High School Mathematics Test 2015

Year 10 **Non Linear Relations** Non Calculator

Skills and Knowledge Assessed:

- Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations (ACMNA296)
- Explore the connection between algebraic and graphical representations of relations such as simple quadratics, circles and exponentials using digital technology as appropriate (ACMNA239)
- 10A Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations (ACMNA267)

Name_____

Section 1 Short Answer Section

Write all working and answers in the spaces provided on this test paper.

1. The graph of $y = x^2 + b$ is shown.

What is the value of b?

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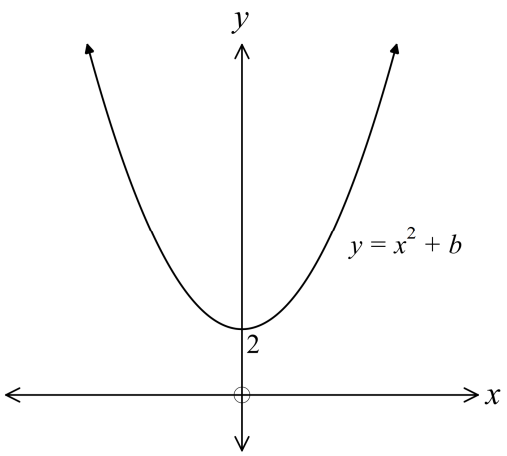

2. The equation of the graph shown is $y = 49 - x^2$.
What is the value of k ?

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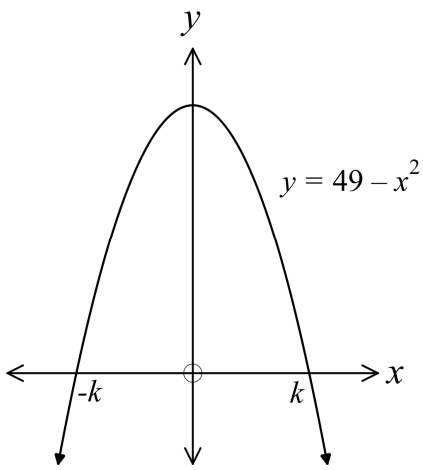

3. The equation of the graph shown is $y = a^x$.
The graph passes through the point (3, 8).

What is the value of a?

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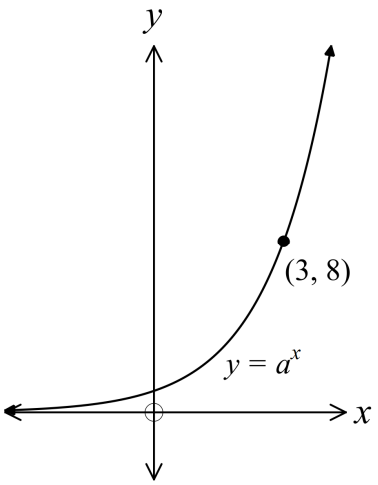

4. The graph shown is a circle with its centre at the origin.

What is the equation of the graph?

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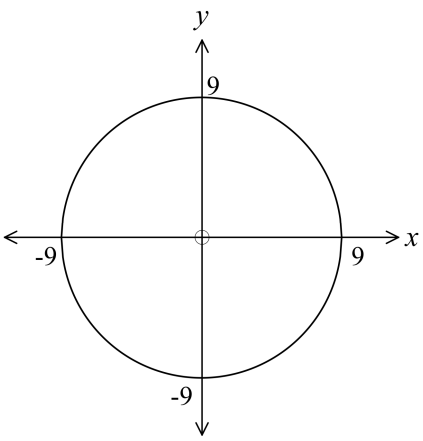

5. The graphs of $y = 12x^2 - 6$ and $y = 2x^2 - 6$ are shown.
One is drawn with a broken line and one with an unbroken line.
Describe which graph is which and explain why you made this decision.

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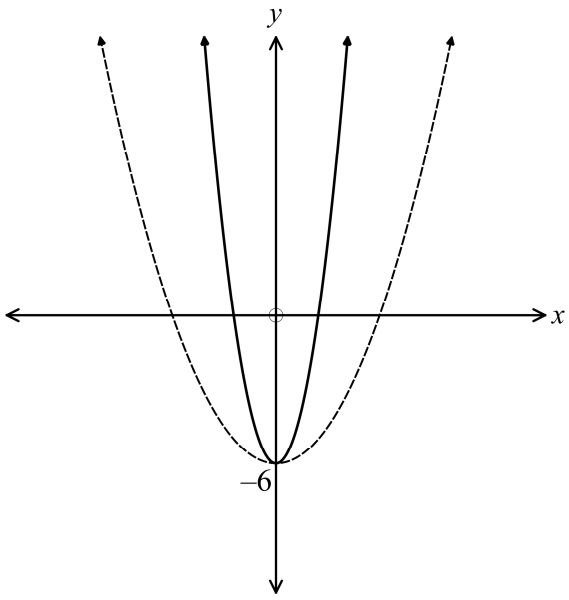
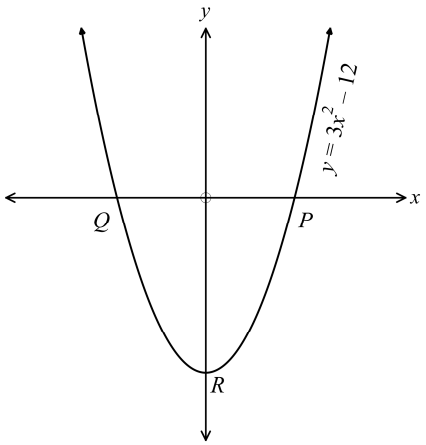


6. The graph of $y = 3x^2 - 12$ is shown.
What are the coordinates of the y intercept R?



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7. What are the coordinates of the x intercepts P and Q in the curve in Question 6?

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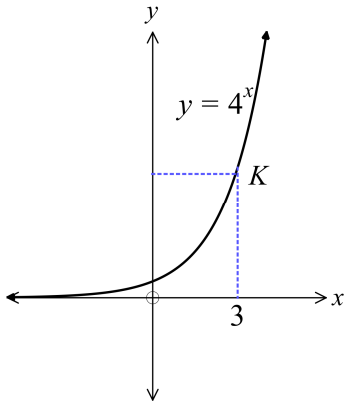
8. The graph of $y = 4^x$ is shown.
What are the coordinates of the point K?



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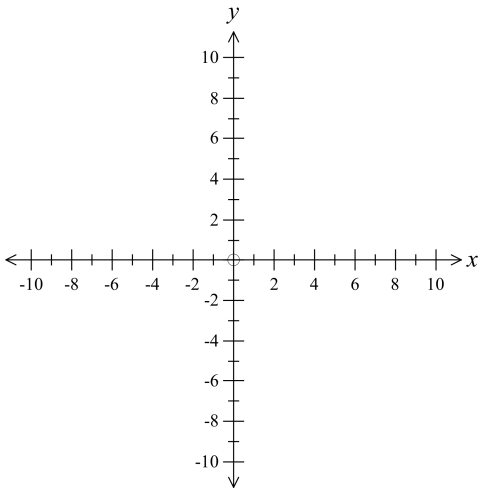
9. Sketch the circle which has an equation $x^2 + y^2 = 36$



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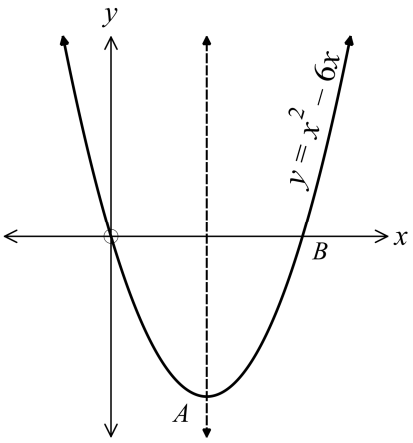
10. The graph of $y = x^2 - 6x$ is shown.
The dotted line is its axis of symmetry.

What are coordinates of the x intercept B?



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11. In the graph in question 10, what are coordinates of the vertex A?

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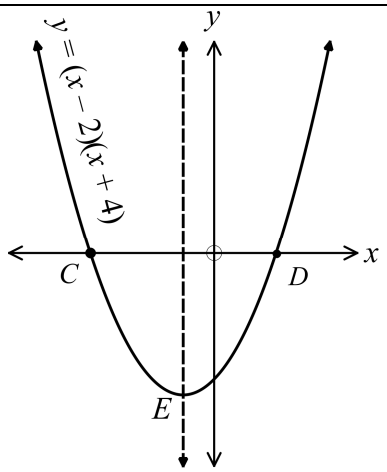
12. The curve below has equation $y = (x - 2)(x + 4)$.
The axis of symmetry is shown by the broken line.
What are the coordinates of the points C and D ?



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13. In the graph in question 12, what are coordinates of the vertex E?

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14. The equation of the parabola shown is $y = x^2 + bx - 16$.

What is the value of b?

