Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 6 6 3 / 0 1	Signature	

Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Advanced Subsidiary

Monday 11 January 2010 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

Materials required for examination
Mathematical Formulae (Pink or Green)

Items included with question papers
Nil

Calculators may NOT be used in this examination.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer to each question in the space following the question.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 10 questions in this question paper. The total mark for this paper is 75.
There are 28 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. Given that $y = x^4 + x^{\frac{1}{3}} + 3$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$.

(3)

$$\frac{dy}{dx} = 4x^3 + \frac{1}{3}x^{-2/3}$$

Q1

(Total 3 marks)

Leave blank

2. (a) Expand and simplify $(7 + \sqrt{5})(3 - \sqrt{5})$.

(3)

(b) Express $\dfrac{7+\sqrt{5}}{3+\sqrt{5}}$ in the form $a + b\sqrt{5}$, where a and b are integers.

(3)

2a) $(7 + \sqrt{5})(3 - \sqrt{5})$

$21 - 7\sqrt{5} + 3\sqrt{5} - 5$

$\underline{16 - 4\sqrt{5}}$

b) $\dfrac{(7+\sqrt{5})(3-\sqrt{5})}{(3+\sqrt{5})(3-\sqrt{5})}$

$\dfrac{16 - 4\sqrt{5}}{9 - 3\sqrt{5} + 3\sqrt{5} - 5}$

$\dfrac{16 - 4\sqrt{5}}{4}$

$\underline{4 - \sqrt{5}}$ $(a = 4 \quad b = -1)$

Q2

(Total 6 marks)

Leave blank

3. The line l_1 has equation $3x + 5y - 2 = 0$

(a) Find the gradient of l_1.

(2)

The line l_2 is perpendicular to l_1 and passes through the point (3, 1).

(b) Find the equation of l_2 in the form $y = mx + c$, where m and c are constants.

(3)

3a) $3x + 5y - 2 = 0$

$3x + 5y = 2$

$5y = -3x + 2$

$y = -\frac{3}{5}x + \frac{2}{5}$

$m = -3/5$

b) perpendicular gradient $= \frac{5}{3}$

$y = \frac{5}{3}x + c$ $\quad (\overset{x}{3}, \overset{y}{1})$

$1 = \frac{5}{3}(3) + c$

$1 = 5 + c$

$c = -4$

$y = \frac{5}{3}x - 4$

Leave blank

4. $$\frac{dy}{dx} = 5x^{-\frac{1}{2}} + x\sqrt{x}, \qquad x > 0$$

Given that $y = 35$ at $x = 4$, find y in terms of x, giving each term in its simplest form.

(7)

$$\frac{dy}{dx} = 5x^{-\frac{1}{2}} + x^{1} \times x^{\frac{1}{2}}$$

$$= 5x^{-\frac{1}{2}} + x^{\frac{3}{2}}$$

$$y = \frac{5x^{\frac{1}{2}}}{\frac{1}{2}} + \frac{x^{\frac{5}{2}}}{\frac{5}{2}} + c$$

$$y = 10x^{\frac{1}{2}} + \frac{2}{5}x^{\frac{5}{2}} + c$$

$x \quad y$

$(4, 35)$ $$35 = 10(4)^{\frac{1}{2}} + \frac{2}{5}(4)^{\frac{5}{2}} + c$$

$$35 = 10(2) + \frac{2}{5}(32) + c$$

$$35 = 20 + \frac{64}{5} + c$$

$$15 = \frac{64}{5} + c$$

$$75 = 64 + 5c$$

$$11 = 5c$$

$$\underline{c = \frac{11}{5}}$$

$$\underline{y = 10x^{\frac{1}{2}} + \frac{2}{5}x^{\frac{5}{2}} + \frac{11}{5}}$$

Leave blank

5. Solve the simultaneous equations

$$y - 3x + 2 = 0$$

$$y^2 - x - 6x^2 = 0$$

(7)

