BAULKHAM HILLS HIGH SCHOOL

2013

YEAR 11

YEARLY EXAMINATIONS

Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
  Black pen is preferred
- Board-approved calculators may be used
- A table of standard integrals is provided at the back of this paper
- Show all necessary working in Questions 11 – 14
- Marks may be deducted for careless or badly arranged work

Total marks – 70

Section I Pages 2 – 4

10 marks

- Attempt Questions 1 – 10
- Allow about 15 minutes for this section

Section II Pages 5 – 9

60 marks

- Attempt Questions 11 – 14
- Allow about 1 hour 45 minutes for this section

Section I

10 marks
Attempt Questions 1 – 10
Allow about 15 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 10

---

1 If $2x^2 - 12x + 11$ is expressed in the form $2(x - b)^2 + c$, what is the value of c?

(A) -25

(B) -7

(C) 2

(D) 29

2 For what values of k does the equation $x^2 - 3x + k = 0$ have equal roots?

(A) $-\frac{9}{4}$

(B) $-\frac{1}{12}$

(C) 0

(D) $\frac{9}{4}$

3 What is the derivative of $\left(x^3 + 4\right)^3$?

(A) $3\left(x^3 + 4\right)^2$

(B) $3\left(3x^2 + 4\right)^2$

(C) $9x^2\left(x^3 + 4\right)^2$

(D) $9x^2\left(3x^2 + 4\right)^2$

4 A function is given by $f(x) = \sqrt{9 - x^2}$. What is a suitable domain of $f(x)$?

(A) $x \geq 3$

(B) $x \leq 3$

(C) $-3 \leq x \leq 3$

(D) $-9 \leq x \leq 9$

5 The line through $P(7, p)$ and $Q(4, -5)$ has a gradient of 3. What is the value of p?

(A) -14

(B) 4

(C) 6

(D) 8

6 What is the gradient of the perpendicular to the line with equation $3y = -2x + 1$?

(A) -2

(B) $-\frac{2}{3}$

(C) $\frac{1}{2}$

(D) $\frac{3}{2}$

7 Find all the values of x in the interval $0^\circ \leq x \leq 360^\circ$ for which $\tan x = -\sqrt{3}$.

(A) 30°, 330°

(B) 120°, 240°

(C) 120°, 300°

(D) 150°, 330°

8 Which of the following is true for the function $g(x)$ where $g'(x) = x^2 + 2x + 1$?

(A) $g(x)$ is never decreasing.

(B) $g(x)$ is increasing then decreasing.

(C) $g(x)$ is decreasing then increasing.

(D) $g(x)$ is never increasing.

9 If $a > b$, which of the following is always true?

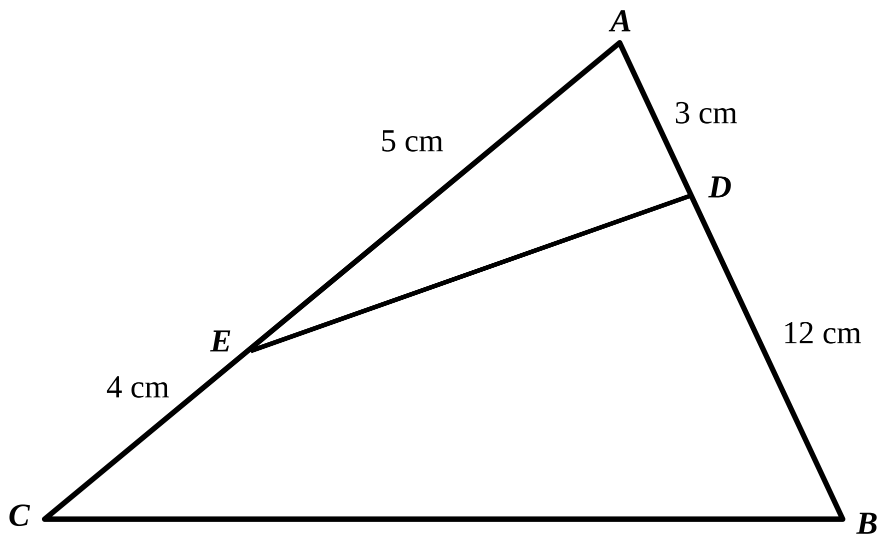
(A) $a^2 > b^2$

(B) $\frac{1}{a} > \frac{1}{b}$

(C) $-a > -b$

(D) $2^a > 2^b$

10 If ΔABC has area 36 cm^2 , then the area of ΔADE is



(A) 4 cm^2

(B) 8 cm^2

(C) 12 cm^2

(D) 16 cm^2

END OF SECTION I

Section II

90 marks
Attempt Questions 11 – 14
Allow about 1 hour 45 minutes for this section

Answer each question on the appropriate answer sheet. Each answer sheet must show your name. Extra paper is available.

