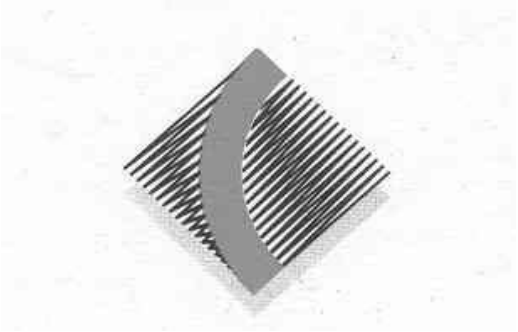
ML
MK
DH
AB
KSIN
KSAX
JI
CF
AM/
YR
BP

Name: _____

Class: 11MTA__ OR 11MTX__

Teacher: _____

CHERRYBROOK TECHNOLOGY HIGH SCHOOL



2018
YEAR 11

AP2 EXAMINATION

MATHEMATICS

Time allowed - 2 HOURS
(Plus 5 minutes reading time)

DIRECTIONS TO CANDIDATES:

SECTION I: Use the multiple-choice answer sheet provided.

SECTION II:

- Each question is to be commenced in a new booklet clearly marked Question 11, Question 12, etc on the top of the page.
- All necessary working should be shown in every question. Full marks may not be awarded for careless or badly arranged work.
- If you do not attempt a question, you must submit a blank booklet clearly indicating the question number, your name and class
- All questions should be placed in order - multiple-choice answer sheet followed by Question 11 to 14.
- NESA approved calculators may be used.
- The NESA Reference Sheet is provided.

Section I

10 marks
Attempt all questions
Allow about 15 minutes for this section

Use the multiple choice answer sheet for Questions 1 - 10

---

1. Which of the following is an expression for $x^2 - 5x - 6$?

(A) $(x - 2)(x + 3)$
(B) $(x + 1)(x - 6)$
(C) $(x - 1)(x + 6)$
(D) $(x + 2)(x - 3)$

2. Which of the following are all rational numbers?

(A) $-0.13, 2\sqrt{9}, \frac{22}{7}, 0$

(B) $3\pi, -0.13, \frac{22}{7}, 0$

(C) $\frac{22}{7}, \sqrt{5}, 2\sqrt{9}, 3\pi$

(D) $\sqrt{5}, 3\pi, -0.13, \frac{22}{7}$

3. Evaluate $\lim_{x \to 4} \frac{x^2 - 3x - 4}{x - 4}$

(A) 0
(B) 1
(C) 5
(D) Undefined

4. Solve $\tan\theta = \sqrt{3}, 0 \leq \theta \leq 360°$

(A) 60°, 120°
(B) 60°, 240°
(C) 30°, 210°
(D) 30°, 150°

5. Simplify $\sin^2 x - \dfrac{\tan^2 x + 1}{\sec^2 x}$

(A) $-\cos^2 x$
(B) $\cos^2 x$
(C) $\sin^2 x$
(D) $\tan^2 x$

6. Consider $f(x) = \dfrac{6}{x}$ and $g(x) = 2x + 4$.
What are the values for x for which $f(x) = g(x)$?

(A) $x = -1$ or $x = 3$
(B) $x = -1$ or $x = -3$
(C) $x = 1$ or $x = 3$
(D) $x = 1$ or $x = -3$

