

Question 1 This question is about fractions, decimals percentages, standard form and significant figures

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

i. $\frac{2}{9} + \frac{1}{3}$

ii. $\frac{2}{9} \times \frac{3}{4}$

[2]

b) Convert

i. $\frac{3}{8}$ to a percentage

ii. 24% to a fraction in simplest form

[2]

c) Freya, Fatima and Fern invest in the ratio 3:5:7. Freya's share is £60,000.

i. What is Fern's share?

ii. What is the total investment made?

[2]

d) Round the following numbers

i. 3.635321 to 2 decimal places

ii. 5.40321 to 3 significant figures

[2]

e) Write

i. 0.00342 in standard form

ii. 3.45×10^4 in full

[2]

Question 2 This question is about algebraic expressions and substitution

a) Expand the following expressions.

i. $(p - q)(p + q)$

ii. $(p + q)^2$

iii. $(p - q)(p + q)^2$

[4]

b) Evaluate the following expressions when $p = 2$ and $q = -1$

i. $(p - q)(p + q)$

ii. $(p - q)(p + q)^2$

[2]

c) Simplify the following expressions, give answers as a single fraction in its simplest form

i. $\frac{2x}{9} - \frac{1}{3}$

ii. $\frac{2x}{9} \div \frac{1}{3}$

[2]

d) Simplify the following expressions.

i. $(ab^5) \times (a^{-2}bc)$

ii. $(a^{-2}b)^2$

[2]

Question 3
bases

This question is about indices and number

a) Evaluate

i. $4^1 \times 4^3$

ii. $(4^1)^3$

iii. $4^1 \div 4^3$

iv. $4^{\frac{3}{2}}$

[4]

b) Convert the following numbers to decimal

i. 256_8

ii. 256_{16}

[2]

c) Convert 1011_{16} to:

i. binary

ii. decimal

[2]

d) Calculate the following. Give your answers in binary

i. $1110_2 + 1011_2$

ii. $1110_2 - 1011_2$

[2]

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

a)

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

$$(\neg P \rightarrow P) \wedge Q$$

[3]

- ii. Hence, or otherwise, find a simpler expression that is logically equivalent to $(\neg P \rightarrow P) \wedge Q$

[1]

- iii. State whether $(\neg P \rightarrow P) \wedge Q$ is a tautology, a contradiction or a contingency

[1]

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

$$\mathcal{E} = \{x: x \text{ is an integer and } 10 < x \leq 25\}$$

$$A = \{x: x \text{ is a multiple of } 3\}$$

$$B = \{15, 16, 17, 18, 19, 20\}$$

$$C = \{x: x \text{ is an odd number}\}$$

List the following sets:

i. $A \cap B$

ii. $B \cup \bar{C}$

iii. $(A \cap B) \cup \bar{C}$

[3]

c) Draw and shade a Venn diagrams to represent the following general sets

i. $X \cup Y$

ii. $X \cup \bar{Y}$

[2]

Question 5 **This question is about linear, simultaneous and quadratic equations**

a) Solve the following equations.

i. $21 = 3 + 2x$

ii. $21 = 3(2 + x)$

iii. $3 + 2x = 3(2 + x)$

[3]

b) Solve the following simultaneous equations.

i.
$$\begin{cases} 3a - 2b = -3 \\ 3a + 2b = 9 \end{cases}$$

ii.
$$\begin{cases} 3c + 4d = 19 \\ 4c + 3d = 16 \end{cases}$$

[4]

c) Solve the following quadratic equations, you may use any method

i. $s^2 - 5s = 0$

ii. $t^2 - 6t + 8 = 0$

iii. $2v^2 - 8v + 6 = 0$

[3]

Question 6 **This question is about sequences and series.**

a) Given the sequence $a_i = \frac{1}{2^{i+1}}$ $i = 1, 2, 3 \dots$

i. State whether it is an arithmetic progression, a geometric progression or neither [1]

ii. Find a_1, a_2 and a_{10} [3]

iii. Find the sum of the first 10 terms of the sequence [2]

b) Write out the following sum in full

$$\sum_{i=3}^6 (2^i + 1)$$

[2]

c) Write the following using sigma notation

$$3 + 5 + 7 + \dots + 17$$

[2]

Question 7 **This question is about functions and matrices**

Consider the following functions:

$$f(x) = 3x - 2 \qquad g(x) = (x - 2)^2 \qquad h(x) = x^2 - 4$$

a) Evaluate the following.

i. $f(2)$

ii. $h(g(2))$

iii. $f(f(0))$

[3]

b) Write an expression for:

i. $f(2x)$

ii. $f(h(x))$

[2]

c) Find

$$f^{-1}(9)$$

[1]

d) Evaluate

$$\begin{pmatrix} 2 & 1 \\ -1 & -2 \end{pmatrix} \begin{pmatrix} -1 \\ 1 \end{pmatrix}$$

[2]

e) Find the inverse M^{-1} of the following matrix M .

$$M = \begin{pmatrix} 3 & 4 \\ 1 & 1 \end{pmatrix}$$

[2]

Question 8 **This question is about trigonometry**

a) Triangle RST is a right angled triangle with angle $R = 90^\circ$ and side $r = 6.8m$ and side $s = 5.3m$

- i. Find the length of side t
- ii. Find angle S

[3]

b) In the triangle ABC angle $A = 100^\circ$ side $b = 64mm$ and $c = 22mm$

- i. Find the length of side a
- ii. Find angle B

[3]

c)

- i. Draw the graph of $y = \sin x$ for $-360^\circ \leq x \leq +360^\circ$, show where it cuts the axes
- ii. Use your graph to find all the values of x between -360° and $+360^\circ$ for which $\sin x = 0.2$

[4]

Question 9 **This question is about graphs**

- a) Plot the graph of $y = 3x - 1$ for $-3 \leq x \leq 3$, show where it cuts the axes
[2]
- b) On the same grid plot the graph of $y = x^2 - 2$ for $-3 \leq x \leq 3$
[2]
- c) State the co-ordinates of the points of intersection of the two graphs.
[2]
- d) Find the equation of the line that passes through $(3,4)$ and $(6, -2)$. State its gradient and intercept.
[2]
- e) Sketch a graph of $y = 3^x + 1$ showing clearly where it cuts the axes and marking any asymptotes
 $y = 3^x + 1$
[2]

Question 10 This question is about probability

- a) You have two spinners both numbered 1 to 4. You spin both spinners and multiply the numbers
- i) Draw a space diagram (table of results) to show the possible outcomes. [2]
 - ii. Find the probability of getting an outcome of
 - i) 1
 - ii) 2
 - iii) less than 10 [3]
- b) A biased 6 sided dice is thrown. The probability of scoring 6 is 0.2. The scores 1 to 5 all have equal probability
- i. What is the probability of scoring 1
 - ii. What is the probability of scoring less than 6 [2]
- c) You have letter cards that spell LONDON. You pick 2 cards without replacement. Find the probability of getting:
- i. Both cards with the letter N
 - ii. Two cards with the same letter
 - iii. Two cards with different letters [3]

END OF EXAMINATION