All necessary working should be shown in every question.

Marks

Question 11 ***(15 marks)*** Use a *separate* answer sheet

(a) Express $0.6\dot{0}\dot{4}$ as a fraction in its simplest form. *2*

(b) Factorise $x^3 - 2x^2 - 15x$ *2*

(c) Solve $|5x - 9| > 21$ *2*

(d) Write $\dfrac{\sqrt{2}}{\sqrt{3} + 2}$ with a rational denominator *2*

(e) Find the coordinates of the focus of the parabola $x^2 = 12(y - 4)$ *2*

(f) Simplify $\dfrac{1}{x^2 + x} - \dfrac{1}{x^2 - x}$ *2*

(g) Solve the following pair of simultaneous equations *3*

$$xy = 2$$
$$x - 2y = 3$$

Marks

<u>Question 12</u> ***(15 marks)*** Use a *separate* answer sheet

(a) Find the derivative of

(i) $5x^3 + 4x - 7 + \dfrac{3}{x^2}$ *2*

(ii) $\dfrac{2x-5}{3x+7}$ *2*

(iii) $\sqrt{4-x^2}$ *2*

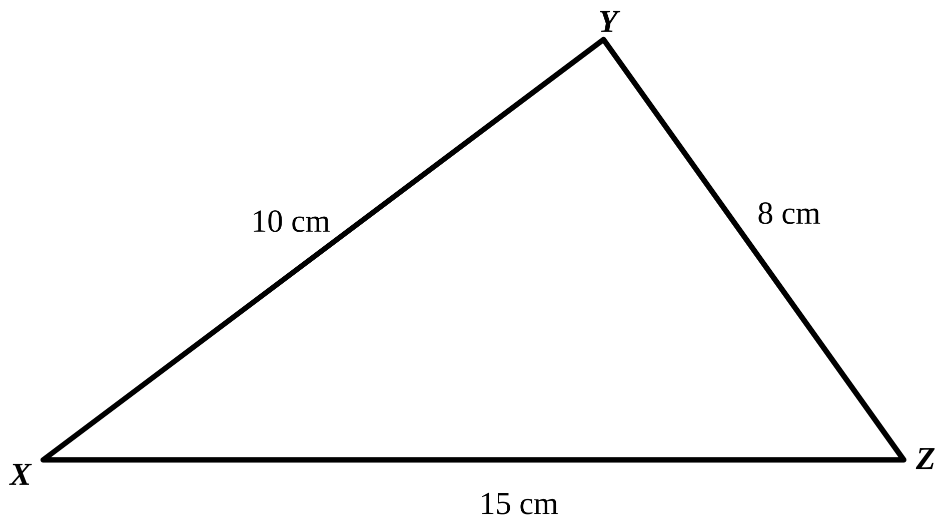
(b) If α and β are the roots of $x^2 - 2x + 5 = 0$, find

(i) $\dfrac{1}{\alpha} + \dfrac{1}{\beta}$ *2*

(ii) $\alpha^2 + \beta^2$ *2*

(c) If θ is a reflex angle such that $\tan\theta = \dfrac{2}{3}$, find the value of $\cos\theta$. *2*

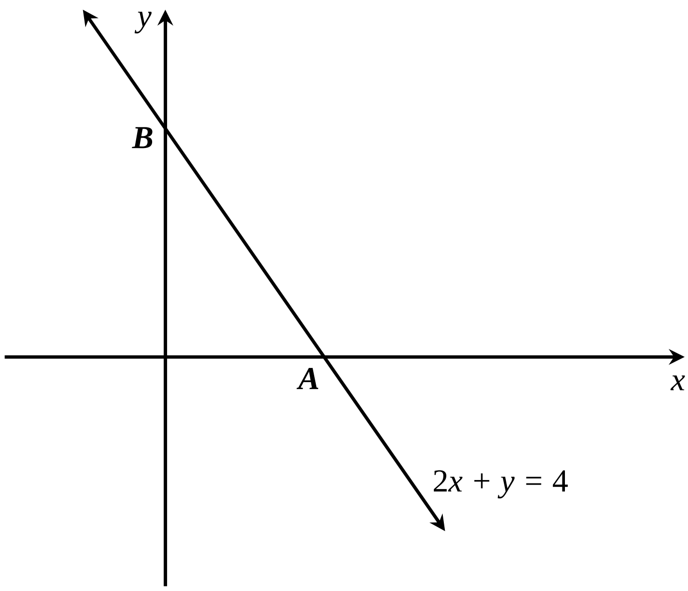
(d) Use the cosine rule to find the largest angle in this triangle, correct to the nearest minute. *3*



Marks

<u>Question 13</u> ***(15 marks)*** Use a *separate* answer sheet

(a) In the diagram, the line $2x + y = 4$ cuts the x-axis at A and the y-axis at B



Copy the diagram onto your answer sheet.