7. If $\log_x 3 = 2$ and $\log_x 5 = 3$, evaluate $\log_3 15$.

(A) $\dfrac{5}{2}$
(B) 3
(C) 5
(D) 6

8. Which of the following is the equation of a circle with centre (– 1, 0) and radius 3?

(A) $x^2 + 2x + y^2 = 2$

(B) $x^2 - 2x + y^2 = 8$

(C) $x^2 - 2x + y^2 = 2$

(D) $x^2 + 2x + y^2 = 8$

9. Differentiate $y = \sqrt[4]{2x^2 - 8}$

(A) $\frac{1}{4}\sqrt[4]{(2x^2-8)^3}$

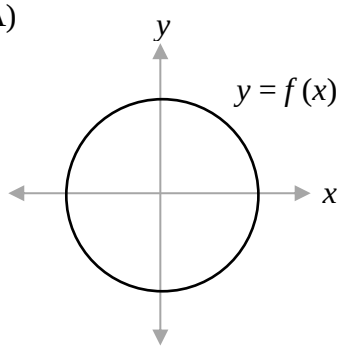
(B) $\frac{x}{\sqrt[4]{(2x^2-8)^3}}$

(C) $x\sqrt[4]{(2x^2-8)^3}$

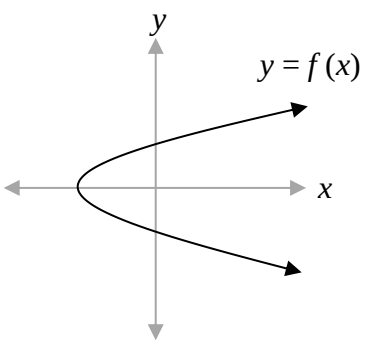
(D) $\frac{1}{16x\sqrt[4]{(2x^2-8)^3}}$

10. Which of the following graphs is a function?

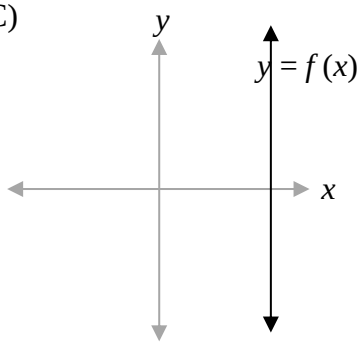
(A)



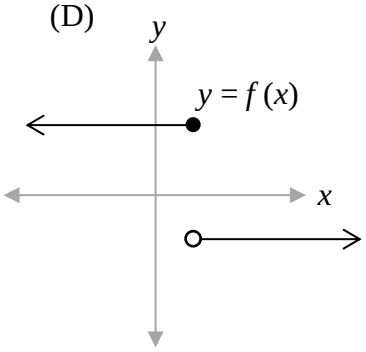
(B)



(C)



(D)



END OF SECTION I

Section II

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

Your responses should include relevant mathematical reasoning and/or calculations.

Question 11 (15 Marks) Start a new writing booklet **Marks**

(a) Simplify $\sqrt{32}-\sqrt{18}+\sqrt{2}$ **1**

(b) Evaluate $|30-12\times3|-|-30+12\times3|$ **1**

(c) Solve $9^{3y+1}=27$ **1**

(d) Simplify and leave your answer as a positive index. **2**

$$\left(x^{-1}+\frac{1}{y^{-2}}\right)^{-1}$$

(e) Evaluate $\frac{\sqrt[3]{2.75\times10^8}}{7.1\times5}$ correct to four significant figures. **1**

(f) Factorise a^3-8b^3 **1**

(g) Find the integers *a* and *b* such that $\frac{\sqrt{5}}{2+\sqrt{5}}=a+b\sqrt{5}$. **2**

(h) Solve $3x^2-10x+3=0$ **2**

(i) Solve $|2x-3|\geq7$ **2**

(j) Express $\frac{x-1}{5}-\frac{2x-3}{9}$ as a fraction in its simplest form. **2**

End of Question 11

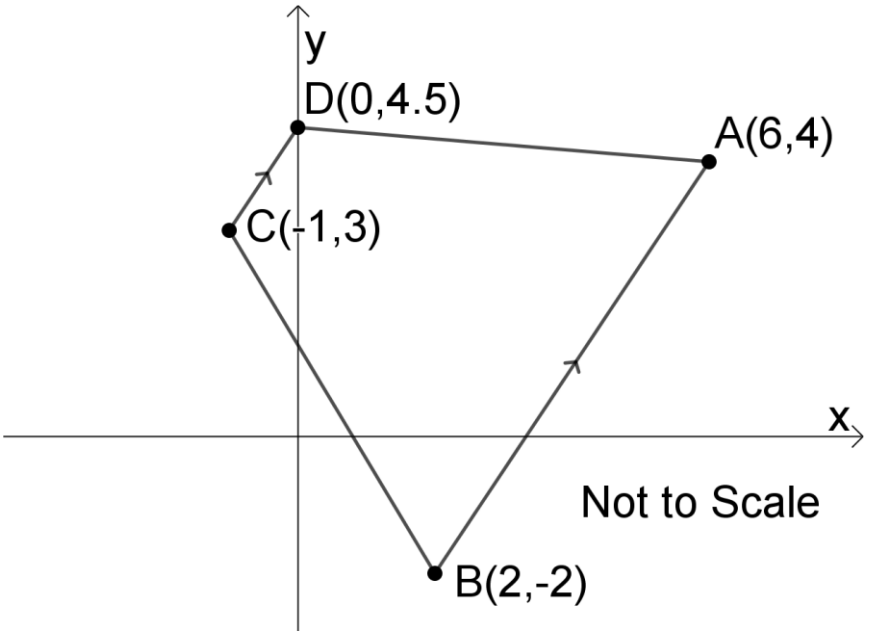
Question 12 (15 Marks) **Start a new writing booklet** **Marks**

(a) Factorise completely $2x^2 - 2 - y + x^2y$ **2**

(b) Solve simultaneously $5x - 2y = 8$ and $2x - y = 5$ **2**

(c) Sketch the curve y = 3sin 2*x* for $0 \leq x \leq 360°$. **2**

(d) The points A (6, 4), B (2, –2), C (–1, 3) and $D(0, 4.5)$ are plotted on a number plane. AB is parallel to CD.



