

CSEE ‘Answer Booklet’ Basic Maths (Form 4)



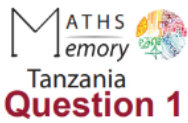
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ANSWERS

Basic Numbers



Core 1- Bronze

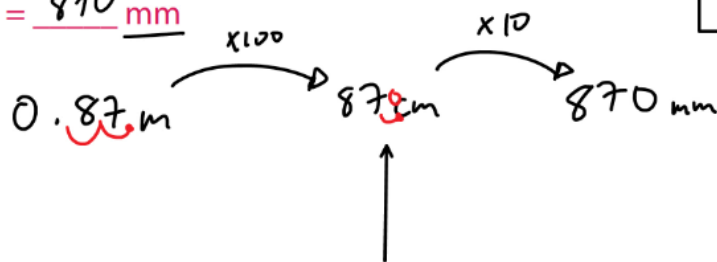
Topic: Basic Numbers

a) i) $550 \text{ mm} = \underline{55} \text{ cm}$

ii) $6500 \text{ m} = \underline{6.5} \text{ km}$

iii) $0.057 \text{ km} = \underline{57} \text{ m}$

iv) $0.87 \text{ m} = \underline{870} \text{ mm}$



$$\begin{aligned} 1 \text{ cm} &= 10 \text{ mm} \\ 1 \text{ m} &= 100 \text{ cm} \\ 1 \text{ km} &= 1000 \text{ m} \end{aligned}$$

Bronze



Core 2 - Bronze

Topic: Basic Numbers

Write 3549 to

i) 1 significant figure 4000

ii) 2 significant figures 3500

b) Write 7.853 to

i) 1 decimal place $= 7.9$

ii) 2 decimal places $= 7.85$

c) Estimate: $\frac{24.3 \times 55}{0.025} = \frac{20 \times 60}{0.03} = \frac{1200}{0.03} \begin{matrix} (\times 100) \\ (\times 100) \end{matrix} = \frac{120000}{3} = \underline{40,000}$

Bronze



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Core 3 - Bronze Topic: Basic Numbers

a) Work out :

i) $1\frac{3}{4} + 2\frac{1}{2}$



$$1\frac{3}{4} + 2\frac{1}{2} = \frac{7}{4} + \frac{5}{2} \begin{matrix} (\times 2) \\ (\times 2) \end{matrix}$$

$$= \frac{7 + 10}{4} = \frac{17}{4} = 4$$

ii) $2\frac{1}{4} \div 3\frac{1}{2}$

$$2\frac{1}{4} \div 3\frac{1}{2} = \frac{9}{4} \div \frac{7}{2} = \frac{9}{4} \times \frac{2}{7} = \frac{18}{28}$$

Bronze

Core 4 - Bronze

Topic: Basic Numbers

a) From the set of numbers {3, 4, 6, 7, 8, 12, 15, 20, 25, 27, 29}; write down :

i) the prime numbers

3, 7, 29

ii) Square numbers

4, 25

iii) Cube numbers

8, 27

iv) Multiples of 4

4, 8, 12, 20

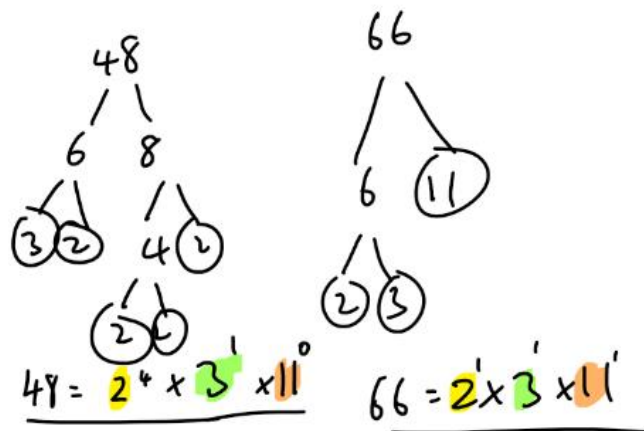
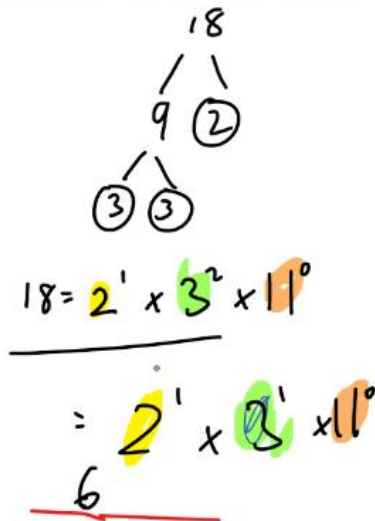
$$[2^2 = 4, 5^2 = 25]$$

$$[2^3 = 8, 3^3 = 27]$$

Bronze

Core 5 - Bronze Topic: Basic Numbers

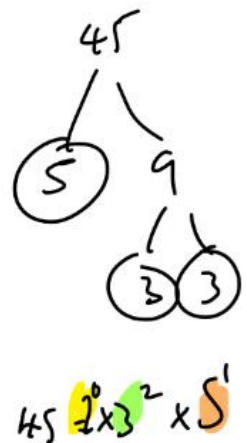
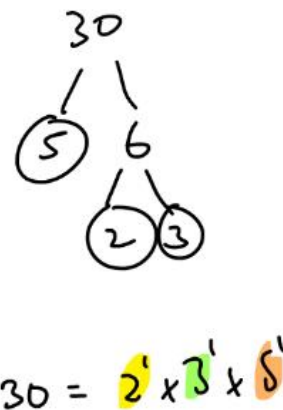
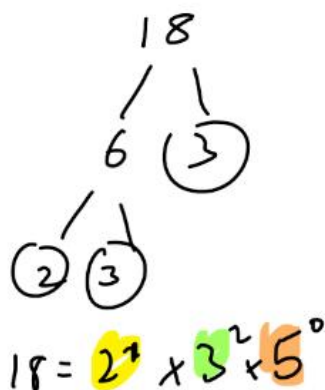
Find the GCF of 18, 48, 66.



Bronze

Core 6 - Bronze Topic: Basic Numbers

Find the LCM of 18, 30, 45.



LCM = $2^1 \times 3^2 \times 5^1$
 = $2 \times 9 \times 5 = \underline{90}$

Bronze

Core 7 - Bronze

Topic: Basic Numbers

Bus A, B and C leave the main bus depot at 8am.

Bus A stops every 12 minutes at bus stops along its journey.
Bus B stops every 15 minutes at bus stops along its journey.
Bus C stops every 20 minutes at bus stops along its journey.

When is the next time they will all meet together at a bus stop?

$$8 \text{ am} + 1 \text{ hr} = \underline{9 \text{ am}}$$

[60 min]

LCM

A	B	C
12	15	20
24	30	40
36	45	60
48	60	80
60	75	100
72	90	120
84	105	140

Bronze



Core 8 - Silver

Topic: Basic Numbers

a) If $p = 4.2 \times 10^5$ and $q = 2.5 \times 10^2$ find the values of:

i) $p \times q = \underline{10.5 \times 10^7} = \underline{1.05 \times 10^8}$

ii) $p - q = \underline{419750} = \underline{4.1975 \times 10^5}$

b) If $p = 2.1 \times 10^7$ and $q = 3 \times 10^3$ find the values of

i) $p \div q = \underline{0.7 \times 10^4} = \underline{7 \times 10^3}$

$$4.2 \times 2.5$$

$$= \begin{array}{r} 42 \text{ (1dp)} \\ \times 25 \text{ (1dp)} \\ \hline 210 \\ + 840 \\ \hline 1050 \text{ (2dp)} \end{array}$$

Silver



a) Edward buys 3 litres of water. His cup can take a maximum capacity of 200ml. How many days will it him take to finish all the water.

$$3 \text{ litres} = 3000 \text{ ml}$$

$$1 \text{ litre} = 1000 \text{ ml}$$

$$\frac{3000}{200} = \frac{30}{2} = \underline{15 \text{ cups}}$$

b) A school's mini bus has a maximum capacity of 30 pupils. A school has 440 pupils. How many mini buses will it need.

$$\begin{array}{r} 30 \overline{) 440} \\ \underline{140} \\ 30 \overline{) 44} \\ \underline{30} \\ 14 \end{array} = \underline{15 \text{ buses}} +$$

Silver

a) Samuel's Maths exam paper has a total of 120 marks available. 25% is for Geometry, 60% for Algebra. The remainder percentage is Statistics.
What is the mark allocation for Statistics?

$$\begin{array}{r} G = 30 \text{ marks} \\ A = 72 \text{ marks} \\ \hline 102 \end{array}$$

$$\begin{array}{r} 120 \\ 102 \\ \hline 18 \text{ marks} \end{array}$$

b) Jessica has 45,000 shillings. She spends $\frac{2}{5}$ on her rent. She spends $\frac{1}{3}$ on travel. How many shillings does she have left?

$$\underline{12,000}$$

$$R = \frac{2}{5} \text{ of } 45,000$$

$$\begin{array}{r} 9,000 \\ 5 \overline{) 45,000} \\ \underline{45,000} \\ 0 \end{array} \quad 9,000 \times 2 = \underline{18,000}$$

$$T = \frac{1}{3} \text{ of } 45,000$$

$$= 15,000 \times 1 = \underline{15,000}$$

Silver

ANSWERS

Indices and Logs



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Question 1

Core 1 - Bronze

Topic: Indices and Logs

c) Simplify $\frac{2}{(1+\sqrt{5})} \times \frac{(1-\sqrt{5})}{(1-\sqrt{5})} = \frac{2-2\sqrt{5}}{1-\sqrt{5}+\sqrt{5}-5} = \frac{2-2\sqrt{5}}{-4}$

$$= \frac{2}{-4} - \frac{2\sqrt{5}}{-4} = -\frac{1}{2} + \frac{1}{2}\sqrt{5}$$

$$= \frac{1}{2}\sqrt{5} - \frac{1}{2}$$

$$= \frac{\sqrt{5}-1}{2}$$

d) Simplify $\frac{2}{(3\sqrt{2}-1)} \times \frac{(3\sqrt{2}+1)}{(3\sqrt{2}+1)} = \frac{6\sqrt{2}+2}{18+3\sqrt{2}-3\sqrt{2}-1}$

$$= \frac{6\sqrt{2}+2}{17}$$



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Question 2

Core 2 - Bronze

Topic: Indices and Logs

Work out the value of x

a) $2^x = \frac{1}{8} = 2^{-3} = \frac{1}{8}$

Hence work out the value of $a + b + c$

b) $2^a = \frac{1}{8}, 2^b = 8\sqrt{2}, 2^c = \frac{1}{2\sqrt{2}}$

$$a = -3, \quad 2^3 \times 2^{\frac{1}{2}} = 2^{3.5} \quad \frac{1}{2^1 \times 2^{\frac{1}{2}}} = \frac{1}{2^{1.5}} \quad c = -1.5$$

$$b = 3.5$$

$$= -1$$



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Question 3

Simplify

Core 3 - Bronze

Topic: Indices and Logs

$$\log_a(b) = x \Rightarrow a^x = b$$

a) $\log_3 3 + \log_3 9 =$ $\log_3(x) + \log_3(y) = \log_3(xy) = \log_3(27) = x$
 $3^x = 27 \therefore \underline{x = 3}$

b) $\log_2 12 - \log_2 3 =$ $\log_2\left(\frac{12}{3}\right) = \log_2 4$

c) $\log 3^x =$ $x \log 3$

Work out the value of x

d) $\log_2 x = 3$ $2^3 = 8 \therefore x = 8$

Bronze

Question 4

Work out the value of x

Core 4 - Bronze

Topic: Indices and Logs

a) $3^3 \times 9 = 3^x$ $3^3 \times 3^2 = 3^x$ $3+2 = x \therefore \underline{x = 5}$

b) $16^{\frac{1}{5}} \times 2^x = 8^{\frac{3}{4}}$ $(2^{\frac{4}{1}})^{\frac{1}{5}} \times (2)^x = (2^{\frac{3}{1}})^{\frac{3}{4}}$ $2^{\frac{4}{5}} \times 2^x = 2^{\frac{9}{4}}$
 $\frac{4}{5} + x = \frac{9}{4}$

c) $4^{(2x-4)} = 8^{(x+2)}$ $(2^2)^{(2x-4)} = (2^3)^{(x+2)}$ $2^{4x-8} = 2^{3x+6}$ $4x-8 = 3x+6$ $x = 14$
 $x = \frac{9}{4} - \frac{4}{5}, \frac{45-16}{20} = \frac{29}{20} = 1\frac{9}{20}$

Question 5

Show that $\frac{2 - 4\sqrt{2}}{2 + 2\sqrt{2}}$ can be simplified to $3\sqrt{2} - 5$

$$\begin{aligned} \frac{(2-4\sqrt{2})}{(2+2\sqrt{2})} \times \frac{(2-2\sqrt{2})}{(2-2\sqrt{2})} &= \frac{4 - 4\sqrt{2} - 8\sqrt{2} + [8 \times 2]}{4 - 2\sqrt{2} + 2\sqrt{2} - [4 \times 2]} \\ &= \frac{4 - 12\sqrt{2} + 16}{4 - 8} = \frac{20 - 12\sqrt{2}}{-4} \\ &= \frac{20}{-4} + 3\sqrt{2} \\ &= \underline{3\sqrt{2} - 5} \end{aligned}$$

Question 6

Work out the value of n

a) $n \log_3 81 = \log_2 8$

$$\begin{aligned} n \log_3 (81) &= \log_2 (8) \\ n \log_3 (3^4) &= \log_2 (2^3) \\ 4n \log_3 (3) &= 3 \log_2 (2) \\ 4n &= 3 \\ n &= \frac{3}{4} \end{aligned}$$

Silver



Question 7

Work out the value of y

a) $\log_3 (4y - 2) - 2 = \log_3 (y + 2)$

$$\log_3 (4y - 2) - \log_3 (y + 2) = 2$$

$$\log_3 \left(\frac{4y - 2}{y + 2} \right) = 2$$

$$3^2 = \frac{4y - 2}{y + 2}$$

$$\frac{9}{1} = \frac{4y - 2}{y + 2}$$

$$\begin{aligned} 9(y + 2) &= 4y - 2 \\ 9y + 18 &= 4y - 2 \\ 9y - 4y &= -2 - 18 \\ 5y &= -20 \\ y &= -4 \end{aligned}$$

Silver



Question 8

Work out the value of

a) $8^{\frac{1}{4}} \times (\sqrt{2})^{-4} \times 2^{\frac{3}{2}}$

$$= (2^3)^{\frac{1}{4}} \times (2^{\frac{1}{2}})^{-4} \times 2^{\frac{3}{2}}$$

$$= 2^{\frac{3}{4}} \times 2^{-2} \times 2^{\frac{3}{2}}$$

$$= 2^{\frac{3}{4}} \times 2^{-2} \times 2^{\frac{3}{2}}$$

$$= \frac{3}{4} + -\frac{2}{1} + \frac{3}{2} = \frac{3}{4} - \frac{8}{4} + \frac{6}{4} = \frac{1}{4}$$

Silver



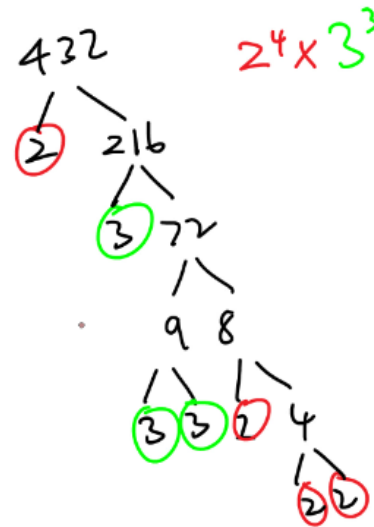
Question 9

Work out the value of x and y

a)
$$\frac{2^{x-2}}{3^{3y}} = 432$$

$$2^{x-2} \times 3^{-3y} = 2^4 \times 3^3$$

$$\begin{array}{l} 2: x-2 = 4 \quad \therefore x = 6 \\ 3: -3y = 3 \quad \therefore y = -1 \end{array}$$



Silver

Question 10

Given that $\log 3 = 0.4771$ and $\log 2 = 0.301$, find the value of $\log(3^{3/8})$, without using mathematical tables.

$$\begin{aligned} \log(3^{3/8}) &= \log\left(\frac{27}{8}\right) = \log 27 - \log 8 \\ &= \log 3^3 - \log 2^3 \\ &= 3\log 3 - 3\log 2 \\ &= 3(0.4771) - 3(0.301) \\ &= 0.5283 \end{aligned}$$