$y = (3x - 2)$

$(3x-2)^2 - x - 6x^2 = 0$

$(3x-2)(3x-2) - x - 6x^2 = 0$

$9x^2 - 6x - 6x + 4 - x - 6x^2 = 0$

$3x^2 - 13x + 4 = 0$

$(3x - 1)(x - 4) = 0$

$\underline{\underline{x = 1/3}}$ $\quad$ $\underline{\underline{x = 4}}$

$y = 3(1/3) - 2$ $\quad$ $y = 3(4) - 2$

$y = 1 - 2$ $\quad$ $y = 12 - 2$

$\underline{\underline{y = -1}}$ $\quad$ $\underline{\underline{y = 10}}$

Leave blank

6. The curve C has equation

$$y = \frac{(x+3)(x-8)}{x}, \quad x > 0$$

(a) Find $\frac{dy}{dx}$ in its simplest form.

(4)

(b) Find an equation of the tangent to C at the point where $x = 2$

(4)

6a) $y = \frac{(x+3)(x-8)}{x}$

$y = \frac{x^2 - 8x + 3x - 24}{x}$

$y = \frac{x^2 - 5x - 24}{x}$

$y = x - 5 - 24x^{-1}$

$\frac{dy}{dx} = 1 + 24x^{-2}$

b/ when $x = 2$

$\frac{dy}{dx} = 1 + \frac{24}{(2)^2}$

$= 1 + \frac{24}{4}$

$= 7$ $(m = 7)$

when $x = 2$

$y = \frac{((2)+3)((2)-8)}{2}$

$= \frac{(5)(-6)}{2}$

$= -15$

Leave blank

Question 6 continued

$y = mx + c$

$-15 = 7(2) + c$

$-15 = 14 + c$

$c = -29$

$\therefore \quad y = 7x - 29$

Q6

(Total 8 marks)

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7. Jill gave money to a charity over a 20-year period, from Year 1 to Year 20 inclusive. She gave £150 in Year 1, £160 in Year 2, £170 in Year 3, and so on, so that the amounts of money she gave each year formed an arithmetic sequence.

(a) Find the amount of money she gave in Year 10. **(2)**

(b) Calculate the total amount of money she gave over the 20-year period. **(3)**

Kevin also gave money to the charity over the same 20-year period.

He gave £A in Year 1 and the amounts of money he gave each year increased, forming an arithmetic sequence with common difference £30.
The total amount of money that Kevin gave over the 20-year period was **twice** the total amount of money that Jill gave.

(c) Calculate the value of A. **(4)**

a) $U_n = a + (n-1)d$ $\quad a = 150$, $d = 10$

$U_{10} = 150 + 9(10)$
$= 150 + 90$
$= £240$

b) $S_n = \frac{n}{2}(2a + (n-1)d)$

$S_{20} = \frac{20}{2}(2(150) + (20-1)(10))$

$= 10(300 + 190)$
$= 10(490)$
$= £4900$

c) Kevin gave $2 \times 4900 = £9800$ $\quad a = A$ $\quad d = 30$

$9800 = \frac{20}{2}(2A + (20-1)(30))$
$9800 = 10(2A + (19)(30))$
$9800 = 10(2A + 570)$
$980 = 2A + 570$
$410 = 2A$
$A = £205$

Leave blank

8.

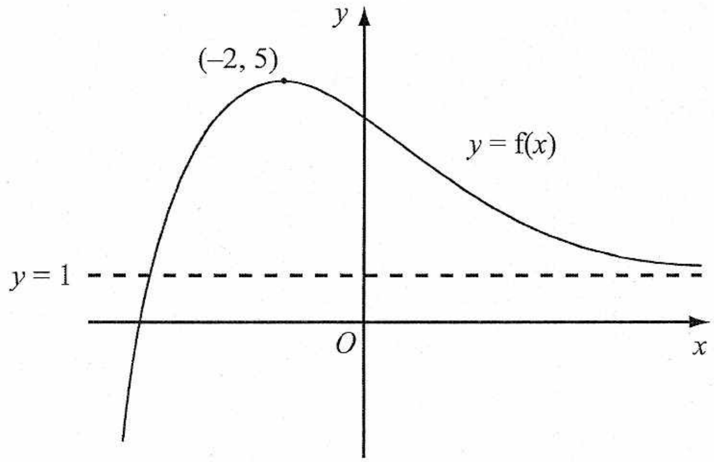


Figure 1

Figure 1 shows a sketch of part of the curve with equation $y = \mathrm{f}(x)$.