(i) Find the coordinates of A and B. *1*

(ii) Find the perpendicular distance of the point $C(5, 2)$ from the line $2x + y = 4$. *2*

(iii) Show that the gradient of the line AC is $\frac{2}{3}$. *1*

(iv) Hence, or otherwise, show that the equation of the line AC is $2x - 3y = 4$. *1*

(v) Find the distance AB. *2*

(vi) Find the exact area of ΔABC. *1*

(vii) On your diagram, sketch the region described by the inequalities $2x + y \geq 4$ and $2x - 3y \leq 4$. *1*

(b) The function $y = x^3 - 3x^2 - 9x + 1$ is defined in the domain $-2 \leq x \leq 5$.

(i) Find the coordinates of any turning points and determine their nature. *3*

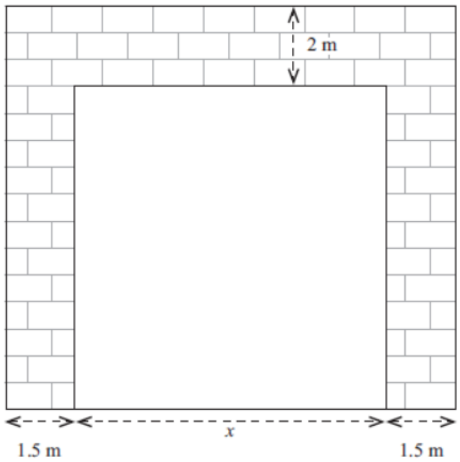
(ii) Find the coordinates of any points of inflection. *1*

(iii) Draw a neat sketch of the curve, clearly labelling the important features. *2*

Marks

<u>Question 14</u> ***(15 marks)*** Use a *separate* answer sheet

(a) A square garage door of length x metres is surrounded on three sides, by brickwork. The brickwork is 1.5 metres wide on each side of the door and of height 2 metres above the door, as shown below.

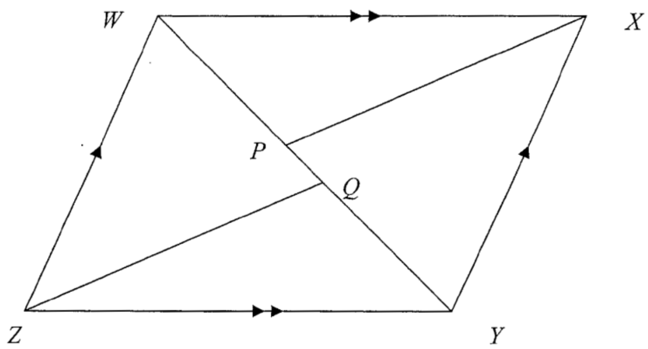


In order to meet building regulations, the area of brickwork must be more than twice the area of the garage door.

(i) Show that $2x^2 - 5x - 6 < 0$ *2*

(ii) Hence find the range of values of x, in order to satisfy building regulations. *2*

(b) $WXYZ$ is a parallelogram. XP bisects $\angle WXY$ and ZQ bisects $\angle WZY$.



Copy or trace the diagram onto your answer sheet.

(i) Explain why $\angle WXY = \angle WZY$ *1*

(ii) Prove $\Delta WXP \equiv \Delta YZQ$ *2*

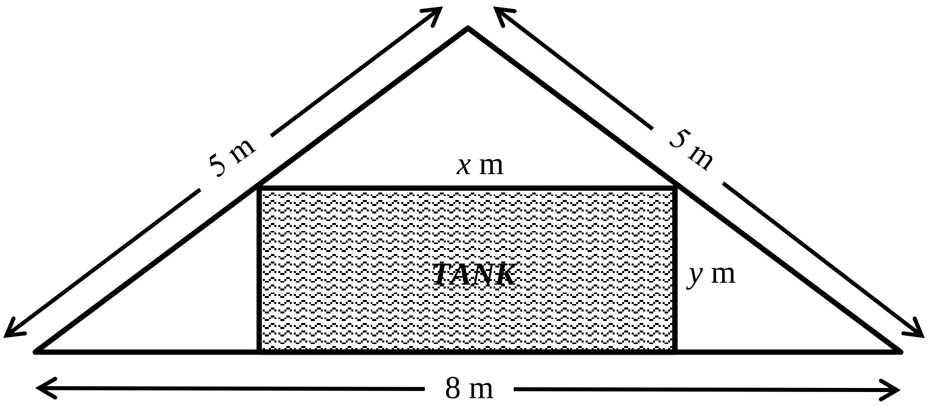
(iii) Hence find the length of PQ, given WY = 20 cm and QY= 8 cm *1*

