SECTION (A)
(Answer **ALL** questions)

1.(a) If $f : R \to R$ and $g : R \to R$ are defined by $f(x) = bx - 57$ where b is a constant and
$g(x) = x + 7$, $(f \circ g)(1) = 7$, find the value of b.   (3 marks)

  (b) Given that the expression $x^3 - ax^2 + bx + c$ leaves the same remainder when divided by
$x + 1$ or $x - 2$, find the relation between a and b.   (3 marks)

2.(a) Given that the coefficient of x^3 in the expansion of $(k + 3x)^6$ is 20, find the value of k.
    (3 marks)

  (b) If the third term and the tenth term of an A.P. are 11 and 39 respectively, find the first
term and the common difference of the A.P.   (3 marks)

3.(a) Given that $A = \begin{pmatrix} h & 3 \\ -3 & 2 \end{pmatrix}$, $B = \begin{pmatrix} 2 & -3 \\ 3 & -4 \end{pmatrix}$ and $AB = I$ where I is the unit matrix of order 2,

      find the value of h.   (3 marks)

  (b) If a die is rolled 240 times, find the expected frequency of getting a factor of 30.
    (3 marks)

4.(a) In the figure, O is the centre of the circle and
     AOD is a diameter. If $\angle CBD = 38°$, find $\angle ADC$.
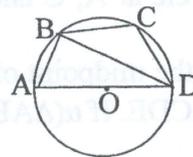
    (3 marks)

  (b) Find the matrix which rotates through $60°$ and find the map of the point (0, 2). (3 marks)

5.(a) Find the value of $\cos 165°$ in surd form.   (3 marks)

  (b) Calculate $\lim\limits_{x \to 4} \dfrac{x^2 - 16}{x - 4}$ and $\lim\limits_{x \to \infty} \dfrac{x^2 - 2x + 1}{2 + x - x^2}$.   (3 marks)

SECTION (B)
(Answer any **FOUR** questions)

6.(a) Functions f and g are defined by $f(x) = cx + d$, where c and d are constants, $g(x) = \dfrac{1}{3}x - 1$.

     If $f(2) = g^{-1}(2)$ and $(f \circ g)(-3) = -3$, find the values of c and d.   (5 marks)

  (b) Given that the equation $2x^3 + px^2 + qx - 12 = 0$ has roots $x = 1$ and $x = 4$, find the values
of p, q and the third root.   (5 marks)

7.(a) Let R be the set of real numbers and a binary operation $\odot$ on R be defined by
$x \odot y = xy + x - y$ for x, y $\in$ R. Find the values of $(2 \odot 3) \odot 4$ and $2 \odot (3 \odot 4)$. Is this
binary operation associative? Why?   (5 marks)

  (b) Using binomial theorem, find the coefficient of x^2 in the expansion of $(3 + 2x - x^2)^5$.
    (5 marks)

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8.(a) Find the solution set in R of the inequation $25x^2 - 5x - 12 \leq 0$ by graphical method and illustrate it on the number line. (5 marks)

(b) The sum to n terms of an A.P. is 18. The common difference is 3 and the sum to 3n terms is 135. Find the sum of the first 20 terms of the progression. (5 marks)

9.(a) The fourth term of a G.P. exceeds the third term by $\dfrac{3}{8}$ and the third term exceeds the second term by $\dfrac{1}{4}$. Find the first term and the sixth term of the G.P. (5 marks)

(b) Given that $A = \begin{pmatrix} 4 & 1 \\ 7 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} -2 & 3 \\ 6 & 8 \end{pmatrix}$, find $3A' + BA^{-1}$. (5 marks)

10.(a) Find the solution set of the system of equations $x + 3y = 7$ and $5y - 2x = -3$ by matrix method. (5 marks)

(b) A coin is tossed three times. Head or tail is recorded each time. Drawing a tree diagram, find the probability of (i) getting exactly one head, (ii) getting at least one head, and (iii) getting at most one head. (5 marks)

SECTION (C)
(Answer any THREE questions)

11.(a) Two circles touch externally at P and through P two straight lines AB, CD are drawn meeting one circle at A, C and the other at B, D respectively. Prove that AC and DB are parallel. (5 marks)

(b) In $\triangle ABC$, D is the midpoint of AC. E is on BC such that DE ∥ AB. Compare the areas of $\triangle ABC$ and $\triangle CDE$. If $\alpha(\triangle ABC) = 120$, what is $\alpha(ABED)$? (5 marks)

12.(a) In the figure, PBX and QBY are segments and $\angle PAB = \angle QAB$. Prove that $PB \cdot BX = QB \cdot BY$.
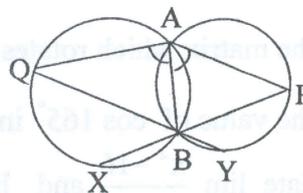
(5 marks)

(b) Given that $2\sin(\alpha + \beta) = 5\sin(\alpha - \beta)$, show that $3\tan\alpha = 7\tan\beta$ and hence show also that $49\cos^2\alpha - 9\cos^2\beta = 40\cos^2\alpha\,\cos^2\beta$. (5 marks)

13.(a) Solve $\triangle ABC$ with $\angle A = 25°$, $\angle C = 55°$, $AC = 12$. (5 marks)

(b) If $y\sin x = e^x$, show that $\dfrac{d^2y}{dx^2} + 2\cot x\,\dfrac{dy}{dx} - 2y = 0$. (5 marks)

14.(a) Position vectors of points P, Q and R relative to an origin O are $2\hat{i} + 7\hat{j}$, $6\hat{i} + \hat{j}$ and $2t\hat{i} + t\hat{j}$ respectively. If P, Q and R are collinear, find the value of t and the value of $|\overrightarrow{PQ}|$. (5 marks)

(b) Show that the equation of the normal to the curve $y = (2x + a)^3$, $a \neq 0$, at the point where $y = a^3$ is $x + 6a^2 y = 6a^5$. (5 marks)

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