General Certificate of Education Ordinary Level 2016
Mathematics 4048/02
Syllabus 4048 Paper 2
SUGGESTED Solutions & Marking Scheme Mark Allocation
Prepared by: Jordan Tew (*@math_stuff_here*)

1	(ai)	$a=10$	B1		
	(aii)	$a=\dfrac{4b-5c}{b+c}$ $ab+ac=4b-5c$ $4b-ab=ac+5c$	M1	Rearranging of terms	
		$b(4-a)=ac+5c$ $b=\dfrac{ac+5c}{4-a}$	A1		
	(b)	$\dfrac{6x-9+4x}{12}=3$	M1	Join fraction	
		$10x-9=36$ $10x=45$ $x=\dfrac{9}{2}$	A1	o.e.	
	(c)	$4x-3y=18\ \ ---(1)$ $6x+2y=1\ \ ---(2)$ $(1)\times 2$ $8x-6y=36\ \ ---(3)$ $(2)\times 3$ $18x+6y=3\ \ ---(4)$ $(3)+(4)$ $26x=39$	M1	Elimination or substitution s.o.i.	
		$x=\dfrac{3}{2}$	A1		
		$y=-4$	A1		
	(d)	$\dfrac{(3x+2)(3x-2)}{(3x+2)(x-4)}$	M2	M1 for each factorisation	
		$=\dfrac{3x-2}{x-4}$	A1		
					[11]

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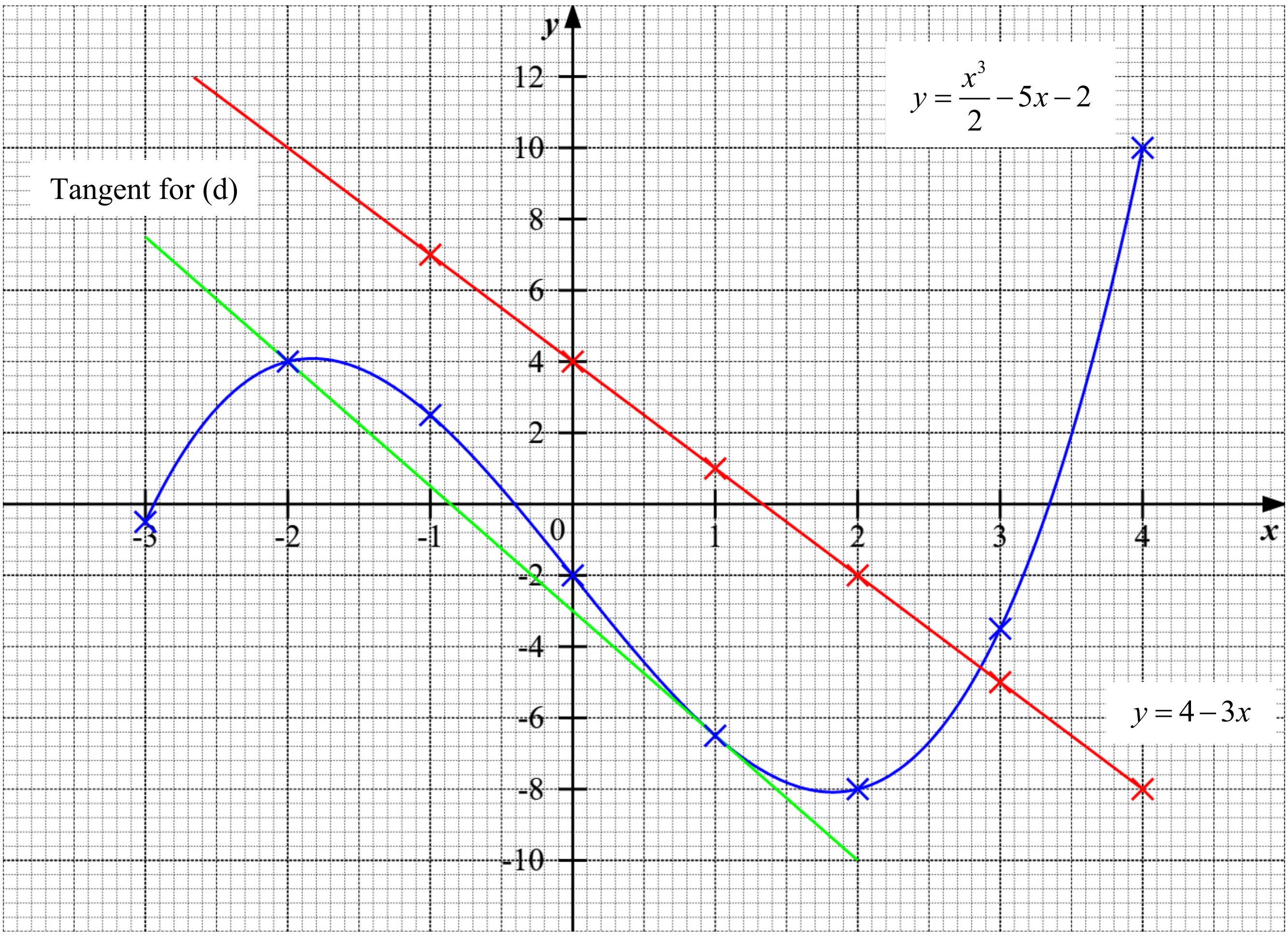
2	(a)	$\mathbf{M} = \begin{pmatrix} 96 & 60 \\ 24 & 48 \end{pmatrix}$	B1		
	(b)	$\mathbf{N} = \begin{pmatrix} 40 \\ 65 \end{pmatrix}$	B1		
	(c)	$\mathbf{P} = \begin{pmatrix} 96 & 60 \\ 24 & 48 \end{pmatrix}\begin{pmatrix} 40 \\ 65 \end{pmatrix} = \begin{pmatrix} 7740 \\ 4080 \end{pmatrix}$	B1		
	(d)	It represents the total session fees collected from a 12-week block of sessions on weekdays and on weekends respectively.	B1		
	(e)	Total $= 12\times\left(19(\$40)(95\%)+9(\$65)(95\%)\right)$	M2	M1 for 95% o.e. M1 for $\times 12$ and no. of students	
		\$15333	A1		
					[7]
3	(a)	$AB = CD$ (Sides of a regular polygon) $BC = DE$ (Sides of a regular polygon) Angle ABC = Angle CDE (Interior angle of a regular polygon)	M1	All reasons given	
		Triangles ABC and CDE are congruent. (SAS Congruency Test)	A1	Must state SAS	
	(bi)	Exterior angle $= 180^\circ - 160^\circ = 20^\circ$	M1	s.o.i.	
		$n = \dfrac{360}{20} = 18$	A1		
	(bii)	Angle BCA $= 10^\circ$	B1		
	(biii)	Angle ACE $= 160^\circ - 2(10^\circ) = 140^\circ$ Angle CAE $= \dfrac{180^\circ - 140^\circ}{2} = 20^\circ$	M1		
		Angle DEA $= 20^\circ + 10^\circ = 30^\circ$	A1		
					[7]

