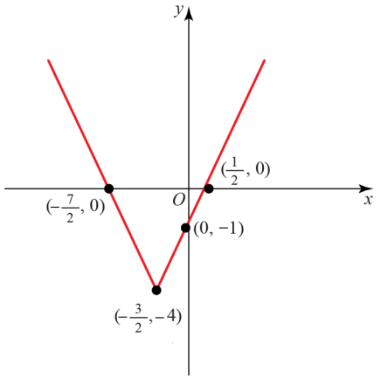
Q	Scheme		Marks	AOs	Pearson Progression Step and Progress descriptor
1a	**Figure 1** 	Graph has a distinct V-shape.	**M1**	2.2a	5th Sketch the graph of the modulus function of a linear function.
		Labels vertex $\left(-\frac{3}{2}, -4\right)$	**A1**	2.2a	
		Finds intercept with the y-axis.	**M1**	1.1b	
		Makes attempt to find x-intercept, for example states that $\lvert 2x+3\rvert - 4 = 0$	**M1**	2.2a	
		Successfully finds both x-intercepts.	**A1**	1.1b	
			(5)		
1b	Recognises that there are two solutions. For example, writing $2x+3=-\frac{1}{4}x+2$ and $-(2x+3)=-\frac{1}{4}x+2$		**M1**	2.2a	5th Solve equations involving the modulus function.
	Makes an attempt to solve both questions for x, by manipulating the algebra.		**M1**	1.1b	
	Correctly states $x = -\frac{4}{9}$ or $x = -\frac{20}{7}$. Must state both answers.		**A1**	1.1b	
	Makes an attempt to substitute to find y.		**M1**	1.1b	
	Correctly finds y and states both sets of coordinates correctly $\left(-\frac{4}{9}, -\frac{17}{9}\right)$ and $\left(-\frac{20}{7}, -\frac{9}{7}\right)$		**A1**	1.1b	
			(5)		
					(10 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2a	States or implies that $\text{pq}(x) = (5-2x)^2$	M1	2.2a	5th Find composite functions.
	States or implies that $\text{qp}(x) = 5-2x^2$	M1	2.2a	
	Makes an attempt to solve $(5-2x)^2 = 5-2x^2$. For example, $25-20x+4x^2 = 5-2x^2$ or $6x^2-20x+20=0$ is seen.	M1	1.1b	
	States that $3x^2-10x+10=0$. Must show all steps and a logical progression.	A1	1.1b	
		(4)		
2b	$b^2-4ac = 100-4(3)(10) = -20 < 0$	M1*	2.2a	5th Find the domain and range of composite functions.
	States that as $b^2-4ac<0$ there are no real solutions to the equation.	B1*	3.2b	
		(2)		
				(6 marks)

Notes

2b

Alternative Method

M1: Uses the method of completing the square to show that $3\left(x-\frac{5}{3}\right)^2+\frac{65}{9}=0$ or $3\left(x-\frac{5}{3}\right)^2=-\frac{65}{9}$

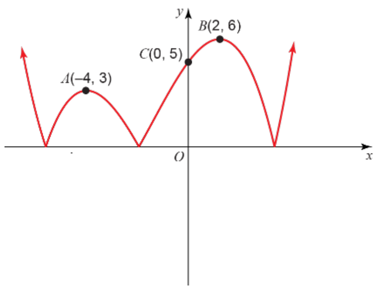
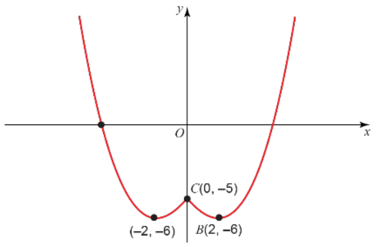
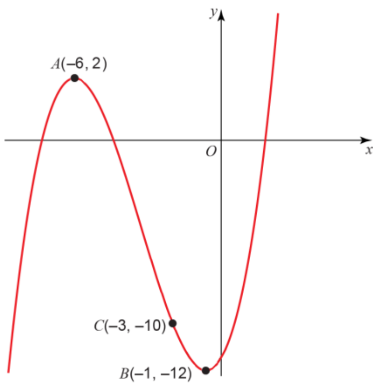
B1: Concludes that this equation will have no real solutions.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	Makes an attempt to find $\text{fg}(x)$. For example, writing $\text{fg}(x) = \text{e}^{2\ln(x+1)} + 4$	M1	2.2a	5th Find composite functions.
	Uses the law of logarithms to write $\text{fg}(x) = \text{e}^{\ln(x+1)^2} + 4$	M1	1.1b	
	States that $\text{fg}(x) = (x+1)^2 + 4$	A1	1.1b	
	States that the range is $y > 4$ or $\text{fg}(x) > 4$	B1	3.2b	
		(4)		
3b	States that $(x+1)^2 + 4 = 85$	M1	1.1b	5th Find the domain and range of composite functions.
	Makes an attempt to solve for x, including attempting to take the square root of both sides of the equation. For example, $x+1 = \pm 9$	M1	1.1b	
	States that $x = 8$. Does not need to state that $x \neq -10$, but do not award the mark if $x = -10$ is stated.	A1	3.2b	
		(3)		
				(7 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4	Understands the need to complete the square, and makes an attempt to do this. For example, $(x-4)^2$ is seen.	M1	2.2a	6th Find the domain and range of inverse functions.
	Correctly writes $g(x)=(x-4)^2-9$	A1	1.1b	
	Demonstrates an understanding of the method for finding the inverse is to switch the x and y. For example, $x=(y-4)^2-9$ is seen.	B1	2.2a	
	Makes an attempt to rearrange to make y the subject. Attempt must include taking the square root.	M1	1.1b	
	Correctly states $g^{-1}(x)=\sqrt{x+9}+4$	A1	1.1b	
	Correctly states domain is $x > -9$ and range is $y > 4$	B1	3.2b	
				(6 marks)

