Trinity Grammar School

Mathematics Department

2013

YEARLY EXAMINATION

PRELIMINARY ASSESSMENT TASK 4

Year 11

Mathematics

Board of Studies Student Number
(Year 12 only)

Class Teacher:

……

Name:
(Year 11 only)

……

Do NOT write solutions on this question paper. Any working on this question paper will NOT be marked.

Date of examination: 26/08/2013

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
- Only approved calculators for this course are allowed in this task

- Show all necessary working
- Write your Board of Studies Student Number (Year 12 HSC) or Name (Year 11) and your Class teacher on the question paper and on any answer sheets or writing booklets used to write your responses to the questions submitted
- If you do not attempt a question you must submit an answer sheet or writing booklet for that question clearly indicating **N/A** and your Student Number or Name.

- **Preliminary Assessment Weighting:** 45%

Total marks – 80

Section I

10 marks

- Attempt all Questions
- Allow about **15** minutes for this section

Section II

70 marks

- Attempt all Questions
- Allow about **1** hour **45** minutes for this section

Section I **10 marks**

- Shade the correct response on the multiple-choice answer sheet for **Questions 1 – 10**
- Each question is worth **1 mark**

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1 What is $\dfrac{2}{2+\sqrt{3}}$ as a fraction with a rational denominator?

(A) $\dfrac{4-2\sqrt{3}}{7}$

(B) $\dfrac{4+2\sqrt{3}}{7}$

(C) $4-2\sqrt{3}$

(D) $4+2\sqrt{3}$

2 What is the solution to the inequality $|2x+1| \le 3$?

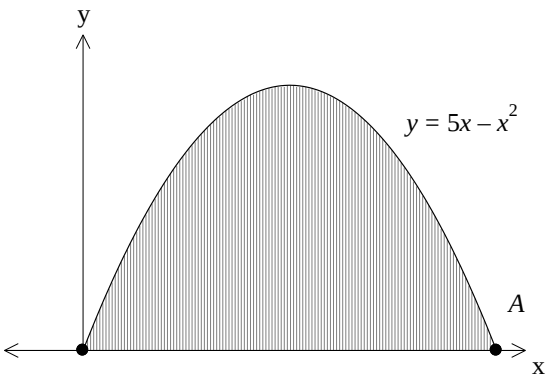
(A) $x \ge 1$ or $x \ge -2$

(B) $x \ge 1$or $x \ge 2$

(C) $x \le 1$ or $x \ge -2$

(D) $x \le 1$ or $x \ge 2$

3 The diagram shows the graph of the function $y = 5x - x^2$.



What pair of inequalities specify the shaded region?

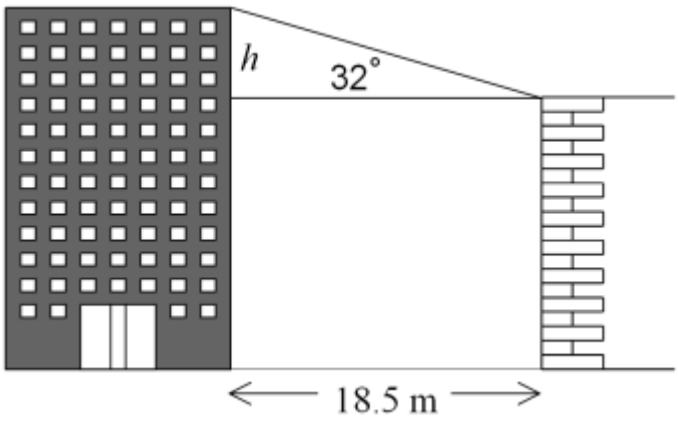
(A) $y \le 5x - x^2$ and $y \le 0$.

(B) $y \le 5x - x^2$ and $y \ge 0$.

(C) $y \ge 5x - x^2$ and $y \le 0$.

(D) $y \ge 5x - x^2$ and $y \ge 0$.

4 The two buildings below are standing on level ground. The horizontal distance between the buildings is 18.5 metres and the angle of elevation between the buildings is 32°.



NOT TO SCALE

What is the difference in the vertical height (h) between the top of the two buildings?