Gold

Question 11

Express the expression

a) $(2)^{3y-1} + 3 \times (2)^{y+2}$

in terms of P given that $P = (2)^y$

$$\begin{aligned} & (2)^{3y} \times \underline{2^{-1}} + 3 \times (2)^y \times \underline{2^2} \\ & \frac{1}{2} (2)^{3y} + 12 (2)^y \\ & = \underline{\underline{\frac{1}{2} P^3 + 12 P}} \end{aligned}$$

Gold



Question 12

a) Work out the value of x

$$\begin{aligned} & \sqrt{4^{3x-3} + 8} = 72 \\ & \sqrt{4^{3x-3}} = 72 - 8 \\ & \sqrt{4^{3x-3}} = 64 \\ & 4^{3x-3} = (4^3)^2 \\ & 4^{3x-3} = 4^6 \end{aligned}$$

$$\begin{aligned} 3x - 3 &= 6 \\ 3x &= 9 \\ \underline{x &= 3} \end{aligned}$$

Gold



Question 12

a) Work out the value of x

$$\sqrt{4^{3x-3}} + 8 = 72$$

$$\sqrt{4^{3x-3}} = 72 - 8$$

$$\sqrt{4^{3x-3}} = 64$$

$$4^{3x-3} = (4^3)^2$$

$$4^{3x-3} = 4^6$$

$$\begin{aligned} 3x - 3 &= 6 \\ 3x &= 9 \\ x &= 3 \end{aligned}$$

Gold

Question 13

Evaluate $\log_{10}(13500)$ given that $\log_{10}2 = 0.301$, $\log_{10}3 = 0.4771$, $\log_{10}5 = 0.699$

$$\begin{array}{r} 13500 \\ \diagdown \end{array}$$

$$13500 = 2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5 \times 5$$

$$\log_{10}(2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5 \times 5)$$

$$\log_{10}(2^2 \times 3^3 \times 5^3)$$

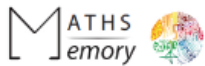
$$\log_{10}(xyz) = \log_{10}(x) + \log_{10}(y) + \log_{10}(z)$$

$$\begin{aligned} &\log_{10}2^2 + \log_{10}3^3 + \log_{10}5^3 \\ &2\log_{10}2 + 3\log_{10}3 + 3\log_{10}5 \\ &= 2(0.301) + 3(0.4771) + 3(0.699) \\ &= 0.602 + 1.4313 + 2.097 \\ &= 4.1303 \end{aligned}$$

Platinum

ANSWERS

Algebra and Sets



Core 1 - Bronze

Topic: Algebra and Sets

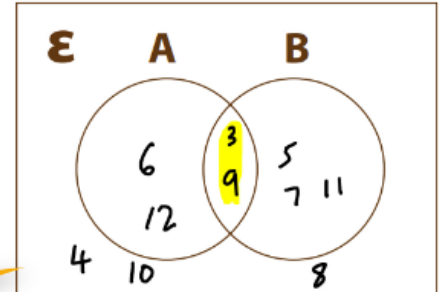
Question 1

$$\mathcal{E} = \{3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$$

$$A = \{\text{Odd Numbers between 3 and 12}\}$$

$$B = \{\text{Multiples of 3 between 3 and 12}\}$$

a) Complete the Venn diagram to represent this information.



STEP 1
Complete Venn

b) A number is chosen at random from the universal set $\mathcal{E}$.
Find the probability that the number is in the set $A \cap B$

$$\frac{2}{10} = \frac{1}{5}$$

STEP 2
Apply



Core 2 - Bronze

Topic: Algebra and Sets

Question 2

a) Solve $3n - 5 > 22$

$$\begin{aligned} 3n - 5 &= 22 \\ 3n &= 22 + 5 \\ 3n &= 27 \quad \therefore n = 9 \Rightarrow n > 9 \end{aligned}$$

b) Solve $9n \leq 3n + 12$

$$\begin{aligned} 9n &= 3n + 12 \\ 9n - 3n &= 12 \\ 6n &= 12 \Rightarrow n = 2 \Rightarrow n \leq 2 \end{aligned}$$

c) Solve $7n - 2 \geq 4n + 7$

$$\begin{aligned} 7n - 2 &= 4n + 7 \\ 7n - 4n &= 7 + 2 \\ 3n &= 9 \Rightarrow n = 3 \Rightarrow n \geq 3 \end{aligned}$$



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Question 3

a) Factorise $3x^2 + 4x - 4$

$$ax^2 + bx + c$$

Step 1: Quad Box
(+ insert)

$$\begin{array}{r} 6x - 2 = +2 \\ 6 + -2 = 4 \end{array}$$

$$3x^2 + 6x - 2x - 4$$

Step 2: Split + factorise

$$3x^2 + 6x - 2x - 4$$

Step 3: Combine

$$(3x-2)(x+2)$$

Hence solve $3x^2 + 4x - 4 = 0$

$$(3x-2)(x+2) = 0$$

$$3x-2=0 \quad x+2=0$$

$$3x=2 \quad x=-2$$

$$x = \frac{2}{3} \quad x = -2$$

b) Solve $6x^2 - 7x - 3 = 0$

(1)

$$\begin{array}{r} -9x^2 = -18 \\ -9 + 2 = -7 \end{array}$$

$$6x^2 - 9x + 2x - 3$$

(2)

$$6x^2 - 9x + 2x - 3$$

$$3x(2x-3) + 1(2x-3)$$

(3)

$$(3x+1)(2x-3)$$

c) Solve $8x^2 - 12x$

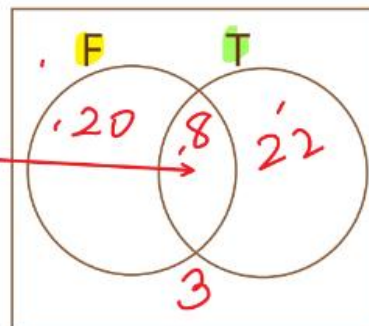
$$4x(2x-3) = x=0 \quad \frac{2x-3=0}{2x=3}$$

Question 4

Here is a Venn diagram.

There are 55 pupils enrolled for a sports club. 28 are enrolled for Football and 30 are enrolled for Tennis. 8 are enrolled for both of these sports.

(a) By using a Venn diagram, find the number of pupils who choose neither sport.



b) In a class of 50 students, 15 students enjoy reading, 30 enjoy sports and 10 enjoy neither.

(i) Represent this information in a Venn diagram.

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

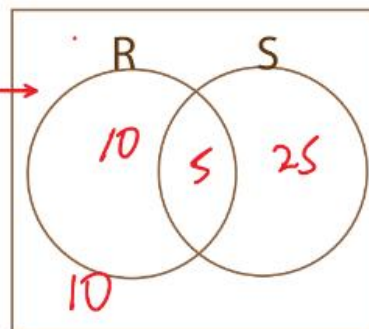
Using part b (i) find;

(ii) the number of students enjoying both subjects

$$40 = 45 - x$$

$$\therefore x = 5$$

5



Silver

Question 5

Here is a Venn diagram.

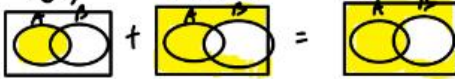
Write down the numbers that are in the set

a) $A \cap B$ $n(A \cap B) = 2, 9$

b) $A \cup B$ $1, 3, 5, 2, 9, 7, 4, 8$

c) B' $1, 3, 5, 6, 10$

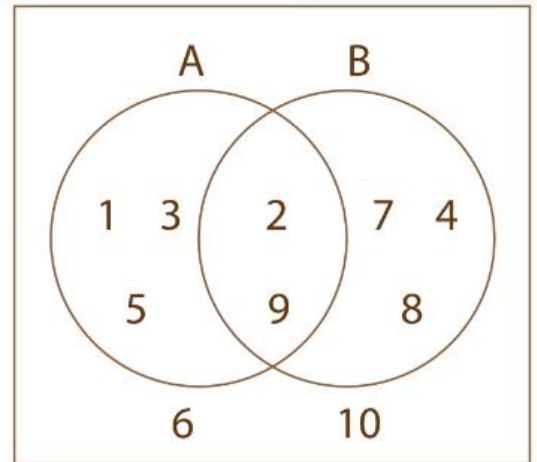
d) $A \cap B'$ $1, 3, 5$ $P(A) + P(B') = P(A \cup B')$

e) $A \cup B'$ 

A number is chosen at random.

f) Find $P(A' \cap B')$ $1 - P(A \cup B) = 1 - \frac{8}{10} = \frac{2}{10}$

g) Find $P(A' \cup B')$ $1 - P(A \cap B) = 1 - \frac{2}{10} = \frac{8}{10}$



Question 6

Here is a Venn diagram.

In a certain school, 36 students were asked whether they would choose Physics or Maths for advanced studies. The number of students who chose Physics and Maths was double the number of students that chose Physics only. Furthermore, the number of students who chose Maths was 4 more than triple the number of students that chose Physics. However, 2 students chose neither Physics or Maths.

a) Represent this information on a Venn diagram, letting x be the number of students that chose Physics only.

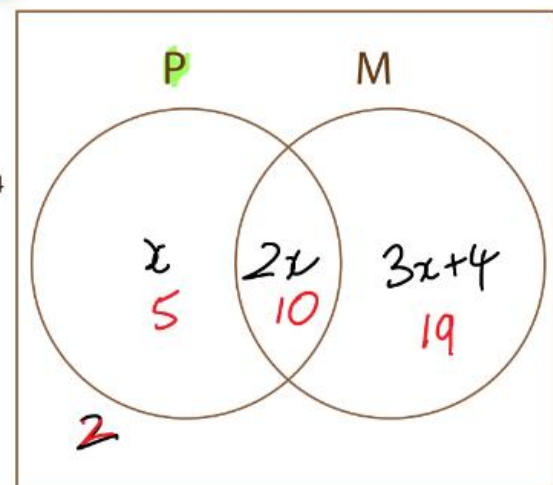
b) Use the results obtained in part (a) to determine a student selected at random likes;

(i) Maths only 19

(ii) Physics and Maths 10

(iii) Physics or Maths 34

$$\begin{aligned} x + 2x + 3x + 4 + 2 &= 36 \\ 6x + 6 &= 36 \\ 6x &= 30 \\ x &= 5 \end{aligned}$$



Gold



Question 7

The Venn diagram shows sets A and B. There are 95 elements in the entire set.

If $n(A \cup B) = 76$, calculate;

(i) The value of x

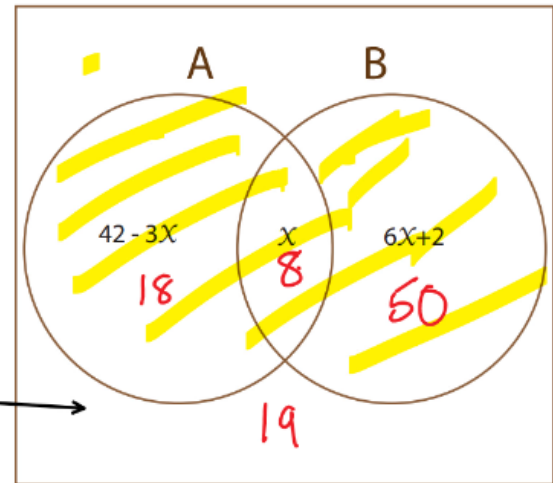
$$\begin{aligned} 42 - 3x + x + 6x + 2 &= 76 \\ 4x + 44 &= 76 \\ 4x &= 32 \therefore x = 8 \end{aligned}$$

(ii) Find $n(A' \cap B')$

$$1 - n(A \cup B) = 95 - 76 = 19$$

(iii) Find $n(A' \cup B')$

$$1 - n(A \cap B) = 95 - 8 = 87$$



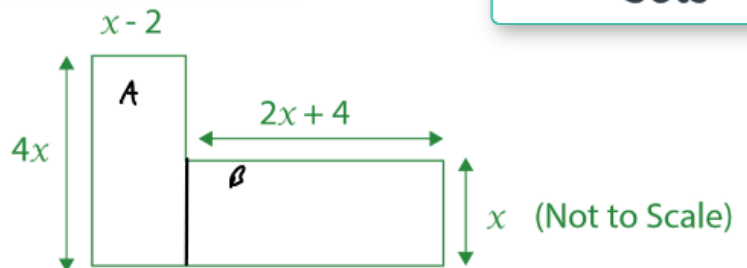
Gold

Question 8

The area of the shape is 40cm^2 .

a) Show that $3x^2 - 2x - 20 = 0$.

$$\begin{aligned} 4x(x-2) + x(2x+4) &= 40 \\ 4x^2 - 4x &= 40 \\ 4x^2 - 4x - 40 &= 0 \\ 2(3x^2 - 2x - 20) &= 0 \end{aligned}$$



b) Solve $3x^2 - 2x - 20 = 0$.

Give your solutions correct to 3 significant figures.

$$\frac{2 + \sqrt{244}}{6} = 2.94 \text{ or } -2.27$$

c) Hence, work out the shortest side.

$$0.94$$

Question 9

a) Factorise $5x^2 + 3xy - 2y^2$

$$5x^2 + 5xy - 2xy - 2y^2$$

$$5x(x+y) - 2y(x+y)$$

$$(5x-2)(x+y)$$

b) $9 - (2x-1)^2$

$$3^2 - (2x-1)^2$$

$$x^2 - y^2 = (x+y)(x-y)$$

$x = 3, y = (2x-1)$

$$(3 + (2x-1))(3 - (2x-1))$$

$$(2 + 2x)(4 - 2x)$$

$$= 8 - 4x - 8x - 4x^2$$

$$= -4x^2 - 12x + 8$$

Platinum

ANSWERS

Geometry

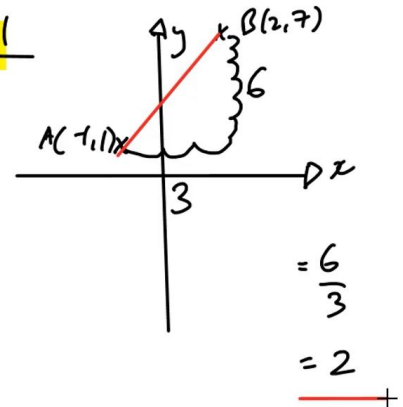
Question 1

A straight line L1 passes through the coordinates A(-1,1) and B(2,7).
Find the **gradient** of L1.

① **Algebra** $A = (x_1, y_1) = (-1, 1), B = (x_2, y_2) = (2, 7)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 1}{2 - (-1)} = \frac{6}{3} = \underline{2}$$

② **Graphical**



Question 2

Which ONE line below is parallel to $y = \frac{1}{2}x - 3$.