Question 14 continues on page 9

Marks

<u>Question 14</u> (continued)

(c) A rectangular hot water tank x metres wide, y metres high and 1.5 metres long, which fits exactly into the roof of the house.
The cross-section of the roof is an isosceles triangle with base 8 metres and equal sides 5 metres in length, as shown below.



(i) Explain why the roof of the house is 3 metres high. *1*

(ii) Show that $y = \frac{3}{8}(8 - x)$. *2*

(iii) Show that the volume of the tank is given by $V = \frac{9}{16}x(8 - x)$. *1*

(iv) Calculate the maximum volume of the tank. *3*

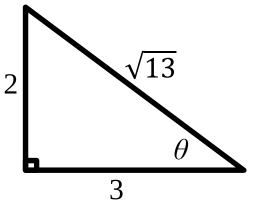
End of paper

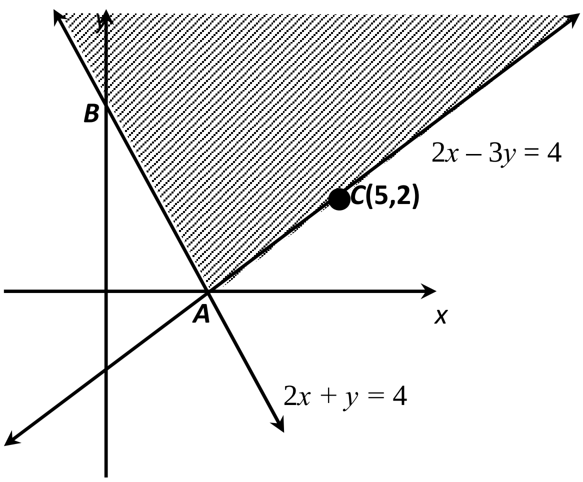
BAULKHAM HILLS HIGH SCHOOL
YEAR 11 MATHEMATICS YEARLY EXAMINATION 2013 SOLUTIONS

Solution	Marks	Comments
SECTION I		
1. B - $2x^2 - 12x + 11 = 2(x^2 - 6x) + 11$ $= 2(x^2 - 6x + 9) - 18 + 11$ $= 2(x-3)^2 - 7$ $\therefore\ c = -7$	**1**	
2. D – equal roots occur when $\Delta = 0$ i.e. $b^2 - 4ac = 0$ $(-3)^2 - 4(1)(k) = 0$ $9 - 4k = 0$ $4k = 9$ $k = \frac{9}{4}$	**1**	
3. C - $f(x) = (x^3 + 4)^3$ $f'(x) = 3(x^3+4)^2(3x^2)$ $= 9x^2(x^3+4)^2$	**1**	
4. C - domain: $9 - x^2 \geq 0$ $x^2 \leq 9$ $-3 \leq x \leq 3$	**1**	
5. B - $m_{PQ} = 3$ $\frac{p+5}{7-4} = 3$ $\frac{p+5}{3} = 3$ $p + 5 = 9$ $p = 4$	**1**	
6. D - $3y = -2x + 1$ $y = -\frac{2}{3}x + \frac{1}{3}$ gradient $= -\frac{2}{3}$ $\therefore$ gradient of perpendicular $= \frac{3}{2}$	**1**	
7. C - $\tan x = -\sqrt{3}$ $\quad 0^\circ \leq x \leq 360^\circ$ Q2 & Q4 $\tan\alpha = \sqrt{3}$ $\alpha = 60^\circ$ $x = 180 - \alpha,\ 360 - \alpha$ $x = 120^\circ,\ 300^\circ$	**1**	
8. A – $g'(x) = x^2 + 2x + 1$ $= (x+1)^2 \geq 0$ $\therefore g'(x)$ is never negative Thus $g(x)$ is never decreasing	**1**	
9. D – (A) $-1 > -2$ however $(-1)^2 > (-2)^2$ is FALSE (B) $3 > 2$ however $\frac{1}{3} > \frac{1}{2}$ is FALSE (C) $3 > 2$ however $-3 > -2$ is FALSE (D) as 2^x increases as x increases then if $a > b$ then $2^a > 2^b$	**1**	

