AB
EW
GB
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MB
AM
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CF

NAME: ________________________________

CLASS: 11MTA___ or 11MTX___

MARK: ____/70

CHERRYBROOK TECHNOLOGY HIGH SCHOOL

2017

YEAR 11

Mathematics
AP2

Time allowed: 2 hours

Reading Time: 5 minutes

DIRECTIONS TO CANDIDATES:

- ◊ Write your name and class in the space provided at the top of this page.
- ◊ Attempt all questions.
- ◊ Board approved calculators may be used.
- ◊ All necessary working should be shown. Full marks may not be awarded for careless or badly arranged work.
- ◊ A formula sheet is provided.

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.

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1 What are the solutions of the equation $|3x - 5| = 10$?

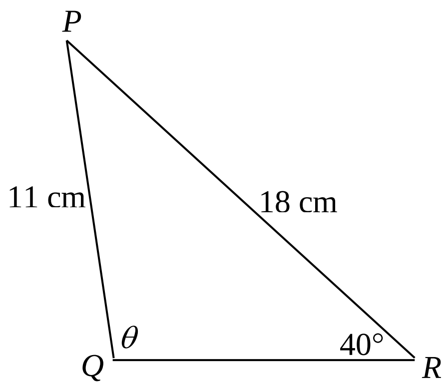
(A) $x = -5, 15$

(B) $x = -5, 5$

(C) $x = -1\frac{2}{3}, 5$

(D) $x = -5, 1\frac{2}{3}$

2 The diagram shows the triangle *PQR* where $PQ = 11$ cm, $PR = 18$ cm and $\angle PRQ = 40^\circ$. Which expression correctly gives the value of $\sin\theta$?



(A) $\dfrac{18}{11\sin 40^\circ}$

(B) $\dfrac{11}{18\sin 40^\circ}$

(C) $\dfrac{11\sin 40^\circ}{18}$

(D) $\dfrac{18\sin 40^\circ}{11}$

3 Evaluate $\log_3 17$ correct to 2 decimal places.

(A) 0.39

(B) 1.23

(C) 2.57

(D) 2.58

4 The function $y = f(x)$ is defined as: $f(x) = \begin{cases} 1 - x^2 & x \geq 0 \\ x^2 + 1 & x < 0 \end{cases}$

What is the range of $f(x)$?

(A) $y \leq -1 , y \geq 1$

(B) all real y

(C) $y < -1 , y \geq 1$

(D) $-1 \leq y \leq 1$

5 What is the value of x if $8^{x+3} = 4^{3x-1}$?

(A) $\frac{7}{3}$

(B) 2

(C) $\frac{29}{3}$

(D) $\frac{11}{3}$

6 Solve $sin\theta = \frac{1}{\sqrt{2}}$, $0° \leq \theta \leq 360°$

(A) $\theta = 45^\circ, 135^\circ$

(B) $\theta = 135^\circ, 225^\circ$

(C) $\theta = 225^\circ, 315^\circ$

(D) $\theta = 315^\circ, 45^\circ$

7 Simplify $\frac{x^3 + x}{x}$

(A) $x^2 + 1$

(B) $x^2 + x$

(C) $x^3 + 1$

(D) x^3

8 What is the solution to the equation $\sqrt{x} = \sqrt{27} + \sqrt{75}$?

(A) $x = \sqrt{3}$

(B) $x = 3$

(C) $x = 24$

(D) $x = 192$

9 Solve $x^2 + 6x + 2 = 0$

(A) $x = 3 \ or \ 2$

(B) $x = -5.65 \ or \ -0.35$

(C) $x = -4.33 \ or \ 1.67$

(D) $x = 6 \ or \ 2$

10 Which expression is equivalent to $4 + \log_2 x$?

(A) $\log_2(2x)$

(B) $\log_2(16 + x)$

(C) $4\log_2(2x)$

(D) $\log_2(16x)$

End of Section 1

Section II

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

Answer each question in the appropriate writing booklet. Extra writing booklets are available.

In Questions 11–14, your responses should include relevant mathematical reasoning and/or calculations.

Question 11 (15 marks) Use a SEPARATE writing booklet.

(a) Differentiate $y = 3x^2 + 1$ by first principles. **2**

(b) Differentiate:

(i) $y = 6x^2 + 8x$ **1**

(ii) $f(x) = (-3x + 6)(6x^2 - 5)$ **2**

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

(iv) $\frac{3x^4}{x + 2}$ **2**

(c) Given $g = 4\pi r^2 + 2r - 10$, differentiate g with respect to r **1**

(d) Find the equation of the normal to the curve $f(x) = \frac{1}{3}x^3 + x^2 - 2x^{-2}$ at the point (1 , 2) in general form. **3**

