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F4 2nd Term Examination (2022 – 2023)

Subject: Mathematics (Compulsory Part)

Paper 1

Question - Answer Book

Time: 2 hours

Total Marks：130   **Total No. of Pages：19**

INSTRUCTIONS

1. This paper must be answered in English.

2. Write your Name, Class and Class Number in the space provided on Page 1.

3. This paper consists of THREE sections, A(1), A(2) and B.

4. Attempt ALL questions in this paper. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

5. Supplementary answer sheets will be supplied on request. Write your Name, Class and Class Number, mark the question number box on each sheet, and fasten them INSIDE this book.

6. Unless otherwise specified, all working must be clearly shown.

7. Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.

8. The diagrams in this paper are not necessarily drawn to scale.

Section A(1)   (44 marks)

1. Simplify $\dfrac{(mn^4)^3}{m^{-6}n^{17}}$ and express your answer with positive indices.

    (3 marks)

2. Make a the subject of the formula $\dfrac{a+3b}{ab-3}=2$.

    (3 marks)

3. Factorize
    (a) $4xy + 6x^2$,
    (b) $4xy + 6x^2 - 12x - 8y$.

(3 marks)

4. The cost of a wallet is \$120. The percentage profit is 25% if the wallet is sold at its marked price.
    (a) Find the marked price of the wallet.
    (b) If the wallet is sold at a discount of 10% on its marked price, what is the new profit percentage?

(4 marks)

5. Cathy and John bought some stamps. If Cathy gives 3 stamps to John, they will have the same number of stamps. If John gives 3 stamps to Cathy, the number of stamps that Cathy has will be 4 times that of John. Find the total number of stamps Cathy and John have.

(4 marks)

6. Consider the compound inequality

$$-6x \geq 12 \quad \text{and} \quad \frac{2x+5}{3} > 2(x+1) \qquad \ldots\ldots(*)$$

(a) Solve (*).

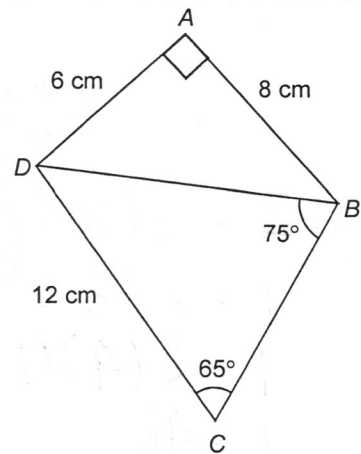**(b)** Write down the greatest negative integer satisfying (*).

7. In the figure, find
   (a) the length of BD and BC,
   (b) the area of the quadrilateral $ABCD$.
   (Give your answer correct to 3
   significant figures.)

   (5 marks)

8. It is given that z varies jointly as $(x-2)$ and y^3. When $x=6$ and $y=1$, $z=1$.

    (a) Express z in terms of x and y.

    (b) Find the value of y when $x=10$ and $z=-16$.

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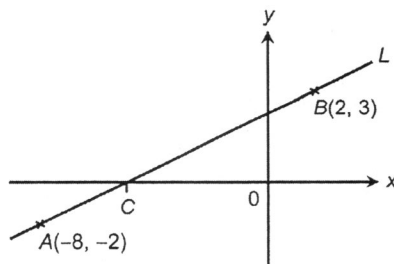
(5 marks)
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9. When a polynomial $f(x)$ is divided by $-3x+3x^2$, the quotient and the remainder are $x+5$ and $-2x+3$ respectively.

    (a) Find the polynomial $f(x)$.

    (b) Find the quotient and the remainder of $f(x) \div (3x^2 + 5)$.

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(6 marks)
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10. In the figure, the straight line L passes through two points $A(-8, -2)$ and $B(2, 3)$, and intersects the x-axis at C.
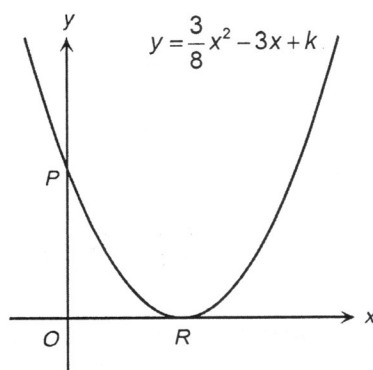

(a) Find the equation of L.

(b) **(i)** Find the coordinates of C.