Solution	Marks	Comments
10. A - $\angle DAE = \angle CAB$ (common $\angle$) $\frac{AD}{AC} = \frac{3}{9} = \frac{1}{3}$ $\frac{AE}{AB} = \frac{5}{15} = \frac{1}{3}$ $\therefore \frac{AD}{AC} = \frac{AE}{AB}$ thus $\Delta DAE \mid\mid\mid \Delta CAB$ (SAS - in ratio 1:3) If sides are in the ratio 1:3 then the areas are in the ratio $1:3^2 = 1:9$ $\therefore$ area $\Delta A\Delta$ = 4 cm^2	**1**	

Solution	Marks	Comments
SECTION II		
QUESTION 11		
11(a) Let $x = 0.6\dot{0}\dot{4}$ $x = 0.604040404\ldots$ $100x = 60.4040404\ldots$ $99x = 59.8$ $x = \frac{59.8}{99}$ $= \frac{598}{990} = \frac{299}{495}$ **OR** $0.6\dot{0}\dot{4} = \frac{604 - 6}{990}$ $= \frac{598}{990} = \frac{299}{495}$	2	**2 marks** • Correct solution **1 mark** • Unsimplified correct answer • Correctly uses a valid technique • Bald simplified answer
11(b) $x^3 - 2x^2 - 15x = x(x^2 - 2x - 15)$ $= x(x-5)(x+3)$	2	**2 marks** • Fully factorised answer **1 mark** • Partially factorised answer
11(c) $\lvert 5x - 9\rvert > 21$ $5x - 9 > 21$ or $-5x + 9 > 21$ $5x > 30$ $\quad$ $-5x > 12$ $x > 6$ $\quad$ $x < -\frac{12}{5}$ $\therefore x < -\frac{12}{5}$ or $x > 6$	2	**2 marks** • Correct solution **1 mark** • Finds two possible critical points via a valid method **0 marks** • Solves without considering the absolute value
11(d) $\frac{\sqrt{2}}{\sqrt{3}+2} \times \frac{\sqrt{3}-2}{\sqrt{3}-2} = \frac{\sqrt{6} - 2\sqrt{2}}{3-4}$ $= \frac{\sqrt{6} - 2\sqrt{2}}{-1}$ $= 2\sqrt{2} - \sqrt{6}$	2	**2 marks** • Correct solution. **1 mark** • Attempts to multiply by the conjugate
11(e) $x^2 = 12(y-4)$ $4a = 12$ $a = 3$ Vertex $= (0, 4)$ Focus $= (0, 4 + a)$ $= (0, 7)$	2	**2 marks** • Correct answer **1 mark** • Finds focal length • Finds vertex
11(f) $\frac{1}{x^2 + x} - \frac{1}{x^2 - x} = \frac{1}{x(x+1)} - \frac{1}{x(x-1)}$ $= \frac{(x-1) - (x+1)}{x(x+1)(x-1)}$ $= -\frac{2}{x(x+1)(x-1)}$	2	**2 marks** • Correct solution **1 mark** • Creates a common denominator
11(g) $xy = 2 \Rightarrow y = \frac{2}{x}$ $x - 2\left(\frac{2}{x}\right) = 3$ $x^2 - 4 = 3x$ $x^2 - 3x - 4 = 0$ $(x+1)(x-4) = 0$ $x = -1$ or $x = 4$ $\therefore y = -2$ or $y = \frac{1}{2}$ $x = -1,\ y = -2$ or $x = 4,\ y = \frac{1}{2}$	3	**3 marks** • Correct solution **2 marks** • Correctly finds one answer • Finds two correct *x*-values or *y*-values **1 mark** • Creates a quadratic equation in an attempt to find a solution *Note: do not penalise for writing answer as coordinates.*