The curve has a maximum point $(-2, 5)$ and an asymptote $y = 1$, as shown in Figure 1.

On separate diagrams, sketch the curve with equation

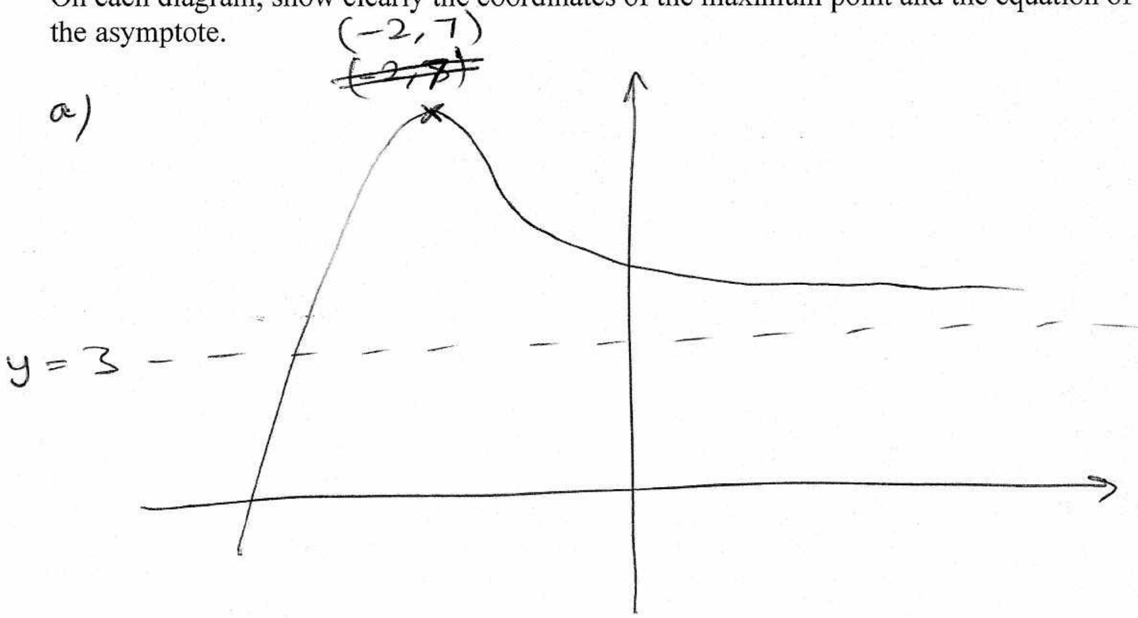
(a) $y = \mathrm{f}(x) + 2$ **(2)**

(b) $y = 4\mathrm{f}(x)$ **(2)**

(c) $y = \mathrm{f}(x + 1)$ **(3)**

On each diagram, show clearly the coordinates of the maximum point and the equation of the asymptote.

a)



