Hougang Secondary School
Mathematics Department
MARKSCHEME
Mathematics Syllabus Express/Normal Academic/Normal Technical
Subject : Mathematics
Examination : Prelim 2
Level : 4E/5N/4AO
Paper : 2

Qn	Working	Marks	Remarks
Q1(a) (i)	$\frac{9p}{4q} \div \frac{p^3}{12q^2}$ $= \frac{9p}{4q} \times \frac{12q^2}{p^3}$ $= \frac{27q}{p^2}$	**M1** **A1**	
(a)(ii)	$9^{2x-1} \times 27^{-x} = \frac{1}{81}$ $(3^2)^{2x-1} \times (3^3)^{-x} = 3^{-4}$ $3^{4x-2-3x} = 3^{-4}$ $3^{x-2} = 3^{-4}$ $x - 2 = -4$ $x = -2$	**M1** **M1** **A1**	**Apply laws of indices** **Simplifying the powers**
Q1(b) (i)	$\text{P(sec 4)} = \frac{14}{30}$ $= \frac{7}{15}$	**B1**	
b(ii)	P(both sec 3) + P(both sec 4) $= \frac{16}{20} \times \frac{15}{29} + \frac{14}{20} \times \frac{13}{29}$ $= \frac{211}{435}$	**M1** **A1**	

b(iii)	Required prob = 1 – P(both boys) $= 1-\frac{13}{30}\times\frac{12}{29}$ $= \frac{119}{145}$ Alternative Mtd: P(boy , girl) + P(girl, boy) + P(both girls) $=\frac{13}{30}\times\frac{17}{29}+\frac{17}{30}\times\frac{13}{29}+\frac{17}{30}\times\frac{16}{29}$ $=\frac{119}{145}$	**M1** **A1** **M1** **A1**	
Q2(a)	$\angle OAD = \frac{180^o - 76^o}{2}$ (base $\angle$ of isos $\triangle$) $= 52^o$ $\angle DAQ = 90^o - 52^o$ (rad $\perp$ tangent) $= 38^o$	**M1** **A1**	
Q2(b)	$\angle CDA = 38^o + 39^o$ (ext $\angle$ = sum of 2 int opp $\angle s$) $= 77^o$ $\angle ABC = 180^o - 77^o$ ($\angle$ in opp seg are supp) $= 103^o$	**M1** **A1**	
Q2(c)	$\angle ACD = \frac{76^o}{2}$ ($\angle$ at centre = 2 $\angle$ at circumference) In ΔACD, $\angle CAD = 180^o - 38^o - 39^o$ (sum of $\angle s$ in a Δ) $= 103^o$ $\angle CAD = \angle OAC + \angle OAD$ $103^o = \angle OAC + 90^o$ $\angle OAC = 103^o - 90^o$ $= 13^o$	**M1** **M1** **A1**	

Q3(a)	5 x \$0.90 + 4 x \$1.70 = \$11.30	**M1** **A1**	
Q3(b) (i)	$0.60x = \frac{1}{3}(0.90y)$ $x = \frac{0.30y}{0.60} = \frac{1}{2}y$ (shown)	**B1**	
(b)(ii)	$x = \frac{1}{2}y$ -----(1) Also, total cost $24 = 0.60x + 0.90y$ ----------(2) Sub (1) into (2) $0.60(\frac{1}{2}y) + 0.90y = 24$ $1.2y = 24$ $y = 20$ $x = \frac{1}{2}(20) = 10$	**M1** **M1** **A1**	A1 for both x and y
Q4(a)	$\measuredangle TPQ = \measuredangle URQ = 90^o$ (property of a square) $TQ = UQ$ (*given*, $\triangle UTQ$ equilateral) $PQ = RQ$ (side of a square) $\Delta TPQ \equiv \Delta URQ$ (*RHS*)	**M2** **A1**	Any 2 correct State correct test
Q4(b)	$UQ = \sqrt{x^2 + 15^2} = \sqrt{x^2 + 225}$	**B1**	Accept $\sqrt{x^2 + 15^2}$
Q4(c)	$ST = SU = 15 - x$ $UT = \sqrt{(15-x)^2 + (15-x)^2} = \sqrt{2(15-x)^2}$ $UT = UQ$ $\sqrt{2(15-x)^2} = \sqrt{x^2 + 225}$ $2(225 - 30x + x^2) = x^2 + 225$ $x^2 - 60x + 225 = 0$ (*shown*)	**M1** **M1**	For *UT* For expanding
Q4(d)	$x = \frac{60 \pm \sqrt{(-60)^2 - 4(1)(225)}}{2(1)}$ $= 55.98$ *or* 4.0192 Since $x < 15$, $x = 4.02$	**M1** **M1** **A1**	Using formula
Q4(e)	*TU* = diameter of circle	**M1**	

