Find the coordinates of the two points where the line intersects the circle.

[5 marks]

Question 9

- (i) Before it is sharpened, a pencil is a cylinder 15 cm long with a diameter of 0.6 cm. What is its volume ?
- (ii) It is now sharpened, so that the last 2cm of the pencil forms a cone. How much volume has been lost.

$$V_{prism} = \text{Area of Base} \times \text{Height}$$

(A cylinder is a prism with a circular base)

$$V_{pyramid} = \frac{\text{Area of Base} \times \text{Height}}{3}$$

(A cone is a pyramid with a circular base)

[4 marks]

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Brief Answers to Grade Grabber 4

Answer 1

- (i) $2a + 2b$
- (ii) $-2a + b$
- (iii) $-b - a$
- (iv) $k = -2$ because $2a + 2b = (-2)(-b - a)$
- (v) they are parallel

[1, 1, 1, 2, 1 marks]

Answer 2

- (i) 0.45 m^3
- (ii) 5103 kg
- (iii) 5.103 tonnes
- (iv) No !

[4 marks]

Answer 3

- (i) $A = \{ 1, 2, 4, 8, 16 \}$
- (ii) $B = \{ 1, 2, 4, 5, 10, 20 \}$
- (iii) $A \cap B = \{ 1, 2, 4 \}$
- (iv) $A \cup B = \{ 1, 2, 4, 5, 8, 10, 16, 20 \}$
- (v) $A' \cap B = \{ 5, 10, 20 \}$
- (vi) $A \cap B' = \{ 8, 16 \}$
- (vii) $(A' \cap B) \cap (A \cap B') = \emptyset$

Mr Fussy

Mr Greedy

the part of B that's not in A

the part of A that's not in B

empty set

[7 marks]

Answer 4

(i)

Car speed (miles per hour, mph)	Number of cars Frequency = Area	Width	Height
$0 \leq m < 20$	100	20	5
$20 \leq m < 28$	160	8	20
$28 \leq m < 32$	400	4	100
$32 \leq m < 36$	160	4	40
$36 \leq m < 48$	180	12	15
$48 \leq m < 56$	40	8	5

[3 marks]

(ii) 1040

[2 marks]

(iii) $\frac{400}{1040} \times 100 = 38.5\%$

[2 marks]

Answer 5

$$x \times 0.8 = 320 \quad \therefore x = \text{£}400$$

[2 marks]**Answer 6**

$$y = 4x^3 + 5x^{0.5}$$

$$\frac{dy}{dx} = 12x^2 + 2.5x^{-0.5}$$

[3 marks]**Answer 7**

$$\frac{x^2 - 2x - 24}{x^2 - 6^2} = \frac{(x - 6)(x + 4)}{(x - 6)(x + 6)}$$

$$= \frac{x + 4}{x + 6}$$

[2 marks]**Answer 8**

$$x^2 + y^2 = 100$$

$$(3y - 10)^2 + y^2 = 100$$

$$9y^2 - 60y + 100 + y^2 = 100$$

$$10y^2 - 60y = 0$$

Divide through by 10

$$y^2 - 6y = 0$$

$$y(y - 6) = 0$$

Either $y = 0$ or $y = 6$

Points are, $(-10, 0)$, $(8, 6)$

[5 marks]**Answer 9****(i)** Note that the radius is 0.3 cm

$$V = \pi r^2 h$$

$$= 3.14 \times 0.3^2 \times 15$$

$$= 4.24 \text{ cm}^3$$

(ii) Geek method :

$$V_{LOST} = \frac{2}{3} \times 3.14 \times 0.3^2 \times 2$$

$$= 0.38 \text{ cm}^3$$

[4 marks]

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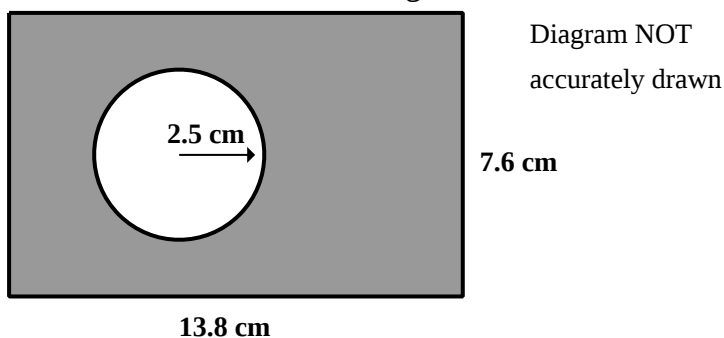
Grade Grabber 5