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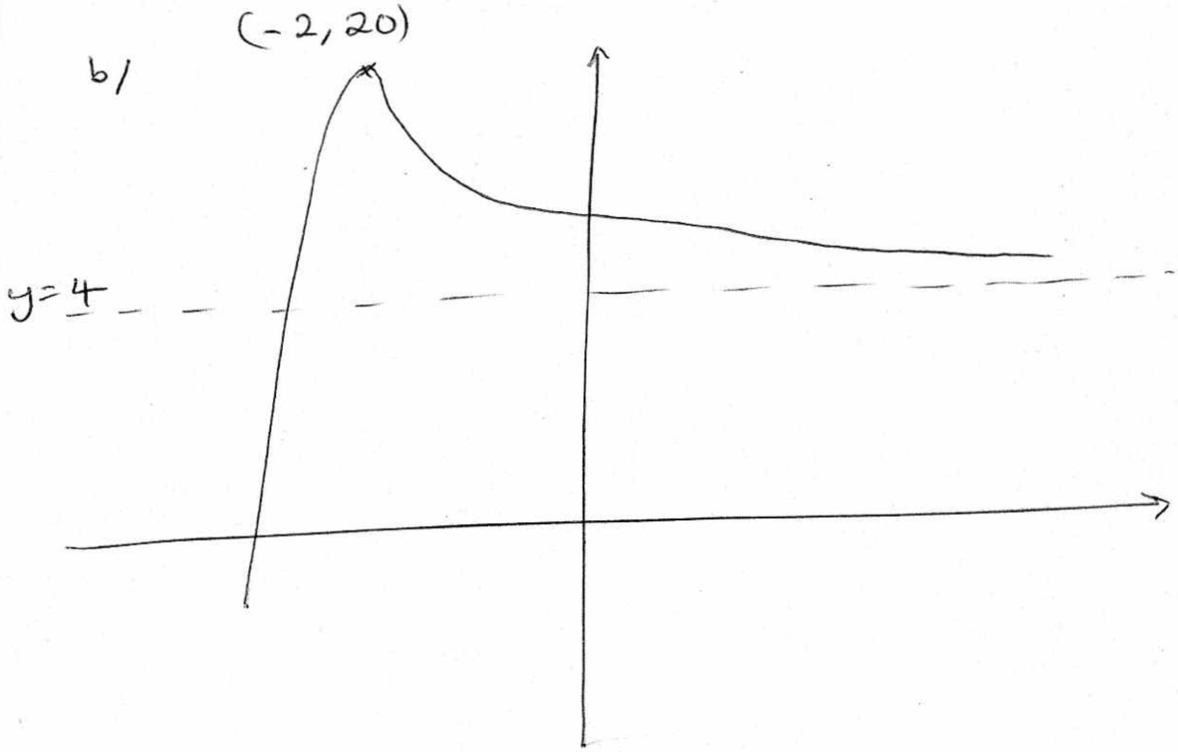
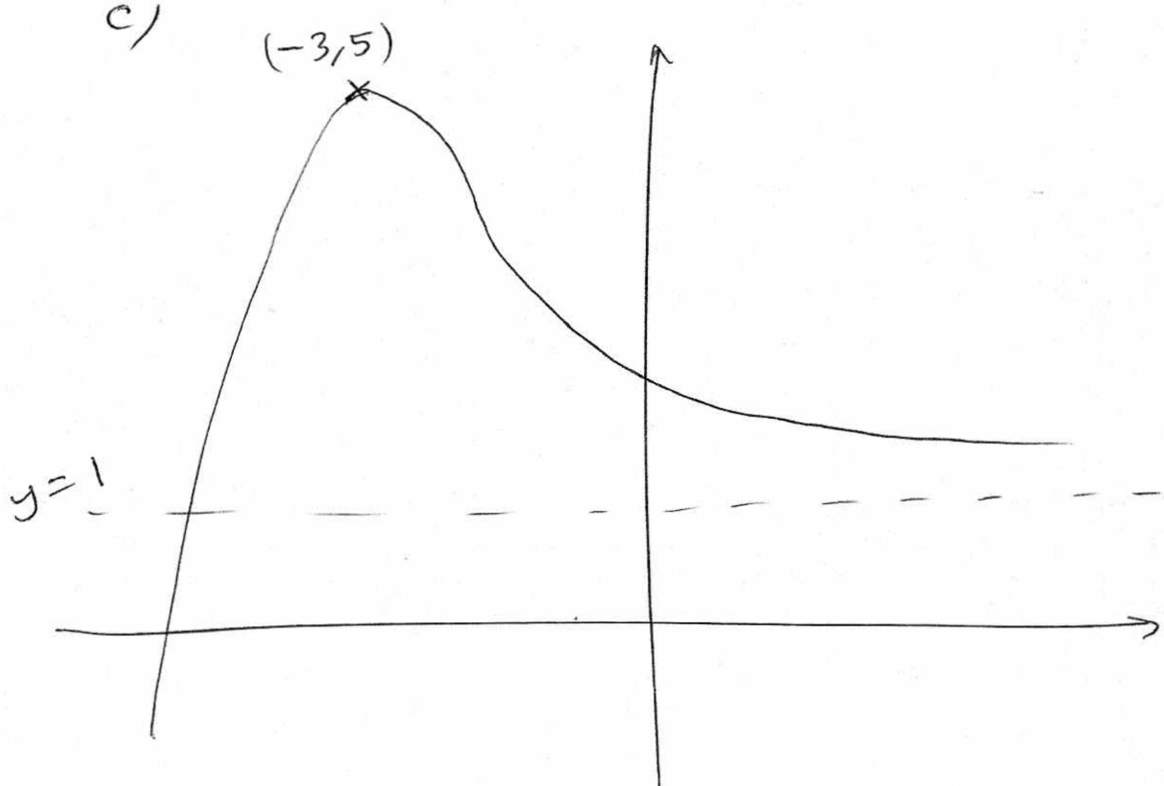
Question 8 continued