A: $y = -\frac{1}{2}x + \frac{1}{2}$ X

B: $2y = 1 - x$ X $y = \frac{1-x}{2} \Rightarrow y = \frac{1}{2} - \frac{1}{2}x \Rightarrow y = -\frac{1}{2}x + \frac{1}{2}$ X

C: $2x - 4y = 6$ ✓ $-4y = -2x + 6 \Rightarrow y = \frac{-2x+6}{-4} \Rightarrow y = \frac{1}{2}x - \frac{3}{2}$

D: $2y = 4x + 3$ X $y = \frac{4x+3}{2} \Rightarrow y = 2x + \frac{3}{2}$

Core 3 - Bronze Topic: Coordinate Geometry

Question 3

Find the equation of the line that passes through point (3,7) and the midpoint between (1,5) and (3,7).

gradient

$$(x_1, y_1) \quad (3, 7)$$

$$(x_2, y_2) \quad (2, 6)$$

$$M = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - 7}{2 - 3} = \frac{-1}{-1} = 1 \therefore m = 1$$

$y = mx + c$

$y = 1x + c$

$7 = (1 \times 3) + c$

$7 = 3 + c \therefore c = 4$

$y = 1x + 4$

SILVER

Core 4 - Silver

Topic: Coordinate Geometry

Question 4

Find the equation of the line that passes through points (-2,3) and which is parallel to the line $2x + 3y - 10 = 0$.

$$2x + 3y - 10 = 0$$

$$3y = -2x + 10$$

$$y = -\frac{2x}{3} + \frac{10}{3}$$

$$y = mx + c$$

(x, y)

$y = mx + c$

$y = -\frac{2}{3}x + c$

$3 = (-\frac{2}{3} \times -2) + c$

$3 = \frac{4}{3} + c$

$\frac{3}{1} - \frac{4}{3} = c \therefore \frac{9 - 4}{3} = \frac{5}{3}$

$y = -\frac{2}{3}x + \frac{5}{3}$

SILVER

Question 5

i) Find the intersection point of $y = 3x + 4$ and $y = 6 - x$

$$\begin{aligned} 3x + 4 &= 6 - x \\ 3x + x &= 6 - 4 \\ 4x &= 2 \quad \therefore x = \frac{2}{4} = \frac{1}{2} \end{aligned}$$

$$\left(\frac{1}{2}, \frac{11}{2} \right)$$

ii) Find the intersection point of $3x + 2y = 12$ and $2x + 4y = 8$

$$\begin{aligned} 3x + 2y &= 12 \\ 2y &= -3x + 12 \\ y &= -\frac{3x}{2} + \frac{12}{2} \\ y &= -\frac{3x}{2} + 6 \end{aligned}$$

$$2x + 4y = 8$$

$$4y = -2x + 8$$

$$y = -\frac{2x}{4} + \frac{8}{4}$$

$$y = -\frac{1}{2}x + 2$$

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

$$-x = 2 - 6$$

$$-x = -4$$

$$x = 4$$

$$= (4, 0)$$

SILVER

Question 6

i) Find the perpendicular gradient to:

a) $4/1$

b) $2/3$

c) $-5/2$

$$\begin{aligned} F: \frac{1}{4} &\Rightarrow M: -\frac{1}{4} \\ \frac{3}{2} &\Rightarrow -\frac{3}{2} \\ \frac{2}{-5} &\Rightarrow \frac{2}{5} \end{aligned}$$

ii) Find the equation of the line passing through the mid point of A(-3, 2) and B(1, -6) and perpendicular to AB.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6 - 2}{1 - -3} = \frac{-8}{4} = -2 \therefore \boxed{\frac{1}{2}}$$

$$y = \frac{1}{2}x + c$$

$$-2 = \left(\frac{1}{2} \times -1 \right) + c$$

$$-2 = -\frac{1}{2} + c$$

$$-2 + \frac{1}{2} = c \therefore c = -\frac{3}{2}$$

Gold

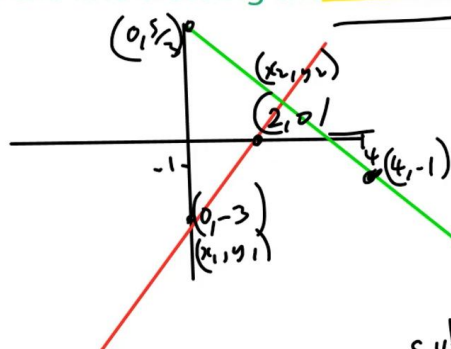
$$(x_1, y_1) \quad (x_2, y_2)$$

$$\left(\frac{-3 + 1}{2}, \frac{2 + (-6)}{2} \right) = (-1, -2)$$

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

Question 7

Find the equation of the line passing through point $(4, -1)$ and perpendicular to the line crossing the x-axis at 2 and the y-axis at -3.



$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - -3}{2 - 0} = \frac{3}{2}$$

$$\frac{3}{2} \Rightarrow \frac{3}{2} = \frac{3}{2} = \frac{3}{2}$$

sub $\rightarrow$

$$y = -\frac{2}{3}x + c$$

$$-1 = (-\frac{2}{3} \times 4) + c$$

$$-1 = -\frac{8}{3} + c$$

$$-\frac{1}{1} + \frac{8}{3} = c$$

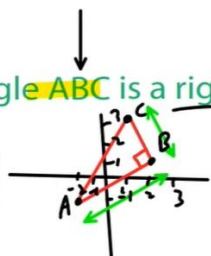
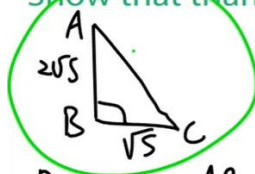
$$c = -\frac{3}{3} + \frac{8}{3} = \frac{5}{3}$$

$$y = -\frac{2}{3}x + \frac{5}{3}$$

Gold

Question 8

Show that triangle ABC is a right angle where $A = (-2, -1)$, $B = (2, 1)$ and $C = (1, 3)$.



Distance of AB

$$A = (-2, -1), B = (2, 1)$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$= \sqrt{(2 - -2)^2 + (1 - -1)^2}$$

$$= 4^2 + 2^2 = 16 + 4 = \sqrt{20}$$

$$= \sqrt{4 \times 5}$$

$$= 2\sqrt{5}$$

Distance BC

$$B = (2, 1), C = (1, 3)$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{(1 - 2)^2 + (3 - 1)^2}$$

$$= (-1)^2 + (2)^2$$

$$= 1 + 4 = \sqrt{5}$$

Distance AC

$$A = (-2, -1), C = (1, 3)$$

$$(3 - -1)^2 + (1 - -2)^2$$

$$= 4^2 + 3^2 = 16 + 9 = \sqrt{25} = 5$$

$$(2\sqrt{5})^2 + (\sqrt{5})^2 = AC^2$$

$$(4 \times 5) + 5 = AC^2$$

$$20 + 5 = AC^2$$

$$25 = AC^2$$

$$\sqrt{25} = AC$$

$$5 = AC$$

Platinum

ANSWERS

Vectors

Question 1

Find the distance between points A $(-3, 1)$ and B $(1, -2)$

$$\begin{aligned}
 d &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\
 &= \sqrt{(1 - (-3))^2 + (-2 - 1)^2} \\
 &= \sqrt{(4)^2 + (3)^2} \\
 d &= \sqrt{16 + 9} \\
 d &= \sqrt{25} \Rightarrow \underline{d = 5}
 \end{aligned}$$

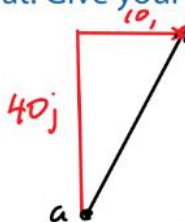
Bronze

Question 2

A ship sails at a velocity of 40km/h north. Water flows 10km/h due west.

Calculate the resultant velocity of the boat. Give your answer to 2 decimal places.

$$\begin{aligned}
 \vec{a} &= 10\vec{i} + 40\vec{j} \\
 &= \begin{pmatrix} 10 \\ 40 \end{pmatrix}
 \end{aligned}$$



$$\begin{aligned}
 |a| &= \sqrt{10^2 + 40^2} \\
 |a| &= \sqrt{100 + 1600} \\
 &= \sqrt{1700} \\
 &= \underline{41.23}
 \end{aligned}$$

Bronze

Core 3 - Silver

Topic: Vectors

Question 3

Given the vectors $\underline{a} = 3\mathbf{i} + 4\mathbf{j}$, $\underline{b} = 2\mathbf{i} + 5\mathbf{j}$ and $\underline{c} = 3\mathbf{i} + 3\mathbf{j}$, determine the magnitude of their resultant.

Sum

$$\underline{a} + \underline{b} + \underline{c} = 3\mathbf{i} + 2\mathbf{i} + 3\mathbf{i} + 4\mathbf{j} + 5\mathbf{j} + 3\mathbf{j}$$

$$= 8\mathbf{i} + 12\mathbf{j}$$

Magnitude

$$|\underline{a} + \underline{b} + \underline{c}| = \sqrt{8^2 + 12^2} = \sqrt{64 + 144} = \sqrt{208}$$

Handwritten calculation for $\sqrt{208}$:

$$\sqrt{208} = \sqrt{16 \times 13} = 4\sqrt{13}$$

Silver

Core 4 - Silver

Topic: Vectors

Question 4

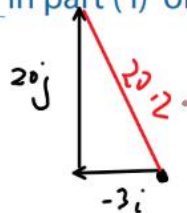
Given vectors $\underline{a} = 4\mathbf{i} + 10\mathbf{j}$, $\underline{b} = 15\mathbf{i} + 10\mathbf{j}$

(i) Find the vector and $\underline{c} = 3\underline{a} - \underline{b}$ and its magnitude correctly to 3 significant figures.

$$\underline{c} = 3(4\mathbf{i} + 10\mathbf{j}) - (15\mathbf{i} + 10\mathbf{j}) \rightarrow \underline{c} = 3\begin{pmatrix} 4 \\ 10 \end{pmatrix} - \begin{pmatrix} 15 \\ 10 \end{pmatrix}$$

$$= 12\mathbf{i} + 30\mathbf{j} - 15\mathbf{i} - 10\mathbf{j} = -3\mathbf{i} + 20\mathbf{j} \quad \underline{c} = \begin{pmatrix} -3 \\ 20 \end{pmatrix}$$

(ii) Represent vector $\underline{c}$ in part (i) on the x - y plane.



$$|\underline{c}| = \sqrt{(-3)^2 + (20)^2}$$

$$= 9 + 400 = \sqrt{409}$$

$$= 20$$

Silver

Core 5 - Silver

Topic: Vectors

Question 5

Given $\underline{a} = 2\mathbf{i} + 3\mathbf{j}$, $\underline{b} = -6\mathbf{i} - 2\mathbf{j}$ and $\underline{c} = 4\mathbf{i} + 6\mathbf{j}$, find:

i) the vector $\underline{d} = 2\underline{a} - \underline{b} + \frac{1}{2}\underline{c}$

$$\underline{d} = 2(2\mathbf{i} + 3\mathbf{j}) - (-6\mathbf{i} - 2\mathbf{j}) + \frac{1}{2}(4\mathbf{i} + 6\mathbf{j})$$

$$= 2\begin{pmatrix} 2 \\ 3 \end{pmatrix} - \begin{pmatrix} -6 \\ -2 \end{pmatrix} + \frac{1}{2}\begin{pmatrix} 4 \\ 6 \end{pmatrix}$$

$$= 4\mathbf{i} + 6\mathbf{j} + 6\mathbf{i} + 2\mathbf{j} + 2\mathbf{i} + 3\mathbf{j}$$

$$\underline{d} = 12\mathbf{i} + 11\mathbf{j} = \begin{pmatrix} 12 \\ 11 \end{pmatrix}$$

(ii) a unit vector in the direction of $\underline{d}$

$$\frac{\underline{d}}{|\underline{d}|} = \frac{12\mathbf{i} + 11\mathbf{j}}{\sqrt{12^2 + 11^2}} = \frac{12\mathbf{i} + 11\mathbf{j}}{\sqrt{144 + 121}} = \frac{12\mathbf{i} + 11\mathbf{j}}{\sqrt{265}}$$

Silver

Core 6 - Gold

Topic: Vectors

Question 6

If $\underline{a} = 3\mathbf{i} + 2\mathbf{j}$, $\underline{b} = 5\mathbf{i} - 11\mathbf{j}$ and $\underline{c} = 3\mathbf{i} - 5\mathbf{j}$, find the value of x and y such that $x\underline{a} + y\underline{c} = \underline{b}$.

$$= x\begin{pmatrix} 3 \\ 2 \end{pmatrix} + y\begin{pmatrix} 3 \\ -5 \end{pmatrix} = \begin{pmatrix} 15 \\ -11 \end{pmatrix}$$

$$\begin{aligned} \textcircled{1} 3x + 3y &= 15 \\ \textcircled{2} 2x - 5y &= -11 \end{aligned}$$

$$\begin{aligned} \text{NEW } \textcircled{1} 6x + 6y &= 30 \\ +3 \textcircled{2} 6x - 15y &= -33 \\ \hline 21y &= 63 \therefore y = \frac{63}{21} = 3 \end{aligned}$$

sol ①

$$\begin{aligned} 3x + (3 \times 3) &= 15 \\ 3x + 9 &= 15 \\ 3x &= 6 \\ x &= 2 \end{aligned}$$

Gold

ANSWERS

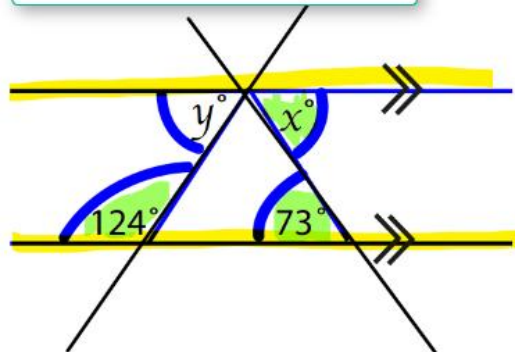
Geometry

Question 1

Work out

Core 1 - Bronze

Topic: Geometry



a) $x = 73$

Reason: Alternate

$$180 - 124 = 56$$

b) $y = 56$

Reason: Supplementary

Question 2

Core 2 - Bronze

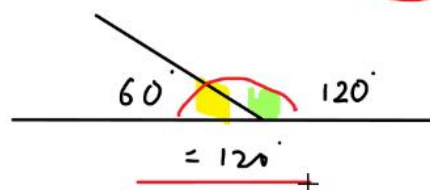
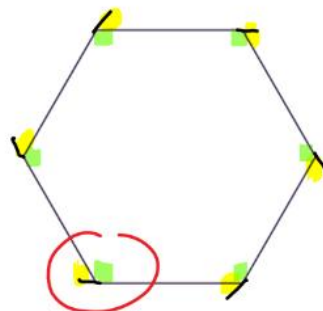
Topic: Geometry

a) What is the exterior angle?

Sum of exterior = 360°

One exterior = $\frac{360}{6} = 60^\circ$

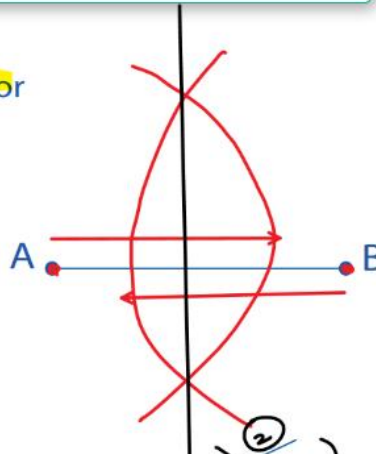
b) What is the interior angle?



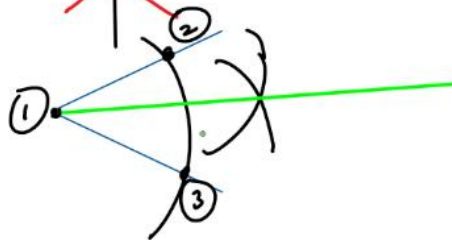
Int + Ext = 180°

Question 3

a) Draw the **perpendicular bisector** between points A and B.



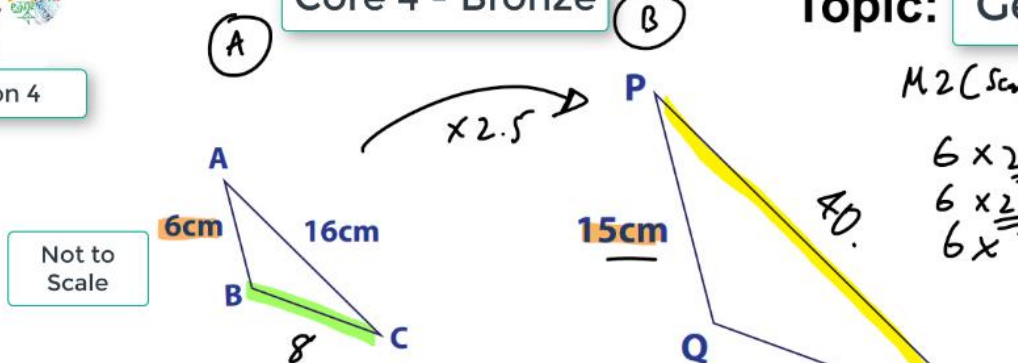
b) Draw the **angle bisector**.



Core 4 - Bronze

Topic: Geometry

Question 4



M2 (Scale factor)

$$\begin{aligned} 6 \times 2 &= 12 \\ 6 \times 2.5 &= 15 \\ 6 \times 3 &= 18 \end{aligned}$$

ABC and PQR are similar triangles.

a) Work out the length PR.

Step 1: Identify 2 separate shapes ✓
Step 2: Calculate scale factor = $\frac{B}{A} = \frac{15}{6} = 2\frac{3}{6} = 2\frac{1}{2} = 2.5$

b) Work out the length BC.

$$\frac{26(x10)}{2.5(x10)} = \frac{200}{25} = 8$$

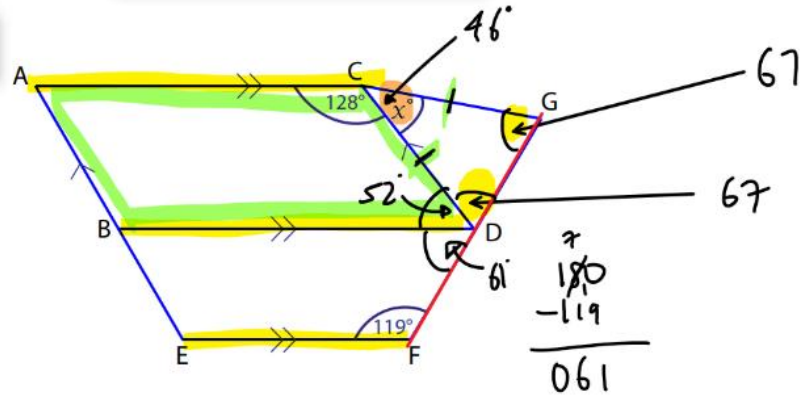
20cm

R

Core 5 - Silver

Topic: Geometry

Question 5



AC, BD and EF are parallel lines.
ABCD is a parallelogram
Angle EFD = 119° . Angle ACD = 128°
Work out the size of angle x.
Show all working.