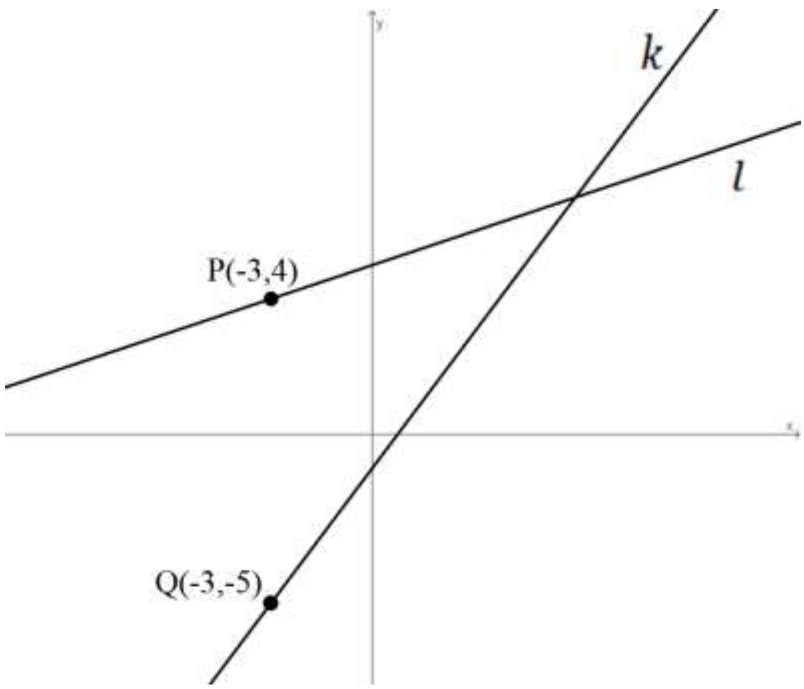
(e) The tangent to the parabola $y = 3x^2 + 4$ at a point P has a gradient of -3. Find the coordinates of P **2**

End of Question 11

Question 12 (15 marks) Use a SEPARATE writing booklet.

(a) The line l passes through the point $P\ (-3,\ 4)$ and has equation $x - 3y + 15 = 0$.
The line k passes through the point $Q\ (-3,\ -5)$ and has equation $4x - 3y - 3 = 0$

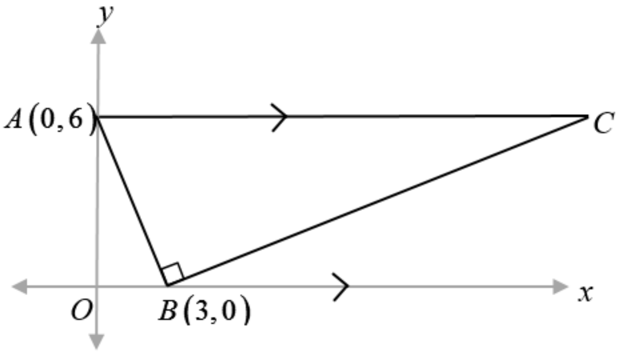
The two lines l and k meet at point R



(i) Show that the coordinates of the point R is $(6,\ 7)$. **2**

(ii) Hence, find the area of triangle PQR. **2**

(b) The diagram shows the triangle ABC. The coordinates of A are (0,6) , the coordinates of B are (3,0) and the coordinates of C are $(15, 6)$. BC is perpendicular to AB. AC is parallel to the x-axis.



NOT TO SCALE

(i) Find the gradient of AB **1**

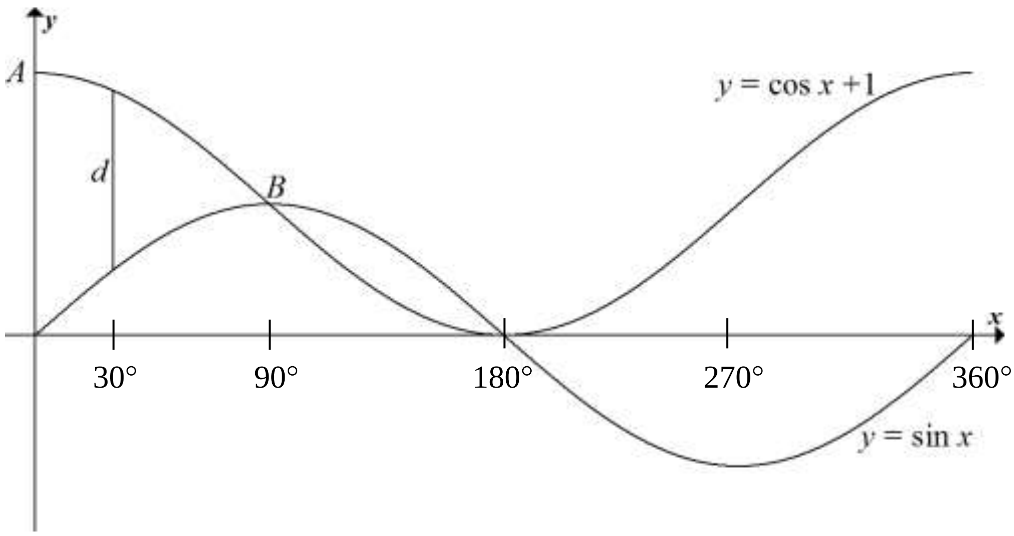
(ii) Show that the equation of BC is $x - 2y - 3 = 0$ **1**

(iii) Find the length of BC.
Express your answer in exact form, simplified if necessary. **2**

(iv) Find the size of $\angle ACB$, correct to the nearest degree. **2**

(v) Find the perpendicular distance from the point D $(5, -3)$ to BC.
Express your answer in exact form, simplified if necessary. **1**

(c) The diagram shows the graphs $y = sinx$ and $y = cosx + 1$ for $0° \leq x \leq 360°$



(i) State the coordinates of the point A. **1**

(ii) Determine the coordinates of the point B. **1**

(iii) Let d be the vertical distance between the two graphs when $x = 30°$ **2**
Find the exact value of d.