(i) Find the exact length of *AB*. **1**

(ii) Find the gradient of *AB*. **1**

(iii) Show that the equation of *AB* is $3x - 2y - 10 = 0$. **1**

(iv) Calculate the perpendicular distance from *C* to *AB*, in exact form. **2**

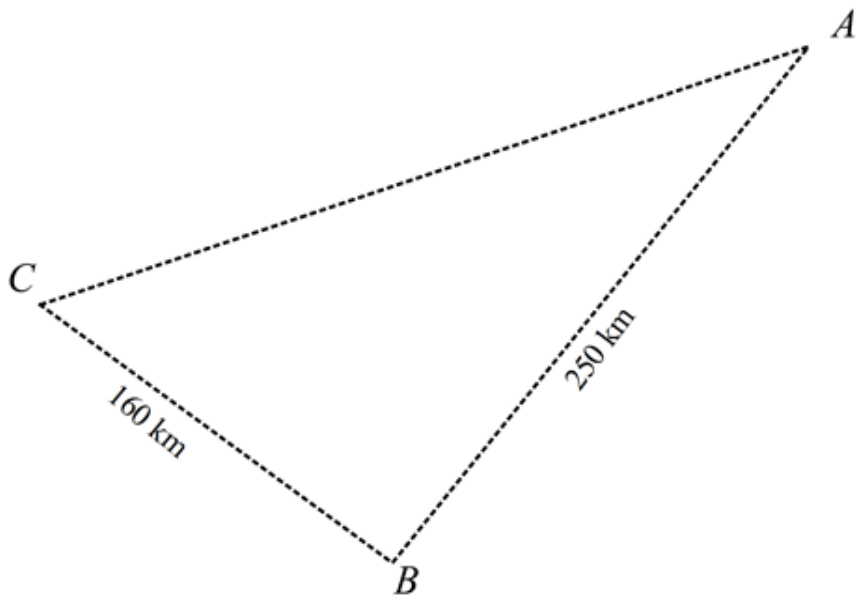
(v) Hence, determine the area of triangle *ABC*. **1**

Question 12 continues on the next page

(e) Three towns, *A*, *B* and *C* are located as shown on the diagram below. **3**

From town *C*, the bearing of *A* is $072°$ and the bearing of *B* is $128°$.

Town *B* is 160 km from *C* and 250 km from *A*.



Calculate the bearing of *B* from *A*.

End of Question 12

Question 13 (15 Marks) **Start a new writing booklet** **Marks**

(a) Differentiate from first principles $f(x) = x^2 - 4x + 8$ **3**

(b) Differentiate:

(i) $y = (x^2 - 3)(x - 4)$ **2**

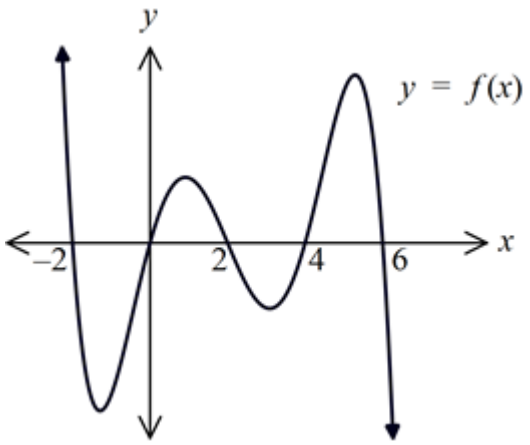
(ii) $y = \sqrt{x} + \dfrac{1}{x^2}$ **2**

(iii) $y = \dfrac{x}{7 - 3x}$ **2**

(c) Write the equation of the normal to the curve $y = 6x^2 - x + 2$ at the point where $x = 1$ in general form. **3**

(d) The tangent to the curve $y = x^3 - 3x^2$ at a point *A* has a gradient of – 3. Find the coordinates of the point *A*. **2**

(e) Sketch the gradient function of the following graph. **1**



End of Question 13

Question 14 (15 Marks) **Start a new writing booklet** **Marks**

(a) State the domain and range of the function $f(x) = \sqrt{4 - x^2}$. **2**

(b) Determine algebraically if the function $f(x) = \frac{x^2}{x-1}$ is even, odd or neither **2**

(c) A function is defined by the rule:

$$f(x) = \begin{cases} x - 3, & x \leq -3 \\ 2x + 2, & -3 < x < 0 \\ x^2, & x \geq 0 \end{cases}$$

(i) Find $f(2) + f(-2) + f(-5)$ **2**

(ii) Sketch the above function. Show all intercepts. **3**

(d) Consider the function $f(x) = \frac{x}{2x^2 + b}$. **2**

Given that $f(-1) = f(1)$, find the value of b.