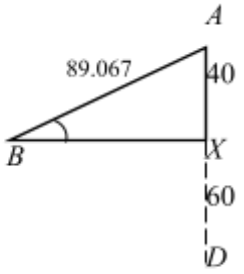
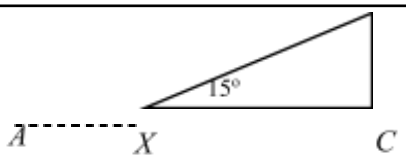
	$= \sqrt{225+(4.0192)^2} = 15.529$ Radius $= \dfrac{15.529}{2} = 7.76$	**A1**	
Q5(a) (i)	$\dfrac{V_1}{V_2} = \left(\dfrac{h_1}{h_2}\right)^3$ & time taken to fill pail α V $\dfrac{V_1}{V_2} = \dfrac{8}{1} = \left(\dfrac{h_1}{15}\right)^3$ $\dfrac{h_1}{15} = 2$ $h_1 = 30$ Height of the larger pail = 30 cm	**M1** **A1**	
(a)(ii)	$\dfrac{A_1}{A_2} = \left(\dfrac{30}{15}\right)^2$ $A_1 = 4A_2$ Total : 5parts where A_1 and A_2 is the exterior surface of the big and small pail respectively. 1 part = 0.25 m^2 5 parts = 1.25 m^2 1 coat of paint covers 1.25 m^2 2 coats of paint cover 2.5 m^2 < 3 m^2 Yes, 1 tin of paint is sufficient to give the 2 pails two coats of paint.	**M1** **M1** **A1**	
Q5(b) (i)	$\dfrac{\text{Area of } \Delta ALM}{\text{Area of } \Delta DLC} = \left(\dfrac{LM}{LC}\right)^2 = \left(\dfrac{1}{3}\right)^2 = \dfrac{1}{9}$,	**B1**	
(ii)	$\dfrac{\text{Area of } \Delta AML}{\text{Area of } \Delta ACL} = \dfrac{\frac{1}{2}(LM)h}{\frac{1}{2}(CL)h} = \dfrac{LM}{CL} = \dfrac{1}{3}$	**B1**	
Q6(a)	Each row increase by 2 units, each column by 10, so sum increase for each no. = 12 Total increase for sum of the 4 numbers = 4 x 12 = 48	**M1** **A1**	Accept 13+15+23+25=76, 1+3+11+13 = 28 M1 76-28 = 48 A1
Q6(b)	Sum of the 4 numbers $=(2x-1)+(2x+1)+(2x+9)+(2x+11)$ $= 8x+20$	**M1** **A1**	
Q6(c)	$8x + 20 = 4(41)$	**M1**	

	$8x = 144$ $x = 18$ Smallest number in the particular square $= 2(18) - 1 = 35$	**M1** **A1**	
Q6(d)	Sum of the 4 nos = $8x + 20 = 2(4x+10)$ is always even since it's a multiple of 2, so can never be odd.	**B1**	
Q7(a)(i)	$Q_3 = 46$, $Q_1 = 31.5$, IQR = 14.5	**B1**	Allowance ±0.5
(ii)	the 80th percentile of the distribution, 0.8N = 40 , no. of hrs = 48	**B1**	Accept 47.5
(iii)	30% of 50 students = 15 students No of students who spend ≤ 40hrs = 26 No of students who spend ≤ x hrs = 26 − 15 = 11 From graph $x = 30$	**M1** **M1** **A1**	
(iv)	From graph, median of class A is 39 > median of class B On average, Class A spent more time on their smartphones than Class B. IQR of Class B < IQR of Class A indicates less variation (or smaller spread) in hours spent by Class B (or no of hours spent on smartphones by Class B is more consistent/ homogenous.	**B1** **B1**	Accept median = 39 ± 0.5
Q7(b)(i)	Mean = $\dfrac{5\times2+15\times5+25\times10+35\times12+45\times16+55\times5}{50}$ $= 35$	**B1**	
(b)(ii)	$\sum fx^2 = 69650$ $\text{S.D.} = \sqrt{\dfrac{69650}{50} - 35^2}$ $= 12.961 = 13.0$	**M1** **A1**	Accept 12.96
Q8(a)(i)	$\mathbf{NC} = \begin{pmatrix} 35 & 46 \\ 43 & 70 \end{pmatrix}\begin{pmatrix} 15 \\ 10 \end{pmatrix}$ $= \begin{pmatrix} 985 \\ 1345 \end{pmatrix}$	 **B1**	
(a)(ii)	The elements represent the total costs of producing both titles at Hougang and Bishan outlets. Or The cost of producing both titles at Hougang and	**B1**	

	Bishan outlets are $985 and $1345 respectively.		