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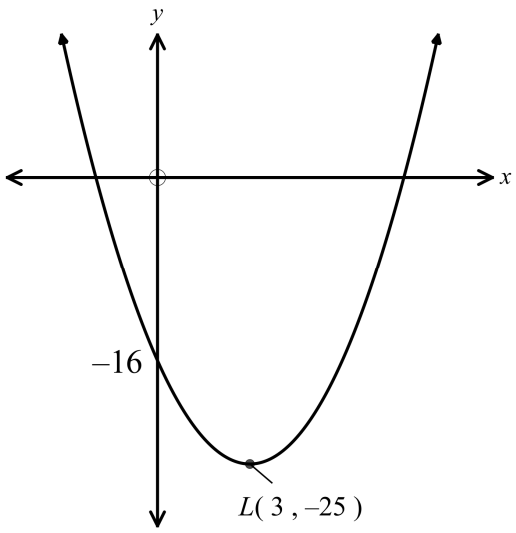

15. The graph of $y = 2^x$ is shown.
Draw a quick sketch, on the same set of axes, of $y = 2^{-x}$

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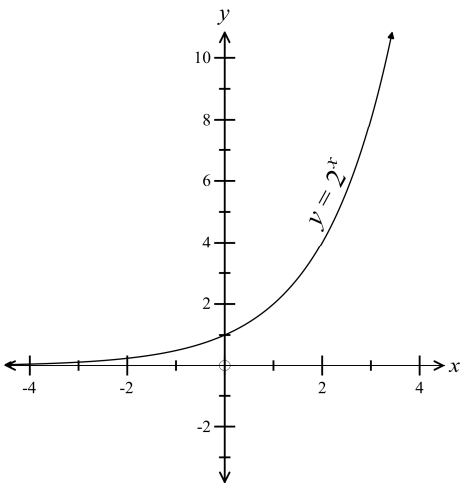

16. What is the centre and radius of the circle which has an equation of $(x-3)^2 + (y+2)^2 = 9$

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High School Mathematics Test 2015

Year 10

Non Linear Relations

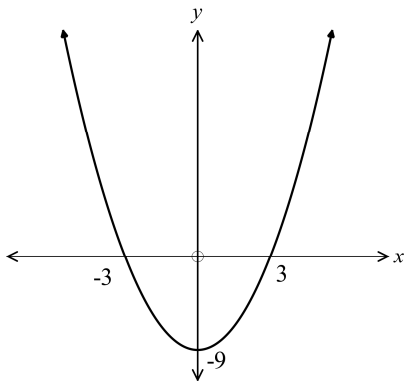
Calculator Allowed

Name_____

Section 2 Multiple Choice Section

Mark all your answers on the accompanying multiple choice answer sheet, not on this test paper. You may do any working out on this test paper. Calculators are allowed for this section.

1. Which equation could describe the graph shown?



A. $y = x^2 - 9$

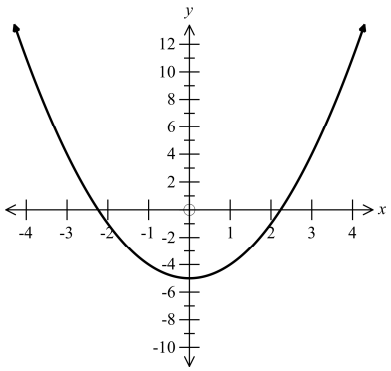
B. $y = x^2 + 9$

C. $y = x^2 - 81$

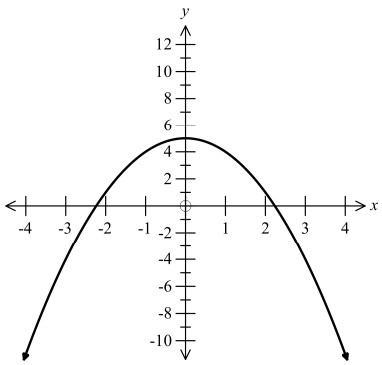
D. $y = x^2 + 81$

2. Which graph below could have an equation of $y = x^2 - 25$?

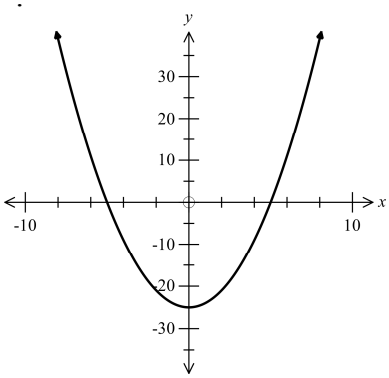
A.



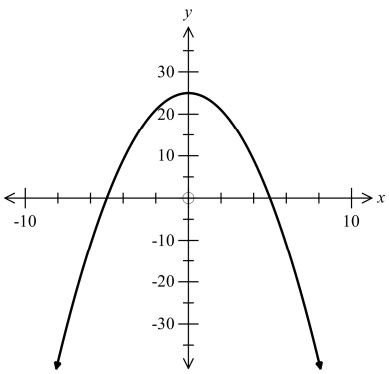
B.



C .



D.

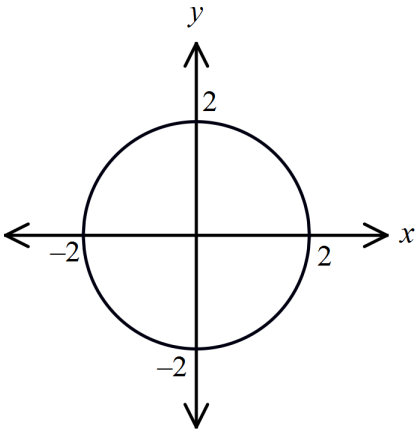


3. Which equation would not represent a parabola?

A. $y = x^2 + 4$ B. $x^2 + y^2 = 4$ C. $y = 4x^2$ D. $y = 2x^2 + 4$

4. Which sketch shows the graph of $x^2 + y^2 = 16$.

A.



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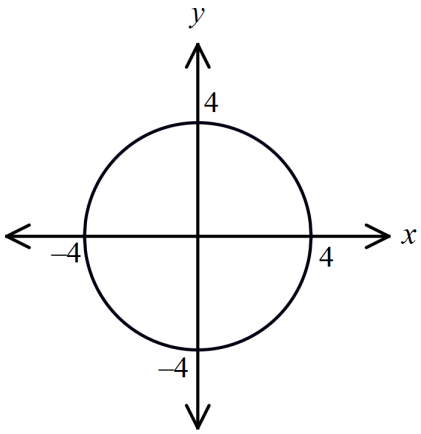
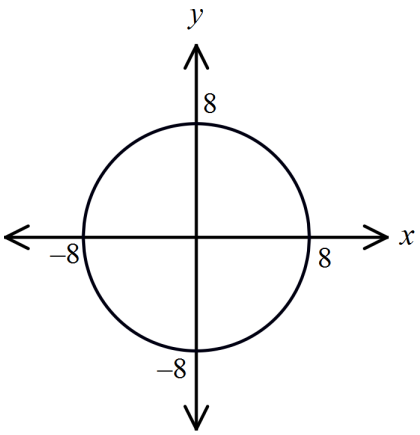
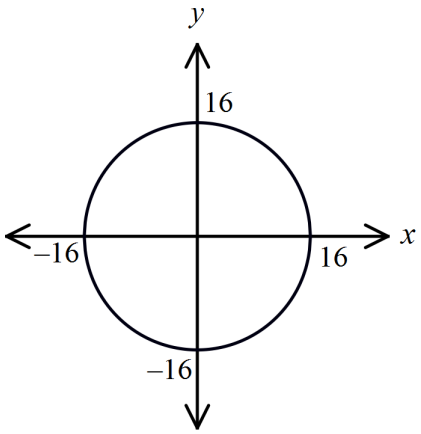


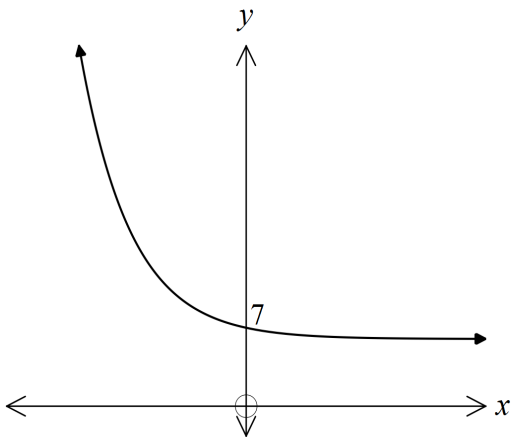
C.



D.



5. Which equation could describe the graph shown?



A. $y = 2^{-x} + 6$

B. $y = 2^{-x} + 7$

C. $y = 2^x + 6$

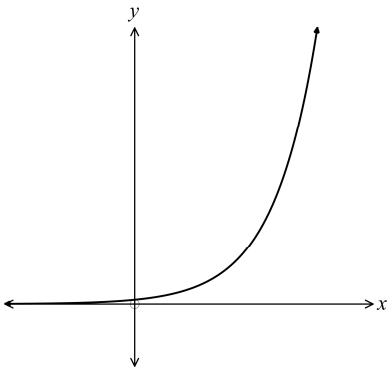
D. $y = 2^x + 7$

6. Which curve has a vertex at (0, –6)?

A. $y = 6x^2 - 4$ B. $y = 4 - 6x^2$ C. $y = 6 - 4x^2$ D. $y = 4x^2 - 6$

7. Which diagram below could be the graph of $y = -5x^2$?

A.



