OUNDLE
School

EXAMINATION PAPER

13+ Academic Scholarship 2024

Mathematics (Paper 2)

Time allowed: 2 hours

Name: _____

Instructions

- Calculators are **NOT** allowed.
- You **are** expected to answer all of Questions 1 – 6.
- You **are not** expected to have time to answer all of Questions 7 – 14.
    - You may answer these questions in any order.
    - Choose those questions which you think you can answer best.
    - You may not need all the space provided to answer the question.
- Write your answers clearly on the lines at the end of each question and show your working in the space provided; there may be more space than required.
    - Answers without working, particularly from Question 7 onwards, will receive little or no credit.

Question 1 Work out the following:

a) 2.3×4.56

b) $\sqrt{\frac{500}{0.05}}$

c) $\frac{3+\frac{1}{3}}{4-\frac{1}{4}}$

d) $78 \times 57 + 19 \times 66$

Question 2 Find the missing terms (?) in each of the following sequences:

a) $-7,\ -5.8,\ -4.6,\ ?,\ ?, \ldots$

b) $16,\ 24,\ 36,\ 54,\ ?,\ ?, \ldots$

_____

c) $5,\ 20,\ 45,\ ?,\ 125,\ ?,\ \ldots$

_____

d) $?, \frac{2}{9},\ \frac{3}{16},\ \frac{4}{25},\ \frac{5}{36},\ ?, \ldots$

_____

Question 3 Simplify the following expressions fully:

a) $5a + 4ab - 3b - a + 7b$

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

c) $\frac{6x^3}{8x^2}$

d) $7(2 + x) - (3x - 4)$

Question 4 If $a = \frac{2}{5}$, $b = -2$, and $c = 10$, find the value of the following expressions. Leave your answers as simplified mixed numbers where necessary.

a) $2a - 3b$

b) ac^2

_____

c) $\frac{2c}{ac-3}$

_____

d) $\frac{4(2b+3)^2}{ac-2}$

_____

Question 5 Solve the following equations:

a) $\frac{2}{3x} - 5 = 0$

b) $4 = \frac{3x+4}{5} + 2$

c) $x(x-3) = x^2 + 5x - 20$

d) $3(x+5) - 2(5-4x) = 7$

Question 6

You are given that $\frac{19\times27}{9-0.45} = 60$.

Without doing lots of lengthy calculations, write down the values of:

a) $\frac{0.19\times2.7}{9-0.45}$

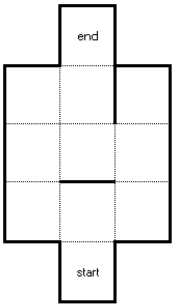
b) $\frac{19\times27}{900-45}$

_____

c) $\frac{1.9\times135}{90-4.5}$

_____

Question 7 A robot is programmed to move in a square grid maze like the one below. The robot starts facing into the maze, and the thicker lines represent barriers through which the robot cannot pass.



The robot has only four commands:

- C: Turn 90° clockwise
- A: Turn 90° anti-clockwise
- F: Move forwards until a barrier prevents movement
- B: Move backwards until a barrier prevents movement

a) Give an ordered list of commands which will get the robot from the start to the end; use the letters for each command.

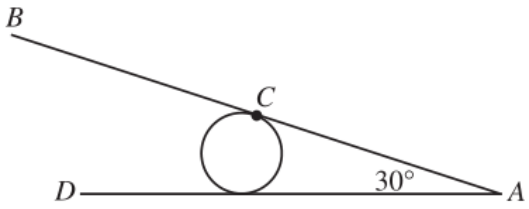
_____

The robot malfunctions and the "C" command stops working. Combining three "A" commands to replicate the "C" command will work, but it is possible to complete the maze without increasing the total number of commands.

b) Give an ordered list of commands which will get the *malfunctioning* robot from the start to the end using the same number of commands as part (a). You should clearly state which direction the robot is facing at the end (into, or out of the maze).

_____

Question 8 A metal rod with ends A and B is welded at its middle, C, to a cylindrical drum of diameter $\frac{12}{\pi}\,cm$. The rod touches the ground at A making a 30° angle. The drum starts to roll along AD in the direction of D.



How far along AD must the drum roll for B to touch the ground?

Question 9 A bag contains a mixture of only red, blue, green, and yellow sweets.

- The ratio of red to blue sweets is 2: 3
- The ratio of green to yellow sweets is 5: 4
- One quarter of the sweets are red.

a) What fraction of the sweets are blue?

_____

b) What is the ratio of red to yellow sweets?

_____

Question 10 You are given a list of distinct positive integers:

$$11,\ 4,\ 3,\ 7,\ x \text{ and } y$$

a) When 7 is ignored, the mean of the remaining five numbers is 8.

Find the sum of x and y.

_____

b) Two more means are calculated in the same way, by ignoring one number from the list. When y is ignored, the mean is 1.2 more than when x is ignored.

Find the difference between x and y.

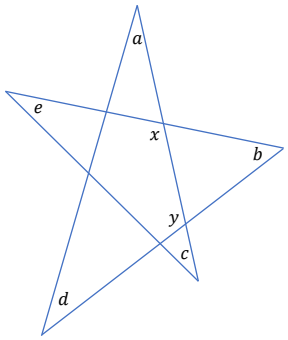
_____

c) Hence find the values of x and y.

_____

Question 11 A runner takes part in a 5 km race. After each kilometre she takes a 60 second break and when she resumes running she runs 2 km/h slower than she ran the previous kilometre. If she runs the first kilometre at 12 km/h, how long does it take her to complete the race?

Question 12 The diagram below shows a five-pointed star. The angles a, b, c, d, and e are the angles in each of the points.



a) Write an expression for angle x in terms of angles e and c.

b) Write a similar expression for angle y in terms of a and d, and hence find the sum of angles a, b, c, d, and e. You should justify your solution with angle reasons.

Question 13 a, b and c are distinct positive integers such that $abc = 16$.

Find the largest possible value of $a^b - b^c + c^a$.

Question 14 In the addition problem below, each letter stands for a **different** non-zero digit.

$$\begin{array}{cccc} & X & X \\ & Y & Y \\ + & Z & Z \\ \hline X & Y & Z \end{array}$$

a) Explain why X must be less than three.

b) Show that X cannot equal two (you should start by assuming that X does equal two).

c) Find the correct values for X, Y and Z.