4	(a)	$T_5 = 53$	B1		
	(b)	$T_n = (n+1)^2 + 3n + 2$ For an even value of n, $(n+1)^2$ is odd and $3n + 2$ is even. Hence, T_n is odd for all even n. For an odd value of n, $(n+1)^2$ is even and $3n + 2$ is odd. Hence, T_n is odd for all odd n.	B1	Consider nth term for even and odd values of n	
	(c)	$T_n = (n+1)^2 + 3n + 2$	M1		
		$= n^2 + 2n + 1 + 3n + 2$	M1	Expand	
		$= n^2 + 5n + 3$ (Shown)	A1		
	(d)	$T_{p+1} - T_p$ $= (p+1)^2 + 5(p+1) + 3 - \left(p^2 + 5p + 3\right)$	M1		
		$= p^2 + 2p + 1 + 5p + 5 + 3 - p^2 - 5p - 3$	M1	Expand	
		$= 2p + 6$	A1		
	(e)	If the difference is 4, $2p + 6 = 4 \Rightarrow p = -1$. Since p cannot be negative, two consecutive terms of the sequence cannot have a difference of 4.	*B1*		
		<u>Alternatively:</u> Since $p > 0$, $2p > 0$ then $2p + 6 > 6 > 4$. Thus, the difference is greater than 6, which cannot be 4.	*B1*		
					[9]