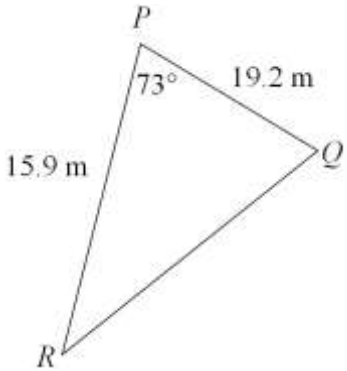
(A) 9.8 m

(B) 11.6 m

(C) 15.7 m

(D) 29.6 m

5 What is the area of triangle PQR to the nearest square metre?



NOT TO SCALE

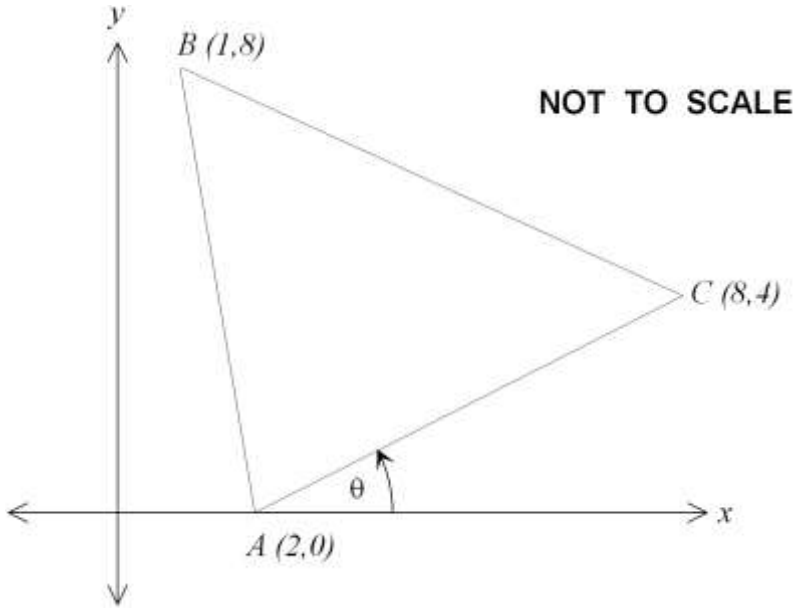
(A) 141 m^2

(B) 146 m^2

(C) 283 m^2

(D) 296 m^2

6 The points *A*, *B* and *C* have coordinates (2,0), (1,8) and (8,4) respectively. The angle between the line *AC* and the *x*-axis is θ.



What is the equation of line *AC*?

(A) $2x-3y-4=0$ (B) $3x-2y-4=0$

(C) $2x-3y+6=0$ (D) $3x-2y-6=0$

7 What is the point of intersection of the lines $y=x+2$ and $y=-x+4$?

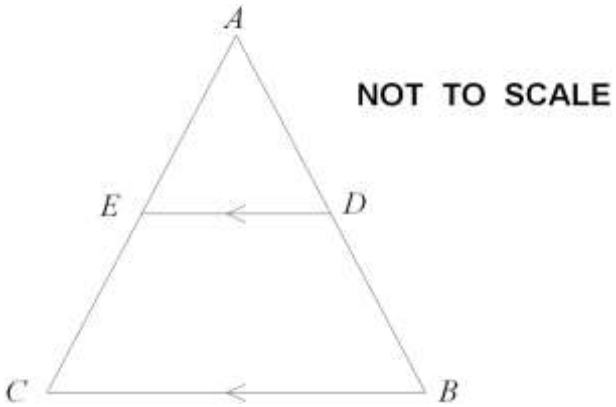
(A) (1, 2)

(B) (2, 1)

(C) (1, 3)

(D) (3, 2)

8 In the diagram below, *ABC* is a triangle and *DE* is parallel to *BC*.



Given that $AE = 1.5$, $BD = 1.3$ and $EC = 0.9$, what is the value of *AD* correct to two decimal places?

(A) 2.17

(B) 5.25

(C) 7.50

(D) 9.33

9 If $y = 2\sqrt{x}$, then which expression for $\frac{dy}{dx}$ is correct?

(A) $\frac{dy}{dx} = \frac{1}{\sqrt{x}}$

(B) $\frac{dy}{dx} = \frac{2}{\sqrt{x}}$

(C) $\frac{dy}{dx} = \frac{\sqrt{x}}{2}$

(D) $\frac{dy}{dx} = 2$

10 What is the equation of the tangent to the curve $y = x^2 - 2x$ at the point $(1, -1)$?

(A) $y = -1$

(B) $y = 1$

(C) $y = x + 2$

(D) $y = x - 2$

End of Section I

Section II commences on the next page

Section II 70 marks

- Begin each question in a SEPARATE writing booklet.
- Show all relevant mathematical reasoning and/or calculations.

Question 11 (10 marks) Use a SEPARATE writing booklet **Marks**

(a) Evaluate $\dfrac{(1.49)^2 - 1.98}{\sqrt{11.62 + 8.34 \times 2.72}}$ correct to:

(i) 2 decimal places, **1**

(ii) 3 significant figures. **1**

(b) A copper sphere has a mass of 700 g. Calculate the radius of the sphere, correct to 1 decimal place, given that 1cm^3 of copper has a mass of 8.95 g. **3**

(c) Simplify $\dfrac{2x^2 + 3x - 2}{4x^2 - 1}$. **1**

(d) Simplify $\sqrt{50} - \sqrt{32}$. **2**

(e) Expand and simplify $(2y + 3)(4y - 3)$. **1**

(f) Express $0.2\dot{1}\dot{3}$ as a fraction in its simplest form. **1**

(Show all working steps.)

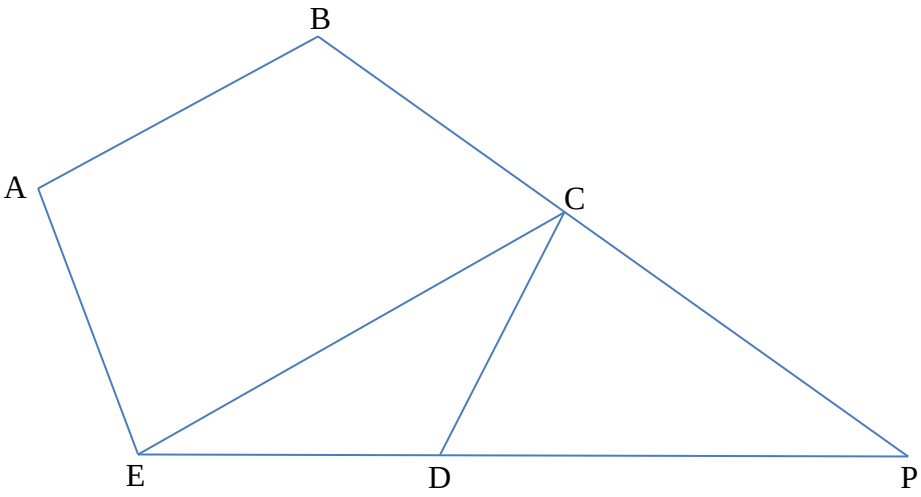
Question 12 (10 marks) Use a SEPARATE writing booklet **Marks**

(a) Factorise $x^3 + 2x^2 - 25x - 50$. **2**

(b) Solve simultaneously: **3**

$$xy = -12$$
$$x - y = 7$$

(c) The diagram shows a regular pentagon *ABCDE*. Sides *ED* and *BC* are produced to meet at *P*.



