MARKING SCHEME

MATHEMATICS Compulsory Part · Paper 1

Topic practice: Quadratic Equations in One Unknown · 2027

This marking scheme has been prepared for markers' reference. It is not a set of model answers. Award method marks where the working is sound. Accept equivalent methods unless the question specifies otherwise.

Question	Solution	Marks	Remarks
SECTION A(1) (16 marks)			
1.	$x = 2$ **or** $x = 3$ $x^2 - 5x + 6 = (x - 2)(x - 3) = 0$, so $x = 2$ or $x = 3$.	3	
2.	$2x^2 + 5x - 3 = 0$ The roots give $(x + 3)(x - \frac{1}{2}) = 0$. Multiplying by 2: $(x + 3)(2x - 1) = 0$, so $2x^2 + 5x - 3 = 0$.	3	
3.	$k = 8$ For equal roots, the discriminant is zero: $\Delta = k^2 - 4(2)(8) = k^2 - 64 = 0$. Hence $k = \pm 8$. Since $k > 0$, $k = 8$.	4	
4.	$x = \frac{-1 \pm \sqrt{22}}{3}$**;** $x \approx 1.23$ **or** $x \approx -1.90$ Using the quadratic formula with $a = 3$, $b = 2$, $c = -7$: $x = \frac{-2 \pm \sqrt{2^2 - 4(3)(-7)}}{2(3)} = \frac{-2 \pm \sqrt{88}}{6} = \frac{-1 \pm \sqrt{22}}{3}$. Numerically, $x \approx 1.230$ or $x \approx -1.897$, i.e. 1.23 or −1.90 (3 s.f.).	6	
SECTION A(2) (24 marks)			
5.	**Width** = 5 m**, length** = 8 m Let the width be w metres. Then the length is $(w + 3)$ metres. The area gives $w(w + 3) = 40$, so $w^2 + 3w - 40 = 0$. Factorising: $(w + 8)(w - 5) = 0$, so $w = 5$ or $w = -8$. Since $w > 0$, $w = 5$. The length is $5 + 3 = 8$ m.	7	
6.	**(a)** 14 **(b)** 4 By the relations between roots and coefficients, $\alpha + \beta = 4$ and $\alpha\beta = 1$. (a) $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = 4^2 - 2(1) = 14$. (b) $\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\alpha + \beta}{\alpha\beta} = \frac{4}{1} = 4$.	8	
7.	**(a)** $y = (x - 3)^2 - 4$ $y = x^2 - 6x + 5 = (x^2 - 6x + 9) - 9 + 5 = (x - 3)^2 - 4$.	3	

TUTGATHER

Question	Solution	Marks	Remarks
	(b) Vertex $(3, -4)$; axis of symmetry $x = 3$ From $y = (x-3)^2 - 4$, the vertex is $(3, -4)$ and the axis of symmetry is the vertical line $x = 3$.	2	
	(c) $(1, 0)$ and $(5, 0)$ Set $y = 0$: $(x-3)^2 = 4$, so $x - 3 = \pm 2$. Hence $x = 1$ or $x = 5$. The x-intercepts are $(1, 0)$ and $(5, 0)$.	2	
	(d) Translate the graph of $y = x^2$ right by 3 units and down by 4 units. Since $y = (x-3)^2 - 4$, the graph is obtained from $y = x^2$ by a translation of 3 units to the right and 4 units downwards.	2	
SECTION B (10 marks)			
8.	**(a)** $h = -5(t-2)^2 + 21.5$ $h = -5(t^2 - 4t) + 1.5 = -5[(t-2)^2 - 4] + 1.5 = -5(t-2)^2 + 20 + 1.5 = -5(t-2)^2 + 21.5$.	3	
	(b) Maximum height 21.5 m at $t = 2$ s Since $-5(t-2)^2 \le 0$, $h \le 21.5$. The maximum height is 21.5 m, reached when $t = 2$.	2	
	(c) $t \approx 4.07$ s Set $h = 0$: $-5t^2 + 20t + 1.5 = 0$, i.e. $10t^2 - 40t - 3 = 0$. Then $t = \frac{40 \pm \sqrt{1600 + 120}}{20} = 2 \pm \frac{\sqrt{430}}{10}$. Since $t > 0$, $t = 2 + \frac{\sqrt{430}}{10} \approx 4.0736$, i.e. 4.07 s (3 s.f.).	3	
	(d) $1.16 \le t \le 2.84$ Require $-5t^2 + 20t + 1.5 \ge 18$, i.e. $10t^2 - 40t + 33 \le 0$. The roots are $t = 2 \pm \frac{\sqrt{70}}{10}$, so $1.163 \ldots \le t \le 2.836 \ldots$. Hence $1.16 \le t \le 2.84$ (3 s.f.).	2	

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