End of Question 12

Question 13 (15 marks) Use a SEPARATE writing booklet.

(a) Given $f(x) = \begin{cases} x^3 & , \quad x > -2 \\ 2 - x & , \quad x \leq -2 \end{cases}$

(i) Find $f(-5)$ **1**

(ii) Find $f(4) + f(-2)$ **1**

(b) Show that $x = y^2$ is not a function. **1**

(c) State the domain of $y = \frac{x}{x+2}$. **1**

(d) Show that $f(x) = 4x^5 + x^2$ is not an odd function. **1**

(e) Given $f(x) = x^2 + 2x - 8$

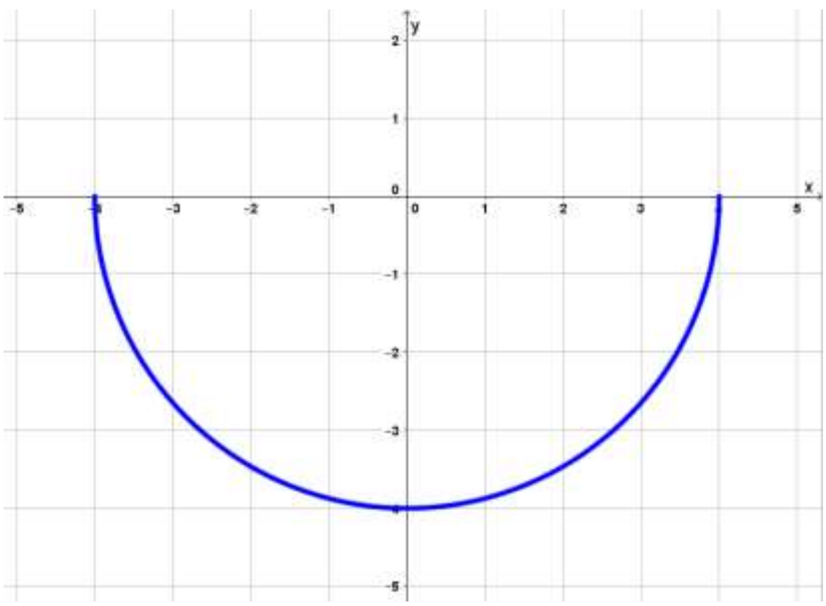
(i) Sketch the graph of $f(x)$ showing all intercepts. **3**

(ii) Find the equation of the axis of symmetry. **1**

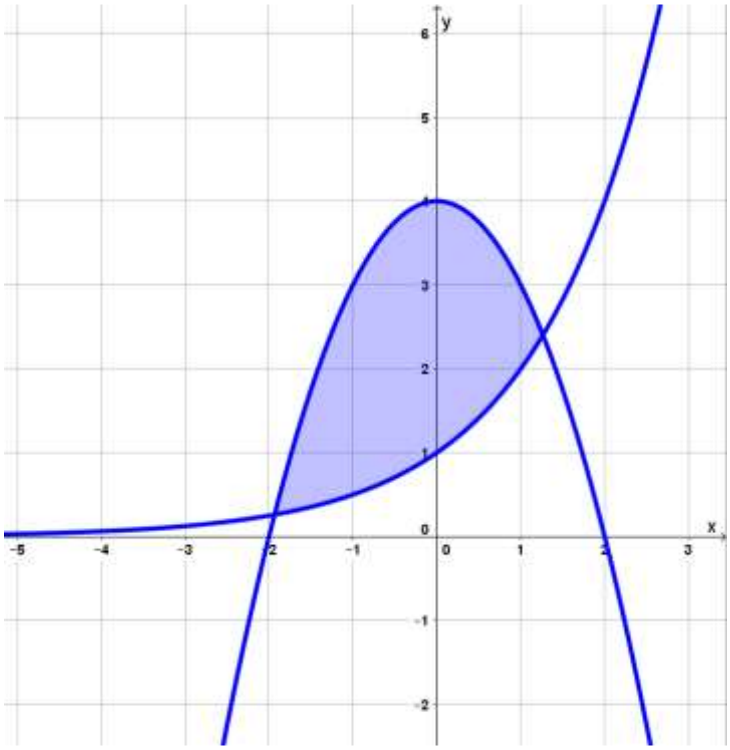
(iii) Hence or otherwise, find the minimum value of $f(x) = x^2 + 2x - 8$. **1**

(f) Sketch the graph of $y = \frac{1}{x+3}$. **2**

(g) Write the equation of the graph shown below **1**



(h) The diagram shows the graphs $y = -x^2 + 4$ and $y = 2^x$. **2**

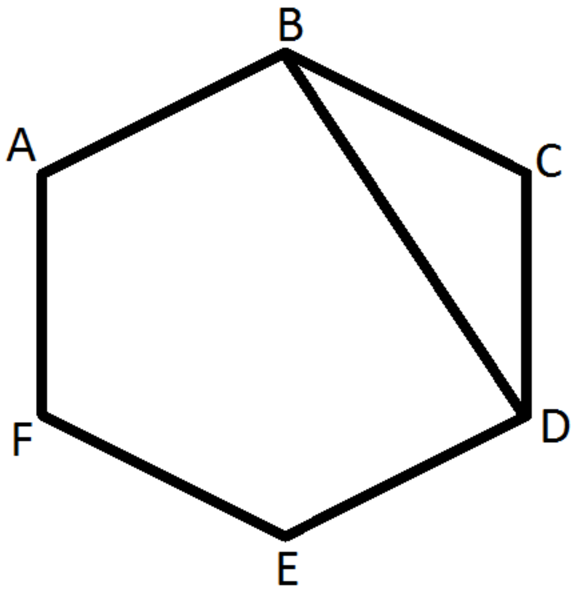


Write down the inequalities that together describe the shaded region.