(ii) If L_1 is a straight line passing through C and $(-4, -5)$, find the equation of L_1.
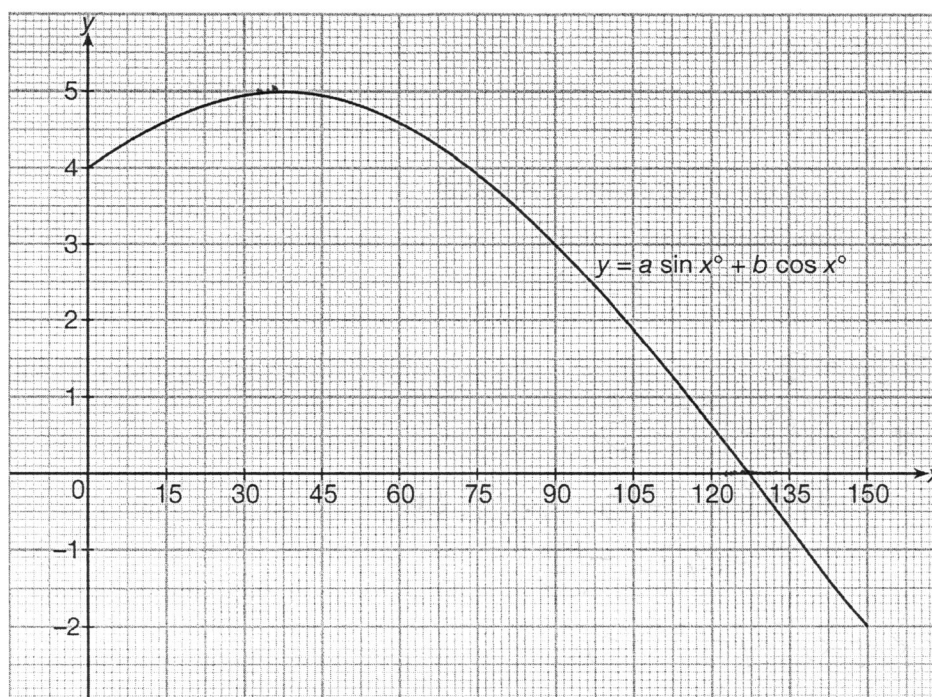
(6 marks)

Section A(2)   (43 marks)

11.   The figure shows the graph of $y = \dfrac{3}{8}x^2 - 3x + k$ which touches the x-axis at

one point R, and cuts the y-axis at P.

(a) **(i)**   Find the value of k.

   (ii)   Find the coordinates of P and R.   **(5 marks)**

(b)   It is given that another point Q lying on the graph of $y = \dfrac{3}{8}x^2 - 3x + k$

such that PQ is parallel to the x-axis. Find the area of $\triangle PQR$.

                                                                                                    (2 marks)

12. The figure shows the graph of $y = a \sin x° + b \cos x°$ for $0 \le x \le 150$.

(a) Find the values of a and b.   **(4 marks)**

(b) Find the maximum value of y and the corresponding value of x. **(2 marks)**

(c) Using the graph, solve the following equations.

    (i) $6 \sin x° + 8 \cos x° = 0$

    (ii) $3 \sin x° + 4 \cos x° - 2 = 0$

(Give the answers correct to the nearest grid scale.)   **(4 marks)**

13. $f(x)$ is partly constant and partly varies as $(x-1)^2$. It is given that $f(0)=6$ and $f(4)=-10$.

    (a) Find $f(x)$.   **(4 marks)**

    (b) If V is the vertex of the graph of $y=f(x)$, and the graph cuts the x-axis at A and B.

        (i) Find the coordinates of A and B.

        (ii) Find the area of $\triangle VAB$.   **(5 marks)**

14. Let $f(x) = (x-m)(x-n)(3x-1) - 24$, where m and n are positive integers and $m > n$. It is given that $x-3$ is a factor of $f(x)$.

(a) (i) Show that $(m-3)(n-3) = 3$.

(ii) Write down the values of m and n. **(4 marks)**

(b) It is given that $f(x) \equiv (x-3)(ax^2 + bx + c)$, where a, b and c are constants. Find the values of a, b and c. **(4 marks)**

15. In **Figure (1)**, $\triangle ABC$ is an equilateral triangle of side 9 cm. D is a point on BC such that $\angle BAD = 25°$ and $BD = x$ cm.
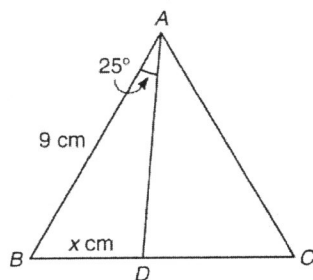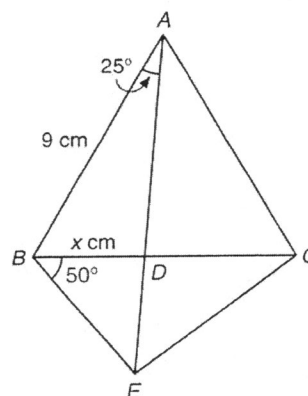

Figure (1)	**Figure (2)**

(a) (i)   By considering $\triangle ABD$ and $\triangle ACD$, show that $\dfrac{x}{\sin 25°} = \dfrac{9 - x}{\sin 35°}$.