Marks Available : 40

Question 1

GCSE Examination Question from May 2016, Paper 3H, Q10 (Edexcel)

The diagram shows a circle inside a rectangle

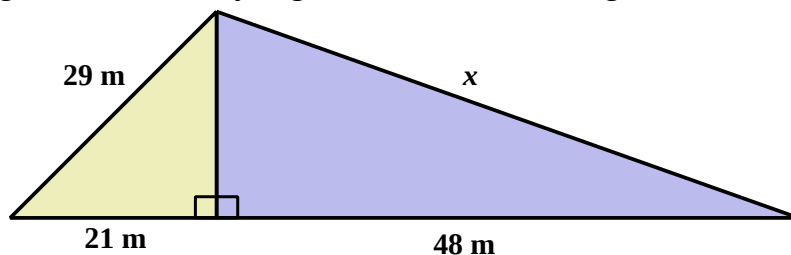


Work out the area of the shaded region
Give your answer to 3 significant figures

[3 marks]

Question 2

By using the theorem of Pythagoras' twice, find the length of the side marked x

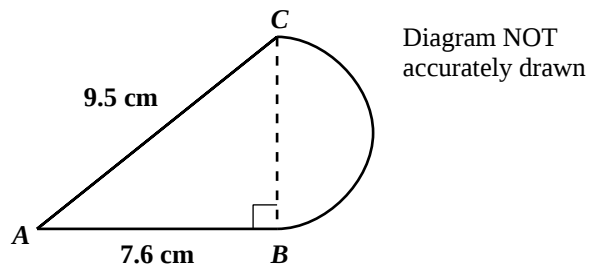


[3 marks]

Question 3

GCSE Examination Question from January 2014, Paper 3H, Q12 (Edexcel)

The diagram shows a shape made from triangle ABC and a semicircle with diameter BC



Triangle ABC is right-angled at B

$AB = 7.6$ cm and $AC = 9.5$ cm

Calculate the area of the shape

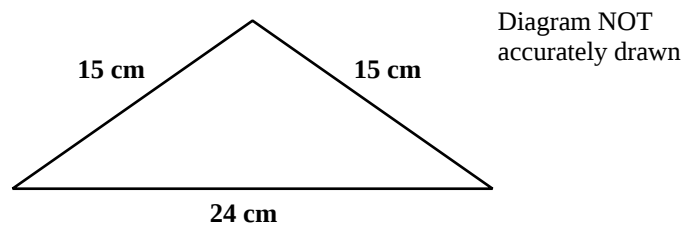
Give your answer correct to 3 significant figures

[3 marks]

Question 4

GCSE Specimen Examination Question, 2018, Paper 1H, Q9 edited (Edexcel)

The diagram shows an isosceles triangle



Work out the area of the triangle

[3 marks]

Question 5

GCSE Specimen Examination Question from 2018, Paper 2F, Q12 (Edexcel)

The width of a rectangle is 8 cm less than the length of the rectangle

The perimeter of the rectangle is 54 cm

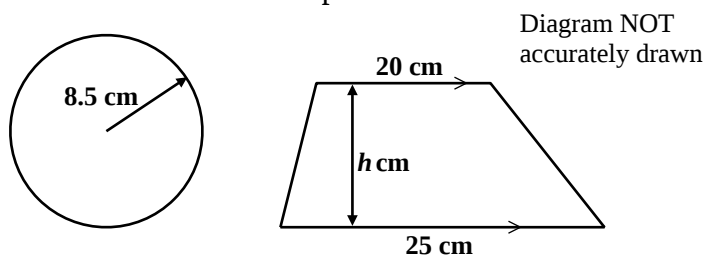
Find the area of the rectangle

[4 marks]

Question 6

GCSE Specimen Examination Question, from 2018, Paper 2H, Q2 (Edexcel)

The diagram shows a circle and a trapezium



The height of the trapezium is h cm

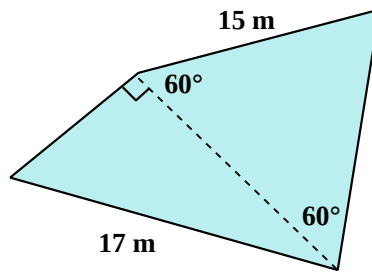
The area of the circle is equal to the area of the trapezium

