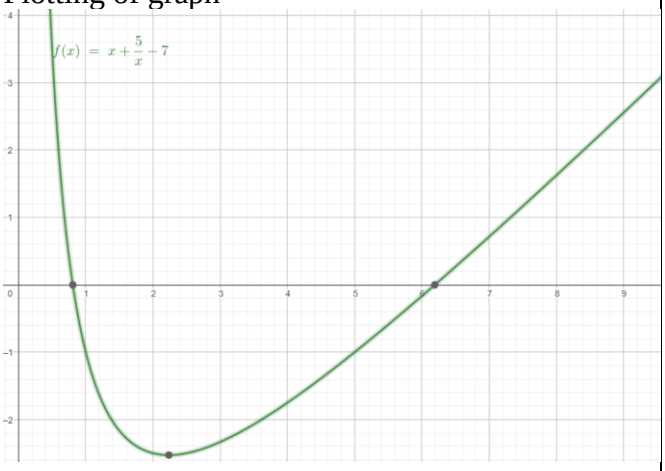
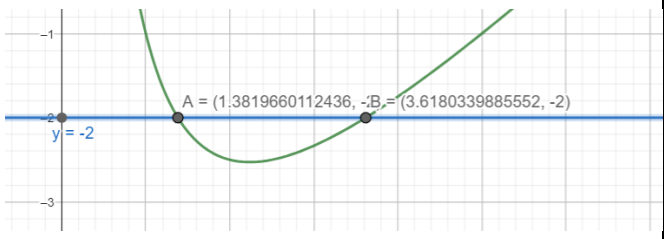
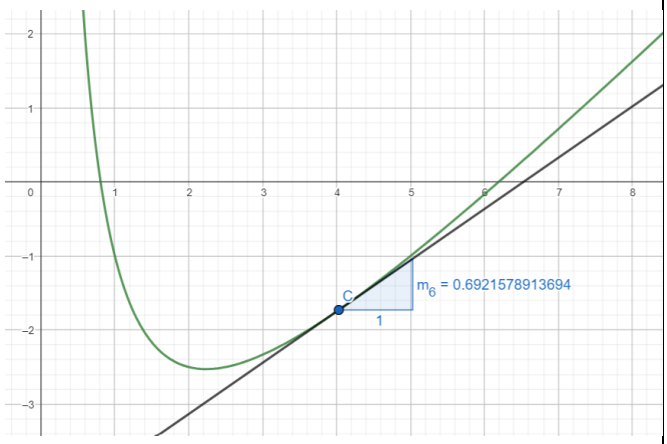
Q/N			Solution	Marks	Remarks
1	**(a)**	**(i)**	$b=\frac{a}{a-1}+\frac{2}{c}$ $b=\frac{3}{3-1}+\frac{2}{4}$ $b=2$	**B1**	
		(ii)	$b=\frac{a}{a-1}+\frac{2}{c}$ $b=\frac{ac}{(a-1)c}+\frac{2(a-1)}{c(a-1)}$ $bc(a-1)=ac+2a-2$ $abc-bc=ac+2a-2$ $abc-ac-2a=bc-2$ $a(bc-c-2)=bc-2$ $a=\frac{bc-2}{bc-c-2}$ or $\frac{2-bc}{2-bc+c}$	**M1** **M1** **A1**	Combine fractions, common denominator Grouping of 'a' terms and factorising
	(b)		$4x-y=-11$ -------- (1) $5x+3y=-1$ -------- (2) (1) $\times 3$ $12x-3y=-33$ ------- (3) (2) + (3) $17x=-34$ $x=-2$ Sub $x=-2$ into (1) $4(-2)-y=-11$ $-y=-11+8$ $y=3$	**M1** **A1** **A1**	Elimination method
			Alternate solution : solving by substitution		
			$4x-y=-11$ -------- (1) $5x+3y=-1$ -------- (2) From (1) $4x-y=-11$ $y=4x+11$ -------- (3)	**M1**	Substitution method