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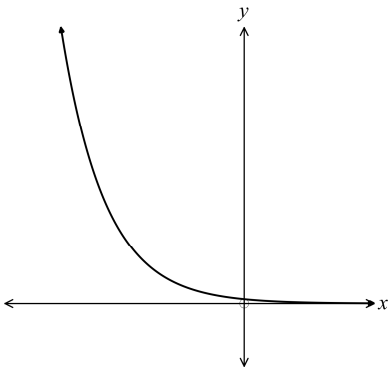
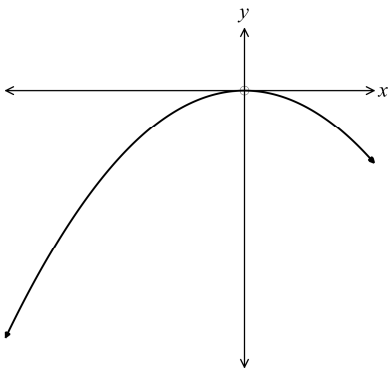
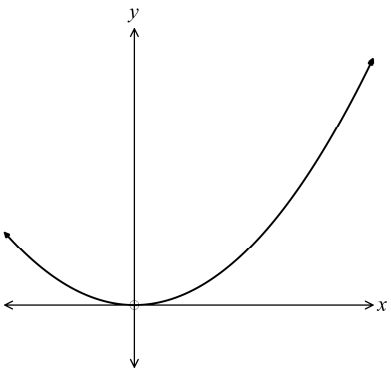


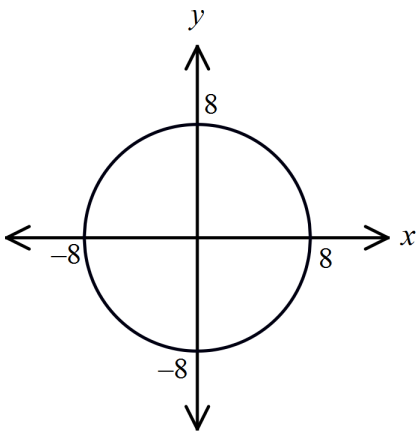
C



D.



8. What is the equation of the curve shown?



A. $x^2 + y^2 = 16$

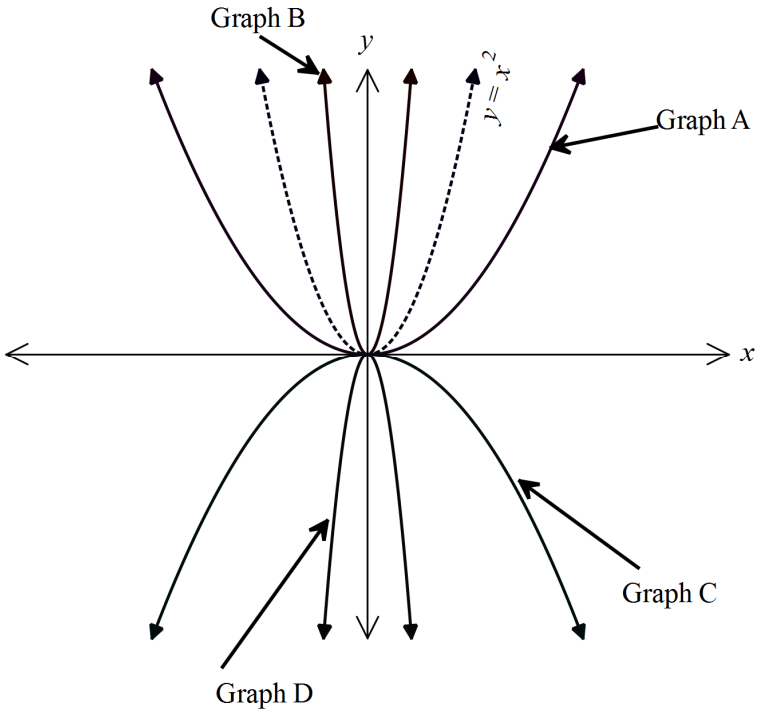
B. $x^2 + y^2 = 64$

C. $x^2 + y^2 = 256$

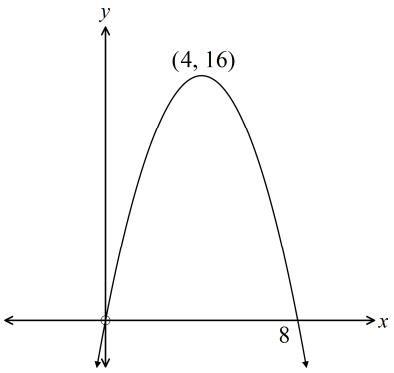
D. $x^2 + y^2 = 1024$

9. The graph of $y = x^2$ is shown as the dotted curve.
The graphs of four other equations are also shown, labelled Graphs A, B, C and D. Which graph could have an equation of $y = -6x^2$?

A. Graph A
B. Graph B
C. Graph C
D. Graph D



10. Which diagram shows the graph of $y = 8x - x^2$?

A.


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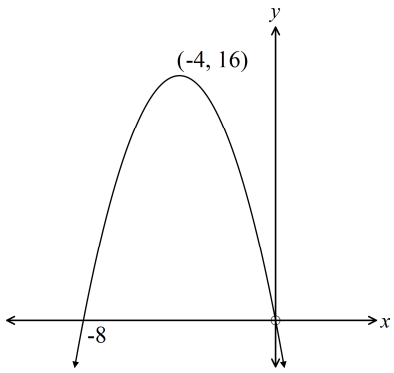
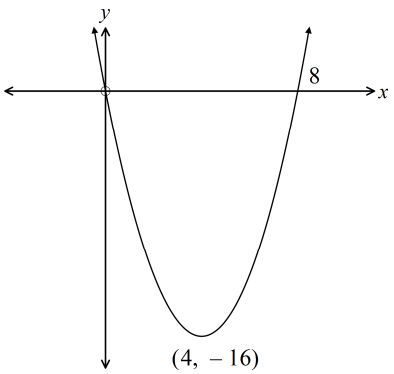
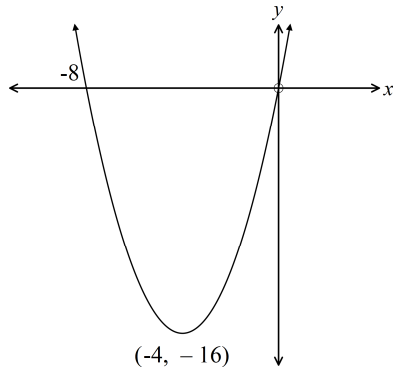
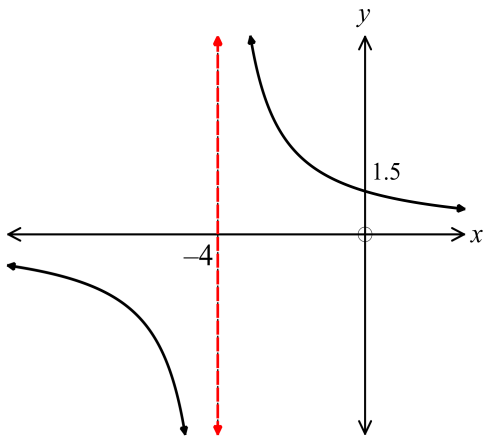


C.


D.