Work out the value of h

Give your answer correct to 1 decimal place

[4 marks]

Question 7



Calculate the perimeter of this shape
Explain your method and show full working at each stage

[2 marks]

Question 8

GCSE Examination Question from June 2017, Paper 4H, Q11 (Edexcel)

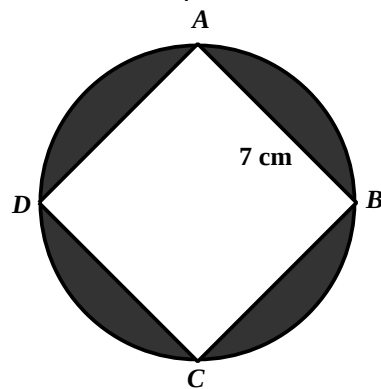


Diagram NOT
accurately drawn

A , B , C and D are points on a circle
 $ABCD$ is a square of side 7 cm
Work out the total area of the shaded regions
Give your answer correct to the nearest whole number

[4 marks]

Question 9

The solutions of a quadratic equation, $ax^2 + bx + c = 0$ can be found by use of the formula,

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

Show how you would use this formula to determine the solutions of the quadratic equation;

$$x^2 + 6x - 11 = 0$$

writing your answer in the form $x = p \pm q\sqrt{r}$, for integer values of p , q and r

[4 marks]

Question 10

Find the two points at which the straight line with equation; $y = 3x + 4$ intersects the ellipse with equation;

$$y^2 + 5x^2 = 6$$

[5 marks]

Question 11

GCSE Examination Question from June 2015, Paper 3H, Q11 (Edexcel)

Here is a prism

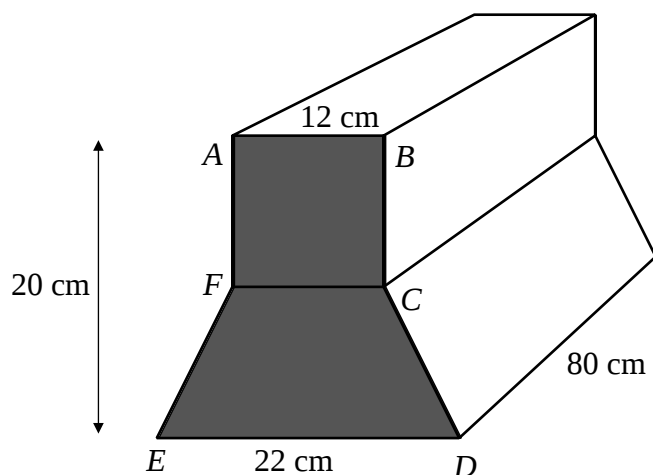


Diagram NOT
accurately drawn

$ABCDEF$ is a cross section of the prism

$ABCF$ is a square of side 12 cm

$FCDE$ is a trapezium

$ED = 22$ cm

The height of the prism is 20 cm

The length of the prism is 80 cm

Work out the total volume of the prism

[5 marks]

Brief Answers to Grade Grabber 5

Answer 1

$$\begin{aligned} \text{Area Shaded} &= 13.8 \times 7.6 - \pi \times 2.5^2 \\ &= 104.88 - 19.63495 \\ &= 85.2 \quad \text{must be to 3 sf} \quad 85.3 \text{ is acceptable} \end{aligned}$$

[3 marks]

Answer 2

$$\begin{aligned} x &= \sqrt{48^2 + 29^2 - 21^2} \quad \text{geek method} \\ x &= 52 \text{ cm} \end{aligned}$$

[3 marks]

Answer 3

The diameter of the circle will be $\sqrt{9.5^2 - 7.6^2} = 5.7 \text{ cm}$

$$\begin{aligned} \therefore \text{Area of shape} &= \frac{1}{2} \times 7.6 \times 5.7 + \frac{1}{2} \times \pi \times 2.85^2 \\ &= 34.4 \text{ cm}^2 \quad \text{must be to 3 sf} \end{aligned}$$

[3 marks]

Answer 4

Easiest method is to first get the triangle's perpendicular height, h , using Pythagoras' Theorem and then get the area using *half the base times the perpendicular height*

$$\begin{aligned} h &= \sqrt{15^2 - 12^2} \\ &= 9 \text{ cm} \\ \text{Area} &= \frac{1}{2} \times 24 \times 9 \\ &= 108 \text{ cm}^2 \end{aligned}$$