			Sub (3) into (2) $5x+3(4x+11)=-1$ $5x+12x+33=-1$ $7x=-34$ $x=-2$ Sub $x=-2$ into (3) $y=4(-2)+11$ $y=3$	**A1** **A1**	
	(c)		$\frac{x}{3x-1}-\frac{5}{2x+3}=1$ $\frac{x(2x+3)}{(3x-1)(2x+3)}-\frac{5(3x-1)}{(3x-1)(2x+3)}=1$ $\frac{2x^2+3x-15x+5}{(3x-1)(2x+3)}=1$ $2x^2+3x-15x+5=6x^2+9x-2x-3$ $4x^2+19x-8=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $x=\frac{-19\pm\sqrt{(19)^2-4(4)(-8)}}{2(4)}$ $x=\frac{-19\pm\sqrt{489}}{8}$ $x=0.38916$ or -5.1391 $x=0.389$ or -5.139 (to 3 dp)	**M1** **M1** **M1** **A1**	Combine fraction, common denominator $4x^2+19x-8=0$ $x=\frac{-19\pm\sqrt{489}}{8}$ Both answers
2	**(a)**		**Plan *B***. Plan *B* pays a higher interest amount as it is **compounded** yearly. Or the **principal sum increases** every year.	**B1**	
	(b)		Total simple interest $=8000\times\frac{3.5}{100}\times12$ $=\$3360$ Total amount = 8000 + 3360 = \$11360	**M1** **A1**	Interest = \$3360

	(c)		$50000\left(1+\frac{r}{100}\right)^{14}=65320$ $\left(1+\frac{r}{100}\right)=1.01927$ $r=1.92744$ $r=1.93\%$ (to 3 sf)	**M1** **M1** **A1**	M1: forming equations using compound interest M1: 1.01927
	(d)		Discounted price in THB $56000\times0.85=47600$ THB Total cost in THB $47600\times1.02=48552$ THB Cost in SGD $=\frac{48552}{27.16}$ $=1787.6288$ $=\$1787.63$ (to nearest cent)	**M1** **M1** **A1**	47600 THB (after discount) and Multiply by 1.02 Divide by exchange rate
3	**(a)**		$y=x+\frac{5}{x}-7$ $y=5+\frac{5}{5}-7=-1$ $k=-1$	**B1**	
	(b)		Plotting of graph 	**G1** **G1** **G1**	G1: 0 – 4 points plotted correctly G1: all points plotted correctly G1: smooth curve

	(c)		$x+\frac{5}{x}=5$ $x+\frac{5}{x}-7=5-7$ $y=-2$ Intersection points  $x=1.4\pm0.1$ $x=3.6\pm0.1$	**M1** **A1** **A1**	M1: draw $y=-2$
	(d)		Drawing of suitable tangent line at $(4,\ -1.8)$  Estimated gradient = 0.688 ± 0.1 (3sf as its an estimate of the gradient)	**M1** **A1**	
	(e)		$x+\frac{5}{x}-7=-x+3$ $x^2+5-7x=-x^2+3x$ $2x^2-10x+5=0$ $P=2$ and $Q=-10$	**M1** **A1** **A1**	Equating both equations

4	**(a)**	**(i)**	- Angle *ACB* equal to angle *OCD* (Common angle) (A) - Angle *ABC* = 90° (angle in semi circle) and Angle *ODC* = 90° (tangent to radius) (A) Hence using **AA test**, triangles *ABC* and *ODC* are similar.(AA)	**B1** **B1**	* minus 1 mark if student did not state the test used.
		(ii)	$\frac{\text{Area triangle } ABC}{\text{Area triangle ODC}} = \left(\frac{2}{1}\right)^2$ $\frac{\text{Area triangle } ABC}{15} = \left(\frac{4}{1}\right)$ Area triangle $ABC = 60$ Trapezium $ABDO = 60 - 15 = 45\text{cm}^2$	**M1** **A1**	M1: 60
	(b)	**(i)**	angle QRS $= \frac{156}{2} = 78°$ (angle at centre is twice angle at circumference)	**B1**	*minus maximum of 1 mark if no reasons are give for whole of Q4(b). But to circle and highlight to student importance of following question and give reasons to support answer.
		(ii)	angle SRO $= 78° - 50°$ (Isosceles triangle) $= 28°$ angle $RSO = 28°$ (Isosceles triangle) angle PSO $= 73° - 28°$ $= 45°$	**M1** **A1**	*also accept other correct methods of finding answer e.g. angles in opp segment (longer method)