NOT TO SCALE

Copy or trace the diagram into your writing booklet.

(i) Find the size of $\angle CDE$. **1**

(ii) Hence, show that ΔEPC is isosceles. **4**

Question 13 (10 marks) Use a SEPARATE writing booklet **Marks**

(a) Find the distance between the points (1,3) and (-3,0). **1**

(b) Find the values of a and b if (4,1) is the midpoint of (a,b) and (-1,5). **2**

(c) Show that the points (3,8), (6,14) and (-3,-4) are collinear. **2**

(d) Find the gradient of the line that makes an angle of 120^0 with the x-axis in the positive direction. **1**

(e) Find the equation of the straight line that passes through (-2,3) and has a gradient of -4. **2**

(f) Find the perpendicular distance between (-3,2) and $5x+12y+7=0$. **2**

Question 14 (10 marks) Use a SEPARATE writing booklet **Marks**

(a) State the range of the function $y = 3^x + 1$. **1**

(b) State the domain of the function $y = \dfrac{1}{x+3}$ **1**

(c) Show whether the function $f(x) = x^3 - x$ is odd, even or neither. **2**

(d) A function is defined as follows:

$$f(x) = \begin{cases} x+1 \text{ if } -2 \le x < 3 \\ 4 \text{ if } x \ge 3 \end{cases}$$

(i) Draw a sketch graph of the function $y = f(x)$ for the given domain. **2**

(ii) Evaluate $f(-2) + f(2) - f(5)$. **1**

(e) Indicate on a diagram using shading, the region for which the following inequalities hold simultaneously: **3**

$y < x^2 + 1$ and $x^2 + y^2 \le 9$.

Question 15 (10 marks) Use a SEPARATE writing booklet **Marks**

(a) Differentiate from first principles, $f(x) = x^2 + x$, **3**

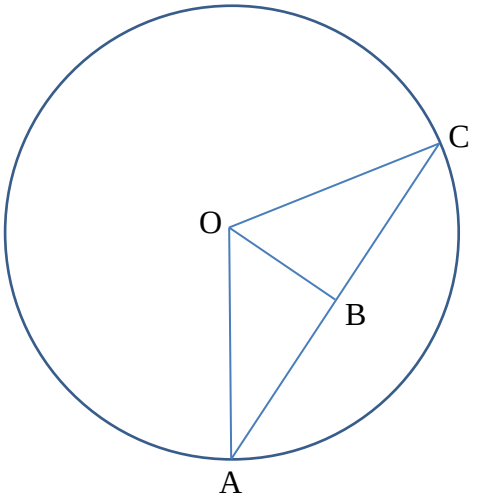
using the formula $f'(x) = \lim_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$.

(b) Differentiate with respect to x:

(i) $\dfrac{-2}{x^5}$ **1**

(ii) $x^2(5x+3)^5$ **3**

(c) The circle below has centre *O* and *OB* bisects chord *AC*.



Copy or trace this diagram into your writing booklet.

Prove that ΔOAB is congruent to ΔOBC. **3**

Question 16 (10 marks) Use a SEPARATE writing booklet **Marks**

(a) Simplify $\sqrt{1+\tan^2\theta}$. **1**

(b) Write down the exact value of $\cos(-150^0)$. **1**

(c) Solve the equation: $\sin\theta = \frac{\sqrt{3}}{2}$ for $0^0 \le \theta \le 360^0$. **1**

(d) (i) Sketch the graph of $y = \cos x$ for $-180^0 \le x \le 180^0$. **1**

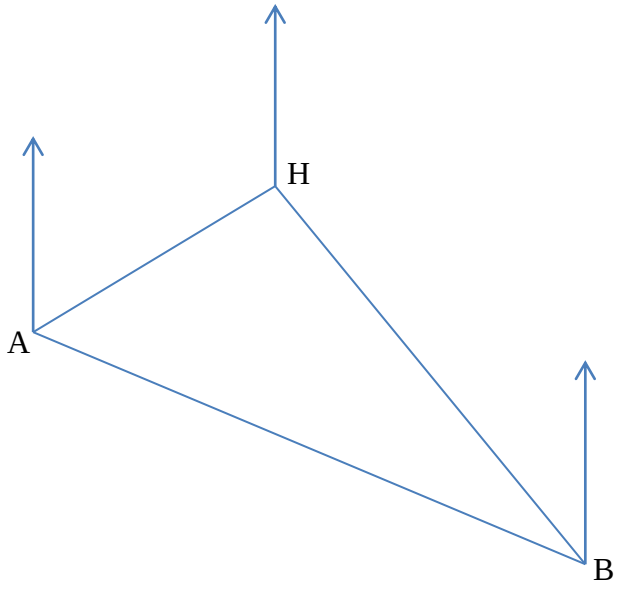
(ii) How many solutions to the equation $\cos x = \frac{-1}{2}$ are there **1**

in the interval $-180^0 \le x \le 180^0$.

(e) Asif leaves home (H) and travels on a bearing of 248^0 for 109.8 km to a place at A.
He then turns and travels for 271.8 km on a bearing of 143^0 to a place at B.

Asif then turns and travels home (H) on a bearing of α.

An incomplete diagram of Asif's journey is provided below.