b)



c)



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9. (a) Factorise completely $x^3 - 4x$ **(3)**

(b) Sketch the curve C with equation

$$y = x^3 - 4x,$$

showing the coordinates of the points at which the curve meets the x-axis. **(3)**

The point A with x-coordinate -1 and the point B with x-coordinate 3 lie on the curve C.

(c) Find an equation of the line which passes through A and B, giving your answer in the form $y = mx + c$, where m and c are constants. **(5)**

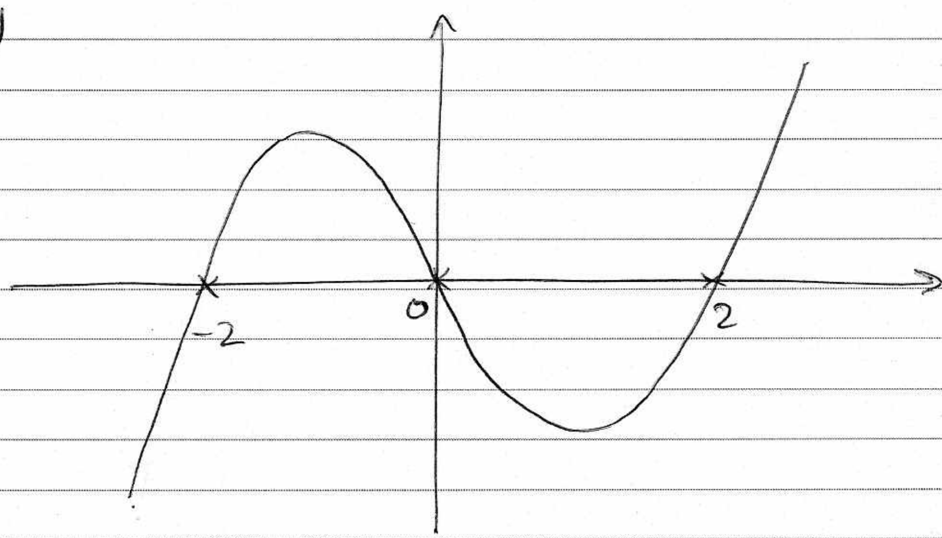
(d) Show that the length of AB is $k\sqrt{10}$, where k is a constant to be found. **(2)**

9a) $x^3 - 4x$

$x(x^2 - 4)$

$\underline{x(x+2)(x-2)}$

b)



c) when $x = -1$ $\quad y = (-1)^3 - 4(-1)$

$= -1 + 4$

$= 3$

when $x = 3$ $\quad y = (3)^3 - 4(3)$

$= 27 - 12$

$= 15$

Leave blank

Question 9 continued

$x_1 \; y_1 \qquad\qquad x_1 \; y_2$

$(-1, 3)$ and $(3, 15)$

$m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$= \dfrac{15 - 3}{3 - -1} = \dfrac{12}{4} = \underline{\underline{3}}$

