

FORM FOUR PRE-NATIONAL EXAMINATIONS 2025

Additional Mathematics - Detailed Worked Solutions (Q1–Q14)

Q1 Solution:

(a) Sequence terms: $1 \times \frac{1}{2}$, $3 \times \frac{1}{4}$, $9 \times \frac{1}{8}$, $27 \times \frac{1}{16}$... Numerators are powers of 3, denominators are powers of 2. Next term = $81/32$.

(b) Sum of digits of 31752 = 18, divisible by 9. Test for 7: $31752 \rightarrow 3171 \rightarrow 315$, divisible by 7. Hence divisible by both 7 and 9.

Q2 Solution:

(a) $A \cup B \cup C = \{1, 2, 3, 4, 5, 6\}$.

(b) Verified: $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ and $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$. Both hold true.

Q3 Solution:

(a) $P(x) = 6x^2 + x + 7$. Remainders equal $\Rightarrow P(a) = P(-2a)$. Solving gives $a=0$ or $a=1/6$.

(b) Expression $(3a^2 - 4b^2)/(a^3 + 2b)$ cannot be simplified further.

Q4 Solution:

(a) Exterior angle assumed $= 72^\circ$. Interior $= 108^\circ$, sum $= 540^\circ$, sides $= 5$.

(b) Squares: $x^2 + y^2 = 100$, $x + y = 14$. Solving gives sides 6 cm and 8 cm.

Q5 Solution:

(a) $f(x) = (x^2 + x)(x + 4) = x^3 + 5x^2 + 4x \Rightarrow f'(x) = 3x^2 + 10x + 4$.

(b) $\int_0^{\pi/2} (4\cos x + 2\sin^2 x) \cos x \, dx$. Let $u = \sin x \Rightarrow \text{integral} = \int_0^1 (4 + 2u^2) du = 14/3$.

Q6 Solution:

(b) Locus equidistant from A(2,3), B(2,7). Equation: $(x-2)^2 + (y-3)^2 = (x-2)^2 + (y-7)^2 \Rightarrow y=5$.

Q7 Solution:

(a) Equidistant from A(1,2), B(-2,-1). Perpendicular bisector: $y = -x$.

(b) Circle with diameter (0,1), (2,3). Centre (1,2), $r^2 = 2 \Rightarrow (x-1)^2 + (y-2)^2 = 2$.

Q8 Solution:

(a) P(x,0), A(8,4), B(6,6). Given $PA = PB \Rightarrow x=2$.

(b) $x = a \tan \theta$, $y = b \cos \theta$. Identity: $1 + \tan^2 \theta = 1/\cos^2 \theta \Rightarrow y^2 = (a^2 b^2)/(a^2 + x^2)$.

Q9 Solution:

- (a) Front elevation = view from front; Plan view = top view.
 (b) Angle between lines $4x+3y-21=0$ (slope= $-4/3$) and $y=3x$ (slope=3). $\tan\theta=13/9$.

Q10 Solution:

- (a) Circle $x^2+y^2-4x+6y-12=0 \Rightarrow (x-2)^2+(y+3)^2=25 \Rightarrow \text{radius}=5 \Rightarrow \text{diameter}=10$.
 (b) Line $4x-3y-5=0$ intersects circle $x^2+y^2+3x-y-10=0$ in 2 points $\Rightarrow$ chord.

Q11 Solution:

- (a) Six-digit even numbers from $\{1,2,3,4,5,7\}$. Cases: first=4, last=2 $\Rightarrow 24$. First=5/7, last=2/4 $\Rightarrow 96$. Total=120.
 (b) Logical formula unreadable in PDF (needs exact text).
 (c) Distance from (6,5) to line $y=(5/12)x-7/6$. Line: $-5x+12y+14=0$.
 Distance= $|-30+60+14|/13=44/13$.

Q12 Solution:

- (a) (i) Arrangements of BARAZA = $6!/3!=120$. (ii) Choose 3 of 5 teachers and 2 of 15 students: $10 \times 105=1050$.
 (b) $P(\text{Red then Black})=5/12 \times 7/12=35/144$.
 (c) $P(\text{exactly one of Husna/Ally})=0.4(0.3)+0.7(0.6)=0.54$.

Q13 Solution:

- (a) $f(x)=(1-x)^3$. x-intercept at 1, y-intercept 1. Stationary point (1,0) is inflection.
 (b) Reflect (4,8) in line $y-x=2 \Rightarrow (6,6)$.
 (c) $a \times (b \times c) = b(a \cdot c) - c(a \cdot b) = 2b + (c) = 3i - 4j + k$.

Q14 Solution:

- (a) Frequency distribution:
 10–19:7, 20–29:10, 30–39:11, 40–49:9, 50–59:6, 60–69:3, 70–79:4. Total=50.
 (b)(i) Median=37. (ii) Mean= $1930/50=38.6$ g.