F4 Diagnostic Test
MATHEMATICS Compulsory Part
Question Paper

Instructions

1. This paper must be answered in English.
2. Unless otherwise specified, all working must be clearly shown.
3. Unless otherwise specified, numerical answers must be exact.
4. This paper is for **internal use** only.

1. This is a simple algebra question.

   (a) Solve the following system of equations:

   $$\begin{cases} 2x + 3y - 5 = 0 \\ 3x - 2y + 1 = 0 \end{cases}$$

   (b) Given $L_1 : 2x + 3y - 5 = 0$ and $L_2 : 3x - 2y + 1 = 0$ be two straight lines.

      i. Show that they are perpendicular to each other.

      ii. Find the points of intersection of L_1 and L_2.

      iii. Find the distance from the origin to the points of intersection of L_1 and L_2.

2. This is a simple algebra question.

   (a) Make y the subject of $\dfrac{x}{y} = \dfrac{\sqrt{y - 7x - 8}}{3y}$.

   (b) Suppose α and β satisfy the above equation when $y = 2$.

      i. Find $\alpha + \beta$ and $\alpha\beta$.

      ii. Find $\alpha^2 + \beta^2$.

      iii. Form an quadratic equation with roots α^2 and β^2.

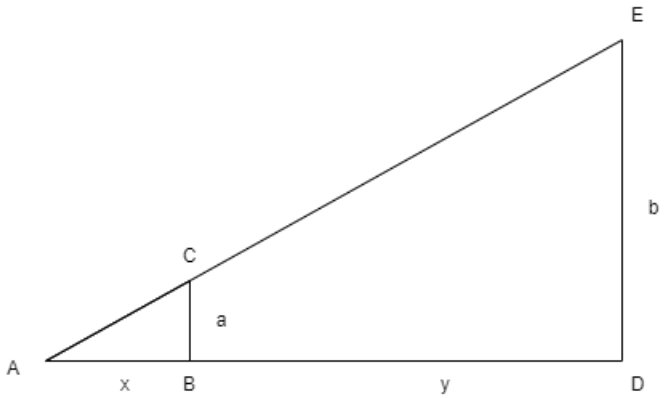
   (c) Suppose $f(y) = y^2 + 2y$ and y satisfy the equation in (a) with $y \neq 0$. Write $g(x) = f(y)$ when y is being substituted by the corresponding formula in x.

      i. Factorize $g(x)$ in terms of x.

      ii. Solve for $g(x)$

      iii. Find the remainder when $g(x)$ is divided by $x - 2$.

3. This is some basic geometry.



   Given the above figure. ACE and ABD are straight lines. Also known that $AB = x$, $BD = y$, $BC = a$ and $DE = b$.

(a) Prove that $\triangle ABC \sim \triangle ADE$.

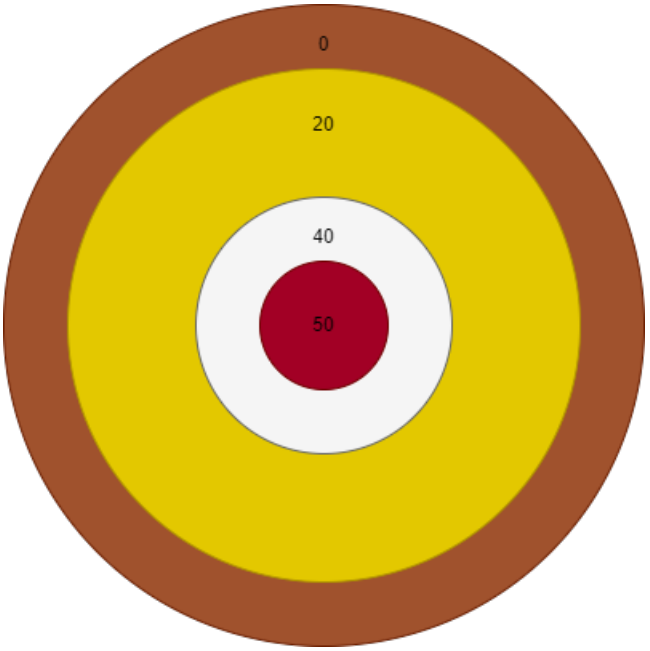
(b) Find a in terms of b, x, y.

(c) If $\angle CAB = 30°$, with $b = 10$ and $y = 7\sqrt{3}$, find the area of $\triangle ABC$.

4. Find the mean, mode, median of the following data:

$$12, 13, 13, 13, 14, 14, 15, 15, 15, 17, 17, 18$$

5. Given a shooting board as following:



It is given that the red zone is a circle of radius 5 cm, the white zone is a path of width 5 cm, the yellow zone is a path of width 10 cm, and the orange zone is a path of width 5 cm. Each zone owes the value written on the board. Suppose Owen is a shooter who has never missed any shots.

(a) Find the probability for Owen to hit the red zone, the white zone, the yellow zone and the orange zone respectively. You may assume the chance of hitting every position on the board is equal.

(b) Find the expected value of each shot for Owen.