Question 1 This question is about fractions, ratios, rounding and standard form

a) Calculate the following, give your answers as fractions in their simplest form

i. $\frac{2}{5} + \frac{1}{4}$

ii. $\frac{2}{5} \times \frac{1}{4}$

[2]

b) Convert the following to decimal fractions (decimals)

i. $\frac{4}{11}$

ii. 52.5%

[2]

c) A metal alloy is made from tin, copper and antimony in the ratio 94: 1: 5. Calculate the weight of each metal needed to make 1kg of the alloy.

[2]

d) Round the following numbers

i. 5.040302 to 2 decimal places
ii. 2.030405 to 2 significant figures

[2]

e) Write the following numbers in standard form

i. 23.45
ii. 0.0002345

[2]

Question 2 This question is about algebraic expressions and substitution

a) Expand the following expressions, give your answers in their simplest form

i. $(a+b)(a-b)$
ii. $(a-b)^2$
iii. $(a-b)^3$

[4]

b) Evaluate the following expressions when $a = 1$ and $b = 2$

i. $(a+b)(a-b)$
ii. $(a-b)^2$

[2]

c) Simplify the following expressions, give your answers in their simplest form

i. $\frac{2x}{5} \times \frac{1}{4x}$

ii. $\frac{2x}{5} + \frac{1}{4x}$

[2]

d) Simplify the following expressions, give your answers in their simplest form

i. $(xy^2) \times (yx^3)$
ii. $(xy^2)^0$

[2]

Question 3 This question is about indices and number bases

a) Evaluate

i. $2^2 \times 2^3$
ii. $(2^2)^0$
iii. $2^2 \div 2^3$
iv. $2^2 \div 2^0$

[4]

b) Convert the following numbers to decimal (base 10)

i. 1010111_2
ii. 247_{16}

[2]

c) Convert 77_{10}

i. to binary
ii. to hexadecimal

[2]

d) Convert 387_{10} to base 5

[2]

Question 4 **This question is about sets and logic**

a)

i. Construct and complete a truth table for the following logical expression.

$$(P \wedge Q) \rightarrow (P \vee R)$$

[3]

ii. Hence decide whether the expression is a tautology, a contradiction or a contingency

[1]

b) Sets A and B are subsets of a universal set $\mathcal{E}$ defined as follows:

$\mathcal{E} = \{10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80\}$
$A = \{x: x \text{ is a multiple of } 10\}$
$B = \{x: x \leq 50\}$

i. List the following sets:

1. $A \cap B$
2. $\bar{A} \cap B$
3. $\bar{A} \cap \bar{B}$
4. $\overline{A \cap B}$

[4]

ii. Draw a Venn diagram to show the sets A and B. Put all the elements of $\mathcal{E}$ in your diagram.

[2]

Question 5 This question is about equations

a) Solve the following equations

i. $3x - 2 = 19$
ii. $3(x - 2) = 18$
iii. $3x - 2 = 5x - 8$

[3]

b) Solve the following quadratic equations

i. $y^2 - 9 = 0$
ii. $y^2 + 5y = 0$
iii. $y^2 - 5y - 6 = 0$

[3]

c) Solve the following simultaneous equations

i. $\begin{cases} 5a + 2b = 7 \\ 4a + 2b = 4 \end{cases}$

ii. $\begin{cases} 3s + 2t = 7 \\ 4s - 5t = -6 \end{cases}$

[4]

Question 6 This question is about sequences and series

a) Given the sequence 10, 13, 16…

i. Find the next two terms of the sequence
ii. Find an expression for the n^{th} term of the sequence
iii. Find the sum of the first 20 terms of the sequence

[6]

b) Given the sequence 1024, 512, 256 …. 1, with first term 1024 and last term 1

i. Find the 5^{th} and 8^{th} terms in the sequence
ii. Find the total number of terms in the sequence

[4]

Question 7 This question is about functions and graphs

a) Consider the following functions

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

i. Evaluate

1. $f(2)$
2. $g(1)$

[2]

ii. Write an expression for $g\big(f(x)\big)$

[1]

iii. Find an expression for $g^{-1}(x)$

[1]

iv. Draw the graph of $g(x) = 3x - 2$ for $-5 \leq x \leq +5$, show where it cuts the axes

[2]

b) Sketch the following graphs showing where they cut the axes

i. $y = 2^x$
ii. $y = 2^x + 1$
iii. $y = 2^{x+1}$

[4]

Question 8 This question is about trigonometry

a) A triangle PQR has

angle $Q = 90°$ and sides $PQ = 14cm$ and $PR = 22cm$

i. Find the length of QR

[2]

ii. Find the value of $cosP$, give your answer as a fraction

[1]

iii. Find the size of angle P

[2]

b)

i. Draw the graph of $y = cosx$ for $-180° \leq x \leq +180°$, show where it cuts the axes

[3]

ii. Use your graph to find all the values of x between $-180°$ and $+180°$ for which $cosx = 0.5$

[2]

Question 9 This question is about probability

a) Two fair dice are rolled. The scores are then added. Find the probability of getting

i. a score of 12
ii. a score of 11 or 12
iii. a score that is less than or equal to 10

[3]

b) Three fair dice are rolled. What is the probability of rolling

i. three sixes
ii. three of the same number

[2]

c) Bag A contains three balls, two black and one white. Bag B contains 3 balls, 1 black and 2 white. One ball is picked from each bag.

i. Draw a tree diagram to represent this process, showing the probabilities at each stage

[3]

ii. Find the probability that both balls are black

[1]

iii. Find the probability that the balls are different colours

[1]

Question 10 This question is about matrices

a) Evaluate the following:

i. $\begin{pmatrix} 2 & 1 \\ 0 & 1 \end{pmatrix} - \begin{pmatrix} 1 & 0 \\ 3 & -1 \end{pmatrix}$

ii. $2\begin{pmatrix} 2 & 3 \\ 1 & -1 \end{pmatrix}$

[4]

b) The following matrix M represents a transformation T of the xy plane.

$$M = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$$

i. Apply the transformation T to the following 3 points (0, 0) (2, 0) and (2, 1), which represent a triangle. Find the coordinates of the transformed triangle.

[3]

ii. Give a geometrical description of the transformation T

[1]

iii. Find the inverse of matrix M

[2]

END OF EXAMINATION

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