Solution	Marks	Comments
QUESTION 12		
12(a) (i) $f(x) = 5x^3 + 4x - 7 + \frac{3}{x^2}$ $= 5x^3 + 4x - 7 + 3x^{-2}$ $f'(x) = 15x^2 + 4 - 6x^{-3}$ $= 15x^2 + 4 - \frac{6}{x^3}$	**2**	**2 marks** • Correct answer **1 mark** • Correctly differentiates at least two terms *Note: may be left in index form*
12(a) (ii) $f(x) = \frac{2x-5}{3x+7}$ $f'(x) = \frac{(3x+7)(2)-(2x-5)(3)}{(3x+7)^2}$ $= \frac{6x+14-6x+15}{(3x+7)^2}$ $= \frac{29}{(3x+7)^2}$	**2**	**2 marks** • Correct answer **1 mark** • Correct use of the quotient rule or equivalent merit
12(a) (iii) $f(x) = \sqrt{4-x^2}$ $= \left(4-x^2\right)^{\frac{1}{2}}$ $f'(x) = \frac{1}{2}\left(4-x^2\right)^{-\frac{1}{2}}(-2x)$ $= -x\left(4-x^2\right)^{-\frac{1}{2}}$ $= -\frac{x}{\sqrt{4-x^2}}$	**2**	**2 marks** • Correct answer **1 mark** • Correct use of the chain rule or equivalent merit • *Note: may be left in index form*
12(b) (i) $\alpha + \beta = 2 \quad \alpha\beta = 5$ $\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\beta + \alpha}{\alpha\beta}$ $= \frac{2}{5}$	**2**	**2 marks** • Correct answer. **1 mark** • Correctly finds $\alpha + \beta$ and $\alpha\beta$ • Rewrites $\frac{1}{\alpha} + \frac{1}{\beta}$ in terms of sum and product of roots
12(b) (ii) $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$ $= (2)^2 - 2(5)$ $= 4 - 10$ $= -6$	**2**	**2 marks** • Correct answer. **1 mark** • Rewrites $\alpha^2 + \beta^2$ in terms of sum and product of roots
12(c) θ is reflex and $\tan\theta > 0$, $\therefore$ 3rd quadrant and thus $\cos\theta < 0$  $\therefore \cos\theta = -\frac{3}{\sqrt{13}}$	**2**	**2 marks** • Correct answer **1 mark** • Establishes the sign of the answer • Finds the correct ratio, disregarding sign
12(d) $y^2 = x^2 + z^2 - 2xz\cos Y$ $\cos Y = \frac{x^2 + z^2 - y^2}{2xz}$ $= \frac{8^2 + 10^2 - 15^2}{2 \times 8 \times 10}$ $Y = \cos^{-1}\left(-\frac{61}{160}\right)$ $= 112°25'$	**3**	**3 marks** • Correct solution **2 marks** • Correctly finds one of the other angles • Uses the cosine rule in an attempt to find the largest angle **1 mark** • Correctly identifies Y as the largest angle • Uses the cosine rule in an attempt to find one of the other angles *Note: do not penalise for the incorrect rounding of minutes*

Solution	Marks	Comments
QUESTION 13		
13(a) (i) x-intercept occurs when $y = 0$ $2x = 4$ $x = 2$ A is $(2, 0)$ y-intercept occurs when $x = 0$ $y = 4$ B is $(0, 4)$	**1**	**1 mark** • Correct answer for both A and B
13(a) (ii) $d = \dfrac{\lvert 2(5) + (2) - 4\rvert}{\sqrt{2^2 + 1^2}}$ $= \dfrac{8}{\sqrt{5}}$ units	**2**	**2 marks** • Correct answer **1 mark** • Correctly substitutes into the perpendicular distance formula
13(a) (iii) $m_{\text{AB}} = \dfrac{2-0}{5-2}$ $= \dfrac{2}{3}$	**1**	**1 mark** • Correct solution
13(a) (iv) $y - 0 = \dfrac{2}{3}(x-2)$ $3y = 2x - 4$ $2x - 3y = 4$	**1**	**1 mark** • Correct solution
13(a) (v) $d_{\text{AB}} = \sqrt{(2-0)^2 + (0-4)^2}$ $= \sqrt{4 + 16}$ $= \sqrt{20}$ $= 2\sqrt{5}$ units **OR** By Pythagoras $\text{AB}^2 = 2^2 + 4^2$ $= 20$ $\text{AB} = \sqrt{20}$ $= 2\sqrt{5}$ units	**2**	**2 marks** • Correct answer **1 mark** • Correctly substitutes into the distance formula or equivalent merit *Note: Need to use answers found in part (i)*
13(a) (vi) Area $\Delta ABC = \dfrac{1}{2} \times 2\sqrt{5} \times \dfrac{8}{\sqrt{5}}$ $= 8 \text{ units}^2$	**1**	**1 mark** • Correct answer *Note: May use answers found in (ii) and (v)*
13(a) (vii)  	**1**	**1 mark** • Correct answer