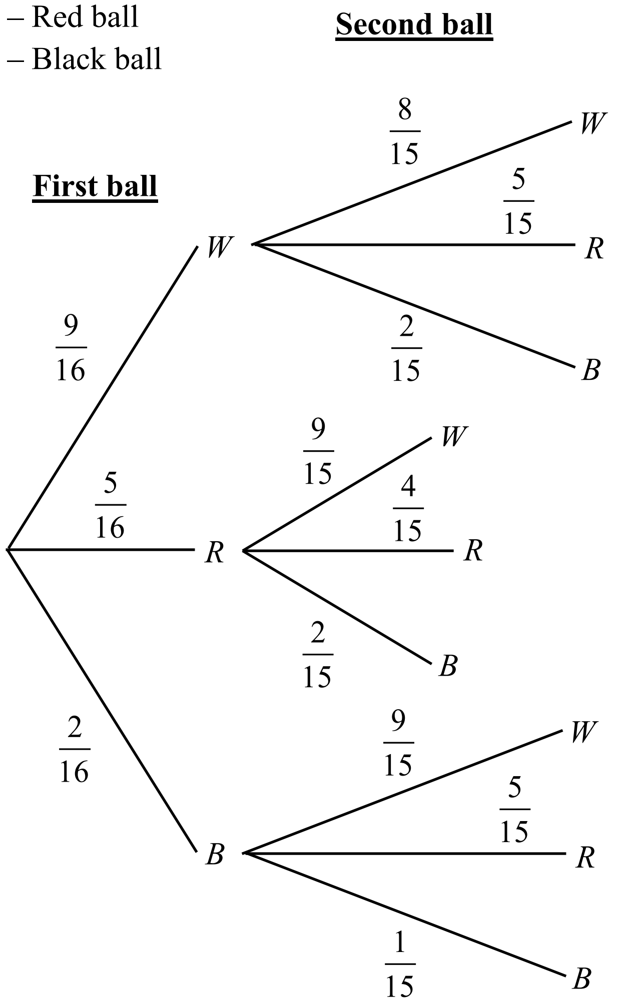
5	(a)	$p = -0.5$	B1		
	(b)	Refer to graph drawn on page 5			
		Correct scale drawn	S1		
		Plotting of all 8 points correctly	P1		
		Smooth curve passing through all points	C1		
	(c)	$\frac{x^3}{2} - 5x = 8$ $\frac{x^3}{2} - 5x - 2 = 6 \Rightarrow y = 6$	M1		
		Since the line $y = 6$ only intersects the curve once, then the equation only has one solution.	A1		
	(d)	Drawing of tangent	M1	Green Line	
		Gradient $= \frac{4-(-10)}{-2-2} = 3.5$	A1		
	(ei)	Plotting of at least three relevant points	P1		
		Line drawn for $-1 \le x \le 4$	L1	Red Line	
	(eii)	$x = 2.85$	B1	Accept ± 0.1	
	(eiii)	$A = -4$	B1		
		$B = -12$	B1		
					[13]


y
x
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-3
-2
-1
1
2
3
4
$y = \frac{x^3}{2} - 5x - 2$
Tangent for (d)
$y = 4 - 3x$

6	(a)	Angle DAO = Angle BAC (Shared angle) Angle $ADO = 90°$ (Tangent perpendicular to radius) Angle $ABC = 90°$ (Right angle in semicircle)	M1	Either reason seen	
		Triangles ABC and ADO are similar. (AA Similarity Test)	A1		
	(b)	Area of triangle ADO : Area of triangle ABC $=1^2:2^2=1:4$	M1		
		Area of triangle BOC : Area of triangle ADO $=4-1-1:1$ $=2:1$	A1		
	(c)	$\cos 65° = \dfrac{3}{AO} \Rightarrow OA = \dfrac{3}{\cos 65°}$	M1		
		Shaded area $= \pi\left(\dfrac{3}{\cos 65°}\right)^2 - \pi(3)^2$	M2	M1 for each circle's area	
		$=130.0311149=130\ \text{cm}^2$ (3 s.f.)	A1		
					[8]

7	(a)	Total number of mugs $=\dfrac{15}{2}\times 140$	M1		
		$=1050$	A1		
	(bi)	$\dfrac{3600}{x}$	B1		
	(bii)	$\dfrac{3600}{x-50}$	B1		
	(biii)	$\dfrac{3600}{x}+\dfrac{3600}{x-50}=\dfrac{68}{4}$	M1	Form equation	
		$\dfrac{3600x-180000+3600x}{x^2-50x}=17$	M1	Join fraction	
		$7200x+180000=17x^2-850x$ $17x^2-8050x+180000=0$ (Shown)	A1 AG		
	(biv)	$x=\dfrac{-(-8050)\pm\sqrt{(-8050)^2-4(17)(180000)}}{2(17)}$	M1	Quadratic formula o.e.	
		$x=450$ or $x=\dfrac{400}{17}$	A2		
	(bv)	Number of mugs $=\dfrac{3600}{450-50}$	M1		
		$=9$	A1		
					[12]