End of Question 13

Question 14 (15 marks) Use a SEPARATE writing booklet.

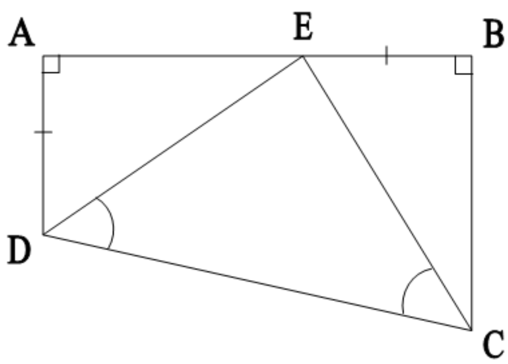
(a) In the diagram, ABCDEF is a regular hexagon, with diagonal BD shown.



(i) Show that $\angle BCD = 120°$ **1**

(ii) Find the size of $\angle BDC$. Give reasons for your answer. **2**

(b) In the diagram $ABCD$ is a trapezium such that $\angle CBA = \angle BAD = 90°$
E is a point on AB such that $EB = DA$ and $\angle ECD = \angle EDC$



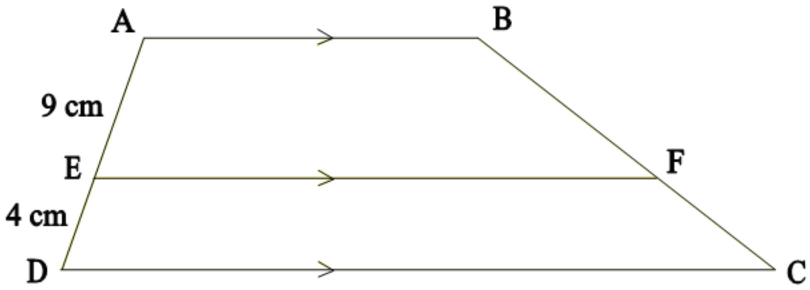
(i) Prove that triangle AED is congruent to triangle BCE. **2**

(ii) Let $\angle EDA = x$
Show that $\angle DEC$ is a right angle. **2**

(c) In the diagram $ABCD$ is a trapezium with $AB \parallel DC$. **3**

E is a point on AD such that $EA = 9cm$ and $ED = 4\ cm$.

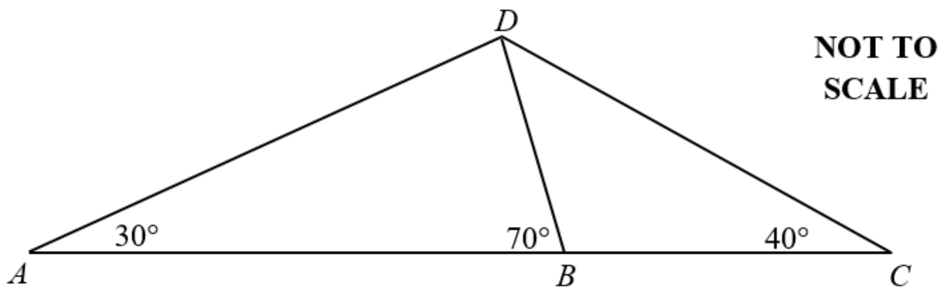
The line from E which is parallel to AB meets BC at F, such that $BF = FC + 4$



Find the length of FC, giving reasons.

(d) The diagram shows ΔACD where $\angle DAC = 30°$ and $\angle DCA = 40°$

The point B lies on AC such that $\angle DBA = 70°$.



(i) Prove that ΔACD and ΔDCB are similar. **3**

(ii) Let $CD = x\ cm$, $AC = (x + 3)\ cm$ and $BC = (x - 2)\ cm$ **2**

Using part (i), or otherwise, find the value of x.

End of paper

Mathematics Year 11 AP2- 2017

Multiple Choice Answer Sheet

Name: ______________________ **Class: 11MTA**_____ **or 11MTX**___

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think that you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

~~●~~ ● ○ ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.

correct

~~●~~ ~~●~~ ○ ○

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 ●

MARKER's USE ONLY

	MARKS
SECTION I	/10
SECTION II Q11	/15
Q12	/15
Q13	/15
Q14	/15
TOTAL	/70

Q1) $3x-5=10$

$3x=15$

$x=5$

$-(3x-5)=10$

$-3x+5=10$

$-3x=5$

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

$=-1\frac{2}{3}$

C

Q2) $\frac{\sin\theta}{18}=\frac{\sin 40}{11}$

$\sin\theta=\frac{18\sin 40}{11}$

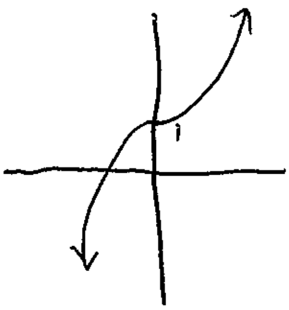
D

Q3) $\frac{\log 17}{\log 3}=2.5789$

$=2.58$

D

Q4)