<table>
<tr><th>Solution</th><th>Marks</th><th>Comments</th></tr>
<tr>
<td>

13(b) (i) $y = x^3 - 3x^2 - 9x + 1$

$\frac{dy}{dx} = 3x^2 - 6x - 9$

$\frac{d^2y}{dx^2} = 6x - 6$

$\frac{d^3y}{dx^3} = 6$

Stationary points occur when $\frac{dy}{dx} = 0$

i.e. $3x^2 - 6x + 9 = 0$

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

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

$x = 3$ or $x = -1$

when $x = -1$, $\frac{d^2y}{dx^2} = 6(-1) - 6$ $= -12 < 0$

when $x = 3$, $\frac{d^2y}{dx^2} = 6(3) - 6$ $= 12 > 0$

$\therefore (-1, 6)$ is a maximum turning point $\therefore (3, -26)$ is a minimum turning point

</td>
<td>3</td>
<td>

3 marks
- Correct solution

2 marks
- Finds both stationary points
- Finds one stationary point and determines its nature

1 mark
- Acknowledges the condition for stationary points

</td>
</tr>
<tr>
<td>

13(b) (ii) possible inflection points occur when $\frac{d^2y}{dx^2} = 0$

i.e. $6x - 6 = 0$

$x = 1$

<table>
<tr><td>x</td><td>1^- (0)</td><td>1</td><td>1^+ (2)</td></tr>
<tr><td>$\frac{d^2y}{dx^2}$</td><td>-6</td><td>0</td><td>6</td></tr>
</table>

OR

when $x = 1$, $\frac{d^3y}{dx^3} = 6 \neq 0$

$\therefore$ there is a change in concavity

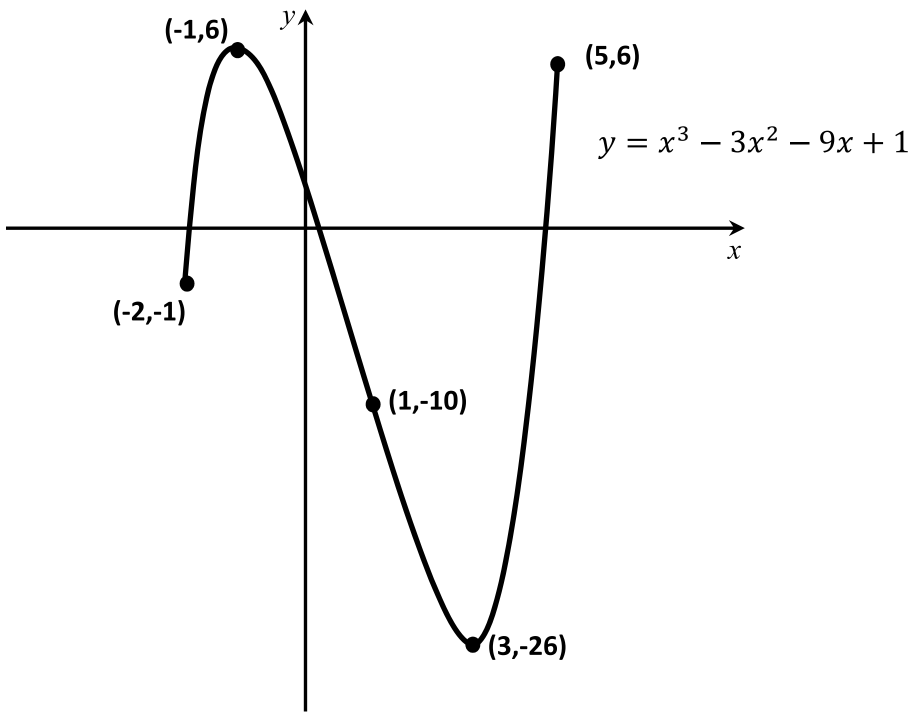
thus $(1, -10)$ is a point of inflection

</td>
<td>1</td>
<td>

1 mark
- Finds the possible inflection point and explains the change in concavity

</td>
</tr>
<tr>
<td>

13(b) (iii)



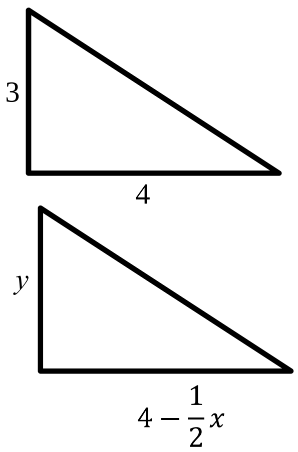
</td>
<td>2</td>
<td>

2 marks
- Neat sketch with key points labelled

1 mark
- A complete sketch with a poor scale
- Neat sketch with correct basic shape, with only some key features labelled
- A correct sketch that extends outside the given domain