(i) **Copy and complete the diagram above by marking on the information provided.** **1**

(ii) How far does he travel on the final part of the journey? **2**

(Give your answer correct to 1 decimal place.)

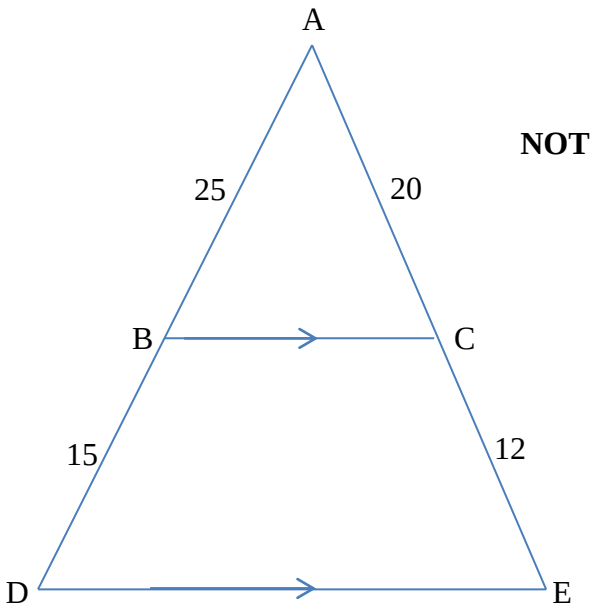
(iii) Evaluate α. **2**

(Give your answer correct to the nearest degree.)

Question 17 (10 marks) Use a SEPARATE writing booklet **Marks**

(a) Find the equation of the normal to the curve $y = \dfrac{x^2}{4-x}$ at the point where $x = 2$. **3**

(b) In the diagram below, AB=25, BD=15, AC=20, CE=12 and $BC \parallel DE$.



NOT TO SCALE

(i) Prove that the triangles ABC and ADE are similar. **3**

(ii) If DE=20, find the length of BC. **2**

(c) Evaluate $\lim\limits_{x \to 3} \dfrac{x^3 - 27}{(x-3)}$. **2**

End of Section II
End of Examination

Trinity Grammar School
Mathematics Department
2013
Year 11 Mathematics
YEARLY EXAMINATION

Preliminary Assessment Task 4
Section I
Multiple Choice Answer Sheet

NSW Board of Studies Student Number
(Year 12 only)

Name: SOLUTIONS
(Year 11 only)

Class Teacher: _____

- Write your answers for **Section I** on this answer sheet.
- ***Shade completely only ONE answer for each question.***
- To change an answer, erase your previous mark completely and then record your new 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

Year 11 Mathematics Yearly examination - TASK 4, 2013

Section I (Multiple Choice) - Solutions

	Solution	Criteria
1	$\frac{2}{2+\sqrt{3}}=\frac{2}{2+\sqrt{3}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}$ $=\frac{4-2\sqrt{3}}{4-3}$ $=4-2\sqrt{3}$	1 Mark: C
2	$\lvert 2x+1\rvert \le 3$ $2x+1\le 3$ and $2x+1\ge -3$ $2x\le 2$ $2x\ge -4$ $x\le 1$ $x\ge -2$	1 Mark: C
3	Point A lies of the x axis ($y=0$). To find x when $y=0$ substitute into $y=5x-x^2$. $0=5x-x^2$ $=x(5-x)$ $\therefore\ x=0$ or $x=5$ Point A is $(5,0)$ Inequalities are $y\le 5x-x^2$ and $y\ge 0$. Test by substituting points into the inequalities. $(2,1):1\le 5\times 2-2^2$ and $1\ge 0$ True.	1 Mark: B
4	$\tan 32^\circ=\frac{h}{18.5}$ $h=18.5\times\tan 32^\circ$ $=11.56008301\approx 11.6$ m	1 Mark: B
5	$A=\frac{1}{2}ab\sin C$ $=\frac{1}{2}\times 15.9\times 19.2\times\sin 73$ $=145.970358...$ $\approx 146\ \text{m}^2$	1 Mark: B

6	Gradient of AC $m=\frac{y_2-y_1}{x_2-x_1}=\frac{4-0}{8-2}=\frac{4}{6}=\frac{2}{3}$ $y-y_1=m(x-x_1)$ $y-0=\frac{2}{3}(x-2)$ $3y=2(x-2)$ $2x-3y-4=0$	1 Mark: A
7	Point of intersection has the same y value. $x+2=-x+4$ $\quad y=x+2$ $2x=2$ $\quad y=1+2$ $x=1$ $\quad =3$ Point of intersection is (1, 3)	1 Mark: C
8	$\frac{AD}{1.3}=\frac{1.5}{0.9}$ (ratio of intercepts theorem) $AD=\frac{1.3\times1.5}{0.9}$ $=2.17\ (2d.p.)$	1 Mark: A
9	$\frac{dy}{dx}=2\times\frac{1}{2}x^{-\frac{1}{2}}=\frac{1}{\sqrt{x}}$	1 Mark: A

10	$y=x^2-2x$ At the point $(1,-1)$ $\frac{dy}{dx}=2\times1-2=0$ $\frac{dy}{dx}=2x-2$ Point slope formula $y-y_1=m(x-x_1)$ $y-(-1)=0(x-1)$ $y=-1$	1 Mark: A