B

Q5) $8^{x+3}=4^{3x-1}$

$2^{3(x+3)}=2^{2(3x-1)}$

$\therefore 3(x+3)=2(3x-1)$

$3x+9=6x-2$

$3x=11$

$x=11/3$

D

Q6) $\theta=45°$

and

$180-45$

$=135°$

S	A
T	C

A

Q7) $\frac{x^3+x}{x}=x^2+1$

A

Q8) $\sqrt{27}+\sqrt{75}$

$=\sqrt{9\times3}+\sqrt{25\times3}$

$=3\sqrt{3}+5\sqrt{3}$

$=8\sqrt{3}$

$=\sqrt{64\times3}$

$=\sqrt{192}$

$\therefore x=192$

D

Q9) $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$= \frac{-6 \pm \sqrt{6^2 - 4 \times 1 \times 2}}{2 \times 1}$

$= -0.35, -5.65$

B

Q10) $4 + \log_2 x$

$= 4\log_2 2 + \log_2 x$

$= \log_2 2^4 + \log_2 x$

$= \log_2 16 + \log_2 x$

$= \log_2 (16x)$

D

Question 11.

a) $y = 3x^2 + 1$

$$\frac{dy}{dx} = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \to 0} \frac{3(x+h)^2 + 1 - (3x^2+1)}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{3x^2} + 6xh + h^2 \cancel{+1} - \cancel{3x^2} \cancel{-1}}{h}$$

$$= \lim_{h \to 0} \frac{6xh + h^2}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{h}(6x+h)}{\cancel{h}}$$

$$= 6x.$$

Answers with no evidence of first principles working scored zero.

b) i) $\frac{d}{dx}(6x^2 + 8x) = 12x + 8$

ii) $f(x) = (-3x+6)(6x^2-5)$

$$u = -3x + 6$$
$$u' = -3$$
$$v = 6x^2 - 5$$
$$v' = 12x$$

$$f'(x) = -3(6x^2 - 5) + 12x(-3x+6)$$
$$= -18x^2 + 15 - 36x^2 + 72x$$
$$= -54x^2 + 72x + 15$$

Best practice is to simplify

OR $f(x) = (-3x+6)(6x^2-5)$
$$= -18x^3 + 15x + 36x^2 - 30$$
$$= 18x^3 + 36x^2 + 15x - 30$$

$$f'(x) = -54x^2 + 72x + 15$$

iii) $\sqrt[4]{2-x} = (2-x)^{\frac{1}{4}}$

$$\frac{d}{dx}(2-x)^{\frac{1}{4}} = \frac{1}{4}(2-x)^{-3/4} \times (-1)$$
$$= \frac{-1}{4}(2-x)^{-3/4}$$
$$= \frac{-1}{4\sqrt[4]{(2-x)^3}}$$

Best practice

11) b) iv) $\dfrac{3x^4}{x+2}$

$u = 3x^4$
$u' = 12x^3$
$v = x+2$
$v' = 1$

$$\frac{d}{dx}\left(\frac{3x^4}{x+2}\right) = \frac{12x^3(x+2) - 1 \times 3x^4}{(x+2)^2}$$

$$= \frac{12x^4 + 24x^3 - 3x^4}{(x+2)^2}$$

$$= \frac{9x^4 + 24x^3}{(x+2)^2}$$

Best practice

c) $g = 4\pi r^2 + 2r - 10$
$g' = 8\pi r + 2.$

d) $f(x) = \frac{1}{3}x^3 + x^2 - 2x^{-2}$

$f'(x) = \frac{1}{\cancel{3}}.\cancel{3}x^2 + 2x - 2(-2)x^{-3}$

$= x^2 + 2x + \frac{4}{x^3}$

$f'(1) = 1^2 + 2(1) + \frac{4}{1^3}$

$= 1 + 2 + 4$
$= 7$

$m_{tangent} = 7 \quad \therefore \quad m_{normal} = \frac{-1}{7}$

$y - y_1 = m(x - x_1)$
$y - 2 = \frac{-1}{7}(x - 1)$
$7y - 14 = -x + 1$
$7y - 14 + x - 1 = 0$
$7y - 14 - 15 = 0$ is equation of normal.
$x + 7y - 15 = 0$

e) $y = 3x^2 + 4$
$\frac{dy}{dx} = 6x$
At P, $6x = -3$
$x = \frac{-3}{6}$
$= -\frac{1}{2}$

$y = 3(-\frac{1}{2})^2 + 4 = \frac{19}{4} \qquad \therefore P = \left(-\frac{1}{2}, \frac{19}{4}\right)$

Greg

(Q12) a) i) $x - 3y + 15 = 0$ — (1)

$4x - 3y - 3 = 0$ — (2)

(1) − (2)

$4x - 12y + 60 = 0$

$4x - 3y - 3 = 0$

$\therefore -9y =$

$-3x \quad + 18 = 0$

$3x = 18$

$\boxed{x = 6}$ — 1

into (1)