$y = 3x + c \qquad (3, 15)$

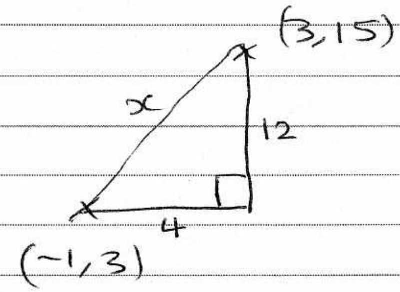
$15 = 3(3) + c$

$15 = 9 + c$

$c = 6$

$\underline{\underline{y = 3x + 6}}$

d/



$x^2 = 4^2 + 12^2$

$x^2 = 16 + 144$

$x^2 = 160$

$x = \sqrt{160}$

$= \sqrt{16}\sqrt{10}$

$= \underline{\underline{4\sqrt{10}}} \qquad \underline{\underline{k = 4}}$

Leave blank

10. $\quad \mathrm{f}(x) = x^2 + 4kx + (3 + 11k),\quad$ where k is a constant.

(a) Express f(x) in the form $(x + p)^2 + q$, where p and q are constants to be found in terms of k.

(3)

Given that the equation f(x) = 0 has no real roots,

(b) find the set of possible values of k.

(4)

Given that $k = 1$,

(c) sketch the graph of y = f(x), showing the coordinates of any point at which the graph crosses a coordinate axis.

(3)

a) $x^2 + 4kx + (3 + 11k)$

$(x + 2k)^2 - (2k)^2 + (3 + 11k)$

$(x + 2k)^2 - 4k^2 + 3 + 11k$

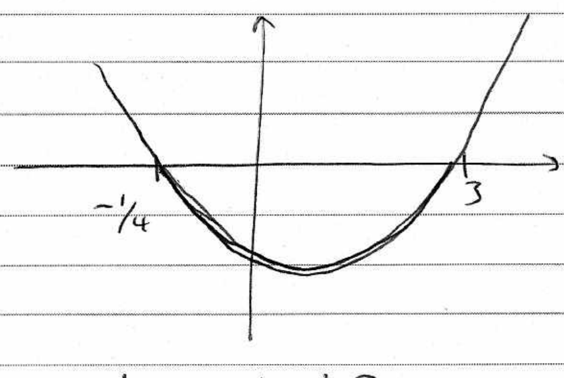
$p = 2k \qquad q = -4k^2 + 11k + 3$

b) $f(x) = 0$ has no roots

$\therefore \; 4k^2 - 11k - 3 < 0$

$(4k + 1)(k - 3)$

$k = -1/4 \qquad k = 3$



$\underline{-1/4 < k < 3}$

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Question 10 continued

c) $k = 1$

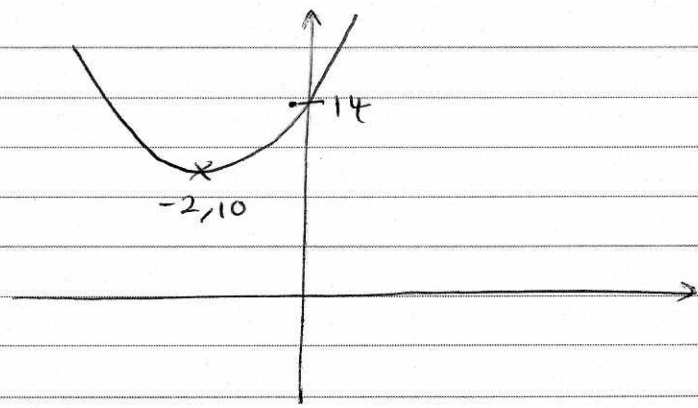
$(x + 2k)^2 - 4k^2 + 11k + 3$

$(x + 2)^2 - 4(1)^2 + 11(1) + 3$

$(x + 2)^2 - 4 + 11 + 3$

$(x + 2)^2 + 10$

Min point at $(-2, 10)$



crosses y axis when $x = 0$

$y = x^2 + 4\cancel{x} + 14$

when $x = 0$ $y = 14$