Q8(b) (i)	$\begin{pmatrix} 35 & 46 \\ 43 & 70 \end{pmatrix}\begin{pmatrix} p \\ q \end{pmatrix} = \begin{pmatrix} 35p+46q \\ 43p+70q \end{pmatrix}$ **S** = $\begin{pmatrix} p \\ q \end{pmatrix}$, **NS** =	**B1 B1**	
(b) (ii)	**NS – NC**= $\begin{pmatrix} 1905 \\ 2745 \end{pmatrix}$ $\begin{pmatrix} 35p+46q \\ 43p+70q \end{pmatrix} - \begin{pmatrix} 985 \\ 1345 \end{pmatrix} = \begin{pmatrix} 1905 \\ 2745 \end{pmatrix}$ $35p+46q-985=1905$ $43p+70q-1345=2745$ $35p+46q=2890$ ------(1) $43p+70q=4090---(2)$ (1) x 43 – (2)x 35 : $(1505p+1978q)-(1505p+2450q)=-18880$ $-472q=-18880$ $q=40,$ $p=\frac{2890-46(40)}{35}=30$	**M1** **M1** **M1** **A1**	Accept solving by substitution
Q9(a)	$p = 4^2+\frac{2}{4}-1=15.5$	**B1**	
Q9(b)	Graph sketching	**B3**	B1- correct scale B1- correct points plotted B1- shape
Q9(c)	Sketch of tangent line to curve at $x=2$ Gradient of tangent at $x=2$ is $\frac{11-4}{4-2}=3.5$	**M1** **A1**	Accept 2.73 – 4.44
Q9(d) (i)	Sketch of $y=3x$	**B1**	Accept if line does not start from x = 0.5
Q9(d) (ii)	$y=3x$ ----------(1) $y=x^2+\frac{2}{x}-1$ --------(2) At points of intersection, (1) = (2) $x^2+\frac{2}{x}-1 = 3x$	**M1** **M1**	

	$x^3 + 2 - x = 3x^2$ $x^3 - 3x^2 - x + 2 = 0$ (shown)		
(iii)	From graphs, $x =$ 0.75 (± 0.1) or , x = 3.05 (± 0.1)	**B2**	

Q10(a) (i)	$\frac{AB}{\sin 40^o} = \frac{120}{\sin 60^o}$ $AB = 89.067 = 89.1$	**M1** **A1**	
(a)(ii)	$\text{Area} = \frac{1}{2}(89.067)(120)\sin 80^o$ $= 5263.83$ $= 5260$ (3sf)	**M1** **A1**	
(a)(iii)	In ΔBEC, $BE = 120\sin 30^o = 60 = XD$ Angle of depression = Angle of elevation of A from B $= \theta$ $AX = 100 - 60 = 40$ m $\sin\theta = \frac{40}{89.067}$ $\theta = 26.7^o$ 	**M1** **M1** **A1**	
Q10(b) (i)	$\measuredangle ABC = 150^o - (245^o - 180^o) = 85^o$ By cosine rule, $AC^2 = 90^2 + 160^2 - 2(90)(160)\cos 85^o$ $AC = 176.61 = 177$ m	**M1** **M1** **A1**	
(b)(ii)	$h = \frac{1}{3}(28) = \frac{28}{3}$ m $\tan 15^o = \frac{\frac{28}{3}}{XC}$ $XC = \frac{\frac{28}{3}}{\tan 15^o} = 34.832$ 	**M1** **M1**	

	Distance walked = 176.61-34.832 = 141.78 = 142 m	**A1**	

Q11(a)	$\cos \angle COB = \frac{10}{20}$ $\angle COB = \cos^{-1}\left(\frac{1}{2}\right) = 60^o$ Reflex $\angle AOB = 240^o$ Area of shaded segment $= \frac{240^o}{360^o} \times \pi \times (20)^2 + \frac{1}{2}(20)(20)\sin 120^o$ $= 837.758 + 173.205$ $= 1010.96 \text{ cm}^2$ $\approx 1010 \text{ cm}^2$	**M1** **M1,M1** **A1**	M1- Area of triangle, M1 – Area of sector
Q11(b)	Volume of water used in Fig 1 $= 1010.96 \times 55$ $= 55602.8 \text{ cm}^3$ $\approx 0.0556 \text{ m}^3$	**M1** **A1**	
Q11)c)	Cost of water used $= 0.05560885 \times 4 \times \$1.17$ $= \$0.26$	**M1** **A1**	
Q11(d)	Volume of water used in Fig 2 $= \frac{90}{100} \times \pi \times (20)^2 \times (55)$ $= 62203.53 \text{ cm}^3$ Since 55608.85 < 62211.6, the washing machine in **Fig 1** is more water efficient.	**M1** **M1** **A1**	