46°

$$\begin{array}{r} 180 \\ - 119 \\ \hline 61 \end{array}$$

$$61 + 52 = 113$$

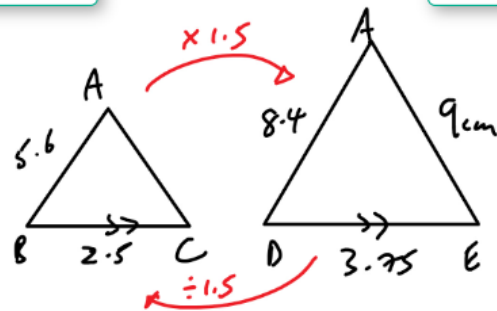
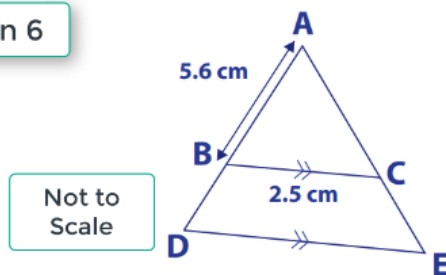
$$\begin{array}{r} 180 \\ - 113 \\ \hline 67 \end{array}$$

$$\begin{array}{r} 180 \\ - 134 \\ \hline 46 \end{array}$$

Core 6 - Silver

Topic: Geometry

Question 6



Triangles ABC and ADE are similar triangles. BC and DE are parallel lines.

$AD = 8.4$, $AB = 5.6$ cm, $BC = 2.5$ cm.

a) Work out the length DE.

$$2.5 \times 1.5$$

$$\text{Scale factor} = \frac{\text{Largest}}{\text{Smallest}} = \frac{8.4}{5.6} = \frac{84}{56} = \frac{28}{16} = \frac{7}{4} = 1\frac{1}{4} = 1.5$$

$$\begin{array}{r} 2.5 \text{ (1dp)} \\ \times 1.5 \text{ (1dp)} \\ \hline 12.5 \\ + 25.0 \\ \hline 37.5 \text{ (2dp)} \end{array} = 3.75 \text{ cm (DE)}$$

b) $AE = 9$ cm. Work out length CE.

$$\begin{array}{r} 9 \text{ (1dp)} \\ \div 1.5 \text{ (1dp)} \\ \hline 6 \end{array} = \frac{90}{15} = 6$$

$$CE = 3 \text{ cm}$$

Question 7



Core 7 - Gold

Topic: Geometry

STEP 1
Identify TWO 3-D
shapes
(Small and Large)

STEP 2
Draw
LAV
table

STEP 3
Complete
'Known'
values
and find 'r'
first.

	A		B
L	3	$\times r$ $\times 2$	6
A	50	$\times r^2$ $\times (2)^2$	200
V	50	$\times r^3$ $\times (2)^3$	400

These two triangular prisms are **mathematically similar**.
The surface area of A is 50 cm^2 .

a) Find the surface area of B.

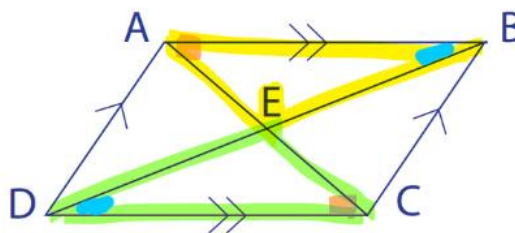
200 cm^2

b) The volume of B is 400 cm^3 . Find the volume of A.

50 cm^3

Question 8

ABCD is a **parallelogram**.



Core 8 - Gold

Topic: Geometry

Step 1: **Identify shapes**

[Choose Type] Step 2: S: $AB = DC$ [Parallel lines - Parallelogram]
[SSS, SAS, KAS, RHS] $\rightarrow$ $\angle A = \angle C$ [Alternate angles]
 $\angle A = \angle C$ [Alternate angles]
 $\angle ABE = \angle CDE$ [Alternate angles]

Step 3: Justify []
 $\therefore$ **AAS**

E is the point where the diagonals AC and BD meet.
Prove that triangle AEB is **congruent** to triangle DEC.



Tanzania

Question 9

A regular hexagon is inscribed in a circle. If the perimeter of the hexagon is 30 cm, find:

a) The radius of the circle.

b) The area of the circle.

c) The area of the regular hexagon.

Perimeter of regular polygon

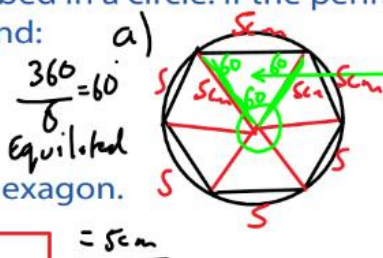
$$P = 2nr \sin\left(\frac{180}{n}\right)$$

$$30 = 2 \times 6 \times r \sin\left(\frac{180}{6}\right)$$

$$30 = 12r \sin(30)$$

$$30 = 12r \times \frac{1}{2} \Rightarrow \frac{30}{1} \times \frac{2}{6} = 60 = 12r$$

$$r = 5 \text{ cm}$$



= 5 cm

$$b) \pi r^2$$

$$\pi \times 5^2$$

$$= 25\pi \text{ cm}^2$$



$$A = \frac{1}{2} nr^2 \sin\left(\frac{360}{n}\right)$$

$$= \frac{1}{2} \times 6 \times 5^2 \times \sin(60)$$

$$= 75 \times \frac{\sqrt{3}}{2}$$

$$= 75 \frac{\sqrt{3}}{2} \text{ cm}^2$$

$$= \frac{1}{2} \times \sin A \times b \times c$$

$$= \frac{1}{2} \times \sin 60 \times 25 = \frac{1}{2} \times \frac{\sqrt{3}}{2} \times 25$$

$$= \frac{\sqrt{3} \times 25}{4} = \frac{25\sqrt{3}}{4}$$

$$\textcircled{\times 6}$$

$$\frac{150\sqrt{3}}{4} = \frac{75\sqrt{3}}{2} \text{ cm}^2$$

Gold



Tanzania

Question 10

Solid A and Solid B are mathematically similar.

The ratio of the surface area of solid A to the surface area to solid B is 4:25.

The volume of B is 1250 cm³.

Show that the volume of A is 80 cm³.

	A		B
L		$\left(\frac{5}{4}\right)$ $\times \frac{1}{2}$	
A	4	$\left(\frac{25}{16}\right)$ $\times \frac{1}{2}$	25
V		$\left(\frac{125}{64}\right)$ $\times \frac{1}{2}$	1250

$$\frac{1250}{1} \div \frac{125}{8}$$

$$\frac{1250}{1} \times \frac{8}{125} = \frac{10}{1} \times \frac{8}{1} = 80 \text{ cm}^3$$



Tanzania
MathsMemory

ANSWERS

Units/ Rates & Variations



Question 1

Maureen wants to buy a bag of bananas.

Core 1 - Bronze

Topic: Units/ Rates and Variations

Pack A

8 bananas
£1.10

Pack B

14 bananas
£1.70

Which pack is the best value for money?

$$\frac{\text{Price A}}{\text{Unit A}} = \frac{1.10}{8} = 0.1375 = \underline{14p}$$

$$\frac{\text{Price B}}{\text{Unit B}} = \frac{1.7}{14} = 0.1214 = \underline{12p}$$



Question 2

Core 2 - Bronze

Topic: Units/ Rates and Variations

a) Here is a list of ingredients for making 12 chocolate cupcakes.

120 g butter
160 g flour
2 eggs
40 g chocolate chips

$$\frac{30}{12} = 2\frac{6}{12} = 2\frac{1}{2}$$

Scale factor = **2.5**

James wants to make 30 chocolate cupcakes.

Work out how much of each ingredient he will need?

$$\begin{aligned} 120 \times 2.5 &= 300g \text{ butter} \\ 160 \times 2.5 &= 400g \text{ flour} \\ 2 \times 2.5 &= 5 \text{ eggs} \\ 40 \times 2.5 &= 100g \text{ CC.} \end{aligned}$$



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Core 3 - Bronze

Topic:

Units/ Rates
and Variations

a) Massimo is on holiday in Thailand.

The exchange rate is £1 = 38.25 Thai Bahts.

He set a budget of £3000 for the entire holiday.

He spent 32,000 Thai Bahts on flights.

He spent 45,000 Thai Bahts on accommodation.

How much spending money, in Thai Bahts, will Massimo have left to spend?
(assuming full budget)

$$\begin{array}{r} £3000 \times 38.25 = 114,750 \text{ TB} \\ - 32,000 \\ \underline{45,000} \\ 37,750 \end{array}$$



Core 4 - Bronze

Topic:

Units/ Rates
and Variations

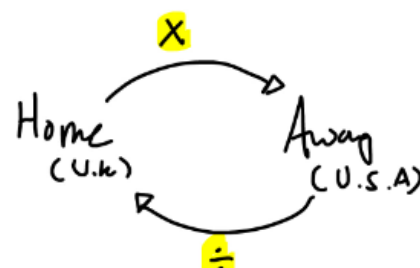
Nicole is travelling to the USA.

She has £250 in the UK.

The exchange rate is £1 = \$1.41

a) How many dollars can she exchange in London?

$$\begin{array}{r} 250 \times 1.41 = \$352.50 \\ £1 \Rightarrow £250 \end{array}$$



b) On her return she has \$48 left. How many pounds could she get from this amount?

(Assume same exchange rate as above)

$$\begin{array}{r} \$48 \\ \$1.41 \end{array} = \underline{\underline{\$34.04}}$$

c) If the Dollar strengthened on Nicole's return, what effect would this have on the amount t
Nicole could exchange back in to pounds?

£ would ↓

Core 5 - Silver

Topic: Units/ Rates and Variations

- a) It takes 4 men 12 days to complete a garden landscaping project.
How many days would it take 6 men to complete the project?

$$\text{Time} = \frac{k}{\text{Labour}}$$

$$12 = \frac{k}{4} \quad \therefore k = 48$$

$$\text{Time} = \frac{48}{6} = 8 \text{ days}$$

- b) State one assumption you made in working out your answer to part (a)

- Same weather conditions
- Same health conditions

Core 6 - Silver

Topic: Units/ Rates and Variations

y is directly proportional to the square of x. When y = 10, x = 2.

- a) Express y in terms of x

1. Proportion type

$$y \propto x^2$$

$$y = kx^2$$

2. Substitute values

$$10 = k(2)^2$$

$$10 = 4k$$

3. Find k. Write formula

$$\frac{10}{4} = k \quad \therefore k = 2.5$$

$$y = 2.5x^2$$

- b) Find the value of y when x = 4

$$y = 2.5 \times (4)^2$$

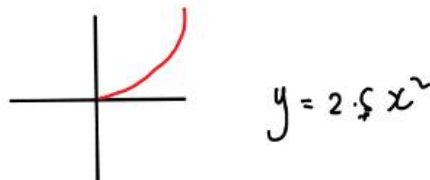
$$y = 40$$

- c) Find the value of x when y = 160

$$160 = 2.5x^2$$

$$64 = x^2 \quad \therefore x^2 = 64, x = 8$$

- d) Sketch the graph



Question 7

c is inversely proportional to m . When $c = 40$, $m = 5$.

a) Express c in terms of m

1. Proportion Type

$$c \propto \frac{1}{m} \therefore c = \frac{k}{m}$$

2. Substitute values

$$\frac{40}{1} = \frac{k}{5} \quad 40 \times 5 = 1 \times k$$

3. Find k formula

$$k = 200$$

$$c = \frac{200}{m}$$

b) Find the value of c when $m = 10$

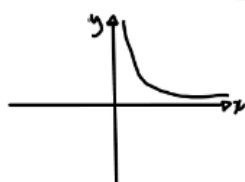
$$c = \frac{200}{10} \therefore c = 20$$

c) Find the value of m when $c = 25$

$$\frac{25}{1} = \frac{200}{m} \therefore 25m = 1 \times 200$$

$$m = 8$$

d) Sketch the graph.



$$y = \frac{200}{x} \quad \text{or} \quad c = \frac{200}{m}$$

Question 8

The table shows a set of values for x and y . y is directly proportional to x .

x	1	2	3	4
y	4	8	12	16

$$y = kx \quad 4 = k \times 1 \therefore k = 4$$

$$y = 4x$$

a) Find an equation for y in terms of x .



b) Find the value of x when $y = 24$.

$$24 = 4x \therefore x = \frac{24}{4} \therefore x = 6$$

The table shows a set of values for x and y . y is inversely proportional to the square of x .

x	1	2	3	4
y	6	$\frac{3}{2}$	$\frac{2}{3}$	$\frac{3}{8}$

$$y = \frac{k}{x^2} \quad \frac{6}{1} = \frac{k}{(1)^2} \therefore k = 6 \times 1^2 \Rightarrow k = 6$$

$$y = \frac{6}{x^2}$$

c) Find an equation for y in terms of x

d) Find the positive value of x when $y = 54$.

$$\frac{54}{1} = \frac{6}{x^2} \quad 54x^2 = 6 \therefore x^2 = \frac{6}{54}$$

$$x = 1/3$$

Question 9

y is directly proportional to d^2 . d is inversely proportional to x .
Given that $y = 12$, $x = 1$ and $d = 2$, find a formula for y in terms of x .

Multiple

$$① y = kd^2$$

$$12 = k(2)^2$$

$$12 = 4k$$

$$\frac{12}{4} = k \therefore k = 3$$

$$y = 3d^2$$

$$② d = \frac{k}{x}$$

$$\frac{2}{1} = \frac{k}{1} \therefore 2 \times 1 = k$$

$$k = 2$$

$$d = \frac{2}{x}$$

$$y = 3\left(\frac{2}{x}\right)^2$$

$$y = \frac{3}{1}\left(\frac{2}{x}\right)^2$$

$$y = \frac{12}{x^2}$$

Question 10

y is inversely proportional to the square of x .

$y = 20$ and $x = 2a$

Show that $y = 5$, when $x = 4a$.

Step 1: Proportion type

$$y \propto \frac{1}{x^2}$$

$$y = \frac{k}{x^2}$$

Step 2: Substitute values

$$y = 20, x = 2a$$

$$20 = \frac{k}{(2a)^2} \therefore \frac{20}{1} = \frac{k}{4a^2}$$

Step 3: Find k . Write formula

$$k = 20 \times 4a^2$$

$$k = 80a^2 \text{ so } \therefore$$

$$y = \frac{80a^2}{x^2}$$

$$\text{If } x = 4a, \text{ then } \Rightarrow y = \frac{80a^2}{(4a)^2}$$

$$y = \frac{80a^2}{16a^2} = 5 \therefore \underline{y = 5}$$



Question 11

This sketch shows part of a graph with equation $y = pq^x$

- a) The points with coordinates (2,3) and (5,24) lie on the line. Find the value of p and q .