</td>
</tr>
</table>

Solution	Marks	Comments
QUESTION 14		
14(a) (i) The total face of the garage must be $> 3x^2$ $\therefore (x+3)(x+2) > 3x^2$ $x^2 + 5x + 6 > 3x^2$ $0 > 2x^2 - 5x - 6$ $2x^2 - 5x - 6 < 0$	**2**	**2 marks** • Obtains desired inequality using a valid argument **1 mark** • Makes some logical statement that would lead to a correct solution
14(a) (ii) $2x^2 - 5x - 6 < 0$ $\frac{5 - \sqrt{5^2 - 4 \times 2 \times (-6)}}{2 \times 2} < x < \frac{5 - \sqrt{5^2 + 4 \times 2 \times (-6)}}{2 \times 2}$ $\frac{5 - \sqrt{73}}{4} < x < \frac{5 + \sqrt{73}}{4}$ However $x > 0$, $\therefore 0 < x < \frac{5 + \sqrt{73}}{4}$	**2**	**2 marks** • Correct solution **1 mark** • Finds the two roots of $2x^2 - 5x - 6$ • Discounts the negative solutions of their inequality
14(b) (i) Opposite $\angle$'s in a parallelogram are =	**1**	**1 mark** • Correct explanation
14(b) (ii) $\angle WXP = \frac{1}{2}\angle WXY$ (XP bisects $\angle WXY$) $\angle YZQ = \frac{1}{2}\angle WZY$ (ZQ bisects $\angle WZY$) $\angle WXY = \angle WZY$ (proven in (i)) $\therefore \angle WXP = \angle YZQ$ (A) $\angle PWX = \angle QYZ$ (alternate $\angle$'s are =, WX||ZY) (A) WX = YZ (opposite sides in ||gram are =) (S) $\therefore \Delta WXP \equiv \Delta YZQ$ (AAS)	**2**	**2 marks** • Correct solution **1 mark** • Significant progress towards a correct solution
14(b) (iii) WP = YQ (matching sides in $\equiv \Delta$'s) WY = WP + PQ + QY (common side) WY = 2QY + PQ PQ = WY – 2QY = 20 – 2 × 8 = 4 cm	**1**	**1 mark** • Correct answer

Solution	Marks	Comments
14(c) (i) Using Pythagoras $h^2 = 5^2 - 4^2$ $= 9$ $h = 3$ m	**1**	**1 mark** • Correct explanation
14(c) (ii) $\frac{y}{3} = \frac{4 - \frac{1}{2}x}{4}$ (ratio of sides in $\vert\vert\,\Delta$'s) $4y = 12 - \frac{3}{2}x$ $y = 3 - \frac{3}{8}x$ $y = \frac{3}{8}(8 - x)$  	**2**	**2 marks** • Correct solution **1 mark** • Shows without using similar figures • Uses similar triangles to establish a relationship between x and y
14(c) (iii) $V = 1.5 \times xy$ $= \frac{3}{2} \times x \times \frac{3}{8}(8 - x)$ $= \frac{9}{16}x(8 - x)$	**1**	**1 mark** • Correct solution
14(c) (iv) $V = \frac{9}{2}x - \frac{9}{16}x^2$ $\frac{dV}{dx} = \frac{9}{2} - \frac{9}{8}x$ $\frac{d^2V}{dx^2} = -\frac{9}{8}$ stationary points occur when $\frac{dV}{dx} = 0$ i.e. $\frac{9}{2} - \frac{9}{8}x = 0$ $\frac{1}{8}x = \frac{1}{2}$ $x = 4$ when $x = 4$, $\frac{d^2V}{dx^2} = -\frac{9}{8} < 0$ $\therefore$ Volume is a maximum when $x = 4$ maximum $V = \frac{9}{2}(4) - \frac{9}{16}(4)^2$ $= 9$ m^3 ***OR*** Function is a concave doen parabola, thus the maximum is the y-value of the vertex $AOS = -\frac{\frac{9}{2}}{2 \times -\frac{9}{16}}$ $= \frac{9}{2} \times \frac{8}{9}$ $= 4$ maximum $V = \frac{9}{2}(4) - \frac{9}{16}(4)^2$ $= 9$ m^3 ***OR*** maximum $V = -\frac{\Delta}{4a}$ $= -\frac{\left(\frac{9}{2}\right)^2 - 0}{4 \times -\frac{9}{16}}$ $= \frac{81}{4} \times \frac{4}{9}$ $= 9$ m^3	**3**	**3 marks** • Correct solution **2 marks** • Proves that $x = 4$ gives the maximum volume • Finds the volume without proving it is a maximum • Finds the axis of symmetry • Finds the discriminant of the function • **1 mark** • Obtains the value of x that will produce a maximum volume • Attempts to show that a maximum is obtained • Recognises the significance of the concavity of the function.