Section II - Solutions

Question 11

(a)

$$\frac{(1.49)^2 - 1.98}{\sqrt{11.62 + 8.34 \times 2.72}} = 0.040993...$$

(i) $\approx 0.04 \,(2d.p.)$ ①

(ii) ≈ 0.0410 (3 signficant figures) ①

(b) $r = ?$

$8.95\,g$ - $1\,cm^3$

$1\,g$ - $\frac{1}{8.95}\,cm^3$

$700\,g$ - $700 \times \frac{1}{8.95} = 78.2122905...\,cm^3$ ①

$$V = \frac{4}{3}\pi r^3$$

$$3V = 4\pi r^3$$

$$r^3 = \frac{3V}{4\pi}$$

$$r = \sqrt[3]{\frac{3V}{4\pi}}$$

$$r = \sqrt[3]{\frac{3 \times 78.2122905...}{4\pi}}$$ ①

$$r = \sqrt[3]{18.67180897...}$$

$$r = 2.652948372...$$

$$r = 2.7 \text{ cm} \quad (1d.p.)$$ ①

(c) $$\frac{2x^2 + 3x - 2}{4x^2 - 1} = \frac{(2x-1)(x+2)}{(2x+1)(2x-1)}$$

$$= \frac{x+2}{2x+1}.$$ ①

Q11. (d) $\sqrt{50} - \sqrt{32} = \sqrt{25} \times \sqrt{2} - \sqrt{16} \times \sqrt{2}$ (1)

$= 5\sqrt{2} - 4\sqrt{2}$

$= \sqrt{2}$. (1)

Q11. (e) $(2y+3)(4y-3) = 8y^2 - 6y + 12y - 9$

$= 8y^2 + 6y - 9$. (1)

Q11. (f) Let $x = 0.21\dot{3}$

$100x = 21.\dot{3}$

$1000x = 213.\dot{3}$

$1000x - 100x = 213.\dot{3} - 21.\dot{3}$

$900x = 192$

$x = \frac{192}{900}$

$\therefore x = \frac{16}{75}$

$\therefore 0.21\dot{3} = \frac{16}{75}$. (1)

Question 12

(a) $x^3 + 2x^2 - 25x - 50 = x^2(x+2) - 25(x+2)$ ①

$= (x+2)(x^2 - 25)$

$= (x+2)(x+5)(x-5)$. ①

(b) $xy = -12$ — ①

$x - y = 7$ — ②

From ②: $x = 7 + y$

$y = x - 7$ — ③

Subst. ③ into ①:

$x(x-7) = -12$ ①

$x^2 - 7x = -12$

$x^2 - 7x + 12 = 0$

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

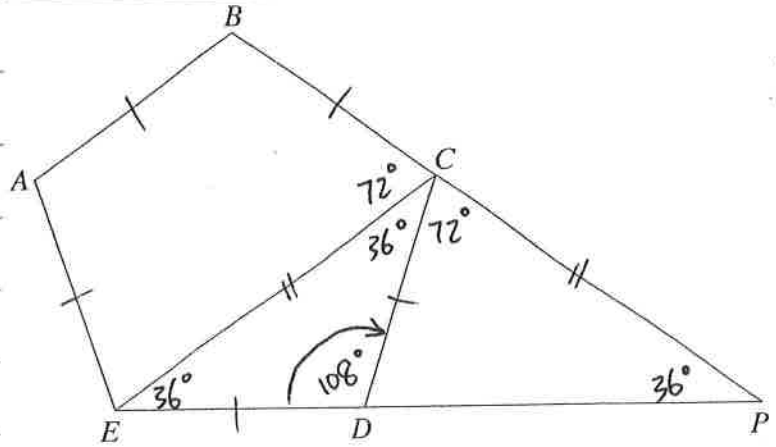
$x = 3, 4$

When $x = 3$, $y = -4$. ①

When $x = 4$, $y = -3$. ①

Do NOT write anything, or make any marks below this line

(c)



Marks

(c)(ii)

1 mark only for angles on diagram without written reasons.

(i) $\angle CDE = \dfrac{(5-2)\times 180^\circ}{5}$

$= \dfrac{540^\circ}{5}$

$= 108^\circ.$ (1)

(ii) $\angle DCE = \angle DEC = 36^\circ$ ($\angle$ sum of ΔDEC is 180° & base $\angle$s of isosceles ΔDEC are equal) (1)

$\angle BCE = \angle BCD - 36^\circ$ ($\angle BCD = 108^\circ$ = internal $\angle$ of pentagon) (1)

$= 108^\circ - 36^\circ$

$= 72^\circ$

$\angle PCD = 180^\circ - (72^\circ + 36^\circ)$ ($\angle BCP$ is a straight angle) (1)

$= 72^\circ$

$\angle EPC + 72^\circ + 36^\circ + 36^\circ = 180^\circ$ ($\angle$ sum of ΔEPC is 180°) (1)

$\therefore \angle EPC = 36^\circ$

Now, $\angle CEP = \angle EPC = 36^\circ$

and ΔEPC is isosceles (equal base angles).

Do NOT write anything, or make any marks below this line

Q13. (a) $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $\quad x_1, y_1 \quad (1, 3) \quad x_2, y_2 \quad (-3, 0)$

$d = \sqrt{(-3 - 1)^2 + (0 - 3)^2}$

$d = \sqrt{(-4)^2 + (-3)^2}$

$d = \sqrt{16 + 9}$

$d = \sqrt{25}$

$d = 5$ units. (1)

(b) $M(4, 1) = M\left(\frac{a + (-1)}{2}, \frac{b + 5}{2}\right)$

$\frac{a-1}{2} = 4$ $\qquad$ $\frac{b+5}{2} = 1$

$a - 1 = 8$ $\qquad$ $b + 5 = 2$

$a = 9$ (1) $\qquad$ $b = -3$ (1)

(c) $x_1, y_1 \quad (3, 8)$ $\qquad$ $x_2, y_2 \quad (6, 14)$

Using two-point formula, $\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$

$\frac{y - 8}{x - 3} = \frac{14 - 8}{6 - 3}$

$3(y - 8) = 6(x - 3)$

$0 = 6x - 3y + 6$

$2x - y + 2 = 0$ (1)

Subst. $(-3, -4)$ into $2x - y + 2 = 0$ (1)

LHS $= 2(-3) - (-4) + 2$

$= -6 + 4 + 2$

$= 0$

$=$ RHS $\quad \therefore$ points are collinear.