8	(a)	Using cosine rule, $6^2 = 3^2 + 7^2 - 2(3)(7)\cos\angle BAC$	M1	Use of cosine rule o.e.	
		$42\cos\angle BAC = 22$ $\cos\angle BAC = \dfrac{11}{21}$	M1	s.o.i.	
		$\angle BAC = \cos^{-1}\left(\dfrac{11}{21}\right)$ $= 58.41186449°$ $= 58.4°$ (1 d.p.) (Shown)	A1 AG		
	(b)	Total surface area $= 2\left(\dfrac{1}{2}(3)(7)\sin 58.41186449°\right) + 10(6+3+7)$	M2	M1 for triangle M1 for three rectangular sides	
		$= 177.8885438 = 178 \text{ cm}^2$ (3 s.f.)	A1		
	(c)	Let the vertical distance of C above AB be h.			
		$\sin 58.41186449° = \dfrac{h}{3}$ $h = 3\sin 48.1186449°$	M1	o.e.	
		$= 2.55550626 = 2.56$ cm (3 s.f.)	A1		
	(d)	Let F denote the last unnamed vertex of the prism and X denote the point on FD vertically below E.			
		By Pythagoras' Theorem, $FX^2 = 3^2 - 2.55550626^2 = 2.469387755$	M1	o.e.	
		$AX = \sqrt{10^2 + 3^2 - 2.55550626^2} = \sqrt{102.4693878}$	M1		
		Let the angle of elevation be θ.			
		$\tan\theta = \dfrac{2.55550626}{\sqrt{102.4693878}}$	M1		
		$\theta = 14.16842544° = 14.2°$ (1 d.p.)	A1		
					[12]

9	(ai)	Percentage $=\frac{11}{20}\times 100\% = 55\%$	B1		
	(aii)	Median $= 31.5$	B1		
	(aiii)	The mean might not be an appropriate average as there is an outlier of 69 minutes.	B1	Mention 'outlier' o.e.	
	(aiv)	Standard deviation $= 10.9$ minutes	B1		
	(av)	The times taken by the second group of students are more consistent than the first as the standard deviation of 8.64 minutes is lower than 10.9 minutes of the second group.	B1	Must state values	
	(bi)	**Legend:** W – White ball R – Red ball B – Black ball 	B2	B1 for first ball's probabilities B1 for second ball's probabilities Deduct B1 for no legend or proper notation of W, R and B	

	(bii) (a)	$\frac{9}{16}\times\frac{8}{15}+\frac{5}{16}\times\frac{4}{15}+\frac{2}{16}\times\frac{1}{15}$	M1	Any two cases correct	
		$=\frac{47}{120}$	A1		
	(bii) (b)	$\frac{9}{16}+\frac{5}{16}\times\frac{9}{15}+\frac{2}{16}\times\frac{9}{15}$ $1-\frac{5}{16}\times\frac{6}{15}-\frac{2}{16}\times\frac{6}{15}$	M1		
		$=\frac{33}{40}$ $=\frac{33}{40}$	A1		
					[11]
10	(a)	\$0.37	B1		
	(b)	Total printed pages $=8\times150\times6=7200$	M1	s.o.i.	
		Toner cartridges needed $=\frac{7200}{1300}=5.5384661583$			
		6 toner cartridges	A1		
	(c)	C5 envelopes needed $=150\times6=900$ Total cost for envelopes $=2\times\$34=\$68$	M1		
		Pieces of paper needed $=7200\div2=3600$ Number of packs of paper needed $=\frac{3600}{500}\approx8$	M1		
		Total cost for paper $=8\times\$3.90=\$31.20$ Total cost for toner $=6\times\$147=\$882$	M1	Both s.o.i.	
		Total cost for supplies $=107\%\times(\$68+\$31.20+\$882)=\$1049.884$	M1	107% o.e.	
		Total cost for all newsletters $=\$1049.884+900\times\$0.37=\$1382.884$	M1	Include postage s.o.i.	
		Cost for a one-year subscription $=\frac{\$1382.884}{150}=\$9.219226667=\$9.22$ (2 d.p.)	M1		
		A sensible amount to charge a one-year subscription is \$9.25 as it is easier to charge and is slightly higher than its original cost.	A1	Must justify price and give reason(s)	
					[10]

END OF MARKING SCHEME