Step 1: Create Two separate equations Step 2: Substitute

$$\textcircled{1} 3 = pq^2$$

$$\textcircled{2} 24 = pq^5$$

$$\textcircled{2} \div \textcircled{1} \quad 8 = q^3$$

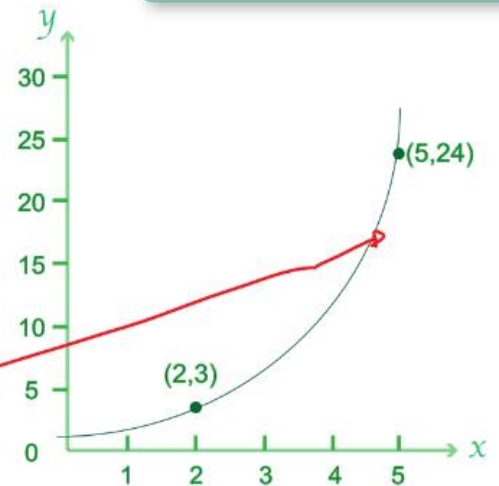
$$\text{Divide} \quad 2 = q$$

$$y = \left(\frac{3}{4}\right)(2)^x$$

$$\textcircled{1} 3 = p(2)^2$$

$$3 = 4p$$

$$\frac{3}{4} = p$$



- b) Another coordinate which lies on the line is (k, 12). Find the value of k .

$$\begin{aligned} (x, y) \\ x = k \\ y = 12 \end{aligned}$$

$$12 = \frac{3}{4}(2)^x \quad \left| \frac{12}{\frac{3}{4}} = 2^x \right| \quad \left| \frac{48}{3} = 2^x \right| \quad \left| 16 = 2^x \right| \quad x = 4$$

ANSWERS

Ratio & PL



Core 1

Topic: **Ratio & PL**

Question 1

a) Find 15% of £520.

$$\begin{array}{r} \boxed{10\% = £52} \\ + 5\% = £26 \\ \hline £78 \end{array}$$

Grade

4 (2 Marks)

b) Massimo achieves 78% in a test. Sarah scores 27 out of 36 in a test. What is the difference between Massimo and Sarah's result?

$$\frac{27}{36} = \frac{3}{4} = 75\%$$

Difference = 3%



Core 2

Topic: **Ratio & PL**

Question 2

a) Amiee's travel commute cost £1200 in 2020. In 2021, her commute cost had increased to £1260. What was the percentage increase in her travel cost from 2020 to 2021?

$$\% \text{ change} = \frac{\text{Difference}}{\text{Initial value}} \times 100$$

$$\frac{60}{1200} \times 100$$

$$= \frac{66}{6120} = \frac{1}{20} \times 100 = 5\%$$

Grade

4 (2 Marks)

b) Sean bought a car for £12,500. The following year it had decreased to £10,000. What was the percentage decrease in the value of the car over the year?

$$\frac{2,500}{12,500} \times 100 = \frac{25}{125} = \frac{1}{5} \times 100 = 20\%$$



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Question 3

- a) Leon has £4000 in his savings account. The interest rate is 2.8% per year.
How much does Leon have after one year in his savings account?

$$4000 \times (1.028) = \underline{\pounds 4,112}$$

M.F. $1 + \frac{x}{100} = 1.028$ Grade 4 (2 Marks)

Calculator

- b) Alice buys a flat for £150,000. It has decreased in value by 4% over the year.
How much is the flat worth now?

$$150,000 \times (0.96) = \underline{\pounds 144,000}$$

M.F. $1 - \frac{x}{100} = 0.96$ Grade 4 (2 Marks)

Calculator

- c) Coby has run 12 km in a marathon. This is only 40% of the whole race.
What is the total distance of the marathon?

$$x \times 0.4 = 12 \text{ km}$$

$$x = \frac{12}{0.4} = \underline{30 \text{ km}}$$

0 km 12 km
← 40% → ← 60% →

Question 4

- Amy, Beth and Carl share £240 in the ratio 3:4:5.

How much do they each receive?

Identify: Total Ratio

Amy: 60 [20 x 3]

Beth: 80 [20 x 4]

Carl: 100 [20 x 5]

Step 1 [Add units]

$$3 + 4 + 5 = 12 \text{ units}$$

Step 2 [Divide]

$$\frac{240}{12} = \pounds 20$$

$$1 \text{ unit} = \pounds 20$$

Step 3

Multiply each one

Question 5

ABC is a straight line.

The ratio of length AB:BC = 2:5.
BC = 60 m



Step 1: Divide
 $\frac{60}{5} = 12$

Step 2
1 unit = 12 m

Step 3
Multiply

a) Work out the length AB.

$$12 \times 2 = \underline{24 \text{ m}}$$

b) Work out the length AC.

$$12 \times 7 = \underline{84 \text{ m}}$$

Question 6

Ben is 5 years younger than Amy. Carl is double Ben's age. The sum of their ages is 33 years

Step 1: Identify context

A: x
B: $(x-5)$
C: $2(x-5)$

Work out all their ages

Step 2: Create expressions

$$= \underbrace{x}_A + \underbrace{x-5}_B + \underbrace{2x-10}_C$$

$$= 4x - 15$$

Step 3: Create equation

$$4x - 15 = 33$$

$$4x = 33 + 15$$

$$4x = 48$$

$$\underline{x = 12}$$

Amy: 12

Ben: 7

Carl: 14

Check: $12 + 7 + 14 = 33$ ✓

Question 7

Sogol invested an amount of money at 4% per annum, compound interest.
At the end of 2 years, the value of the investment was £3652.25.

Calculate the initial amount of money that Sogol invested.

$$\begin{aligned} x \times (1.04)^2 &= 3652.25 \\ x &= \frac{3652.25}{(1.04)^2} \\ x &= \underline{\underline{£3376.71}} \end{aligned}$$



Question 8

Henry invests £4,500 at a compound interest rate of 5% per annum.
At the end of n complete years, the investment has grown to £5743.27. Find the value of n .

$$\begin{aligned} \text{Try } n=4 & \quad 4,500 \times (1.05)^4 = \underline{\underline{£5,469.78}} \quad (\text{Low}) \\ \text{Try } n=6 & \quad 4,500 \times (1.05)^6 = \underline{\underline{£6,030.43}} \quad (\text{High}) \\ \text{Try } n=5 & \quad 4,500 \times (1.05)^5 = \underline{\underline{£5,743.27}} \end{aligned}$$

Core 9 - Gold

Topic: Ratio & PL

Question 9

Lily started a business on 1st September, 2021 with a capital of Tshs 20,000/= cash.

Date	Detail	Day	Tshs	Date	Detail	Day	Tshs
1/9	Capital	01	20,000	2/9	Cash	02	10,000
4/9	Sale	04	4,000	8/9	Wages	08	6,000
9/9	Debtors	09	2,500	10/9	Purchases	10	3,000
21/9	Sale	21	3,000	11/9	Debtors	11	5,000
22/9	Interest	22	300	24/9	Interest	24	500
30/9	Balance b/d		200	29/9	Travel	29	1,000
			29,500				29,500
1/10/21	Balance b/d		29,500				29,500

By using these transactions, prepare the cash account.

Core 10- Gold

Topic: Ratio & PL

Question 10

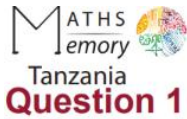
Use the following trial balance to prepare trading, profit and loss account for Mr Smith as at 31st December 2016.

Account name	Dr (-)	Cr (+)
Cash	1,500,000	
Capital		2,800,000
Purchases	1,800,000	
Rent	300,000	
Computer	500,000	
Furniture	1,300,000	
Sales		3,000,000
Wages	400,000	
	5,800,000	5,800,000

Dr	Cr
Purchases 1,800,000	Sales 3,000,000
COGS 4,000,000	
Gross Profit c/d 1,200	
3,000	3,000
Rent 300	
Wages 400	
Net Profit 500	
1,200	1200
	1200

ANSWERS

Sequences and Series



Core 1- Bronze Topic: Sequences and Series

a) Determine which series are arithmetic and geometric?

- 1) 5, 10, 15, 20 (A)
- 2) 3, 6, 12, 24 (G)
- 3) 12, 6, 3, 1.5 (G)
- 4) -2, 3, 8, 13 (A)

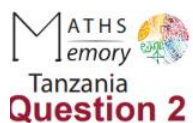
o o

5) What is the fundamental difference between an arithmetic series and a geometric series?

+, -

x

Bronze



Core 2- Bronze Topic: Sequences and Series

a) The first number of an arithmetic sequence is 4. The difference is 6. State the 50th number in the sequence (using the formula).

$$A_n = A_1 + (n-1)d \quad \Rightarrow \quad A_{50} = 4 + (50-1)6$$

$$= 4 + 6(49)$$

$$= 4 + 294$$

$$= 298$$

b) Find the sum of the first 15 numbers (using the formula).

$$S_n = \frac{n}{2} [2A_1 + (n-1)d]$$

$$= \frac{15}{2} [2 \times 4 + (15-1)6]$$

$$= 7.5 [8 + 84] = 7.5 \times 92$$

$$\begin{array}{r} 92 \\ \times 75 (14) \\ \hline 460 \\ 6440 \\ \hline 6900 \end{array} = 6900$$

Bronze



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a) The first number of an geometric sequence is 3. The ratio is 2.
State the 6th number in the sequence (using the formula).

$$G_N = G_1 (r)^{N-1}$$

$$= 3 \times (2)^{6-1}$$

$$= 3(2)^5$$

$$= 3 \times 32$$

$$= 96$$

b) Find the sum of the first 6 numbers (using the formula).

$$r > 1$$

$$G_N = G_1 \left[\frac{r^n - 1}{r - 1} \right]$$

$$= 3 \left[\frac{2^6 - 1}{2 - 1} \right]$$

$$3 \times \left[\frac{64 - 1}{2 - 1} \right]$$

$$= 3 \times 63$$

Bronze

Question 4

Coby is looking at investing £3,000 in either of these two bank accounts.

Cash account

Compound Interest
3.5% per annum
for 4 years

Shares account

Compound Interest
4% for year 1
5% for year 2
5% for year 3

Which bank will give Coby the most interest at the end of their terms?

$$3,000 \times (1.035)^4 = \underline{\underline{£3,442.51}}$$

Cash ✓

$$3000 \times (1.04) \times (1.05)^2 = \underline{\underline{£3,439.80}}$$

Calculator

Question 5

Henry invests £4,500 at a compound interest rate of 5% per annum.

At the end of n complete years, the investment has grown to £5743.27. Find the value of n .

Try $n=4$ $4,500 \times (1.05)^4 = \pounds 5,469.78$ (Low)

Try $n=6$ $4,500 \times (1.05)^6 = \pounds 6,030.43$ (High)

Try $n=5$ $4,500 \times (1.05)^5 = \pounds 5,743.27$

Calculator

Question 6

Natalie invests £5,500 for 5 years. The investment gets compound interest of $x\%$ per annum. At the end of 5 years the investment is worth £7029.35

Calculate the value of x (Give your answer to 2 decimal places).

$$5,500 \times x^5 = 7,029.35$$

$$x^5 = 1.2781 \text{ (4dp)}$$

$$x = (1.2781)^{\frac{1}{5}}$$

$$x = 1.05029306$$

$$x = 5.03$$

Calculator

a) Find the first term and the common difference of an arithmetic progression whose 4th term is 25 and the 7th term is 43.

$$A_n = A_1 + (n-1)d$$

$$A_4 = A_1 + (4-1)d$$

$$\textcircled{1} 25 = A_1 + 3d$$

$$A_7 = A_1 + (7-1)d$$

$$\textcircled{2} 43 = A_1 + 6d$$

7, 13, 19, 25, ...

$$\begin{array}{rcl} \textcircled{1} & A_1 + 3d & = 25 \\ \textcircled{2} & A_1 + 6d & = 43 \\ \hline & 3d & = 18 \\ & d & = 6 \end{array}$$

sub $\textcircled{1}$

$$A_1 + (3 \times 6) = 25$$

$$A_1 + 18 = 25$$

$$A_1 = 7$$

Silver

a) The third and fifth terms of Geometric Progression (G.P.) are 32 and 128 respectively. Find the common ratio and the first term of the G.P.

$$G_n = G_1(r)^{n-1}$$

$$\textcircled{1} 32 = G_1(r)^{3-1}$$

$$32 = G_1(r)^2$$

$$\textcircled{2} 128 = G_1(r)^{5-1}$$

$$128 = G_1(r)^4$$

$$\begin{array}{rcl} \textcircled{1} & 128 & = G_1 r^4 \\ \textcircled{2} & 32 & = G_1 r^2 \\ \hline & 4 & = r^2 \end{array}$$

sub $\textcircled{2}$

$$32 = G_1(2)^2$$

$$32 = 4G_1 \therefore G_1 = 8$$

Silver

Core 9 - Silver Topic: Sequences and Series

a) How many terms of the series 7, 11, 15 are needed to make a sum of 168.

$$S_n = \frac{n}{2} [2A_1 + (n-1)d]$$

$$168 = \frac{n}{2} [14 + 4(n-1)]$$

$$168 = \frac{n}{2} [14 + 4n - 4]$$

$$336 = n[10 + 4n]$$

$$336 = 4n^2 + 10n$$

$$4n^2 + 10n - 336 = 0$$

$$2n^2 + 5n - 168 = 0$$

$$(2n+21)(n-8) = 0$$

$$n = -\frac{21}{2}, n = 8$$

$$\frac{21}{2} \times \frac{-16}{-21} = -336$$

$$\frac{21}{2} + \frac{-16}{-21} = 5$$

Silver

Core 10 - Gold Topic: Sequences and Series

① ② ③
4, 1, 1/4

a) If the sum of n terms of a geometric progression with first term 4 and common ratio $1/4$ is $21/4$, find the number of terms in the sequence.

$$S_n = G_1 \left[\frac{1-r^n}{1-r} \right]$$

$$\frac{21}{4} = 4 \left[\frac{1 - (1/4)^n}{1 - 1/4} \right]$$

$$\frac{21}{4} = \frac{4(1 - (1/4)^n)}{3/4}$$

$$\frac{63}{4} = 16(1 - (1/4)^n)$$

$$\frac{63}{64} = 1 - (1/4)^n$$

$$(1/4)^n = 1 - \frac{63}{64}$$

$$(1/4)^n = \frac{64}{64} - \frac{63}{64}$$

$$(1/4)^n = \frac{1}{64}$$

$$n = 3$$

Gold

Question 11

a, b, c
 $xr \rightarrow x^5$

a) Given that 16, x , 169 are consecutive terms of a geometric progression. Find

i) the value of x

(ii) the geometric mean

$$\pm \sqrt{ac}$$

$$\pm \sqrt{16 \times 169}$$

$$\pm \sqrt{16} \times \sqrt{169}$$

$$\pm 4 \times 13$$

$$= \pm 52$$

$$\frac{169}{x} = r$$

$$\frac{x}{16} = r$$

$$\frac{x}{16} = \frac{169}{x}$$

$$\Rightarrow x^2 = 169 \times 16$$

$$x = \sqrt{169 \times 16}$$

$$x = \sqrt{169} \times \sqrt{16}$$

$$= 13 \times 4$$

$$= 52$$

Gold

Question 12

$-3, 4, 11, 18, 25, 32, 39, 46, 53, 60$

a) The 5th term of an arithmetic progression is 21 greater than the 2nd term. The 10th term is 15 times the 2nd term. Find the common difference and the first term of the arithmetic progression.

$$a_5 = a + 4d$$

$$a_2 = a + d$$

$$a + 4d = a + d + 21$$

$$4d - d = 21$$

$$3d = 21$$

$$\underline{\underline{d = 7}}$$

$$a_{10} = a + 9d$$

$$15(a + d) = a + 9d$$

$$15a + 15d = a + 9d$$

$$14a = -6d$$

$$14a = -42$$

$$a = \frac{-42}{14} \Rightarrow \underline{\underline{a = -3}}$$

Platinum

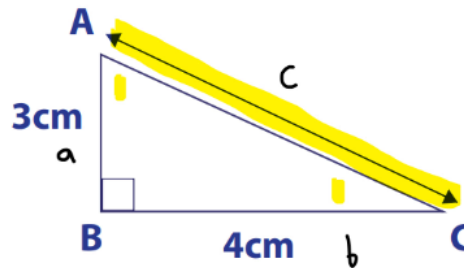
ANSWERS

Trigonometry & Pythagoras



Question 1

ABC is a right angle triangle
Find the unknown length AC



$$\begin{aligned} 3^2 + 4^2 &= c^2 \\ 9 + 16 &= c^2 \\ 25 &= c^2 \Rightarrow \sqrt{25} = c \\ &\underline{5 = c} \end{aligned}$$

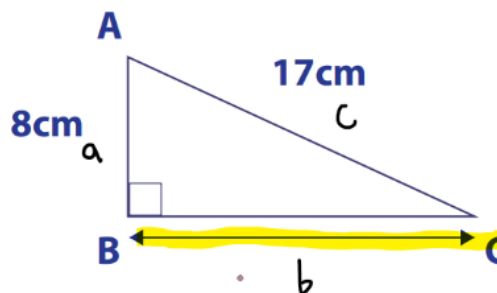
Topic: Trigonometry and Pythagoras' Theorem

3. Apply
2. $a^2 + b^2 = c^2$ ✓
1. Label (a, b, c) ✓



Question 2

ABC is a right angle triangle
Find the unknown length BC



$$\begin{aligned} 8^2 + b^2 &= 17^2 \\ 64 + b^2 &= 289 \\ b^2 &= 289 - 64 \\ b^2 &= 225 \Rightarrow b = \sqrt{225} \Rightarrow \underline{b = 15} \end{aligned}$$

Topic: Trigonometry and Pythagoras' Theorem

3. Apply
2. $a^2 + b^2 = c^2$
1. Label (a, b, c)



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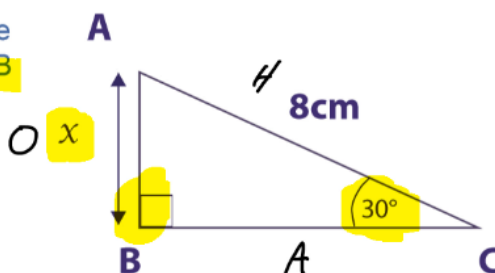
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Core 3 - Bronze

Topic: Trigonometry and Pythagoras' Theorem

Question 3

ABC is a right angle triangle
Find the unknown length AB



SOH, CAH, TOA



$$= \sin(30^\circ) \times 8$$

$$= 4 \text{ cm}$$

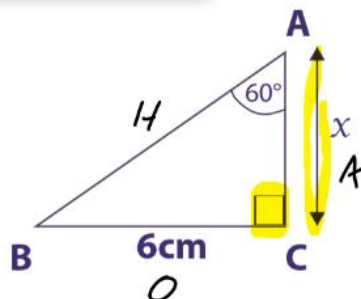
- ✓ 3. Apply ONE
- ✓ 2. 
- ✓ 1. Label sides (H, O, A)

Core 4 - Bronze

Topic: Trigonometry and Pythagoras' Theorem

Question 4

ABC is a right angle triangle
Find the unknown length AC
Give your answer to 3 significant figures.