$6 - 3y + 15 = 0$

$3y = 21$

$\boxed{y = 7}$

$(6, 7)$ — 1

b) i) $\dfrac{6-0}{0-3}$ $\boxed{m_{AB} = -2}$ 1

ii) $m_{AB} = -2$

$\boxed{\therefore m_{BC} = \frac{1}{2}}$ 1

$y - 0 = \frac{1}{2}(x - 3)$

$2y = x - 3$

$x - 2y - 3 = 0$

iii) $d_{BC} = \sqrt{(3-15)^2 + (0-6)^2}$

$= \sqrt{180}$ — 1

$= 6\sqrt{5}$ — 1

15C

iv) $d_{AC} = 15$ units

$\cos\theta = \dfrac{6\sqrt{5}}{15}$

$\theta = \cos^{-1}\left(\dfrac{6\sqrt{5}}{15}\right)$

$= 26°34'$ — 1

$\boxed{\theta = 27°}$

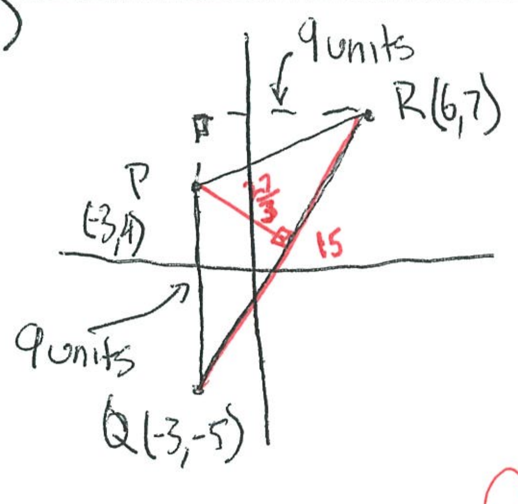
$\angle ACB = 27°$ — 1

v) $d = \dfrac{|1 \times 5 + -2 \times -3 + -3|}{\sqrt{1^2 + (-2)^2}}$

$= \dfrac{8}{\sqrt{5}}$ units 3.5777 1

$= \dfrac{8\sqrt{5}}{5}$

ii)



$\text{Area} = \frac{1}{2} \times 9 \times 9$ 1

$= 40.5 \text{ units}^2$ 1

$A = \frac{1}{2}(15)\left(\frac{27}{3}\right)$

$= \frac{81}{3} \quad (40\frac{1}{2})$

2)(2)(c) i) $A(0, \cos 0 + 1)$

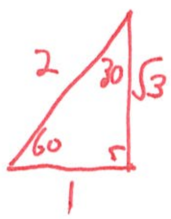
$= \underline{A(0,2)}$

ii) $B(90°, \sin 90)$

$= \underline{B(90°, 1)}$

iii) $d = (\cos 30 + 1) - (\sin 30)$ — 1

$= \left(\frac{\sqrt{3}}{2} + 1\right) - \left(\frac{1}{2}\right)$



$= \frac{\sqrt{3}}{2} + \frac{1}{2}$

$= \frac{1+\sqrt{3}}{2}$ — 1

$= 1.36602$

Q13) a) i) $f(-5) = 2-(-5)$
$= 7$

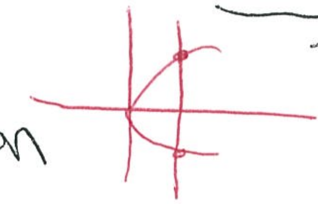
ii) $f(4) + f(-2) = (4)^3 + (2-(-2))$
$= 68$

b) Check $x = 3$ (or any positive value)

$3 = y^2$
$y = \pm\sqrt{3}$

Also accept:
"Doesn't pass the vertical line test"

One x-value gives two y-values.
$\therefore$ Not a function



c) all real x, $x \neq -2$

d) $f(-x) = 4(-x)^5 + (-x)^2$
$= -4x^5 + x^2$

need to show $= -(4x^5 - x^2)$

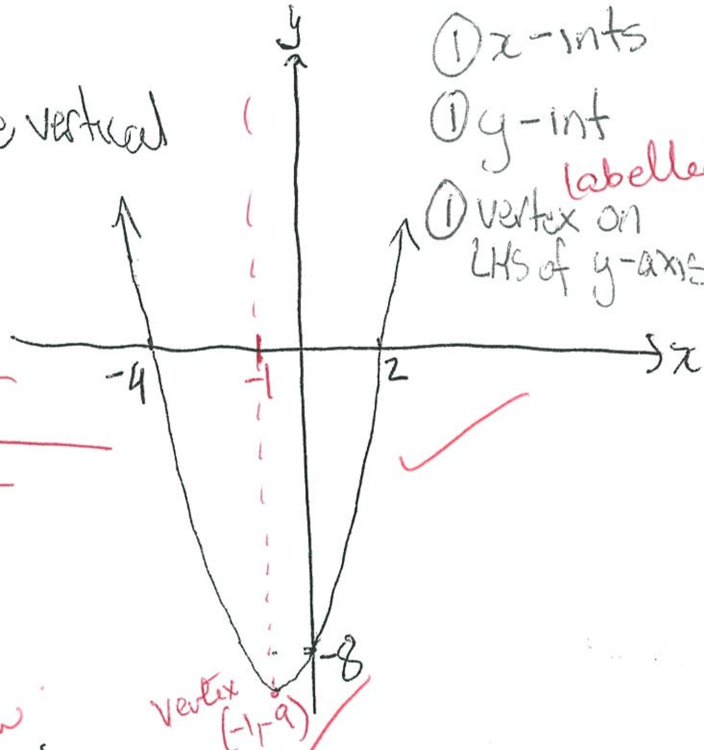
$-f(x) = -(4x^5 + x^2)$ $f(-x) \neq -f(x)$
$= -4x^5 - x^2$

$f(-x) \neq -f(x)$
$\therefore f(x)$ is not odd

e) i) y-int when $x = 0$
$y = -8$

meeau

x-int when $y = 0$
$0 = x^2 + 2x - 8$
$= (x+4)(x-2)$
$x = -4$ and 2



① x-ints
① y-int labelled
① vertex on LHS of y-axis

ii) $x = \dfrac{-4+2}{2} = -1$
$x = -1$

need to write in equation

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

$\therefore$ min value is -9

not vertex $(-1, -9)$

Q13 d) Many students left till

$f(-x) = 4(-x)^5 + (-x)^2$

$= -4x^5 + x^2$

$f(x) \neq -f(x)$.

