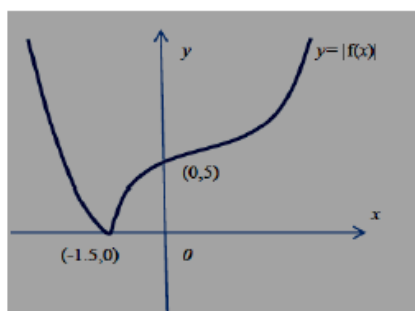


Modulus Functions - Answers

1.

(a)



Shape including cusp

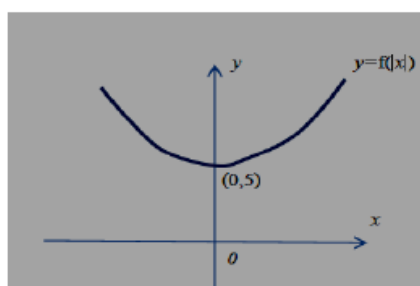
B1

(-1.5, 0) and (0, 5)

B1

(2)

(b)



Shape

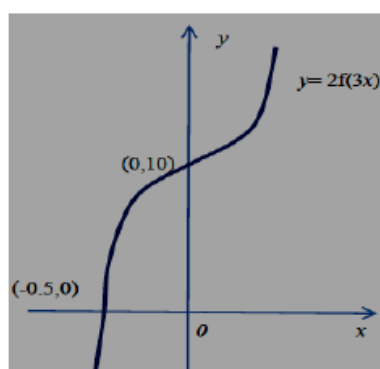
B1

(0, 5)

B1

(2)

(c)



Shape

B1

(0, 10)

B1

(-0.5, 0)

B1

(3)

2.

$$|3 - 2x| = 4|x|$$

$$\Rightarrow 3 - 2x = 4x, x = \frac{1}{2}$$

$$\text{or } 3 - 2x = -4x, x = -1\frac{1}{2}$$

or

$$(3 - 2x)^2 = 16x^2$$

$$\Rightarrow 12x^2 + 12x - 9 = 0$$

$$\Rightarrow x = \frac{1}{2}, -1\frac{1}{2}$$

M1A1

M1A1

not $3/(-2)$

M1

squaring both sides

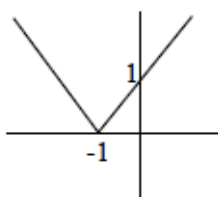
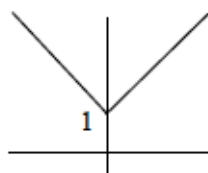
A1

correct quadratic o.e. but with single x^2 term

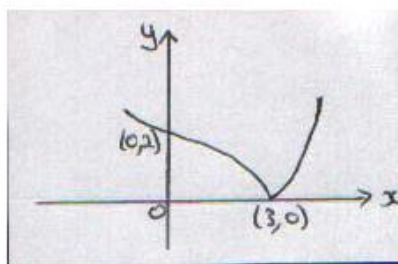
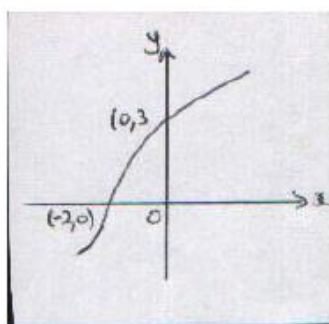
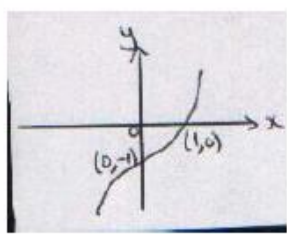
A1 A1

[4]

3.

$fg(x) = x+1 $	$gf(x) = x +1$	B1 B1	soi from correctly-shaped graphs (i.e. without intercepts)
		B1 B1	graph of $ x+1 $ only graph of $ x +1$
		[4]	

4.

(a)		Mod graph, reflect for $y < 0$	M1	
		(0, 2), (3, 0) or marked on axes	A1	
		Correct shape, including cusp	A1	(3)
(b)		Attempt at reflection in $y = x$	M1	
		Curvature correct	A1	
		-2, 0), (0, 3) or equiv.	B1	(3)
(c)		Attempt at 'stretches'	M1	
		(0, -1) or equiv.	B1	
		(1, 0)	B1	(3)

5.

<u>Either:</u> Obtain $x = 0$	B1	ignoring errors in working
Form linear equation with signs of $4x$ and $3x$ different	M1	ignoring other sign errors
State $4x - 5 = -3x + 5$	A1	or equiv without brackets
Obtain $\frac{10}{7}$ and no other non-zero value(s)	A1	or exact equiv
	4	
<u>Or:</u> Obtain $16x^2 - 40x + 25 = 9x^2 - 30x + 25$	B1	or equiv
Attempt solution of quadratic equation	M1	at least as far as factorisation or use of formula
Obtain $\frac{10}{7}$ and no other non-zero value(s)	A1	or exact equiv
Obtain 0	B1	ignoring errors in working
	4	

6.