		(iii)	angle PQR $=180°-73°$ (Angles in opposite segment) $=107°$ angle PQO $=107°-50°$ $=57°$	**M1** **A1**	
		(iv)	angle PQR + angle SRQ $=107°+78°$ $=185°$ angle PQR + angle SRQ is not equal to $180°$, using the rule of interior angles in parallel lines, PQ **is not parallel** to SR.	**M1** **A1**	Add up both angles to get $185°$
5	**(a)**	**(i)**	Median = 74kg	**B1**	
		(ii)	Q3 = 78kg Q1= 70kg Interquartile range $=78-70$ $=8$kg	**M1** **A1**	M1: Q3 – Q1
	(b)		Yes I agree because the **median of factory *B* is larger** than the median of factory *A*.	**B1**	Larger median for factory *B*
	(c)		Interquartile range for factory *B* $=92-78$ $=14$kg Since the IQR for *A* is smaller than *B*, factory *A* is more consistent.	**M1** **A1**	IQR for factory *B*
	(d)		Factory *A*, more than 80kg $=400-340$ or $=400-330$ $=60$ $=70$ Factory *B*, more than 80kg $=400-140$ or $=400-130$ $=260$ $=270$	**M1**	M1: demo understanding of finding number of steel bars more than 80kg

			P(both more than 80kg) $=\frac{60}{400}\times\frac{260}{400}$ $=\frac{39}{400}$ **Also accept $\frac{81}{800},\frac{91}{800},\frac{189}{1600}$	**M1** **A1**	M1: multiplication of probability
6	**(a)**	**(i)**	$\overrightarrow{AB}=\overrightarrow{OB}-\overrightarrow{OA}$ $\begin{pmatrix}-5\\4\end{pmatrix}=\begin{pmatrix}3\\8\end{pmatrix}-\overrightarrow{OA}$ $\overrightarrow{OA}=\begin{pmatrix}3+5\\8-4\end{pmatrix}=\begin{pmatrix}8\\4\end{pmatrix}$ $\lvert\overrightarrow{OA}\rvert=\sqrt{64+16}=\sqrt{80}=8.94$ (to 3sf)	**M1** **A1**	M1: $\overrightarrow{OA}=\begin{pmatrix}3+5\\8-4\end{pmatrix}=\begin{pmatrix}8\\4\end{pmatrix}$
		(ii)	Gradient AP = Gradient PB $\frac{10-4}{k-8}=\frac{10-8}{k-3}$ $6k-18=2k-16$ $4k=2$ $k=\frac{1}{2}$	**M1** **A1**	M1: equating the gradients Also accept $\overrightarrow{AP}=\lambda\overrightarrow{PB}$ where λ is a constant
	(b)	**(i)**	$\overrightarrow{OQ}=\overrightarrow{OR}+\overrightarrow{RQ}$ $\overrightarrow{OQ}=4\mathbf{r}+7\mathbf{p}+4\mathbf{r}$ $\overrightarrow{OQ}=7\mathbf{p}+8\mathbf{r}$	**B1**	
		(ii)	$\rightarrow\quad\rightarrow\quad\rightarrow$		

			$PQ = OQ - OP$ $\overrightarrow{PQ} = 7\mathbf{p} + 8\mathbf{r} - 3\mathbf{p}$ $\overrightarrow{PQ} = 4\mathbf{p} + 8\mathbf{r}$	**B1**	
		(iii)	$\overrightarrow{PR} = \overrightarrow{OR} - \overrightarrow{OP}$ $\overrightarrow{PR} = 4\mathbf{r} - 3\mathbf{p}$ $\overrightarrow{PR} = -3\mathbf{p} + 4\mathbf{r}$ $\frac{PB}{PR} = \frac{3}{5}$ $\overrightarrow{PB} = \frac{3}{5} \times (-3\mathbf{p} + 4\mathbf{r})$ $\overrightarrow{PB} = -\frac{9}{5}\mathbf{p} + \frac{12}{5}\mathbf{r}$ $\overrightarrow{OB} - \overrightarrow{OP} = -\frac{9}{5}\mathbf{p} + \frac{12}{5}\mathbf{r}$ $\overrightarrow{OB} = -\frac{9}{5}\mathbf{p} + \frac{12}{5}\mathbf{r} + 3\mathbf{p}$ $\overrightarrow{OB} = \frac{6}{5}\mathbf{p} + \frac{12}{5}\mathbf{r}$	**M1** **M1** **A1**	M1: $\overrightarrow{PR} = -3\mathbf{p} + 4\mathbf{r}$ M1: $\overrightarrow{PB} = -\frac{9}{5}\mathbf{p} + \frac{12}{5}\mathbf{r}$
	(d)		$\overrightarrow{OB} = \frac{6}{5}\mathbf{p} + \frac{12}{5}\mathbf{r} = \frac{6}{5}(\mathbf{p} + 2\mathbf{r})$ $\overrightarrow{OQ} = 7\mathbf{p} + 8\mathbf{r}$ Points *O*, *B* and *Q* are not colinear because *OB* **cannot be expressed as a scalar multiple** of *OQ*.	**B1**	
7	**(a)**		$AC^2 = AB^2 + BC^2 - 2(AB)(BC)\cos ABC$ $AC^2 = 700^2 + 550^2 - 2(700)(550)\cos 115$ $AC^2 = 1117916.062$ $AC = 1057.32\text{m}$ (shown)	**M1** **A1**	Cosine rule