(ii)   Hence, find the value of x correct to 3 decimal places.
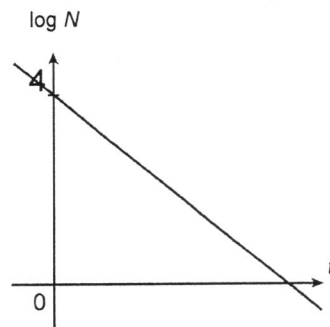
(5 marks)

(b) AD is produced to E such that $\angle EBD = 50°$ as shown in **Figure (2)**. Find the lengths of BE and CE correct to 3 significant figures.

(4 marks)

Section B   (43 marks)

16. The number N of a certain kind of insects in a forest t months after the implementation of a insect control program is given by $N = A(1.2)^{-2t}$, where A is a constant. The graph shows the relation between $\log N$ and t. The vertical intercept of the graph is 4 as shown.

(a) Find the value of A.

(3 marks)

(b) How long will the number of the insects be halved? (Give the answer correct to 3 significant figures.)

(4 marks)

17. **(a)** Express $\dfrac{15}{3-4i}$ and $\dfrac{15}{3+4i}$ in the form $a + bi$, where a and b are real numbers. **(4 marks)**

(b) The roots of the quadratic equation $5px^2 - 9x + q = 0$ are $\dfrac{15}{3-4i}$ and $\dfrac{15}{3+4i}$, where $p \neq 0$ and q is a constant.

By considering the sum of roots and the product of roots, find the values of p and q. **(4 marks)**

18. (a) Let $f(x) = 40x - x^2$. Using the method of completing the square, find the coordinates of the vertex of the graph of $y = f(x)$.

(3 marks)

(b) The length of a piece of wire is 160 m. Jason cuts the wire into three pieces. One piece is used to enclose a rectangular playground of area A m^2. The other two pieces of length x m each are used to divide this playground into three rectangular parts as shown in the figure.
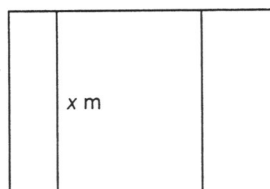
(i) Express A in terms of x.

(ii) Jason claims that the area of the playground enclosed can be larger than 800 m^2. Do you agree? Explain your answer.

(4 marks)

19. It is given that $\dfrac{\cos^2(180° - x) - 3}{5\cos(180° + x)} = \sin(360° - x)$.

    (a) Show that $3\tan^2 x + 5\tan x + 2 = 0$. **(5 marks)**

    (b) Hence, solve $\dfrac{\cos^2(180° - x) - 3}{5\cos(180° + x)} = \sin(360° - x)$ for $0° \le x \le 360°$.

(Give your answers correct to 1 decimal place if necessary.) **(4 marks)**

20. It is given that the straight line L_1 passes through $A(8, 4)$ and is parallel to the straight line $L_2 : 4x + 12y = 21$.

(a) Find the equation of L_1.   **(3 marks)**

(b) It is known that L_1 is perpendicular to the straight line $L_3 : y = kx$.

    (i) Find the value of k.

    (ii) Find the coordinates of the intersection of L_1 and L_3.

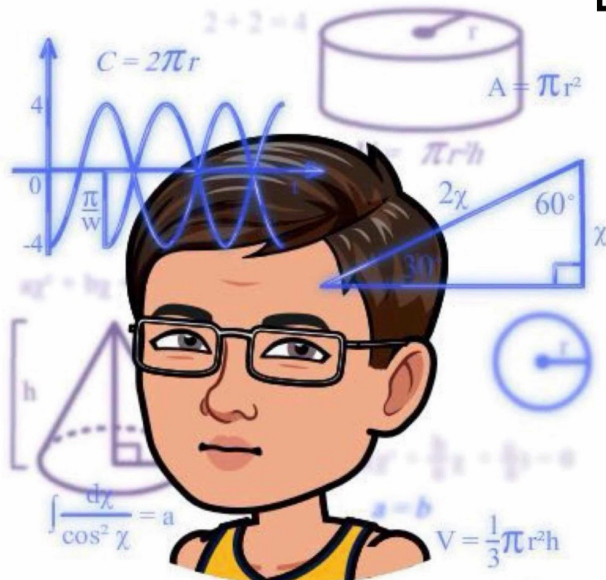   **(iii)** Hence, find the shortest distance from A to L_3. (Leave your answer in surd form.)   **(9 marks)**

END OF PAPER