11. Which equation could describe the graph shown?



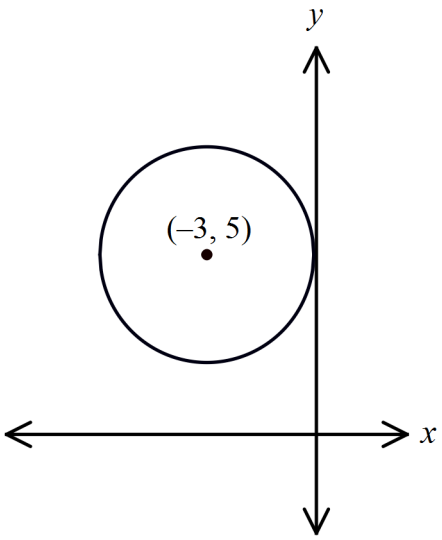
A. $y = 6^x + 4$

B. $y = \dfrac{6}{x - 4}$

C. $y = \dfrac{6}{x + 4}$

D. $y = \dfrac{6}{x} + 4$

12. What is the equation of the circle shown on the number plane?



A. $(x - 3)^2 + (y + 5)^2 = 9$

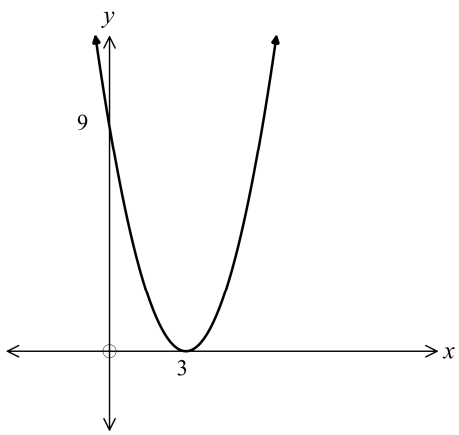
B. $(x + 3)^2 + (y - 5)^2 = 9$

C. $(x - 3)^2 + (y + 5)^2 = 25$

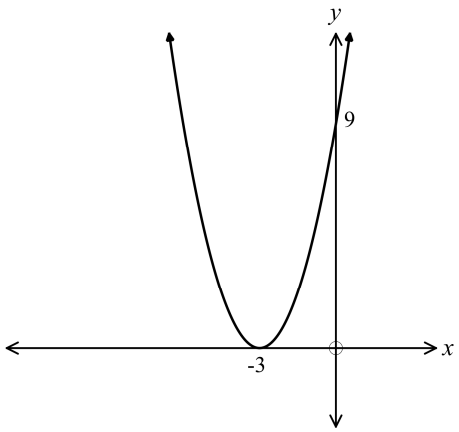
D. $(x + 3)^2 + (y - 5)^2 = 25$

13. Which is the graph of $y = (x - 3)^2$?

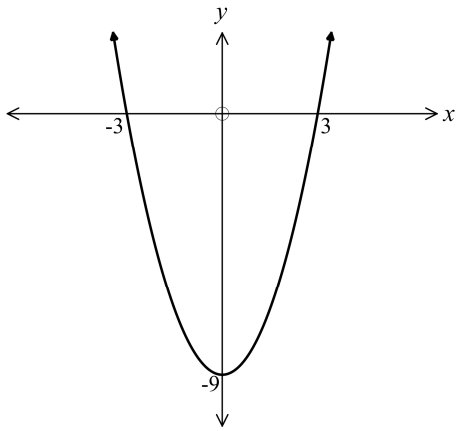
A.



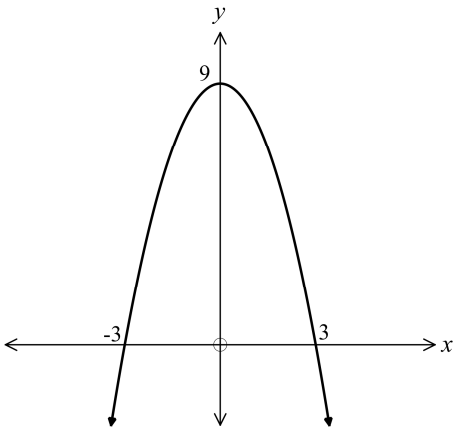
B.



C



D.



14. Which equation describes a circle with centre at $(3, 5)$ and radius 5 units?

A. $x^2 - 6x + y^2 + 10y + 9 = 0$ B. $x^2 + 6x + y^2 - 10y + 25 = 0$

C. $x^2 - 3x + y^2 - 5y + 9 = 0$ D. $x^2 - 6x + y^2 - 10y + 9 = 0$

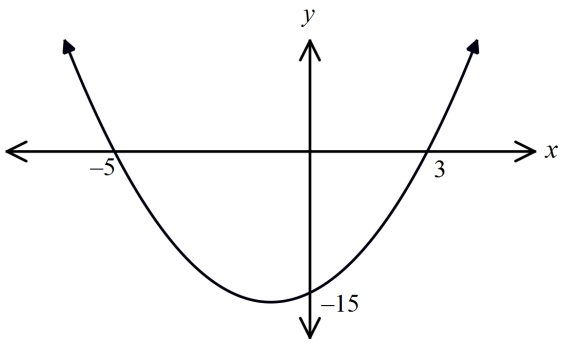
15. Which curve has an intercept at -12 on the y axis ?

A. $y = (x + 2)(x - 3)$ B. $y = (x - 12)(x - 1)$

C. $y = (x + 6)(x + 2)$ D. $y = (x + 4)(x - 3)$

16. Which is the graph of $y = (x + 3)(x - 5)$?

A.



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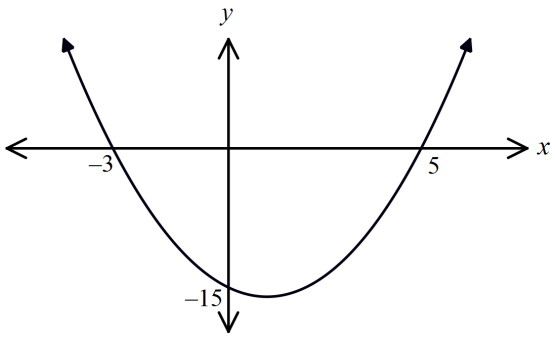
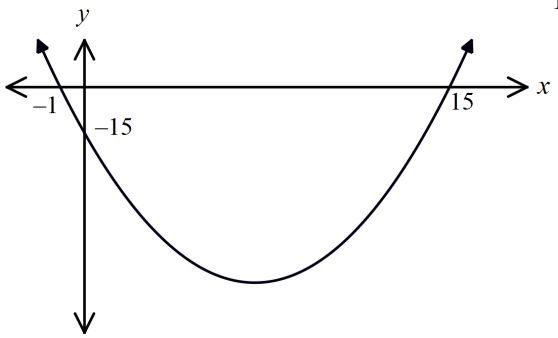
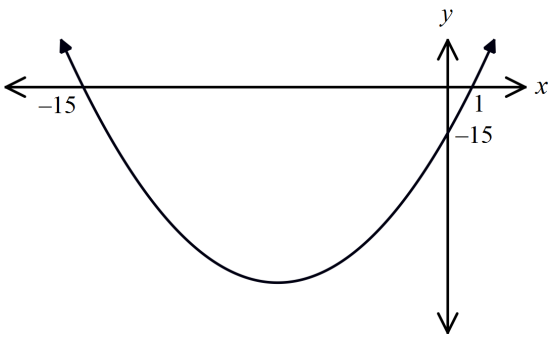


C.



D.



17. Which curve has its vertex at (–2, –36) ?

A. $y = (x - 8)(x - 4)$ B. $y = (x - 8)(x + 4)$

C. $y = (x + 8)(x - 4)$ D. $y = (x + 8)(x + 4)$

18. What are the intercepts on the x axis for the curve $y = x^2 - 9x + 18$?

A. $x = -6$ and $x = -3$. B. $x = -9$ and $x = -2$.

C. $x = 2$ and $x = 9$. D. $x = 3$ and $x = 6$.

High School Mathematics Test 2015

Year 10 **Non Linear Relations**

Calculator Allowed

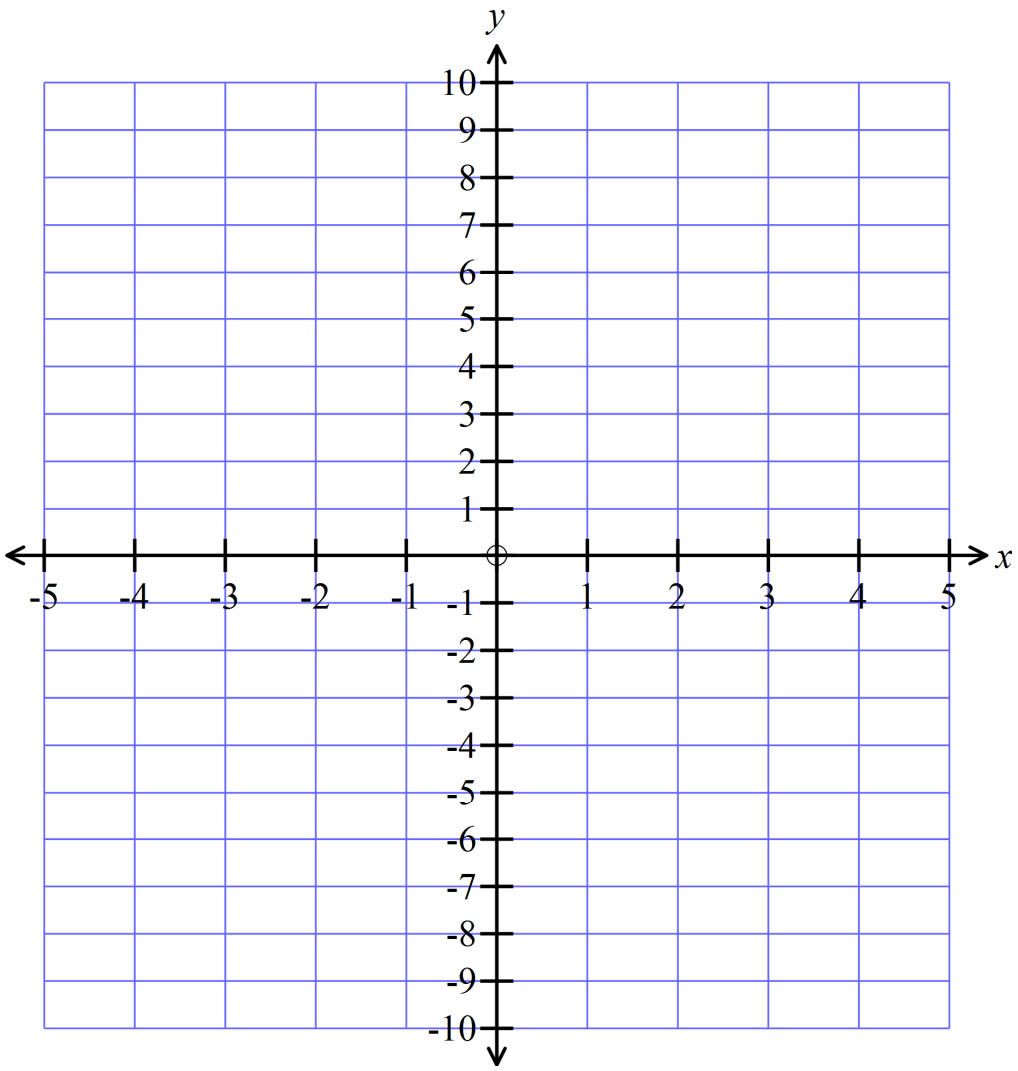
Name_____

Section 3 Longer Answer Section

Write all working and answers in the spaces provided on this test paper.