They need to show

$= -(4x^5 - x^2)$

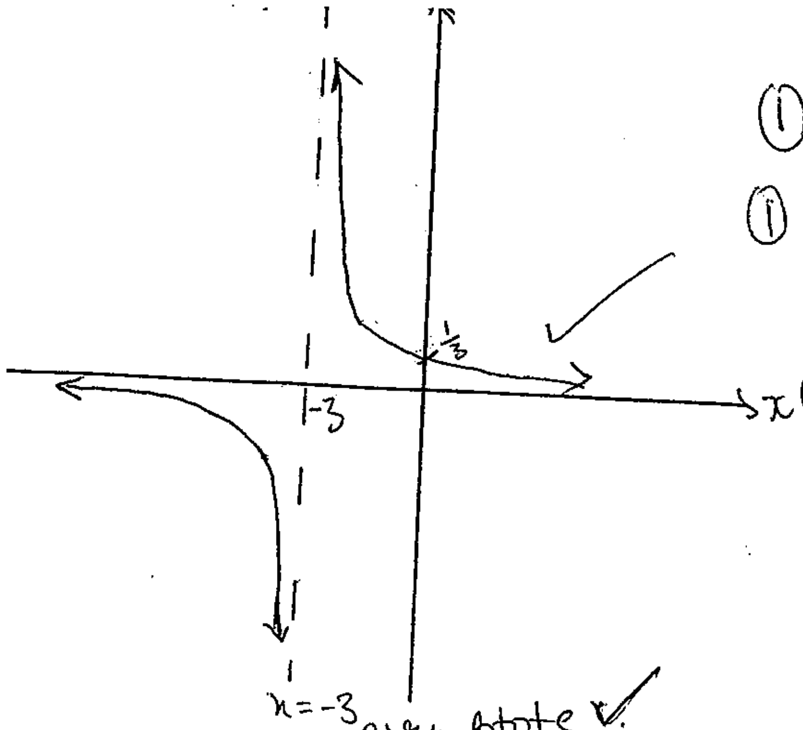
$\neq -f(x)$.

$\therefore f(x) \neq -f(x)$

$\therefore$ it is not a function.

Marks were awarded but next time they should show complete factorisation.

Q13) f)



① Hyperbola shape
① Asymptote

g) $y = -\sqrt{16-x^2}$

h) $y \leq -x^2+4$ and $y \geq 2^x$

OR $2^x \leq y \leq -x^2+4$

① Inequalities
① and

OR $y \leq -x^2+4 \cap y \geq 2^x$

do not accept OR, comma

Q 14 (a)

(i) $S = 180(n-2)$

$= 180(6-2)$

$S = 720^\circ$

$720 \div 6 = 120^\circ$

$\therefore \angle BCD = 120^\circ$ —— 1

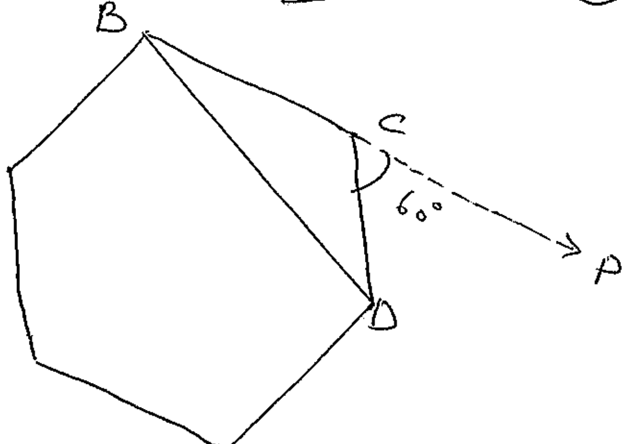
$\boxed{\text{Or}}$

$\angle PCD = \dfrac{360^\circ}{6}$ (exterior angles of a quadrilateral add to 60°)

$= 60^\circ$

$\angle BCD = 180 - 60$ (angles on a straight line add to 180°) —— 1

$= 120^\circ$



(ii) $BC = CD$ (sides of a regular hexagon)

$\therefore \angle CBD = \angle BDC$ (base ∠'s equal in Isosceles Δ) —— 1 for both

$\angle CBD + \angle BDC + \angle BCD = 180^\circ$ (∠ sum of Δ is 180°) not necessary as well as —— 1

$2 \angle BDC + 120 = 180^\circ$

$\angle BDC = \dfrac{180 - 120}{2}$

$\therefore \angle BDC = 30^\circ$

OR 1 For correct w/ no reasons

Q14 (b)

(i) $\angle EAD = \angle CBE$ (given)

$AD = BE$ (given)

$DE = EC$ (equal sides in Isosceles Δ) —— 1

$\therefore \Delta AED \equiv \Delta BCE$ (RHS) —— 1

with all worki

(ii) $\angle ADE = \angle BEC = x$ (corresponding $\angle$'s equal $\Delta AED \equiv \Delta BCE$)

$x + \angle EAD + \angle DEA = 180°$ ($\angle$ sum of a Δ)

$x + 90 + \angle DEA = 180°$ —— 1

$\therefore \angle DEA = 90 - x$

$\angle AED + \angle DEC + \angle BEC = 180°$ (angles on a straight line add to $180°$)

$90 - x + \angle DEC + x = 180°$

$\therefore \angle DEC = 180 - 90 + x$

$= 90°$ —— 1 with all other working.