Q13. (c) Alternative solution:

x_1, y_1 x_2, y_2
$(3, 8)$ $(6, 14)$

$$m_1 = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m_1 = \frac{14 - 8}{6 - 3}$$

$$m_1 = \frac{6}{3}$$

$$m_1 = 2. \quad (1)$$

x_1, y_1 x_2, y_2
$(6, 14)$ $(-3, -4)$

$$m_2 = \frac{y_2 - y_1}{x_2 - x_1}$$

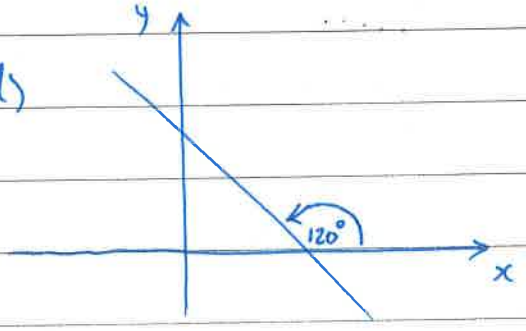
$$= \frac{-4 - 14}{-3 - 6}$$

$$= \frac{-18}{-9}$$

$$= 2. \quad (1)$$

Since the gradient of both intervals is equal, i.e. $m_1 = m_2 = 2$ the points are collinear.

Q13. (d)



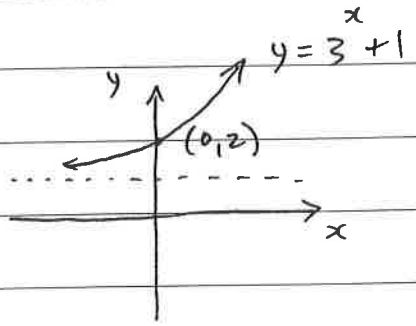
$$m = \tan\theta$$
$$= \tan 120^\circ$$
$$= \tan(180^\circ - 60^\circ)$$
$$= -\tan 60^\circ$$
$$= -\sqrt{3} \quad (1)$$
$$= -1.73 \quad (2\text{d.p.})$$

Q13. (e) $m = -4$ x_1, y_1 $(-2, 3)$

$$y - y_1 = m(x - x_1)$$
$$y - 3 = -4(x - (-2)) \quad (1)$$
$$y - 3 = -4x - 8$$
$$y = -4x - 5 \quad \text{or} \quad 4x + y + 5 = 0 \quad (1)$$

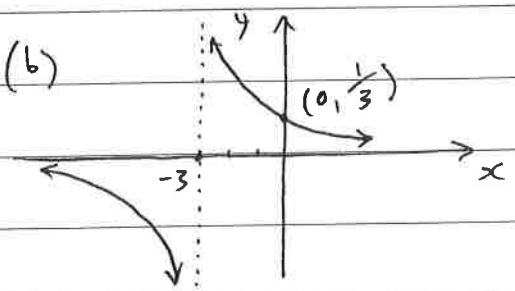
Q13. (f) $$d = \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}} = \frac{|5(-3) + 12(2) + 7|}{\sqrt{5^2 + 12^2}} \quad (1)$$
$$= \frac{|16|}{\sqrt{169}} = \frac{16}{13}. \quad (1)$$

(14) (a)



range : $y > 1$ ①

(b)



domain : all real x, $x \neq -3$. ①

(c) $f(-x) = (-x)^3 - (-x)$ ①

$= (-x \times -x \times -x) + x$

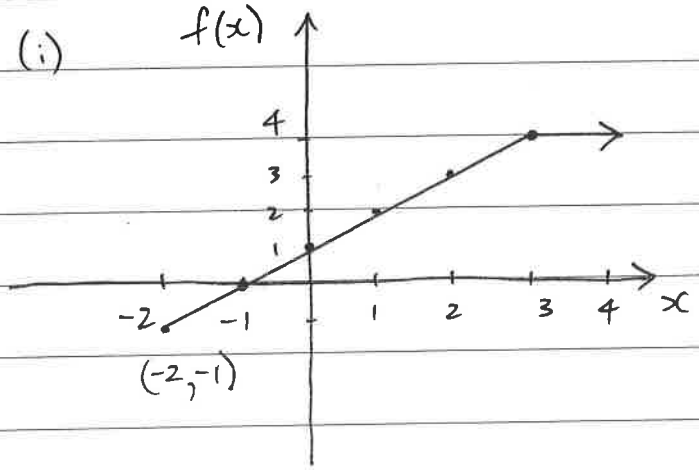
$= -x^3 + x$

$= -(x^3 - x)$ ①

$= -f(x)$

$\therefore$ function is odd.