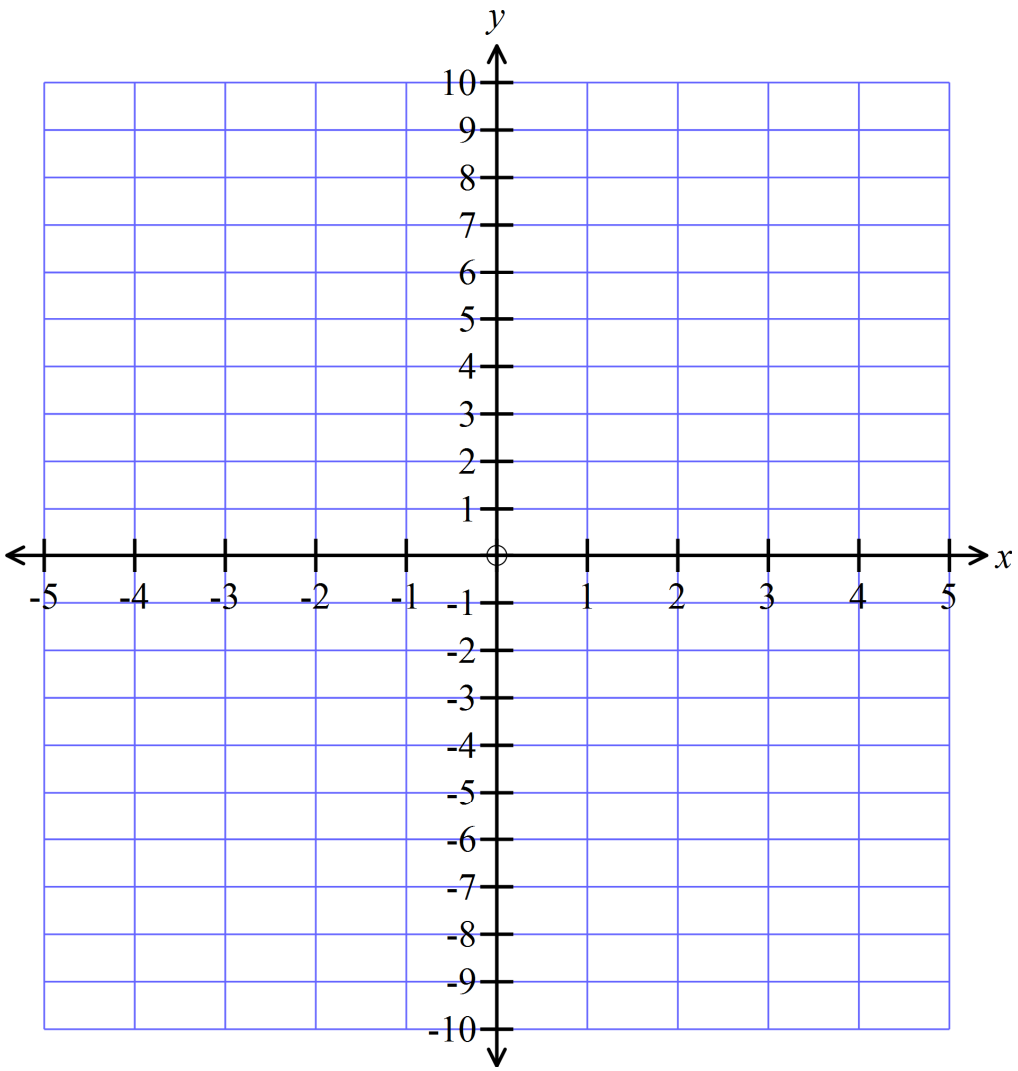
Marks

1. On the axes provided draw neat sketches of $y = x^2 + 2$ and $y = 8 - x^2$. **4**
Clearly mark the x and y intercepts and the vertex of each graph.



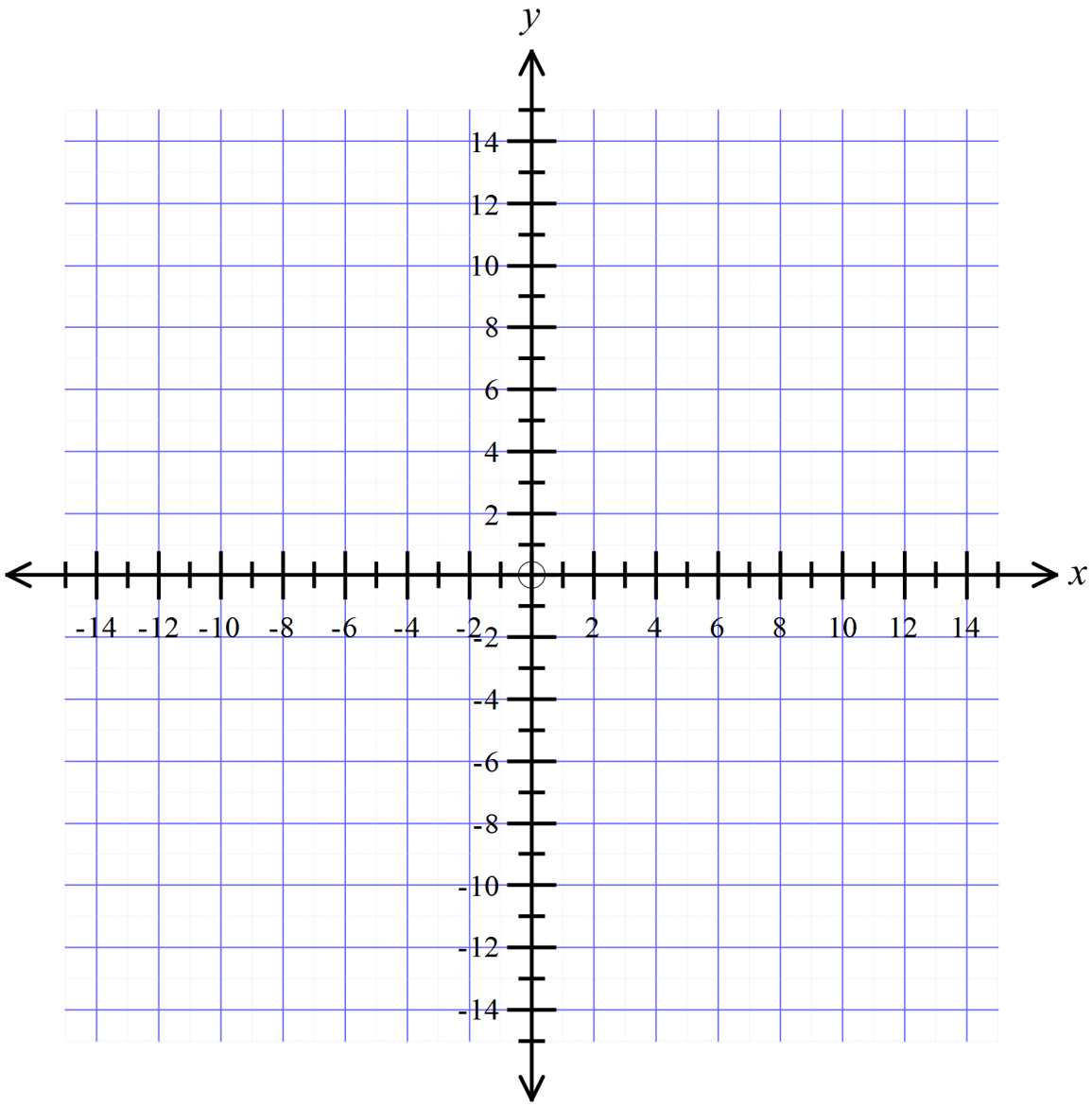
Marks

2. On the axes provided draw neat sketches of $y = (x - 1)(x + 3)$ and $y = x^2 - 2x$. **4**
Clearly mark the vertex of each graph.