[3 marks]

Answer 5

$$\begin{aligned} x + (x - 8) + x + (x - 8) &= 54 \\ x &= 17.5 \text{ cm} \\ \therefore \text{Area} &= 17.5 \times 9.5 \\ &= 166.25 \text{ cm}^2 \end{aligned}$$

[4 marks]

Answer 6

$$\begin{aligned} \pi \times 8.5^2 &= \frac{1}{2} \times (20 + 25) \times h \\ 226.98 &= 22.5 h \\ h &= 10.1 \text{ cm} \quad \text{must be to 1 decimal place} \end{aligned}$$

[4 marks]

Answer 7

Spot the equilateral triangle to give the broken line a length of 15 m
 Then the Theorem of Pythagoras' gives the remaining side a length of 8 m
 $\therefore$ Perimeter is 55 m

[2 marks]**Answer 8**

Get the length of the square's diagonal using the Theorem of Pythagoras, 9.899 cm

$$\begin{aligned} \text{Shaded Area} &= \pi \times 4.9497^2 - 7 \times 7 \\ &= 28 \quad \text{must be to nearest whole number} \end{aligned}$$

[4 marks]**Answer 9**

$$\begin{aligned} x &= \frac{-6 \pm \sqrt{6^2 - 4 \times 1 \times (-11)}}{2 \times 1} \\ &= \frac{-6 \pm \sqrt{80}}{2} \\ &= \frac{-6 \pm \sqrt{16 \times 5}}{2} \\ &= \frac{-6}{2} \pm \frac{4\sqrt{5}}{2} \\ &= -3 \pm 2\sqrt{5} \end{aligned}$$

That is $p = -3$, $q = 2$ and $r = 5$

[4 marks]**Answer 10**

$$\begin{aligned} y^2 + 5x^2 &= 6 \\ (3x + 4)^2 + 5x^2 &= 6 \\ 9x^2 + 24x + 16 + 5x^2 &= 6 \\ 14x^2 + 24x + 10 &= 6 \\ \text{divide through by 2} \\ 7x^2 + 12x + 5 &= 0 \\ (7x + 5)(x + 1) &= 0 \end{aligned}$$

Either $x = -\frac{5}{7}$ or $x = -1$ giving $(-1, 1)$ or $(-\frac{5}{7}, \frac{13}{7})$

[5 marks]**Answer 11**

22400 cm³

[5 marks]

Grade Grabber 6

Marks Available : 40

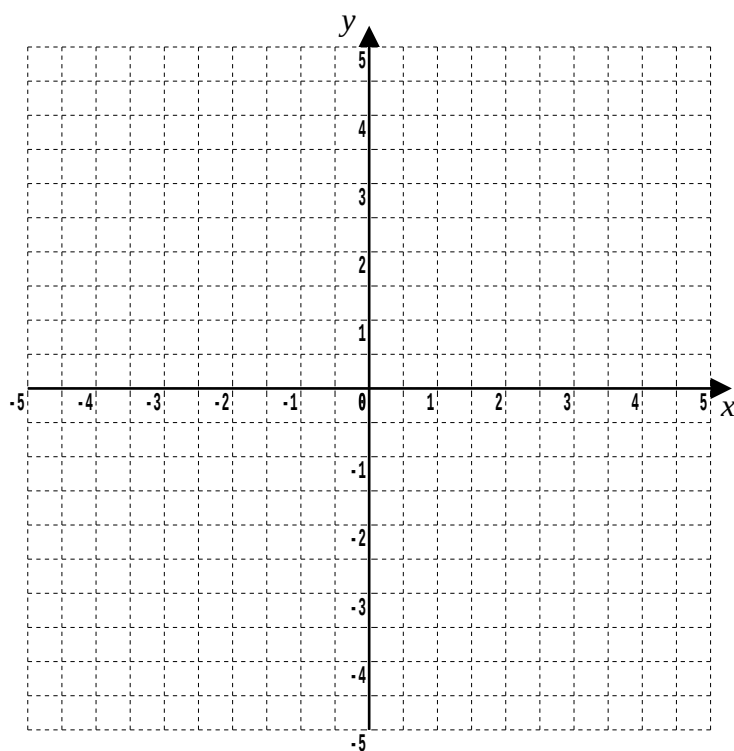
Question 1

(a) On the grid draw the three lines with equations;

(i) $y = 2x - 3$

(ii) $x + y = 3$

(iii) $x = -1$



(b) Shade in the triangle formed

[3 marks]

(c) Determine the area of the triangle that you have shaded

[1 mark]

[1 mark]

Question 2

To the nearest million, how many seconds are there in a year ?