$\boxed{\text{or}}$

14 b (ii) $\angle BEC = \angle EDA = x$ (Corresponding angles of Congruent Δs – $\Delta AED \equiv \Delta BCE$)

$\angle BED = \angle DEC + x$

$\angle BED = 90 + x$ (exterior $\angle$ of a Δ is equal to the sum of two opposite interior $\angle$s)

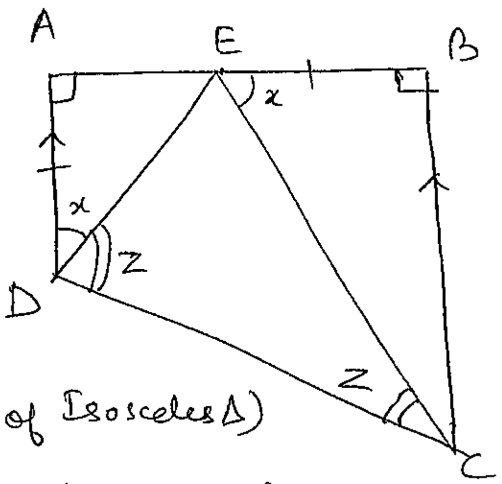
$\therefore \quad 90 + x = \angle DEC + x$

$\angle DEC = 90 + x - x$

$\angle DEC = 90^\circ$

$\boxed{\text{Or}}$

(not to scale)



$\angle ADE + \angle EDC + \angle ECD + \angle BCE = 180^\circ$ —— (1)

[cointerior $\angle$s on parallel lines, AD ∥ BC

$\angle ADE = x$ (given) — (2)

Let $\angle EDC = \angle ECD = z$ — (3) (base $\angle$s of Isosceles Δ)

$\angle BCE = 180 - 90 - x$ ($\angle$ sum of a Δ is 180°)

$\angle BCE = 90 - x$ — (4)

$\therefore$ Rewrite (1) using (2) & (3) & (4)

$\cancel{x} + z + z + 90 - \cancel{x} = 180^\circ$

$2z + 90 = 180^\circ$

$z = 45^\circ$

In ΔDEC

$z + z + \angle DEC = 180^\circ$ ($\angle$ sum of a Δ)

$45 + 45 + \angle DEC = 180°$

$\therefore \angle DEC = 180 - 90$

$= 90°$ Hence proved.

$\boxed{\text{or}}$

$\angle EDA = \angle CEB = x$ (corresponding $\angle s$ in congruent Δs $\Delta EDA \equiv \Delta CEB$

In ΔEAD

$\angle DEB = \angle EDA + \angle EAD$ — 1 (exterior angle of a Δ is equal to the sum of the two opposite interior $\angle s$)

$\angle DEB = x + 90°$ — 2

Also $\angle DEB = \angle DEC + \angle CEB$ (given) — 3

Substitute 2 & 3 in 1

$\therefore \angle DEC + \angle CEB = \angle EDA + \angle EAD$

$\angle DEC + \cancel{x} = \cancel{x} + 90°$

$\therefore \angle DEC = 90°$ Hence proved.

c) $\frac{AE}{ED} = \frac{BF}{FC}$ (Ratios of transversal intercepts are equal on parallel lines)

$$\frac{9}{4} = \frac{FC+4}{FC}$$

$9FC = 4(FC+4)$

$9FC = 4FC + 16$

$5FC = 16$

$FC = 3.2\text{cm}$

OR

$$\frac{13}{4} = \frac{2FC+4}{FC}$$

$13FC = 4(2FC+4)$

$13FC = 8FC + 16$

$5FC = 16$

$FC = 3.2\text{cm}$

Q14) d) i) $\angle DBC + \angle DBA = 180°$ ($\angle$s on a straight line add to 180°)

$\angle DBC + 70 = 180$

$\angle DBC = 110°$

$\angle DBC + \angle BCD + \angle CDB = 180°$ ($\angle$ sum of Δ is 180°)

$110 + 40 + \angle CDB = 180$

$\angle CDB = 30°$

$\angle ADC + \angle DCA + \angle CAD = 180°$ ($\angle$ sum of Δ is 180°)

$\angle ADC + 40 + 30 = 180$

$\angle ADC = 110°$

$\therefore \angle ADC = \angle DBC$ $\quad$ $\angle DCB$ is common

$\angle CDB = \angle DAC$

$\therefore \Delta ACD \parallel\!| \Delta DCB$ (equiangular)

ii) $\frac{x}{x+3} = \frac{x-2}{x}$ (corresponding sides in similar Δ's in the same ratio.)

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

$x^2 = x^2 + x - 6$

$x = 6\text{cm}$