Marks

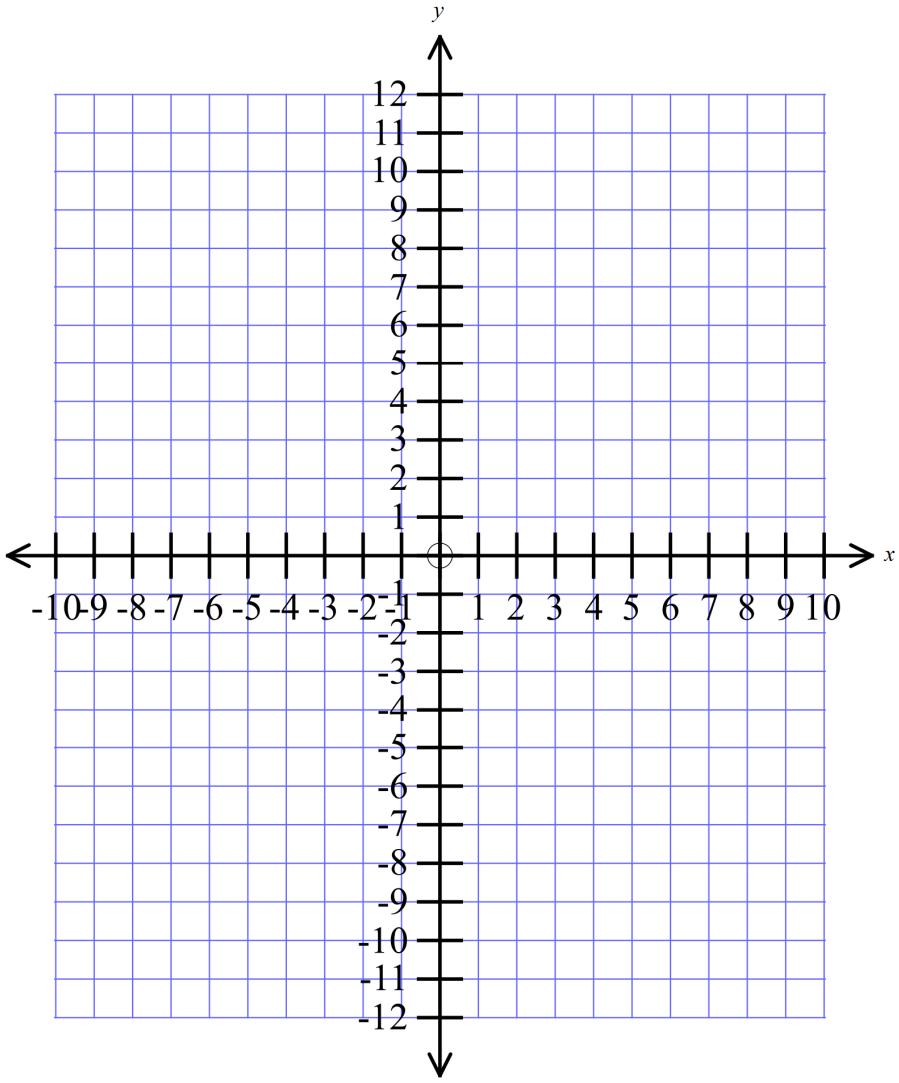
3. On the axes provided draw neat sketches of $y = 4^x - 6$ and $x^2 + y^2 = 144$. **4**
Clearly mark the x and y intercepts of each graph.



Marks

4. On the axes provided draw neat sketches of $y = \dfrac{1}{x+6}$ and $y = x(x-3)(x+3)$. **4**

Clearly mark the x and y intercepts and the vertex of each graph.



5. What is the centre and radius of the circle which has an equation of : **2**

$x^2 - 8x + y^2 + 18y = 24$.

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High School
Mathematics Test 2015

Multiple Choice Answer Sheet

Non Linear Relations

Name _____

Completely fill the response oval representing the most correct answer.

1.	A ⬭	B ⬭	C ⬭	D ⬭
2.	A ⬭	B ⬭	C ⬭	D ⬭
3.	A ⬭	B ⬭	C ⬭	D ⬭
4.	A ⬭	B ⬭	C ⬭	D ⬭
5.	A ⬭	B ⬭	C ⬭	D ⬭
6.	A ⬭	B ⬭	C ⬭	D ⬭
7.	A ⬭	B ⬭	C ⬭	D ⬭
8.	A ⬭	B ⬭	C ⬭	D ⬭
9.	A ⬭	B ⬭	C ⬭	D ⬭
10.	A ⬭	B ⬭	C ⬭	D ⬭
11.	A ⬭	B ⬭	C ⬭	D ⬭
12.	A ⬭	B ⬭	C ⬭	D ⬭
13.	A ⬭	B ⬭	C ⬭	D ⬭
14.	A ⬭	B ⬭	C ⬭	D ⬭
15.	A ⬭	B ⬭	C ⬭	D ⬭
16.	A ⬭	B ⬭	C ⬭	D ⬭
17.	A ⬭	B ⬭	C ⬭	D ⬭
18.	A ⬭	B ⬭	C ⬭	D ⬭

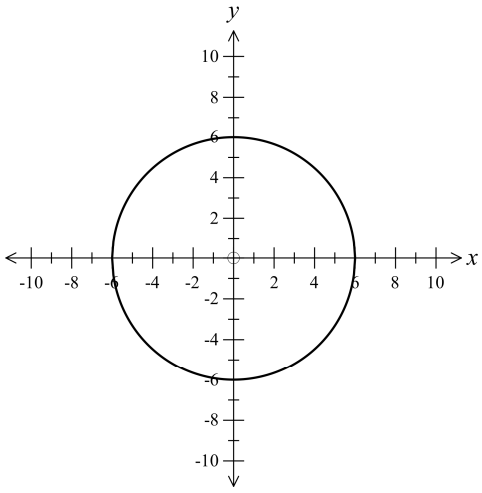
High School Mathematics Test 2015

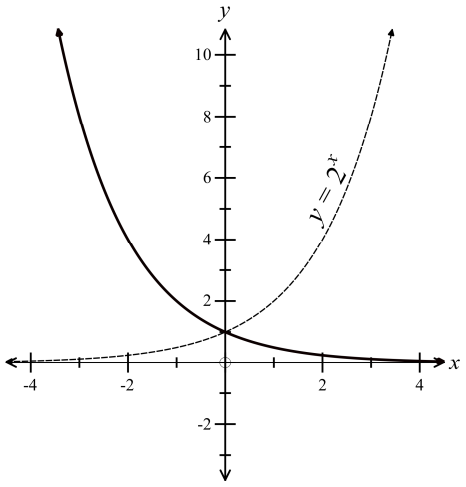
Year 10 **Non Linear Relations** Non Calculator

Section 1 Short Answer Section

ANSWERS

No.	WORKING	ANSWER
1.	b is the y intercept, so $b = 2$.	$b = 2$
2.	a is the x intercept, so $y = 0$. $0 = 49 - x^2$ $x^2 = 49$ $x = \pm 7$ $k = 7$	$k = 7$
3.	Substituting (3, 8) into $y = a^x$ gives $8 = a^3$ *By* trying values $2^3 = 8$, so a = 2.	$a = 2$
4.	Circle has equation $x^2 + y^2 = r^2$. Radius is 9, so equation is $x^2 + y^2 = 9^2$ $x^2 + y^2 = 81$.	$x^2 + y^2 = 81$.
5.	Both have a y intercept of y = -6, so only difference is coefficient of x^2. The larger coefficient gives the steeper curve, so the unbroken curve is $y = 12x^2 - 6$ which is steeper, and $y = 2x^2 - 6$ is the broader broken line curve.	See explanation
6.	The y intercept occurs where $x = 0$. $y = 3x^2 - 12$ $y = 3(0)^2 - 12$ $= -12$	R is (0,–12)

7.	The x intercept occurs where $y = 0$. $y = 3x^2 - 12$ $0 = 3x^2 - 12$ $3x^2 = 12$ $x^2 = \frac{12}{3} = 4$ $x = \pm 2$ P is (2,0) and Q is (–2,0)	P is (2,0) and Q is (–2,0)
8.	K has $x = 3$ $y = 4^3$ $y = 64$ K is (3,64)	K is (3, 64)
9.	$x^2 + y^2 = 36$ so radius = 6, centre (0, 0).  	See Graph
10.	$y = x^2 - 6x$ with x intercepts where $y = 0$. $x^2 - 6x = 0$ $x(x - 6) = 0$ $x = 0$ or $x = 6$ Intercept at B is $x = 6$, $x = 0$ B is (6, 0)	B is (6, 0)
11.	Vertex is midway between x intercepts, so $x = 3$. $y = x^2 - 6x$ $= 3^2 - 6(3)$ $= 9 - 18$ $= -9$ A is (3, –9)	A is (3, –9)