[1 marks]

Question 3

A standard six sided dice is rolled 150 times.

- (i) How many times would you expect a “5” to be rolled ?

[1 mark]

- (ii) What is the probability that the first time a “5” is rolled is on the third roll ?
Give your answer as a decimal, correct to three significant figures.

[2 marks]

Question 4

A *square free number* is an integer that cannot be divided exactly by any square number greater than 1.

- (a) Which one of the following numbers is square free ?

(i) 49 (ii) 50 (iii) 51 (iv) 52

For each numbers that is not square free state the square it is divisible by.

[2 marks]

- (b) Express $\sqrt{162}$ in the form $a\sqrt{b}$
where a and b are integers and b is square free.

[1 mark]

Question 5

An arithmetic progression is a sequence of the form

$$a, \quad a + d, \quad a + 2d, \quad a + 3d, \quad \dots, \quad a + (n - 1) d$$

- (i) If such a sequence has third term 16 and fourth term 21 list the first six terms of the sequence.

[2 marks]

- (ii) Will 2021 be in the sequence ?
Give a reason for your answer.

[2 marks]

Question 6

The kinetic energy, KE , of an object is directly proportional to the square of its velocity, v .

In symbols, this can be written,

$$KE \propto v^2$$

When my car is moving at 25 km h^{-1} , I estimate its kinetic energy to be 125000 joules.

- (i) Write down a formula of the form

$$KE = k v^2$$

that relates the kinetic energy and the velocity of my car,
where k is a constant, the value of which you have determined.

[3 marks]

- (ii) Use your part (i) formula to estimate the kinetic energy of my car when it is travelling at 80 km h^{-1}

[1 mark]

Question 7

A curve has the equation, $y = x^2 - 8x + 15$

- (a) For this curve find,

(i) $\frac{dy}{dx}$

[2 marks]

- (ii) The coordinates of the stationary point.

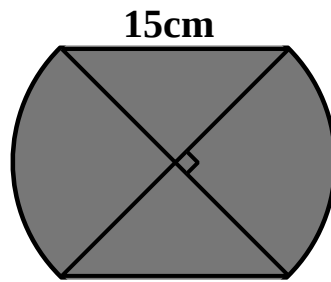
[3 marks]

- (b) State, with a reason, whether the turning point is a minimum or a maximum.

[2 marks]

Question 8

Find the perimeter of the following shape ;



The shape may be thought of as being constructed from two quarter circles and two isosceles, right angled triangles, each with hypotenuse 15 cm.

[3 marks]

Question 9

In $\triangle ABC$, two of the angles are, $A = 68^\circ$, and $C = 34^\circ$

Opposite the angle B , is a side of length $b = 9.4$ cm

- (i) Use a well known fact about the sum of the angles in a triangle to determine the size of angle B .

[1 mark]

- (ii) Sketch the triangle, not to scale, and mark on all known lengths and angles.

[1 mark]

- (iii) Find the length of each missing side, stating which is a and which is c .

[3 marks]

Question 10

In a government survey, a questionnaire is emailed to 15000 people who have previously agreed to take part.

The time taken, in hours, to return the questionnaire is logged.