SOH, CAH, TOA



$$= \frac{O}{\tan} = \frac{6}{\tan(60^\circ)} = 3.46 \text{ cm}$$

3. Apply ONE

- ✓ 2. 
- ✓ 1. Label sides (H, O, A)

Core 5 - Bronze

Topic:

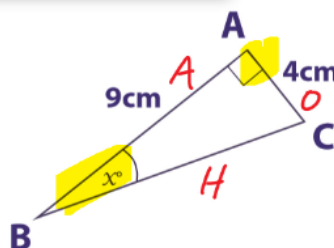
Trigonometry and
Pythagoras' Theorem

Question 5

ABC is a right angle triangle.

Find the unknown angle ABC

Give your answer to 3 significant figures.



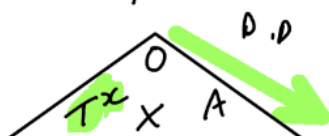
✓ 3. Apply ONE

✓ 2.



✓ 1. Label sides (H, O, A)

SOH, CAH, TOA



$$= \frac{O}{A} = \frac{4}{9}$$

$$\tan^{-1}\left(\frac{4}{9}\right) = \underline{24}$$

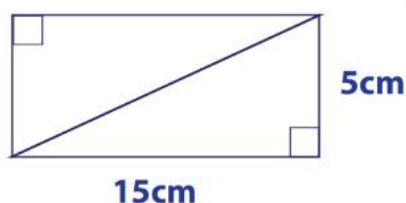
Core 6 - Silver

Topic:

Trigonometry and
Pythagoras' Theorem

Question 6

This rectangular frame is made from 5 straight pieces of metal.



$$\begin{aligned} \text{Total length} &= (2 \times 15) + (2 \times 5) + 15.81 \\ &= 30 + 10 + 15.81 \\ &= 55.81 \text{ cm} \end{aligned}$$

$$\begin{aligned} 5^2 + 15^2 &= c^2 \\ 250 &= c^2 \\ 15.81 &= c \end{aligned}$$

$$55.81 \text{ cm} = 0.5581 \text{ m}$$

$$0.5581 \times 2.5 = \underline{1.40}$$

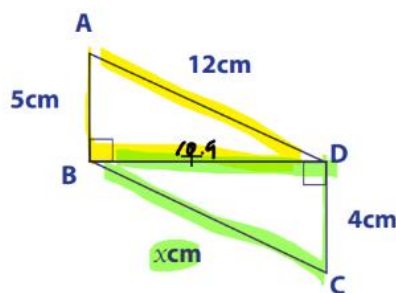
The weight of the metal is 2.5 Kg per metre.

Work out the total weight of the metal in the frame (Give your answer in grams)



Question 7

Triangles ABD and BCD are right angles triangles.



Core 7 - Silver

Topic: Trigonometry and Pythagoras' Theorem

$$12^2 - 5^2 = BD^2$$

$$144 - 25 = 119$$

$$\sqrt{119} = 10.9 \text{ (3sf)}$$

$$10.9^2 + 4^2 = 135$$

$$11.6 = \sqrt{135}$$

Work out the value of x. Give your answer to 3 significant figures.

Question 8

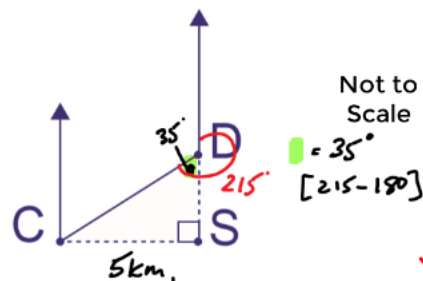
The diagram show two towns, C and D.

Ship S, is exactly 5 km due east of town C and exactly due south of town D.

Town C is on a bearing of 215° from town D. Find the distance, ship S is due south of town D.



Step 2
SOH, CAH, TOA
Choose **Tanx**
[We have side O and need to find A]



Step 3 Apply ✓

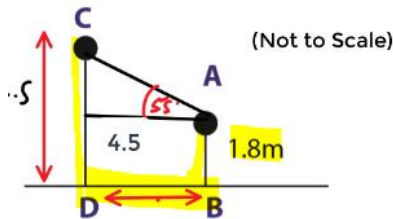
$$\tan 35^\circ = \frac{O}{A} = \frac{5}{A}$$

= Cover up

$$A = \frac{5}{\tan 35^\circ} = 7.11 \text{ km}$$

Question 9

The diagram shows two lamp posts, AB and CD on a horizontal ground.



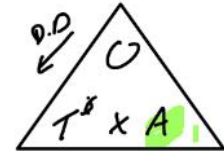
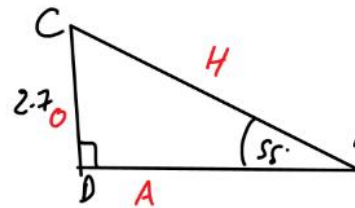
$AB = 1.8\text{m}$

$CD : AB = 2.5 : 1$

The angle of elevation of C from A is 55° .
Calculate the length of BD.

Give your answer to 3 significant figures.

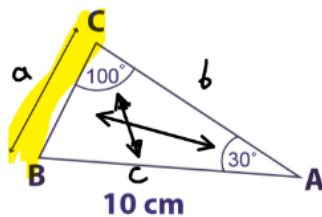
$1.8 \times 2.5 = 4.5\text{m}$



$\frac{2.7}{\tan 55} = 1.89\text{m}$

Question 10

a) Calculate the unknown length BC.

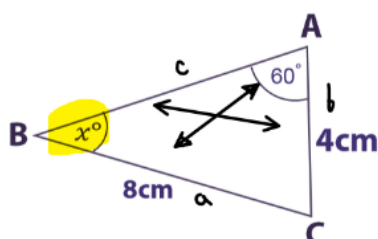


Step 1
Label (a, b, c)
+ Identify

Step 2
Choose formula
 $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Step 3
Substitute values
 $\frac{a}{\sin 30} = \frac{10}{\sin 100}$
 $\frac{a}{\sin 30} = 10.15 \dots$
 $a = 5.01 (2\text{sf})$

b) Calculate the unknown angle ABC.



Step 1
Step 2
 $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

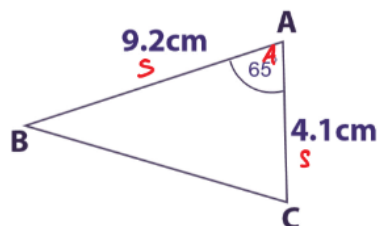
Step 3
 $\frac{\sin 60}{8} = \frac{\sin B}{4} \Rightarrow 0.108 = \frac{\sin B}{4} \Rightarrow \sin B = 0.43 \dots$
 $\sin^{-1}(0.43) = 25.7 (3\text{sf})$

Core 11 - Silver

Topic: Trigonometry and Pythagoras' Theorem

Question 11

Calculate the area of triangle ABC



$$= \frac{1}{2} \times 9.2 \times 4.1 \times \sin 65$$

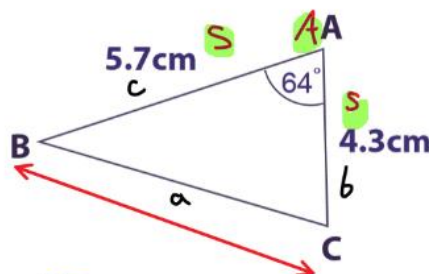
$$= \underline{17.1 \text{ cm}^2}$$

Core 12 - Silver

Topic: Trigonometry and Pythagoras' Theorem

Question 12

Calculate the length BC.



Step 1: Label & Identify

Step 2: Choose formula

$$a^2 = b^2 + c^2 - (2bc \cos A)$$

'AAA'

Step 3: Substitute values

$$a^2 = 4.3^2 + 5.7^2 - (2 \times 4.3 \times 5.7 \times \cos 64)$$

$$a^2 = 29.49$$

$$a = \sqrt{29.49}$$

$$a = \underline{5.43 \text{ (3sf)}}$$

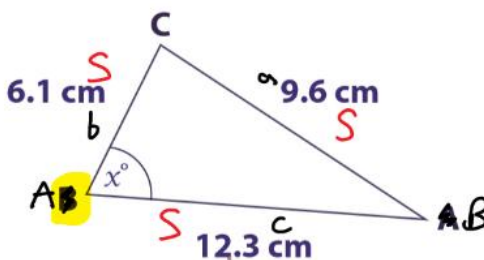
Question 13

Calculate the angle ABC.



Step 1: Label + Identify

'AAA'



Step 2: Choose Formula

$$\cos A = \frac{b^2 + c^2 - a^2}{(2bc)}$$

Step 3: Substitute values

$$= \frac{6.1^2 + 12.3^2 - 9.6^2}{(2 \times 6.1 \times 12.3)}$$

$$\cos A = 0.642$$

$$\cos^{-1}(0.642) = \underline{50.1(3sf)}$$

Question 14

The diagram shows two triangles adjoined to one another.

AB = 8cm BC = 10cm

Angle ADC = 66° Angle DCA = 32°

Calculate the length AD

Pythagoras

$$8^2 + 10^2 = AC^2$$

$$164 = AC^2$$

$$\sqrt{164} = AC \therefore 12.81$$

Step 1 ✓

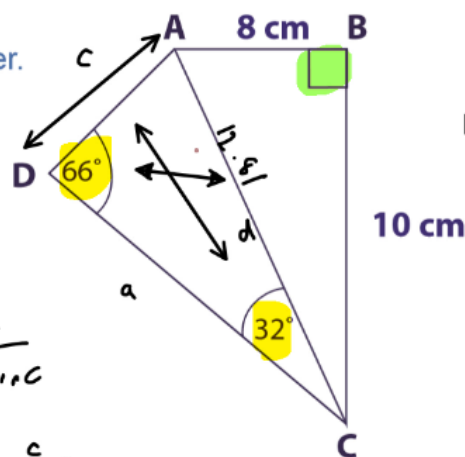
Step 2

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Step 3
sub

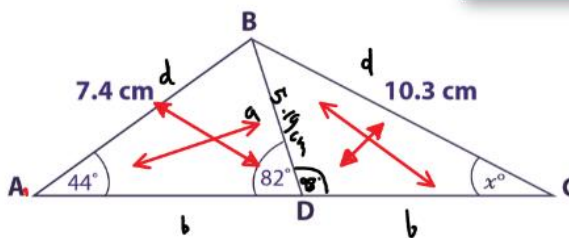
$$\frac{12.81}{\sin 66} = \frac{c}{\sin 32}$$

$$\frac{12.81}{1} = \frac{c}{\sin 32} \therefore c = \underline{7.43(3sf)}$$



Question 15

ABC is a triangle. D is a point on line AC
AB = 7.4 cm and BC = 10.3 cm
Angle BAD = 44° Angle BDA = 82°
Calculate the angle DCB



Step 1: Label + Identify $\triangle ABD$

Step 2: Apply $\frac{a}{\sin A} = \frac{7.4}{\sin 82}$

Step 3: sub $\frac{a}{\sin 44} = 7.47$
 $\therefore a = 5.19$

$BDC = 98 [180 - 82]$

Now look at $\triangle BDC$ + apply same three steps

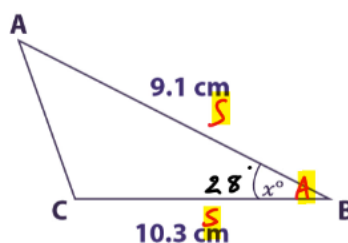
$\frac{\sin C}{5.19} = \frac{\sin 98}{10.3} \therefore \frac{\sin C}{5.19} = 0.096$

$\sin C = 0.499$
 $C = \sin^{-1}(0.499)$
 $= 29.9^\circ (3sf)$

Question 16

The area of the triangle ABC is 22cm^2
AB = 9.1cm CB = 10.3cm

Calculate the angle ABC



Let's find x by rearranging Sine Area formula

$\frac{1}{2} \times 10.3 \times 9.1 \times \sin B = 22$
 $\frac{10.3 \times 9.1 \times \sin B}{2} = \frac{22}{1}$

$93.73 \sin B = 44$

$\sin B = \frac{44}{93.73}$

$B = \sin^{-1}(0.468) \therefore B = 28^\circ$



Identify ✓

Question 17

The shape shows triangles ABC and ADC

Angle $BAC = 59^\circ$ Angle $BCA = 39^\circ$ Angle $DAC = 28^\circ$

$BC = 8\text{cm}$ and $AD = 4\text{cm}$

Calculate length DC

Let's find adjoining length BC first. [Sine Rule]

Angle ABC

Using sine rule

$$\frac{b}{\sin 82} = \frac{8}{\sin 59}$$

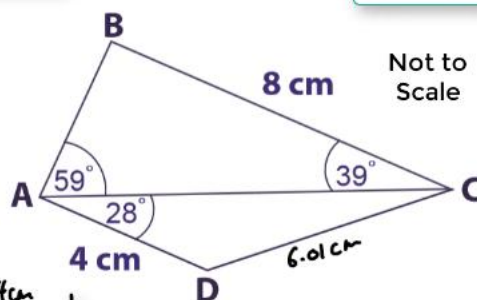
$$\frac{b}{\sin 82} = 9.33$$

$$b = 9.24\text{cm}$$

So AC = 9.24cm

SAS [Cosine]

Let's call this B



$$a^2 = b^2 + c^2 - (2bc \cos A)$$

$$a^2 = 9.24^2 + 4^2 - (2 \times 9.24 \times 4 \times \cos 28)$$

$$a^2 = 36.11$$

$$a = 6.01 \text{ (3sf)}$$

DC = 6.01cm

Question 18

ABC is a triangle. BC is 7.3 cm BD is 7.4 cm

The line AC is such that AD:DC = 2:1. AC is 7.5 cm

Calculate the length AB (Write to 3 sf)

SSS

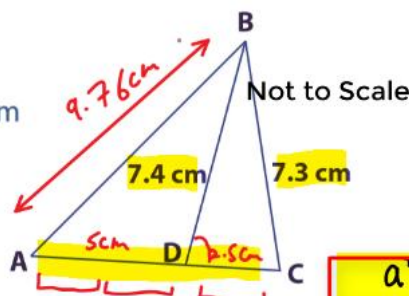
cos A = $\frac{b^2 + c^2 - a^2}{(2bc)}$

$$= \frac{2.5^2 + 7.4^2 - 7.3^2}{(2 \times 2.5 \times 7.4)}$$

cos A = 0.20964

cos⁻¹ (0.20964)

A = 77.96° [77.9568...]