12.	C and D are the x intercepts, so $y = 0$. $0 = (x - 2)(x + 4)$ $x - 2 = 0$ or $x + 4 = 0$ $x = 2$ or $x = -4$ C is $(-4, 0)$ and D is $(2, 0)$	C is $(-4, 0)$ and D is $(2, 0)$
13.	Vertex is midway between x intercepts, so $x = -1$. $y = (-1 - 2)(-1 + 4)$ $y = -3 \times 3 = -9$ E is $(-1, -9)$	E is $(-1, -9)$
14.	$y = x^2 + bx - 16$ Passes through $(3,-25)$ $-25 = 3^2 + 3b - 16$ $-25 = 3b - 7$ $3b = -18$ $b = -6$	$b = -6$
15.	$y = 2^{-x}$ is a mirror image of $y = 2^x$ in y axis. 	The curve drawn with an unbroken line on the graph.
16.	$(x - 3)^2 + (y + 2)^2 = 9$ Centre at $(3,-2)$ and radius = $\sqrt{9} = 3$	Centre at $(3,-2)$ Radius = 3

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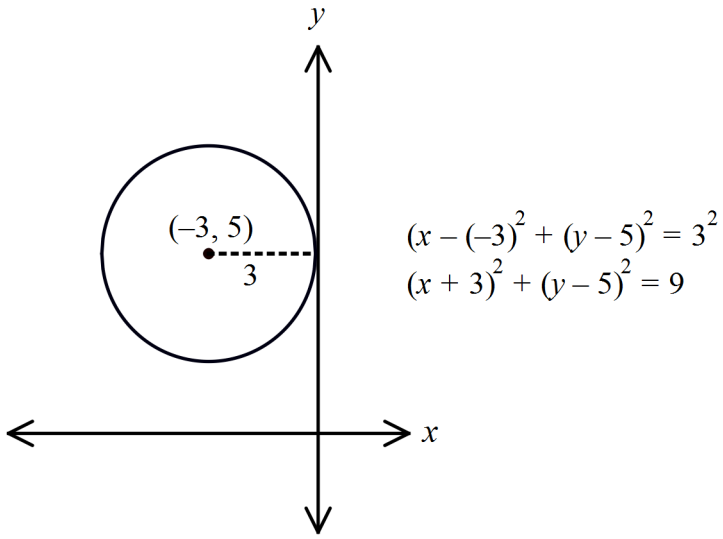
Year 10 **Non Linear Relations** Calculator Allowed

Section 2 Multiple Choice Section

ANSWERS

No.	WORKING	ANSWER
1.	$y = x^2 - 9$ since it has an intercept of -9.	**A**
2.	$y = x^2 - 25$ is concave up and has y intercept of -25.	**C**
3.	$x^2 + y^2 = 4$ is a circle, the others are parabolas.	**B**
4.	The graph of $x^2 + y^2 = 16$ is a circle with radius 4.	**B**
5.	$y = 2^{-x} + 6$, since it is a decreasing function and y intercept has been moved up 6 units from $y = 1$.	**A**
6.	$y = 4x^2 - 6$ is concave up and crosses at $y = -6$ so its vertex is $(0,-6)$.	**D**
7.	Needs to be a parabola which is concave down and through the origin.	**C**
8.	$x^2 + y^2 = 8^2$ $x^2 + y^2 = 64$	**B**
9.	$6x^2$ compared to x^2 is narrower $-6x^2$ is the same shape but concave down. So Graph D	**D**
10.	$y = 8x - x^2 = x(8 - x)$ Curve is concave down and crosses x axis at 0 and 8. When $x = 4$, $y = 4(8 - 4) = 16$	**A**

11.	Since two branches it is a hyperbola. Because asymptote is at $x = -4 \Rightarrow x \neq -4 \Rightarrow x + 4 \neq 0$ So denominator is $x + 4$. Test y intercept $x = 0$ $y = \frac{6}{0+4} = \frac{6}{4} = 1.5$	**C**
12.	 $(x-(-3)^2 + (y-5)^2 = 3^2$ $(x+3)^2 + (y-5)^2 = 9$	**B**
13.	$y = (x-3)^2$ When $x = 0$, $y = -3^2 = 9$ When $y = 0$, $(x-3)^2 = 0$ $x - 3 = 0$ $x = 3$ y intercept is 9 and there is only one x intercept at 3.	**A**
14.	Centre at $(3, 5)$ and radius 5 units gives equation $(x-3)^2 + (y-5)^2 = 5^2$ $x^2 - 6x + 9 + y^2 - 10y + 25 = 25$ $x^2 - 6x + y^2 - 10y + 9 = 0$	**D**
15.	Intercept comes from the constant term, which is the product of the two constants in the factors. The only two with a product of -12 is +4 and -3.	**D**
16.	$y = (x+3)(x-5)$ x intercepts $x = -3$ and $x = 5$ y intercept $y = -5 \times 3 = -15$	**B**

17.	Axis is at $x = -2$, so intercepts are equally spaced either side of this. Testing $x = -8$ and $x = 4$ meet this requirement. Equation is $y = (x - -8)(x - 4)$. $y = (x + 8)(x - 4)$	**C**
18.	$y = x^2 - 9x + 18$ $y = (x - 3)(x - 6)$ Intercepts when $y = 0$ $(x - 3)(x - 6) = 0$ $x = 3$ and $x = 6$	**D**

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Multiple Choice Answer Sheet

Non Linear Relations

Name _____ANSWERS_____

Completely fill the response oval representing the most correct answer.

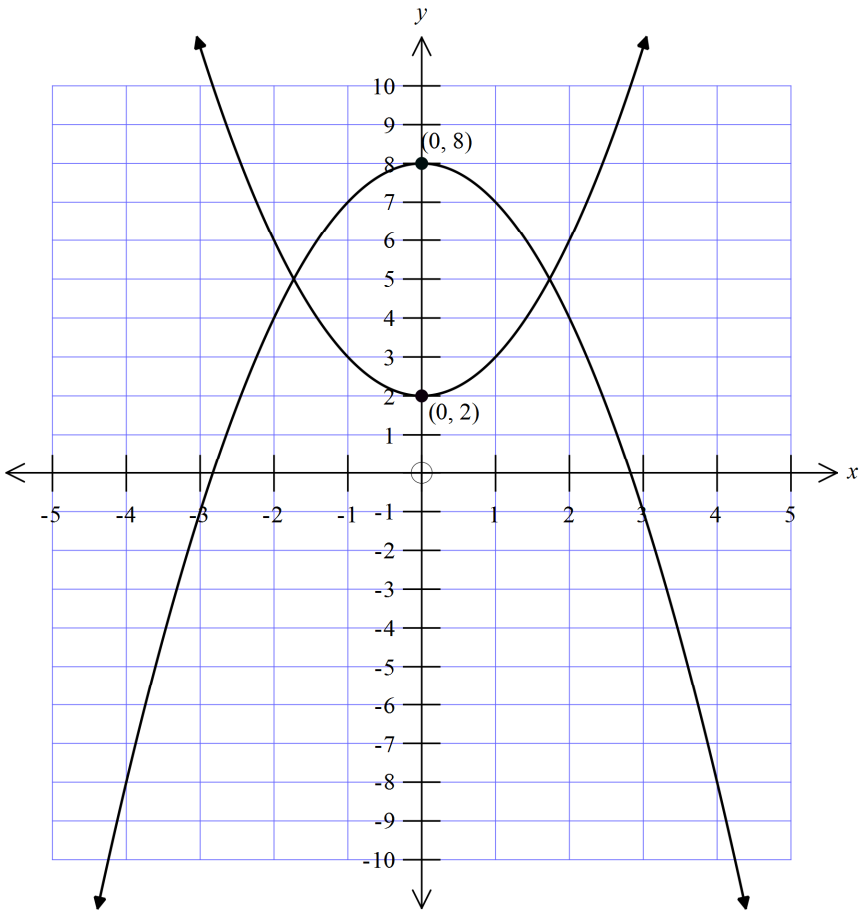
1.	A ●	B ○	C ○	D ○
2.	A ○	B ○	C ●	D ○
3.	A ○	B ●	C ○	D ○
4.	A ○	B ●	C ○	D ○
5.	A ●	B ○	C ○	D ○
6.	A ○	B ○	C ○	D ●
7.	A ○	B ○	C ●	D ○
8.	A ○	B ●	C ○	D ○
9.	A ○	B ○	C ○	D ●
10.	A ●	B ○	C ○	D ○
11.	A ○	B ○	C ●	D ○
12.	A ○	B ●	C ○	D ○
13.	A ●	B ○	C ○	D ○
14.	A ○	B ○	C ○	D ●
15.	A ○	B ○	C ○	D ●
16.	A ○	B ●	C ○	D ○
17.	A ○	B ○	C ●	D ○
18.	A ○	B ○	C ○	D ●