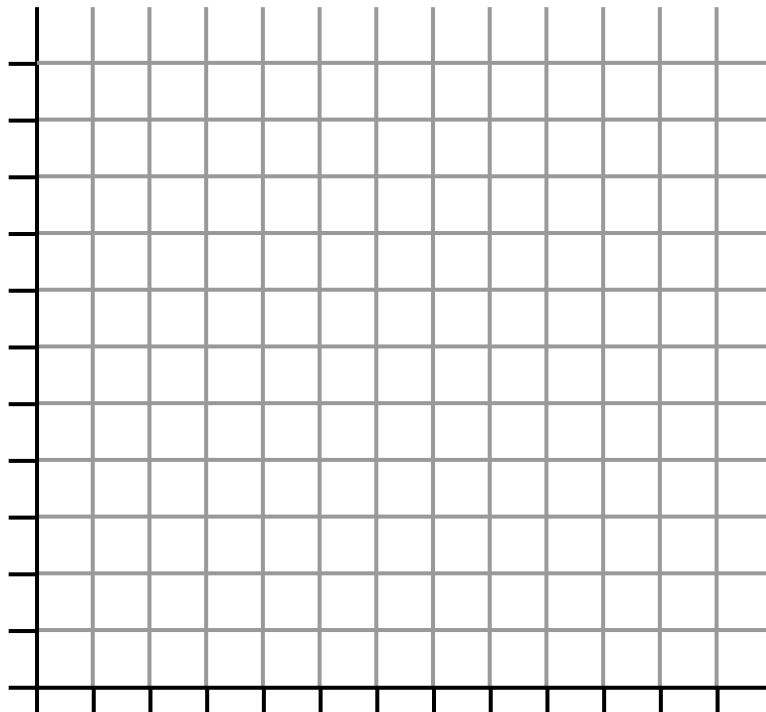
The following table presents a summary.

Response time (hours)	Number of questionnaires Frequency = Area	Width	Height
$0 \leq h < 2$	700		
$2 \leq h < 4$	1100		
$4 \leq h < 6$	2200		
$6 \leq h < 8$	1700		
$8 \leq h < 14$	3500		
$14 \leq h < 24$	2700		

- (i) How many questionnaires have not generated a response ?

[1 mark]

- (ii) Plot a histogram to show the distribution of the times taken in responding to the questionnaire. Complete the columns headed Width and Height in the table above, to help you do this.



[4 marks]

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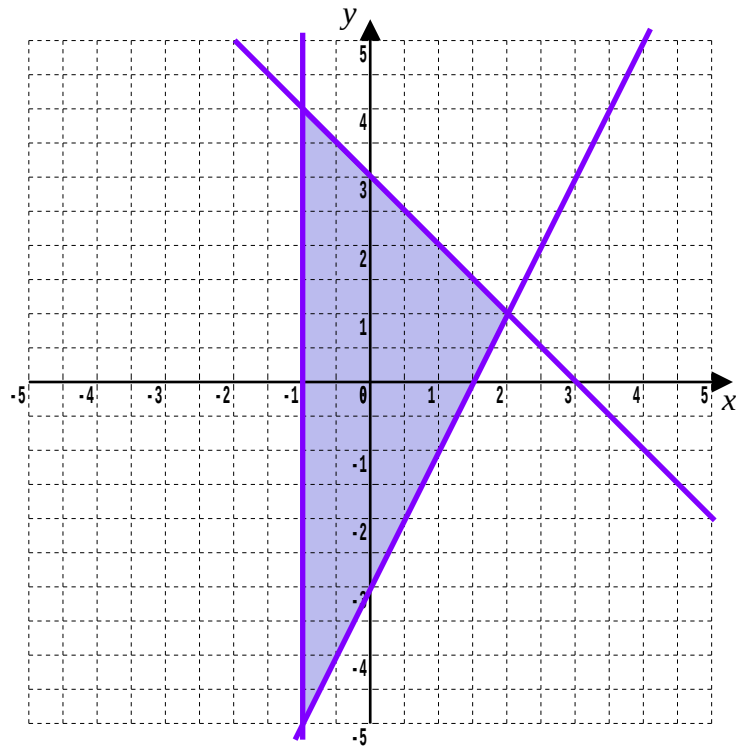
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Brief Answers to Grade Grabber 6

Answer 1

(i) and (ii)



(iii) 13.5 units²

[3, 1 marks]

[1 mark]

Answer 2

$$60 \times 60 \times 24 \times 365 \\ = 32 \text{ million seconds}$$

[1 mark]

Answer 3

(i) 25 times

(ii) 0.116

[1, 2 marks]

Answer 4

(a) 51 is square free

49 divides by 7^2 , 50 divides by 5^2 , 52 divides by 2^2

(b) $9\sqrt{2}$

[2, 1 marks]

Answer 5

(i) 6, 11, 16, 21, 26, 31, ...