(d) (i)



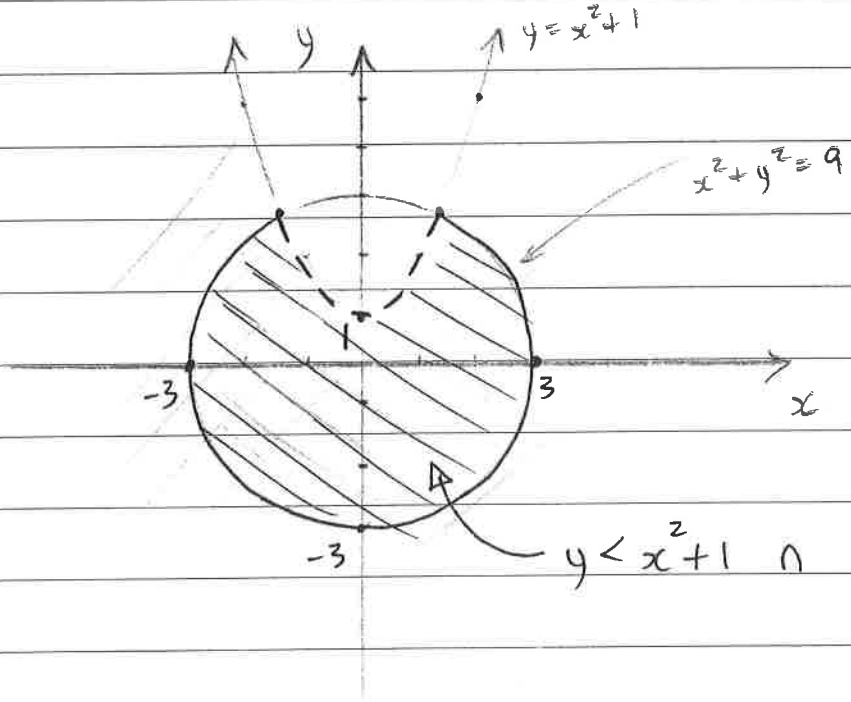
②

(d) (ii) $f(-2) + f(2) - f(5) = -1 + 3 - 4$

$= -2$ ①

Do NOT write anything, or make any marks below this line

(14) (e)



Test (0,0): $y < x^2 + 1$

$0 < 0 + 1$

$0 < 1$

True.

Test (0,0): $x^2 + y^2 \leq 9$

$0 \leq 9$

True.

Marks

(1) circle

(1) parabola

(1) region – dotted parabola
– solid circle.

Tick this box if you have continued this answer in another booklet.

Do NOT write anything, or make any marks below this line

Q15 a)

$$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h} \qquad f(x) = x^2 + x.$$

$$= \lim_{h\to 0} \frac{(x+h)^2 + (x+h) - [x^2 + x]}{h} \quad (1)$$

$$= \lim_{h\to 0} \frac{x^2 + 2xh + h^2 + x + h - x^2 - x}{h}$$

$$= \lim_{h\to 0} \frac{h^2 + 2hx + h}{h} \quad (1)$$

$$= \lim_{h\to 0} \frac{h(h + 2x + 1)}{h} \quad (1)$$

$$f'(x) = 2x + 1$$

b) i) $y = \frac{-2}{x^5} = -2x^{-5}$

$$\left.\begin{aligned} \frac{dy}{dx} &= 10x^{-6} \\ &= \frac{10}{x^6} \end{aligned}\right\} (1)$$

ii) $y = x^2(5x+3)^5$

$u = x^2$ $\quad u' = 2x$

$v = (5x+3)^5$ $\quad v' = 5(5x+3)^4 \times$

$= 25(5x+3)^4$ (1)

$y = uv$

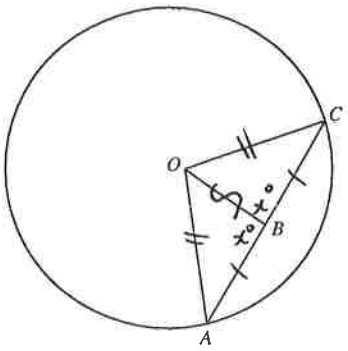
$$\frac{dy}{dx} = uv' + vu'$$

$$= x^2 \times 25(5x+3)^4 + (5x+3)^5 \times 2x \quad (1)$$

$$= x(5x+3)^4\left(25x + 2(5x+3)\right)$$

$$= x(5x+3)^4(35x + 6) \quad (1)$$

(15) (c) The circle below has centre O and OB bisects chord AC.



In ΔOAB and ΔOBC, (1)

$AB = CB$ (OB bisects chord AC) (S)

OB is common (1) (S)

$OA = OC$ (equal radii) (1) (S)

$\therefore \Delta OAB \equiv \Delta OBC$ (SSS)

Q16. (a) $\sqrt{1+\tan^2\theta} = \sqrt{\sec^2\theta}$

$= \sec\theta.$ (1)

(b) $\cos(-150^\circ) = -\cos 30^\circ$

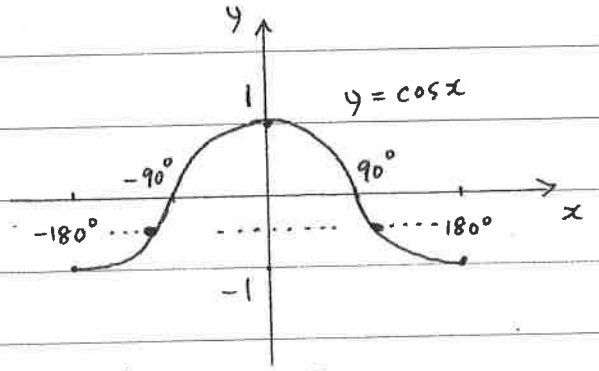
$= -\frac{\sqrt{3}}{2}.$ (1)

(c) $\sin\theta = \frac{\sqrt{3}}{2}$

$\theta = 60^\circ, 180^\circ - 60^\circ$

$\underline{\theta = 60^\circ, 120^\circ}$ for $0^\circ \leq \theta \leq 360^\circ$ (1)