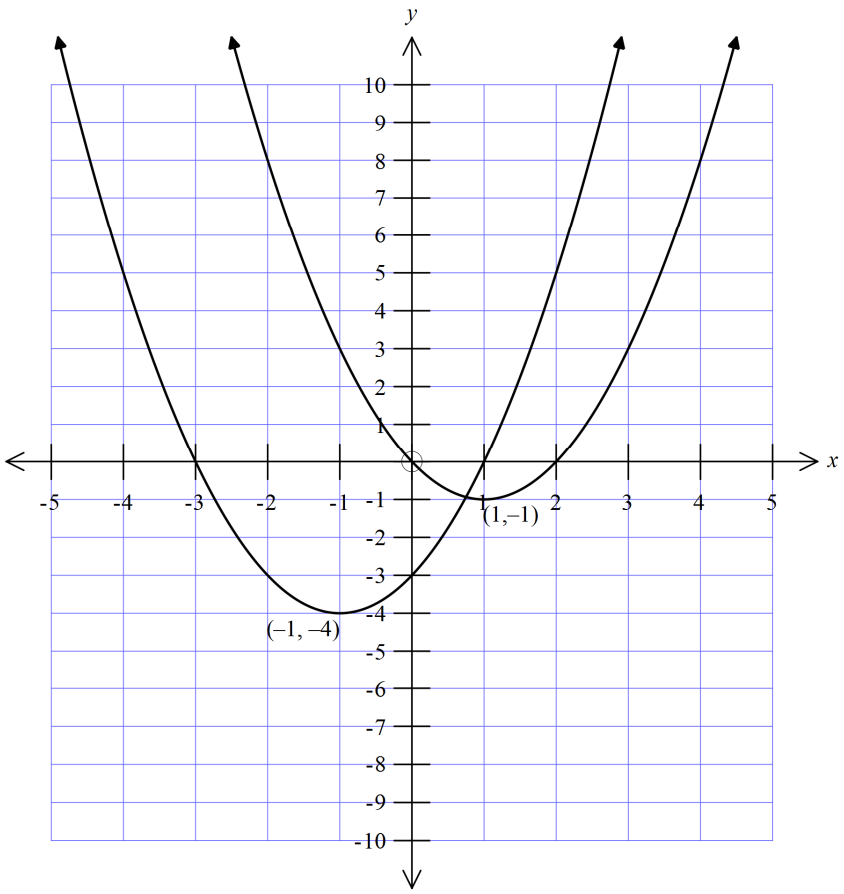
High School Mathematics Test 2015

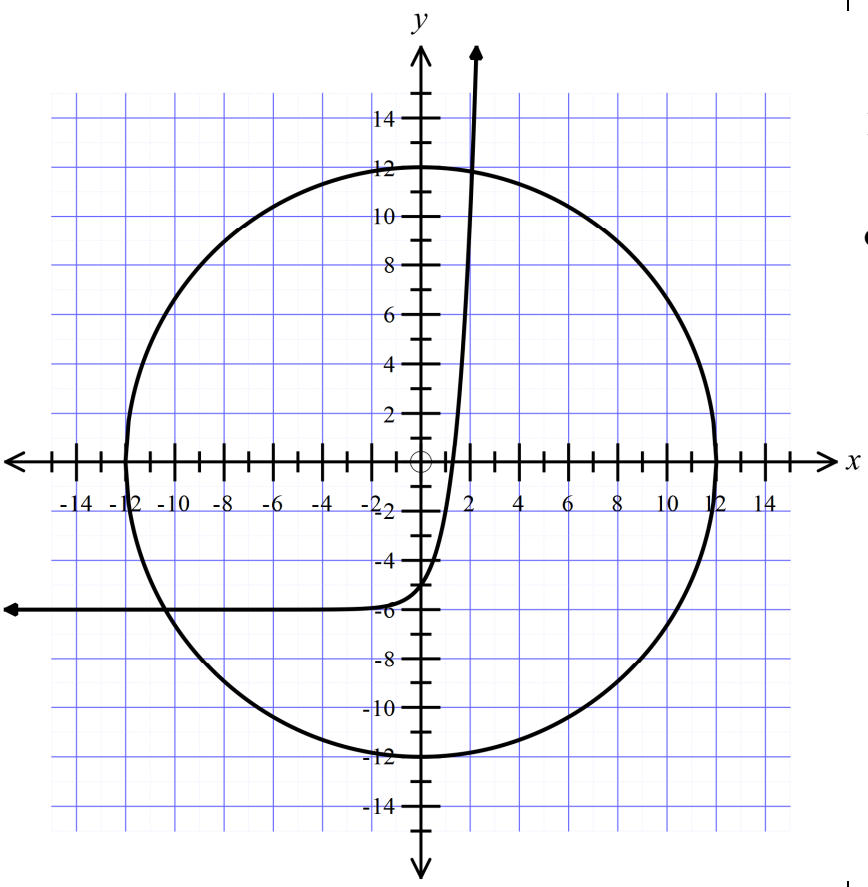
Year 10	*Non Linear Relations*	Calculator Allowed

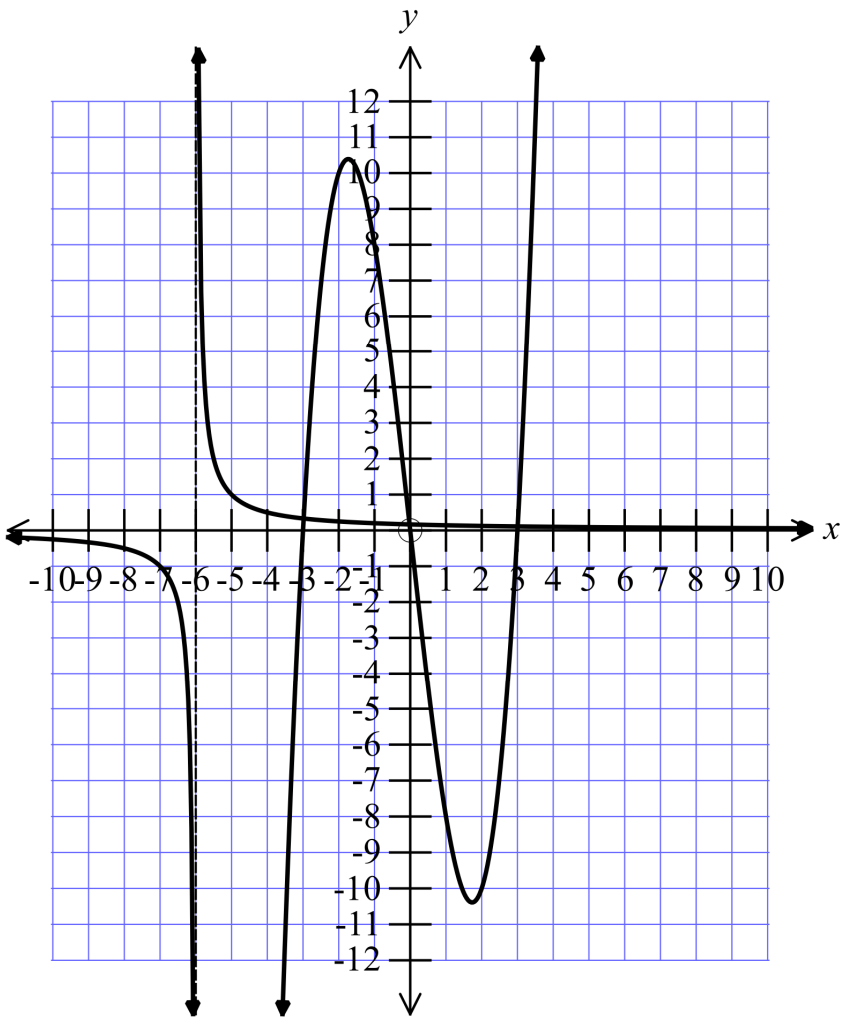
Section 3 Longer Answer Section

ANSWERS

		Marks
1.	On the axes provided draw neat sketches of $y = x^2 + 2$ and $y = 8 - x^2$. Clearly mark the vertex of each graph.  	**4 marks in total for the two curves.** **2 marks for each correct graph of a curve.** **For an incorrect graph, if it is a parabola with correct orientation and it shows some correct features give 1 mark.**

2.	On the axes provided draw neat sketches of $y = (x - 1)(x + 3)$ and $y = x^2 - 2x$. Clearly mark the vertex of each graph.  	**4 marks in total for the two curves.** **2 marks for each correct graph of a curve.** **For an incorrect graph, if it is a parabola with correct orientation and it shows some correct features give 1 mark**

3.	On the axes provided draw neat sketches of $y = 4^x - 6$ and $x^2 + y^2 = 144$. Clearly mark the x and y intercepts of each graph.  	**4 marks in total for the two curves.** **2 marks for each correct graph of a curve.** **For an incorrect graph, if it is the correct type of curve with correct orientation and it shows some correct features give 1 mark**

4.	On the axes provided draw neat sketches of $y = \frac{1}{x+6}$ and $y = x(x-3)(x+3)$. Clearly mark the main features of each graph.  	**4 marks in total for the two curves.** **2 marks for each correct graph of a curve.** **For an incorrect graph, if it is the correct type of curve with correct orientation and it shows some correct features give 1 mark**
5.	$x^2 - 8x + y^2 + 18y = 24$ $x^2 - 8x + 16 + y^2 + 18y + 81 = 97 + 24$ $x^2 - 8x + 16 + y^2 + 18y + 81 = 121$ $(x-4)^2 + (y+9)^2 = 121$ Centre = $(4,-9)$ radius = 11	**2 marks for both correct.** **1 mark if either is correct, or some correct working toward getting both.**