	(b)		$\frac{\sin BCA}{700} = \frac{\sin 115}{1057.315}$ $\sin BCA = 0.6000250$ $BCA = 36.871°$ Bearing of D from $C = 360 - 29 - 36.871°$ $= 294.12°$ $= 294.1°$ (to 1 dp)	**M1** **M1** **A1**	M1: sine rule M1: $BCA = 36.871°$
	(c)		Area of ABC $= \frac{1}{2}(700)(550)\sin 115$ $= 174464.249$ Area of ACD $= \frac{1}{2}(780)(1057.32)\sin 29$ $= 199913.574$ Total Area $ABCD$ $= 174464.249 + 199913.574$ $= 374377.823$ $= 374378$ (to nearest whole number)	**M1** **A1**	M1: use of $\frac{1}{2}ab\sin C$ *Also accept $= 374376.9717$ $= 374377$ (to nearest whole number)
	(d)		$\tan 10.9 = \frac{height}{CD}$ $\tan 10.9 = \frac{height}{780}$ $height = 150.204$ $height = 150$m (to 3 sf)	**M1** **A1**	M1: $\tan 10.9 = \frac{height}{CD}$
8	**(a)**		$l^2 = (3x)^2 + (4x)^2$ $l^2 = 25x^2$ $l = 5x$	 **B1**	Pythagoras' Theorem

	(b)		$\pi(3x)^2(y) = \frac{1}{3}\pi(3x)^2(4x)$ $y = \frac{1}{3}(4x)$ $y = \frac{4}{3}x$ (Shown)	**M1** **A1**	M1: equate both volumes
	(c)		Total curved surface area of 2 cones $2 \times \pi(3x)(5x)$ $= 30x^2\pi$ Curved surface of cylinder $2 \times \pi \times 3x \times \frac{4}{3}x$ $= 8x^2\pi$ Therefore $30x^2\pi + 8x^2\pi = (200 - x)\pi$ $38x^2 + x - 200 = 0$ (Shown)	**M1** **M1** **A1**	Finding total curved surface area of 2 cones Finding Curved surface of cylinder
	(d)		$38x^2 + x - 200 = 0$ $x = \frac{-(1) \pm \sqrt{(1)^2 - 4(38)(-200)}}{2(38)}$ $x = \frac{-1 \pm \sqrt{30401}}{76}$ $x = 2.28$ (2dp) or $x = -2.31$ (NA)	**M1** **M1** **A1**	$x = \frac{-(1) \pm \sqrt{(1)^2 - 4(38)(-200)}}{2(38)}$ $x = \frac{-1 \pm \sqrt{30401}}{76}$ $x = 2.28$ (2dp)
9	**(a)**	**(i)**	Measured distance from airport to hotel = 11.5cm Accept 11.0 to 12.5 cm 1 : 500 000 1cm : 5 km Actual distance : 55km to 62.5km	**M1** **A1**	Accept 11.0 to 12.5 cm 55km to 62.5km

		(ii)	Time taken in mins $= \frac{55}{65} \times 60 = 50.8$ mins or Time taken in mins $= \frac{62.5}{65} \times 60 = 57.7$ mins Time taken : 51 to 58 minutes (accept ans within range)	**M1** **A1**	Calculating time taken in mins
	(b)		Electric vehicle Daily rental : 9 days X 178.20 X 1.10 = **$1764.18** Charging cost: $= \frac{850}{5.25} \times 1.25 = \$202.380$ Total cost for electric vehicle (5 seater) = 1764.18+ 202.380 = $1966.56 Petrol vehicle (5 seater) Daily rental : 9 days X **112.50** X 1.10 = $1113.75 Petrol costs $= \frac{850}{10.3} \times 3.10 \times 1.10 = \$281.407$ Total cost for petrol vehicle (5 seater) = $1113.75+ $281.407 = $1395.1577 = $1395.16 (2 dp) No, the cost of electric car is higher than petrol car, hence David is not correct.	**M1** **M1** **M1** **M1** **M1** **A1**	M1: calculating daily rental with 5 seater electric car M1: calculating total charging cost M1: total cost for electric car M1: calculating daily rental with 5 seater petrol car M1: calculating petrol cost

END OF MARKING SCHEME PAPER 2