Notes

Q	Scheme		Marks	AOs	Pearson Progression Step and Progress descriptor
5a	**Figure 2** 	Clear attempt to reflect the negative part of the original graph in the x-axis.	M1	2.2a	7th Sketch the graphs of the modulus function of unfamiliar non-linear functions.
		Labels all three points correctly.	A1	1.1b	
		Fully correct graph.	A1	1.1b	
			(3)		
5b	**Figure 3** 	Clear attempt to reflect the positive x part of the original graph in the y-axis.	M1	2.2a	7th Sketch the graphs of the modulus function of unfamiliar non-linear functions.
		Labels all three points correctly.	A1	1.1b	
		Fully correct graph.	A1	1.1b	
			(3)		
5c	**Figure 4** 	Clear attempt to move the graph to the left 3 spaces.	M1	2.2a	6th Combine two or more transformations, including modulus graphs.
		Clear attempt to stretch the graph vertically by a factor of 2.	M1	2.2a	
		Fully correct graph.	A1	1.1b	
			(3)		
					(9 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6a	States the range is y Ö -5 or $\mathrm{f}(x)$ Ö -5	**B1**	3.2b	5th Find the domain and range for a variety of familiar functions.
		(1)		
6b	Recognises that $3(x-4)-5=-\frac{1}{3}x+k$ and $-3(x-4)-5=-\frac{1}{3}x+k$	**M1**	2.2a	7th Solve problems involving the modulus function in unfamiliar contexts.
	Makes an attempt to solve both of these equations.	**M1**	1.1b	
	Correctly states $\frac{10}{3}x=k+17$. Equivalent version is acceptable.	**A1**	1.1b	
	Correctly states $-\frac{8}{3}x=k-7$. Equivalent version is acceptable.	**A1**	1.1b	
	Makes an attempt to substitute one equation into the other in an effort to solve for *k*. For example, $x=\frac{3}{10}(k+17)$ and $-\left(\frac{8}{3}\right)\left(\frac{3}{10}\right)(k+17)=k-7$ is seen.	**M1 ft**	2.2a	
	Correctly solves to find $k=-\frac{11}{3}$	**A1 ft**	1.1b	
	States the correct range for *k*. $k>-\frac{11}{3}$	**B1**	3.2b	
		(7)		
				(8 marks)

Notes

6b

Award ft marks for a correct method using an incorrect answer from earlier in the question.

Alternative Method

Student draws the line with gradient $-\frac{1}{3}$ passing through the vertex and calculates that $k = -\frac{11}{3}$, so answer is $k > -\frac{11}{3}$

M1: States the x-coordinate of the vertex of the graph is 4

M1: States the y-coordinate of the vertex of the graph is −5

M1: Writes down the gradient of $-\frac{1}{3}$ or implies it later in the question.

M1: Attempts to use $y - y_1 = m(x - x_1)$ with $(x_1, y_1) = (4, -5)$ and $m = -\frac{1}{3}$

A1: Finds $y = -\frac{1}{3}x - \frac{11}{3}$ o.e.

B1: States the correct range for k: $k > -\frac{11}{3}$

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7a	Makes an attempt to substitute $t = 0$ into $\mathrm{T}(t) = T_R + (90 - T_R)\mathrm{e}^{-\frac{1}{20}t}$. For example, $\mathrm{T}(t) = T_R + (90 - T_R)\mathrm{e}^0$ or $\mathrm{T}(t) = T_R + (90 - T_R)$ is seen.	M1	3.1a	6th Set up and use exponential models of growth and decay.
	Concludes that the T_R terms will always cancel at $t = 0$, therefore the room temperature does not influence the initial coffee temperature.	B1	3.5a	
		(2)		
7b	Makes an attempt to substitute $T_R = 20$ and $t = 10$ into $\mathrm{T}(t) = T_R + (90 - T_R)\mathrm{e}^{-\frac{1}{20}t}$. For example, $\mathrm{T}(10) = 20 + (90 - 20)\mathrm{e}^{-\frac{1}{20}(10)}$ is seen.	M1	1.1b	6th Set up and use exponential models of growth and decay.
	Finds $\mathrm{T}(10) = 62.457...^\circ\mathrm{C}$. Accept awrt 62.5°.	A1	1.1b	
		(2)		
				(4 marks)

Notes