(ii) Yes, all positive integers ending in 1 or 6 are in this sequence and 2021 ends in 1

[2, 2 marks]

Answer 6

(i) $KE = 200 v^2$

(ii) 1280000 J

[3, 1 marks]

Answer 7

(a) (i) $\frac{dy}{dx} = 2x - 8$

(ii) $(4, -1)$

[2, 3 marks]

(b) Minimum

A parabola from a quadratic equation with positive x^2 term has a $\cup$ shape

[2 marks]

Answer 8

In the right angled triangle with hypotenuse 15 cm let the shorter sides each be x

Then, by the Theorem of Pythagoras, $x = 10.607$ cm

This is then the radius of the sector.

$$\begin{aligned} \text{Perimeter Shape} &= 2 \left(15 + \frac{1}{4} \times 2 \times \pi \times 10.607 \right) \\ &= 63.32 \text{ cm} \end{aligned}$$

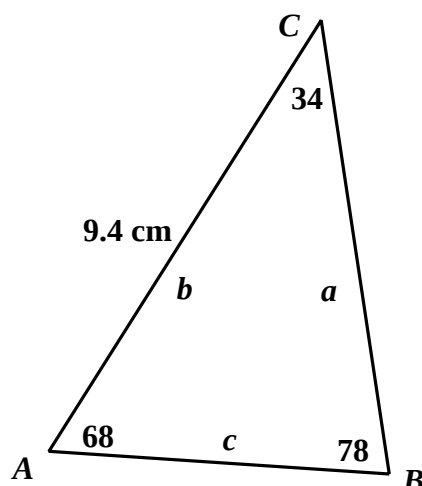
[3 marks]

Answer 9

(i) $\sum \text{angles in } \Delta = 180^\circ$ and so $\angle B = 78^\circ$

[1 mark]

(ii)



[1 mark]

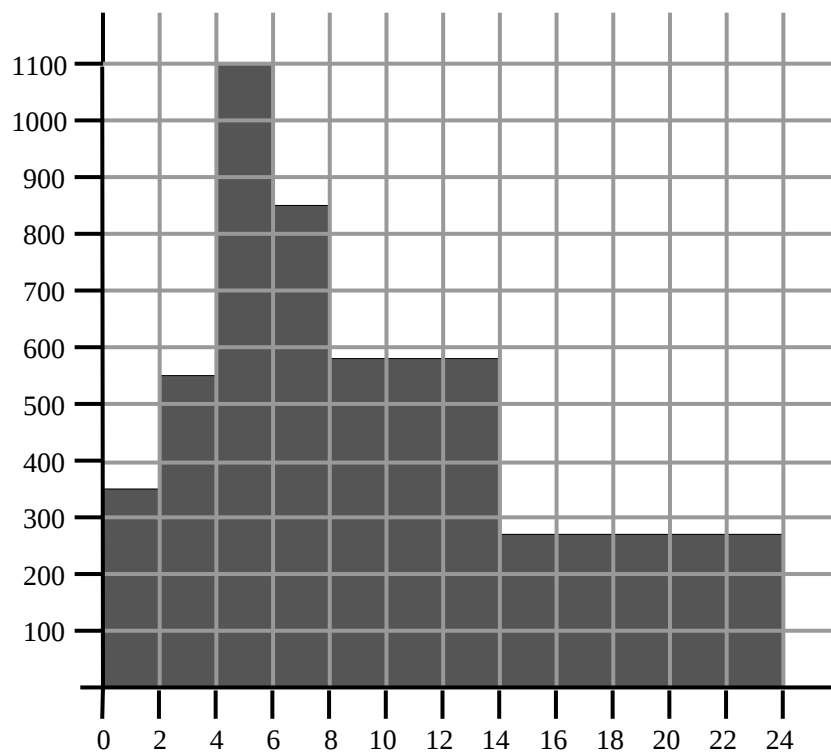
(iii)
$$\frac{a}{\sin 68} = \frac{9.4}{\sin 78} \Rightarrow a = 8.91 \text{ cm}$$

$$\frac{c}{\sin 34} = \frac{9.4}{\sin 78} \Rightarrow c = 5.37 \text{ cm}$$

[3 marks]

Answer 10**(i)** 3100**[1 mark]****(ii)**

Response time (hours)	Number of questionnaires Frequency = Area	Width	Height
$0 \leq h < 2$	700	2	350
$2 \leq h < 4$	1100	2	550
$4 \leq h < 6$	2200	2	1100
$6 \leq h < 8$	1700	2	850
$8 \leq h < 14$	3500	6	583
$14 \leq h < 24$	2700	10	270

**[4 marks]**