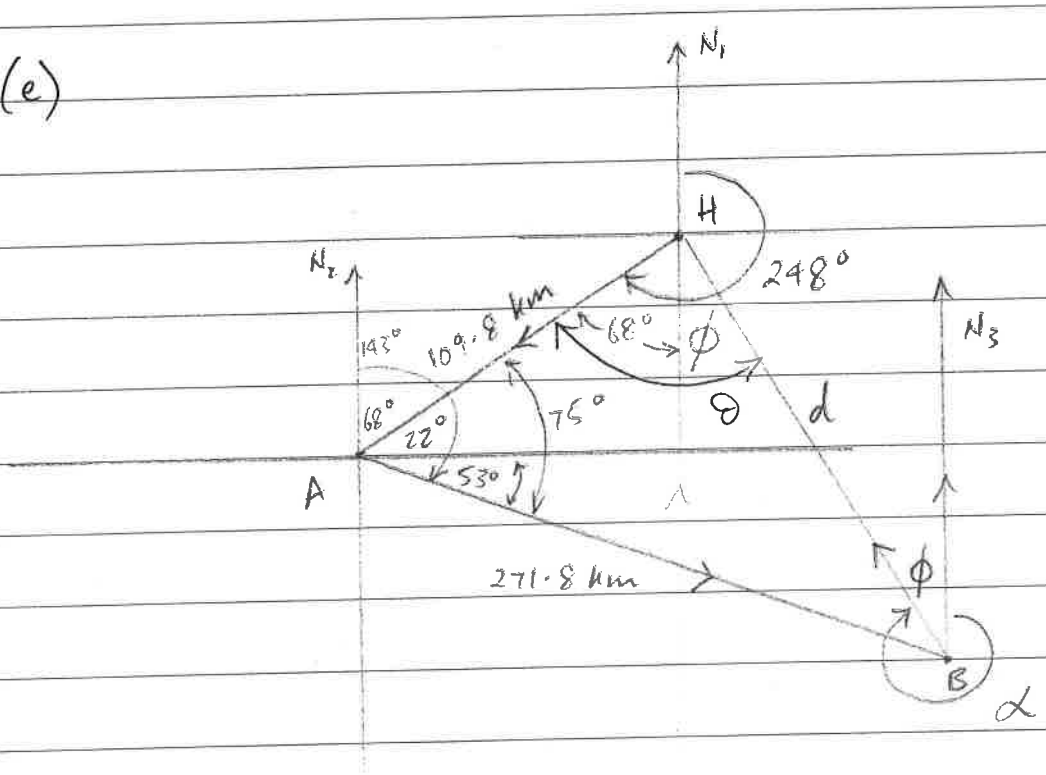
(d) (i)



(1)

(ii) 2 solutions. (1)

(16) (e)



(1)

(i) $d^2 = (109.8)^2 + (271.8)^2 - 2(109.8)(271.8)\cos 75°$ (1)

$d^2 = 70\,483.07519...$

$d = 265.4864878...$

$\therefore$ distance is 265.5 km (1 d.p.). (1)

(ii) $\frac{\sin\theta}{271.8} = \frac{\sin 75°}{265.4864878...}$

$\sin\theta = \frac{271.8 \times \sin 75°}{265.4864878...}$

$\sin\theta = 0.9888964284...$

$\theta = 81.45382758...$

$\therefore \phi = 13.45382758...$ (1)

$\therefore \alpha = 346.5461724... \doteq 347°$ (nearest degree) $(346°33')$ (1)

Tick this box if you have continued this answer in another booklet.

Do NOT write anything, or make any marks below this line

Q17. (a) $u = x^2$ $\quad v = 4 - x$

$u' = 2x$ $\quad v' = -1$

$$\frac{dy}{dx} = \frac{u'v - uv'}{v^2}$$

$$= \frac{2x(4-x) - x^2(-1)}{(4-x)^2}$$

$$= \frac{8x - 2x^2 + x^2}{(4-x)^2}$$

$$= \frac{8x - x^2}{(4-x)^2} \quad (1)$$

At $x = 2$,

$$\left.\frac{dy}{dx}\right|_{x=2} = \frac{8(2) - (2)^2}{(4-2)^2}$$

$$= \frac{12}{4}$$

$m_T = 3$

$m_N = -\frac{1}{3}$ (1)

At $x = 2$, $y = \frac{(2)^2}{4-2} = \frac{4}{2} = 2$.

$(x_1, y_1) = (2, 2)$ $\quad m_N = -\frac{1}{3}$

$y - y_1 = m_N(x - x_1)$

$y - 2 = -\frac{1}{3}(x - 2)$

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

$3y - 6 = -x + 2$

$\boxed{x + 3y - 8 = 0}$ (1)

Q17. (b) (i) In $\triangle ABC$ and $\triangle ADE$,

$\angle A$ is common (1)

$\angle ABC = \angle ADE$ (equal corresponding $\angle$s, $BC \parallel DE$)

$\angle ACB = \angle AED$ (equal corresponding $\angle$s, $BC \parallel DE$) } (1)

$\therefore \triangle ABC /// \triangle ADE$ (equiangular) (1)

(ii) $\frac{BC}{DE} = \frac{AB}{AD}$ (1) (matching sides of similar $\triangle$s in the same ratio)

$\frac{BC}{20} = \frac{25}{40}$

$BC = \frac{20 \times 25}{40} = \underline{12.5}$ (1)

Q17. (c) $\lim_{x \to 3} \frac{x^3 - 27}{(x-3)} = \lim_{x \to 3} \frac{(x-3)(x^2 + 3x + 9)}{(x-3)}$ ①

$= \lim_{x \to 3} (x^2 + 3x + 9)$

$= (3)^2 + 3(3) + 9$

$= \underline{27}$ ①