SAS

$$a^2 = b^2 + c^2 - (2bc \cos A)$$

$$= 5^2 + 7.4^2 - (2 \times 5 \times 7.4 \times \cos 77.96)$$

$$a^2 = 95.2$$

$$a = \sqrt{95.2}$$

a = 9.76 (3sf)

ANSWERS

Quadratic Equations



Tanzania

Question 1

a) Factorise

$$\underline{12x^2} + \underline{15xy}$$

STEP 1
Identify type of
factorising
SIMPLE

$$\underline{3x(4x+5y)}$$

HCF

STEP 2
Apply and
factorise

b) Factorise

$$\underline{18x^2y^3} - \underline{12xy^2}$$

$$\underline{6xy^2(3xy-2)}$$



Tanzania

Question 2

Simplify

a) $\frac{x^2 + x - 12}{x^2 - 9}$

$$= \frac{(x+4)(x-3)}{(x+3)(x-3)}$$

$$= \frac{(x+4)}{(x+3)}$$

$\frac{+4}{+4} \times \frac{-3}{-3} = -12$
$\frac{+4}{+4} + \frac{-3}{-3} = 1$

Core 2 - Bronze

Topic: Quadratic Equations



Tanzania

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Question 3

Simplify

STEP 1
UnRelated
Denominators

$$\frac{\frac{2}{x} + \frac{3}{y}}{\frac{2y + 3x}{xy}}$$

STEP 2
Apply technique
(CAMPING
METHOD)

Question 4

Simplify

STEP 1
Related
Denominators

$$\frac{(x) \frac{1}{(x)} + \frac{2}{x^2} (x)}{\frac{x + 2}{x^2}}$$

STEP 2
Apply technique
(Pick Highest
Denominator)

Question 5

a) Factorise $3x^2 + 4x - 4$

$$ax^2 + bx + c$$

Step 1: Quad Box
(+ insert)

$$\begin{array}{r} 6x^{-2} = 12 \\ 6 + -2 = 4 \end{array}$$

$$3x^2 + 6x - 2x - 4$$

Step 2: Split + factorise

$$\begin{array}{r} 3x^2 + 6x - 2x - 4 \\ 3x(x+2) - 2(x+2) \end{array}$$

Step 3: Combine

$$(3x-2)(x+2)$$

Hence solve $3x^2 + 4x - 4 = 0$

$$(3x-2)(x+2) = 0$$

$$3x-2=0 \quad x+2=0$$

$$3x=2 \quad x=-2$$

$$x=2/3 \quad x=-2$$

b) Solve $6x^2 - 7x - 3 = 0$

(1)

$$\begin{array}{r} -9 \times 2 = -18 \\ -9 + 2 = -7 \end{array}$$

$$6x^2 - 9x + 2x - 3$$

(2)

$$\begin{array}{r} 6x^2 - 9x + 2x - 3 \\ 3x(2x-3) + 1(2x-3) \end{array}$$

(3)

$$(3x+1)(2x-3)$$

c) Solve $8x^2 - 12x$

$$4x(2x-3) = x=0, \quad 2x-3=0$$

$$2x=3$$

$$x=3/2$$

Question 6

Solve

$$ax^2 + bx + c = 0$$

$$1x^2 + 2x - 1 = 0$$

Give your solutions correct to 3 significant figures.

Step 1

Identify a, b, c

$$a=1, b=2, c=-1$$

$$\begin{array}{r} = -2 + \sqrt{4 - (-4)} \\ 2 \end{array}$$

Step 3

Calculate 2nd solution

$$\begin{array}{r} -2 - \sqrt{8} \\ 2 \end{array}$$

Step 2

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

$$\frac{b}{a}$$

$$\begin{array}{r} = -2 + \sqrt{8} \\ 2 \end{array} = 0.414$$

$$= 2.41$$

Apply Formula

$$\begin{array}{r} = \frac{-2 \pm \sqrt{(2)^2 - (4 \times 1 \times -1)}}{2} \end{array}$$

Question 7

The area of the shape is 40cm^2 .

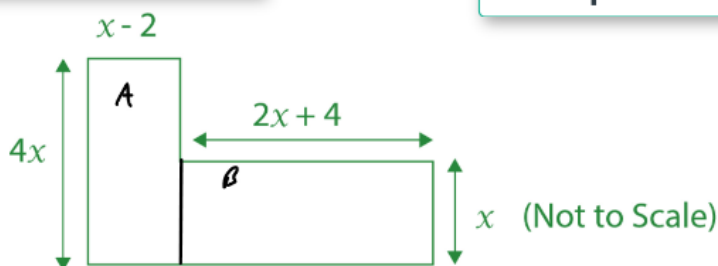
a) Show that $3x^2 - 2x - 20 = 0$.

$$4x(x-2) + x(2x+4) = 40$$

$$6x^2 - 4x = 40$$

$$6x^2 - 4x - 40 = 0$$

$$2(3x^2 - 2x - 20) = 0$$



b) Solve $3x^2 - 2x - 20 = 0$.

Give your solutions correct to 3 significant figures.

$$\frac{2 + \sqrt{244}}{6} = \frac{2.94}{0} \approx 2.94 \text{ or } -2.27$$

$$\approx 2.94 \text{ cm}$$

c) Hence, work out the shortest side.

$$0.94$$

Question 8

Solve

$$\frac{x}{2} - \frac{2}{(x+3)} = 4$$

Write answer to 3 significant figures.

Step 1 Simplify expression

$$= \frac{x(x+3) - 4}{2(x+3)}$$

$$= \frac{x^2 + 3x - 4}{2(x+3)}$$

Step 2
Introduce $=$
+ apply

$$= \frac{x^2 + 3x - 4}{2x + 6} = \frac{4}{1}$$

$$= x^2 + 3x - 4 = 4(2x + 6)$$

$$x^2 + 3x - 4 = 8x + 24$$

$$x^2 - 5x - 28 = 0$$

Step 3
Solve

$$a = 1, b = -5, c = -28$$

$$= \frac{5 \pm \sqrt{(-5)^2 - (4 \times 1 \times -28)}}{2}$$

$$= \frac{5 \pm \sqrt{25 - (-112)}}{2} = \frac{5 \pm \sqrt{137}}{2}$$

$$= \frac{5 \pm 11.7}{2}$$

$$= -3.35$$

Question 9

a) Write $x^2 - 3x - 2$ in the form $(x+p)^2 + q$

$$\begin{aligned} (x - \frac{3}{2})^2 - \frac{9}{4} - 2 &= (x - \frac{3}{2})^2 - \frac{17}{4} \\ -\frac{9}{4} - \frac{2}{1} &= \frac{-9-8}{4} = \frac{-17}{4} \\ p &= -\frac{3}{2}, q = -\frac{17}{4} \end{aligned}$$

b) Hence find the roots of $x^2 - 3x - 2 = 0$. Give your answer in surd form.

$$\begin{aligned} (x - \frac{3}{2})^2 - \frac{17}{4} &= 0 \\ (x - \frac{3}{2})^2 &= \frac{17}{4} \\ x - \frac{3}{2} &= \pm \sqrt{\frac{17}{4}} \\ x &= \frac{\sqrt{17}}{2} + \frac{3}{2} = \frac{3 + \sqrt{17}}{2} \\ x &= -\frac{\sqrt{17}}{2} + \frac{3}{2} = \frac{3 - \sqrt{17}}{2} \end{aligned}$$

Question 10

a) Find two consecutive even numbers whose product is 168.

$$\begin{aligned} \text{Even} &= 2n \\ (2n) \times (2n+2) &= 168 \\ 2n(2n+2) &= 168 \\ 4n^2 + 4n &= 168 \\ 4n^2 + 4n - 168 &= 0 \\ 4(n^2 + n - 42) &= 0 \\ (n-6)(n+7) &= 0 \\ n &= 6, n = -7 \Rightarrow n = 6 \end{aligned}$$

$$\begin{aligned} \underline{6} \times \underline{7} &= -42 \\ \underline{-6} + \underline{7} &= 1 \end{aligned}$$

12 and 14

Core 11 - Gold

Topic: Quadratic Equations

Question 11

$$4^2 + (4+1)^2 = 4^2 + 5^2 = 16 + 25 = 41$$

a) The **sum** of the **squares** of two **consecutive positive numbers** is 41. Find the numbers.

$n, n+1$

$$(n)^2 + (n+1)^2 = 41$$

$$n^2 + (n+1)(n+1) = 41$$

$$n^2 + n^2 + n + n + 1 = 41$$

$$2n^2 + 2n + 1 = 41$$

$$2n^2 + 2n - 40 = 0$$

$$2[n^2 + n - 20]$$

Q.B

$$\begin{array}{r} 5 \\ - \end{array} x \begin{array}{r} -4 \\ - \end{array} = -20$$

$$5 + -4 = 1$$

$$(n+5)(n-4) = 0$$

$$n = -5, n = 4$$

$$\underline{\underline{n = 4}}$$

Core 12- Gold

Topic: Quadratic Equations

Question 12

Sam is five years younger than Joanne. In 2 years to come, the **product** of their ages will be 126 years.

Formulate a quadratic equation representing this information and present their ages.

$J = x, S = x - 5$ | $J = x+2, S = x-3$

Q.B

$$\begin{array}{r} -12 \\ - \end{array} x \begin{array}{r} 11 \\ - \end{array} = -132$$

$$-12 + 11 = -1$$

$$(x-12)(x+11) = 0$$

$$\underline{x = 12}, \underline{x = -11}$$

$$(x+2)(x-3) = 126$$

$$x^2 - x - 6 = 126$$

$$x^2 - x - 132 = 0$$

Test: $14 \times 9 = 126 \checkmark$

Work out their ages

Sam: 9

Joanne: 14

Question 13

a) Two numbers differ by 4. If the sum of their reciprocals is $\frac{2}{3}$, find the numbers.

$$\begin{aligned} \textcircled{1} \quad x - y &= 4 \quad \Rightarrow \textcircled{3} \quad x = y + 4 \\ \textcircled{2} \quad \frac{1}{x} + \frac{1}{y} &= \frac{2}{3} \\ \frac{1}{y+4} + \frac{1}{y} &= \frac{2}{3} \\ \frac{y + y + 4}{y(y+4)} &= \frac{2}{3} \\ \frac{2y+4}{y^2+4y} &= \frac{2}{3} \end{aligned}$$

$$\begin{aligned} 3(2y+4) &= 2(y^2+4y) \\ 6y+12 &= 2y^2+8y \\ 0 &= 2y^2+2y-12 \\ 2[y^2+y-6] &= 0 \\ (y+3)(y-2) &= 0 \\ y &= -3, y = 2 \\ x &= 2+4 = \underline{\underline{6}} \end{aligned}$$

$$\begin{aligned} 3x - 2 &= -6 \\ 3x - 2 &= 1 \end{aligned}$$

Question 14

a) Write $2x^2 - 10x + 3$ in the form $a(x+b)^2 + c$ where a , b and c are integers.

$$\begin{aligned} &= 2[x^2 - 5x] + 3 \\ &= 2\left[\left(x - \frac{5}{2}\right)^2 - \frac{25}{4}\right] + 3 \\ &= 2\left(x - \frac{5}{2}\right)^2 - \frac{50}{4} + 3 = 2\left(x - \frac{5}{2}\right)^2 - \frac{38}{4} \end{aligned}$$

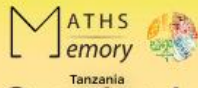
$$-\frac{50}{4} + \frac{3}{1} = \frac{-50+12}{4} = -\frac{38}{4}$$

b) Hence or otherwise, write down the coordinates of the turning points

$$\left(\frac{5}{2}, -\frac{38}{4}\right)$$

ANSWERS

Statistics



Core 1

Topic: Statistics

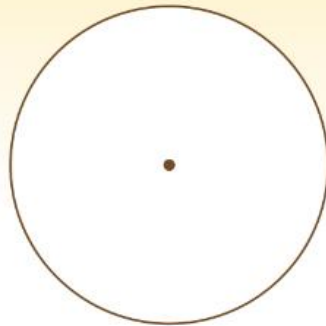
Question 1

The table below shows information about the hobbies of 30 students in their final year.

Hobbies	Number of Students	Angle [Working out]
Football	8	$\frac{8}{30} \times 360 = \frac{8}{1} \times 12 = 96$
Netball	11	$\frac{11}{30} \times 360 = 11 \times 12 = 132$
Cricket	4	$\frac{4}{30} \times 360 = 4 \times 12 = 48$
Tennis	7	$\frac{7}{30} \times 360 = 7 \times 12 = 84$

$$\text{Angle} = \frac{\text{Frequency}}{\text{Total}} \times 360$$

Draw an accurate pie chart to represent this information.



Core 2- Bronze

Topic: Statistics

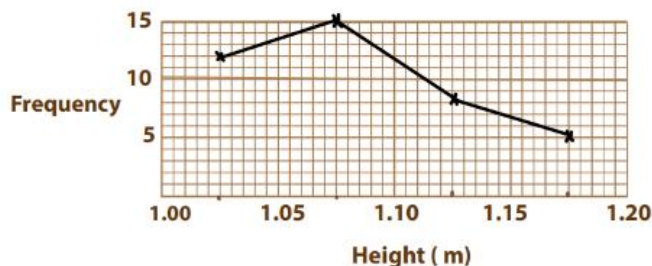
Question 2

The table below shows information about the heights of 40 primary school pupils.

Heights (m)	Frequency	Mid
$1.00 < h \leq 1.05$	12	1.025
$1.05 < h \leq 1.10$	15	1.075
$1.10 < h \leq 1.15$	8	1.125
$1.15 < h \leq 1.20$	5	1.175

STEP 1
Calculate
Mid Point

a) Draw a frequency polygon for the information in the table.



STEP 2:
Plot graph
(Line segments)



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Question 3

The table below shows information about the shoe size's taken from a primary school class.

Shoe Size	Frequency	Σf
1	12	12
2	17	34
3	6	18
4	5	20
		<u>84</u>

STEP 1:
Type of Data?
Discrete

STEP 2
Add Σf
Column

Key
= Definition

a) Find the modal shoe size.

= Shoe size 2 [As 17 shows the most 'common' class]

b) Find the median shoe size.

= $\left(\frac{N}{2}\right)^{\text{th}}$ value = $\frac{40}{2} = 20^{\text{th}}$ value = Shoe size 2

b) Find the mean shoe size.

= $\frac{\Sigma xf}{N} = \frac{84}{40} = 2.1$
= Shoe size 2

STEP 3
Apply 'Mean'
Formula

Question 4

The table below shows information about the time it took a class of pupils to complete a puzzle.

Time (minutes)	Frequency	Mid	Σf
$0 < x \leq 10$	6	5.5	33
$10 < x \leq 20$	13	15.5	201.5
$20 < x \leq 30$	12	25.5	306
$30 < x \leq 40$	9	35.5	229.5
	<u>40</u>		<u>770</u>

STEP 1:
Type of Data?
Continuous

STEP 2
Add 'Mid' and ' Σf '
Columns.

a) Work out an estimate for the mean time.

STEP 3
Apply 'Mean'
Formula

= $\frac{\Sigma xf}{N} = \frac{770}{40} = 19.25$ (2dp)
= 19 min 15 seconds

[Note: $0.25 \times 60 = 15$ min]

b) Find the class interval that contains median.

= $\left(\frac{N}{2}\right)^{\text{th}}$ value = $\left(\frac{40}{2}\right) = 20^{\text{th}}$ value
= $20 < x \leq 30$

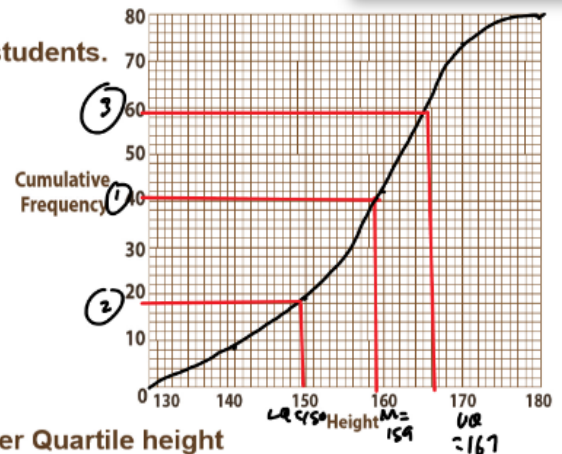
Question 5

The table below shows information about the heights of 80 students.

a) Draw a cumulative frequency graph from the table.

Height (h cm)	Number of Students	cf
$130 < h \leq 140$	8	8
$140 < h \leq 150$	11	19
$150 < h \leq 160$	23	42
$160 < h \leq 170$	32	74
$170 < h \leq 180$	6	80

$$N = 80$$



Find an estimate for the following :

b) Median height

① $\left(\frac{N}{2}\right)^{th} \text{ value} = \left(\frac{80}{2}\right)^{th} = 40^{th} = 159$

c) Lower Quartile height

② $\left(\frac{N}{4}\right)^{th} \text{ value} = 20^{th} \text{ value} = 150$

d) Upper Quartile height

③ $\left(\frac{3N}{4}\right)^{th} \text{ value} = 60^{th} \text{ value} = 167$

e) Interquartile range

$$UQ - LQ = 167 - 150 = 17$$

Question 6

The frequency table below shows the heights of 30 students.