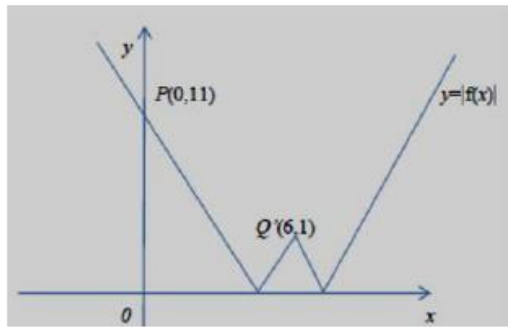
Attempt process for finding critical values	M1	squaring both sides, 2 linear eqns, ineqs, ...
Obtain $\frac{4}{3}$	A1	
Obtain 6	A1	
Attempt process for inequality involving two critical values	M1	sketch, table, ...; implied by plausible soln
Obtain $x < \frac{4}{3}$, $x > 6$	A1	A0 for use of $\leq$ and/or $\geq$
	[5]	

7.

$ 2x + 1 > 4$		
$\Rightarrow 2x + 1 > 4, x > 3/2$	B1	$x > 3/2$ mark final ans; if from $ 2x + 1 > 3$ B0
or $2x + 1 < -4,$	M1	o.e., e.g. $-(2x + 1) > 4$ (or $2x + 1 = -4$)
$x < -2\frac{1}{2}$	A1	if $ 2x + 1 < -4$, M0
	[3]	$x < -2\frac{1}{2}$ mark final ans
		allow 3 for correct unsupported answers

8.

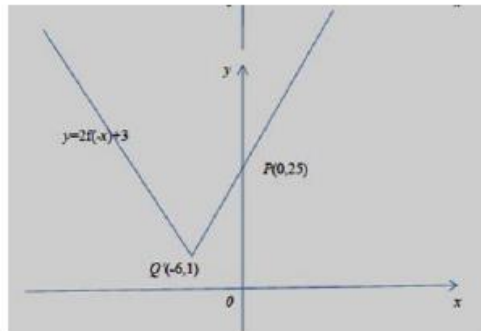
(a)



'W' Shape B1
(0, 11) and (6, 1) B1

(2)

(b)



'V' shape B1
(-6,1) B1
(0,25) B1

(3)

(c)

One of $a = 2$ or $b = 6$

B1

$a = 2$ and $b = 6$

B1

(2)

9.

(i) Attempt process for finding both critical values

M1 squaring both sides to obtain 3 terms on each side or considering 2 different linear eqns/inequalities

Obtain -4

A1

Obtain $\frac{2}{3}$

A1

Attempt process for solving inequality

M1 table, sketch, ...; needs two critical values; implied by plausible answer

Obtain $-4 \leq x \leq \frac{2}{3}$

A1 5 with $\leq$ and not $<$

(ii) Use correct process to find value of $|x+2|$ using any value M1 ... whether part of answer to (i) or not

Obtain $2\frac{2}{3}$ or $\frac{8}{3}$

A1 2 dependent on 5 marks awarded in part (i)

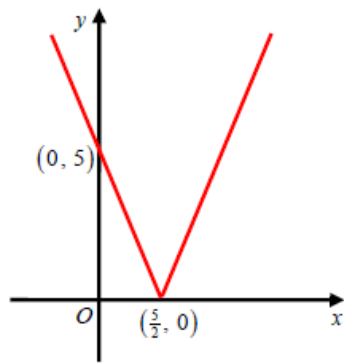
7

10.

(a)		 shape Vertices correctly placed	B1 B1	(2)
(b)		 shape Vertex and intersections with axes correctly placed	B1 B1	(2)
(c)	$P: (-1, 2)$ $Q: (0, 1)$ $R: (1, 0)$		B1 B1 B1	(3)
(d)	$x > -1; \quad 2 - x - 1 = \frac{1}{2}x$ Leading to $x = \frac{2}{3}$ $x < -1; \quad 2 + x + 1 = \frac{1}{2}x$ Leading to $x = -6$		M1 A1 A1 M1 A1	(5) [12]

11.

(a)



M1A1

(b)

$$\underline{x = 20}$$

$$2x - 5 = -(15 + x) ; \Rightarrow \underline{x = -\frac{10}{3}}$$

(2)

B1

M1;A1 oe.

(3)

(c)

$$fg(2) = f(-3) = |2(-3) - 5| = |-11| = 11$$

M1;A1

(2)

(d)

$$g(x) = x^2 - 4x + 1 = (x - 2)^2 - 4 + 1 = (x - 2)^2 - 3. \text{ Hence } g_{\min} = -3$$

M1

$$\text{Either } g_{\min} = -3 \text{ or } g(x) \geq -3$$

B1

$$\text{or } g(5) = 25 - 20 + 1 = 6$$

$$\underline{-3 \leq g(x) \leq 6} \text{ or } \underline{-3 \leq y \leq 6}$$

A1

(3)