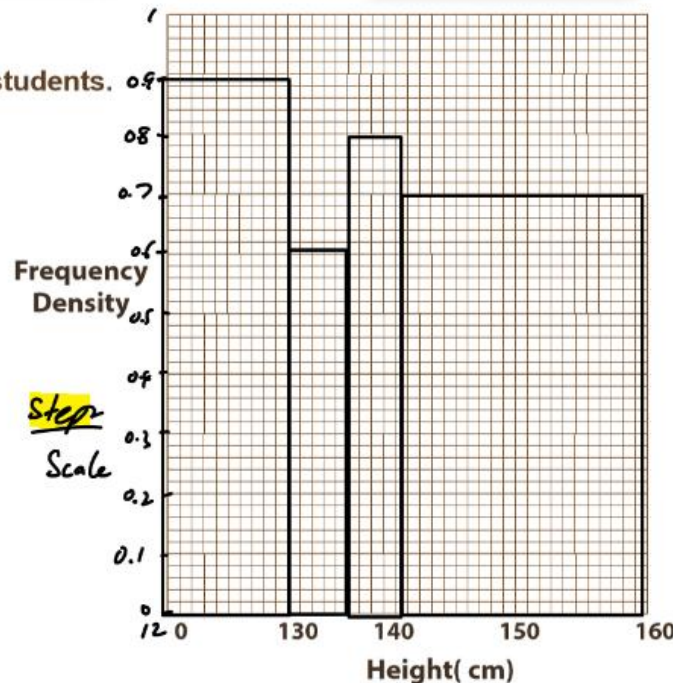
Height (cm)	Frequency	F.D
$120 < h \leq 130$	9	0.9
$130 < h \leq 135$	3	0.6
$135 < h \leq 140$	4	0.8
$140 < h \leq 160$	14	0.7

a) On the grid, represent this information on a histogram.

$F.D = \frac{\text{Frequency}}{\text{class width}}$ Step 1 F.D Column

b) Work out an estimate for the fraction of students who have a height between 130 - 140 cm.

$$\frac{7}{20} +$$



Question 7

The histogram shows information about the time taken by athletes to complete a race (minutes)

- a) 8 athletes took 60 minutes or less to complete the race. Calculate the median.

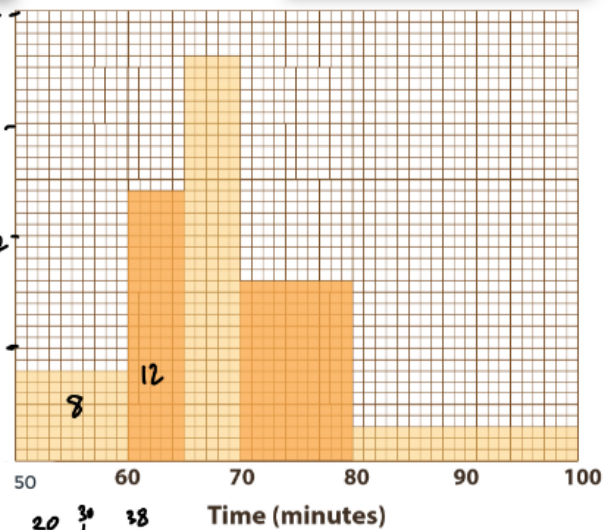
Area of block = frequency

Frequency
Density

Time	Frequency	cf
50 < t ≤ 60	8	8
60 < t ≤ 65	12	20
65 < t ≤ 70	18	38
70 < t ≤ 80	16	54
t > 80	6	60

$$\text{Median} = \frac{N}{2} \text{ value}$$

$$= 30^{\text{th}} \text{ value}$$



$$= 65 + \frac{10}{18} \times 5$$

$$= 65 + 2.7 = 67.7$$

ANSWERS

3- D Figures/ Circles

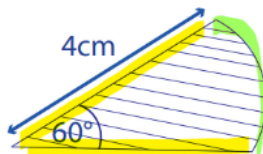


Core 1 - Bronze

Topic: 3-D Figures/
Circles

Question 1

Calculate the **perimeter** of this sector to **2** decimal places.



$$\begin{aligned} & \text{① } \pi \times d = 8\pi \\ & \text{② } \frac{360}{60} = 6 \\ & \frac{8\pi}{6} = 4.19 \text{ cm} \\ & + \\ & 4 + 4 = 8 \text{ cm} \\ & = \underline{12.19 \text{ cm}} \end{aligned}$$

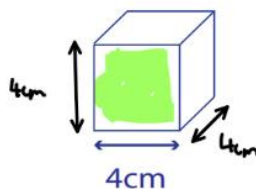


Core 2 - Bronze

Topic: 3-D Figures/
Circles

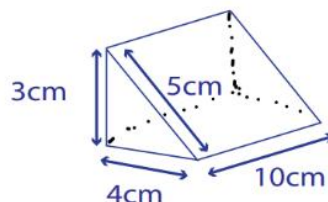
Question 2

a) Find the **surface area** of a **cube** of side length 4 cm.



$$\begin{aligned} & (4 \times 4) \times 6 \\ & = 16 \times 6 \\ & = \underline{96 \text{ cm}^2} \end{aligned}$$

b) Find the **surface area** of this **triangular prism**.



F + B	L + R	Base
6 + 6	30 + 50	40

$$\begin{aligned} & = \begin{array}{r} 30 \\ 50 \\ 40 \\ + 12 \\ \hline 132 \end{array} \\ & \underline{132 \text{ cm}^2} \end{aligned}$$

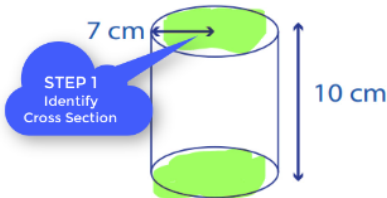


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Question 3

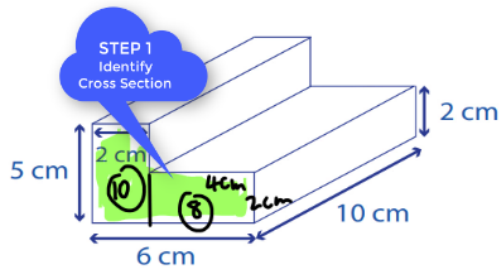
a) Calculate the volume of this cylinder



$$\begin{aligned} &= (\pi \times r^2) \times h \\ &= (\pi \times 7^2) \times 10 \\ &= 49\pi \times 10 \\ &= 1540 \text{ cm}^3 \end{aligned}$$

STEP 2
Multiply by
length

b) Calculate the volume of this shape.



$$\begin{aligned} &= 18 \times 10 \\ &= 180 \text{ cm}^3 \end{aligned}$$

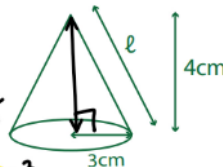
STEP 2
Multiply by
length

Question 4

a) Find

i) Surface Area [Total]
 $= 15\pi + 9\pi = 24\pi = 75.4 \text{ cm}^2$
 (Curved) (base) (Total)

ii) Volume
 $= 12\pi \text{ cm}^3$ or 37.7 cm^3



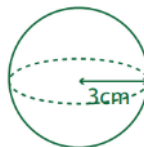
Volume of cone $= \frac{1}{3} \pi r^2 h$

Surface Area of cone (curved) $= \pi r l$

b) Find

i) Surface Area $36\pi \text{ cm}^2$ or 113 cm^2

ii) Volume $36\pi \text{ cm}^3$ or 113 cm^3



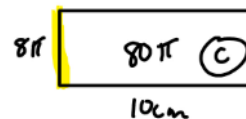
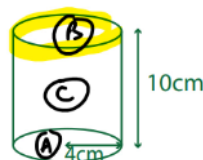
Surface Area of sphere $= 4\pi r^2$

Volume of sphere $= \frac{4}{3} \pi r^3$

c) Find

i) Surface Area
 $= 16\pi + 16\pi + 80\pi = 112\pi \text{ cm}^2$ or 352 cm^2

ii) Volume $160\pi \text{ cm}^3$ or 503 cm^3

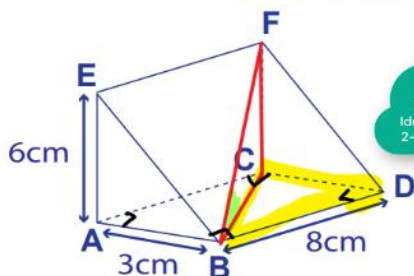


Core 5 - Silver

Topic:

3-D Figures/
Circles

The diagram shows a triangular prism.



STEP 1
Identify the
2-D shapes

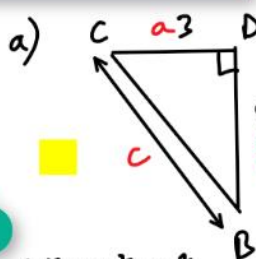
STEP 2
Draw and
Apply EACH
2-D Shape

Find

a) Length CB (3 s.f.)

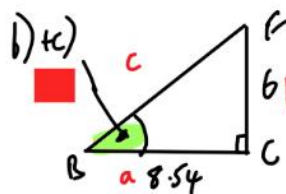
b) Length BF (3 s.f.)

c) Angle FBC (3 s.f.)



$$(3)^2 + (8)^2 = CB^2$$

$$9 + 64 = CB^2 \therefore \sqrt{73} = CB \Rightarrow \underline{8.54}$$



$$(8.54)^2 + (6)^2 = BF^2$$

$$BF = \underline{10.4}$$

$$c) \left(\frac{6}{8.54}\right) \tan^{-1} = \underline{35.1^\circ}$$

Core 6 - Silver

Topic:

3-D Figures/
Circles

a) ABCD are points on the circumference, centre O.

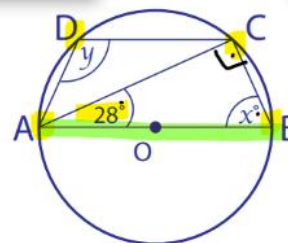
AOB is a diameter of a circle. Angle CAB = 28°.

i) $x = \underline{62}$

Reason Semi-circle Theorem.

ii) $y = \underline{118}$

Reason Cyclic Quad



b) ACD are points on the circumference, centre O.

AB and CB are tangents. Angle ADC = 50°.

i) Angle AOC = 100

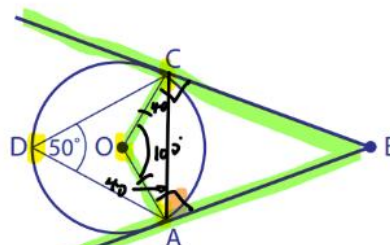
Reason Angle centre is double angle circumference.

ii) Angle ABC = 80

Reason kite [360]

iii) Angle CAB = 50

Reason Isosceles / Alternate angles



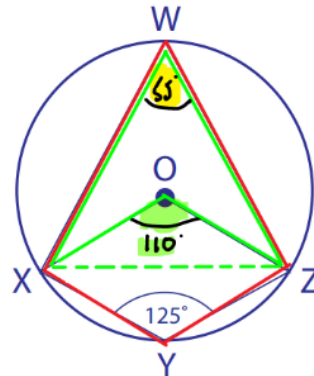
Question 7

WXYZ are points on the circumference, centre O.

Angle XYZ = 125° . XY = YZ

Find angle XOZ. Show your working.

- ① Let's find out $\hat{XWZ}$ first as WXYZ forms a 'Cyclic Quadrilateral'. $\hat{XYZ} + \hat{XWZ} = 180$
[— = Quadrilateral] $125 + x = 180$
 $\therefore x = 55$



- ② Now we can use the 'Double Angle' theorem and say $\hat{XOZ}$ is double $\hat{XWZ}$. — = imaginary chord
 $\hat{XOZ} = 110$



Question 8

ABC are points on the circumference, centre O.

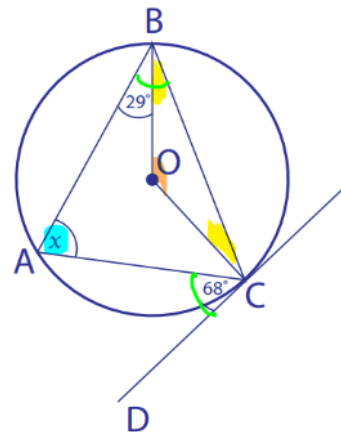
DCE is a tangent to the circle.

Angle ABO = 29° .

Angle DCA = 68° .

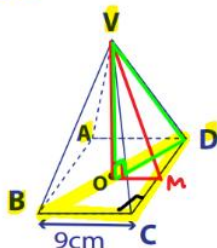
Find angle BAC. Show your working.

- ① Angle $\hat{ACD} = \text{Angle } \hat{ABC}$ [Alternate Segment Theorem]
 $68 = 68$
- ② Hence Angle $\hat{OBC} = 68^\circ - 29^\circ = 39^\circ$ [Isosceles Theorem]
- ③ Angle $\hat{OBC}$ and $\hat{OCB}$ are an isosceles Δ , hence
Angle $\hat{BOC} = 180 - (2 \times 39) = 102$
- ④ Angle $\hat{BAC} = 102 \div 2 = 51$ [Double Angle theorem]



Question 9

The diagram shows square based pyramid ABCD and vertex V.

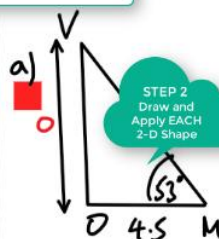


STEP 1
Identify the
2-D shapes

The angle that face VCD makes with the square base ABCD is 53° .

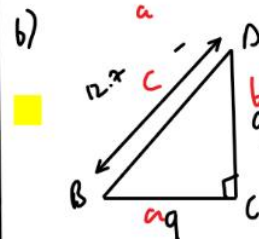
a) Calculate the height of the pyramid.

b) Length of VD.

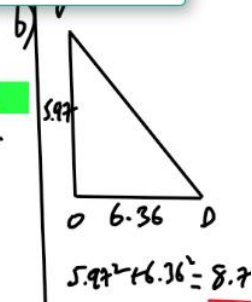


STEP 2
Draw and
Apply EACH
2-D Shape

$$\tan(53) \times 4.5 = 5.97 \text{ cm}$$



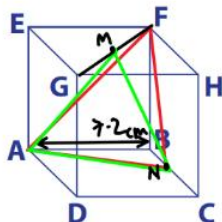
$$\begin{aligned} BD^2 &= 9^2 + 9^2 \\ BD^2 &= 162 \\ BD &= \sqrt{162} \\ BD &= 12.7 \end{aligned}$$



$$5.97^2 + 6.36^2 = 8.7$$

Question 10

ABCDEFGH is a cube.



AB = 7.2 cm,

N is a point on BC such that BN: NC = 4:5

a) Calculate angle FNA (3 s.f.)

b) M is a mid point on FG. Given that $\angle MAN$ is 71° + angle MAN is 73° , calculate length MN (3 s.f.)

a) First let's find FB

$$\begin{aligned} BN &= \frac{4}{9} \text{ of } BC \\ BN &= \left(\frac{7.2}{9}\right) \times 4 = 3.6 \text{ cm} \\ FN^2 &= 7.2^2 + 3.6^2 \\ FN &= 8.05 \text{ cm} \end{aligned}$$

$$\begin{aligned} AN^2 &= 7.2^2 + 3.6^2 \\ AN &= 8.05 \end{aligned}$$

$$\begin{aligned} AN^2 &= 7.2^2 + 3.6^2 \\ AN &= 8.05 \end{aligned}$$

$$\begin{aligned} AF^2 &= 7.2^2 + 7.2^2 \\ AF &= 10.2 \text{ cm} \end{aligned}$$

Let's put it all together = Cosine [SSS]

$$\begin{aligned} \cos A &= \frac{8.05^2 + 8.05^2 - 10.2^2}{(2 \times 8.05 \times 8.05)} \\ &= \cos^{-1}(0.197) \\ \angle FNA &= 78.6^\circ \end{aligned}$$

b) ① Angle AMN = $180^\circ - (73^\circ + 71^\circ)$
 $\angle AMN = 36^\circ$
 ② Sine Rule (Length)

$$\frac{8.05}{\sin 36} = \frac{x}{\sin 73}$$

$$MN = 13.1 \text{ cm}$$