(e) Find the values of the constant p for which $\lim_{x \to p} \frac{x - p}{x^2 - p^2} = 2p$ is correct. **2**

(f) Sketch the region where the graphs of $x + y + 1 > 0$ and $y \leq 1 - x^2$ hold simultaneously. **2**

End of Examination

Student Name……..

Class 11MTA…… or 11MTX…….

2018 CTHS MATHEMATICS AP2 EXAMINATION
Section I Answer Sheet

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

Use the multiple choice answer sheet.

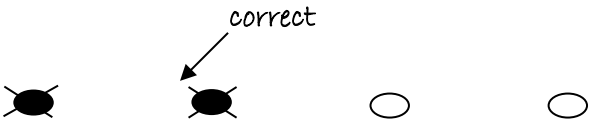
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

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.



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 ⬭

MC	**/10**
Q11	**/15**
Q12	**/15**
Q13	**/15**
Q14	**/15**
Total	**/70**

AP2 Mathematics

Section 1

1. $x^2 - 5x - 6$

$= (x-6)(x+1)$ **B**

2. **A**

3. $\lim_{x \to 4} \dfrac{x^2-3x-4}{x-4}$

$= \lim_{x \to 4} \dfrac{(x-4)(x+1)}{x-4}$

$= \lim_{x \to 4} x+1$

$= 4+1$

$= 5$ **C**

4. $\tan\theta = \sqrt{3}$

$\theta = 60$

$\therefore \theta = 60$ or 240 **B**

5. $\dfrac{\sin^2 x - \tan^2 x + 1}{\sec^2 x}$

$= \dfrac{\sin^2 x - \sec^2 x}{\sec^2 x}$

$= \sin^2 x - 1$

$= -\cos^2 x$ **A**

6. $\dfrac{6}{x} = 2x + 4$

$6 = 2x^2 + 4x$

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

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

$2(x+3)(x-1) = 0$

$\therefore x = -3$ or $x = 1$ **D**

7. $\log_3 15 = \dfrac{\log_x 15}{\log_x 3}$

$= \dfrac{\log_x (5 \times 3)}{\log_x 3}$

$= \dfrac{\log_x 5 + \log_x 3}{\log_x 3}$

$= \dfrac{3+2}{2}$

$= \dfrac{5}{2}$ **A**

8. **D**

9. $y = (2x^2 - 8)^{\frac{1}{4}}$

$\dfrac{dy}{dx} = \dfrac{1}{4}(2x^2-8)^{-\frac{3}{4}} \times 4x$

$= x(2x^2-8)^{-\frac{3}{4}}$

$= \dfrac{x}{\sqrt[4]{(2x-8)^3}}$ **B**

10. **D**

Section 2

Question 11.

a) $\sqrt{32} - \sqrt{18} + \sqrt{2}$

$= 4\sqrt{2} - 3\sqrt{2} + \sqrt{2}$

$= 2\sqrt{2}$

b) $|30 - 12\times3| - |-30 + 12\times3|$

$= |30 - 36| - |-30 + 36|$

$= |-6| - |+6|$

$= 6 - 6$

$= 0$

c) $9^{3y+1} = 27$

$(3^2)^{3y+1} = 3^3$

$6y + 2 = 3$

$6y = 1$

$y = \frac{1}{6}$

d) $\left(x^{-1} + \frac{1}{y^{-2}}\right)^{-1}$

$= \left(\frac{1}{x} + y^2\right)^{-1}$

$= \left(\frac{1 + xy^2}{x}\right)^{-1}$

$= \frac{x}{1 + xy^2}$

e) $\frac{\sqrt[3]{2.75\times10^6}}{7.1\times5}$

$= 18.318189..$

$\doteq 18.32$

f) $a^3 - 8b^3 = a^3 - (2b)^3$

$= (a - 2b)(a^2 + 2ab + 4b^2)$

g) $\frac{\sqrt{5}}{2+\sqrt{5}} \times \frac{2-\sqrt{5}}{2-\sqrt{5}}$

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

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

$\therefore a = 5, \quad b = -2$

h) $3x^2 - 10x + 3 = 0$

$3x^2 - 9x - x + 3 = 0$

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

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

$\therefore x = \frac{1}{3}$ or $x = 3$

i) $|2x-3| \geq 7$

must have or or comma.

$2x-3 \geq 7$ (or) $-(2x-3) \geq 7$

$2x \geq 10$ $-2x+3 \geq 7$

$x \geq 5$ $-2x \geq 4$

$x \leq -2$

j) $\frac{x-1}{5} - \frac{2x-3}{9}$

$= \frac{9(x-1) - 5(2x-3)}{45}$

$= \frac{9x-9-10x+15}{45}$

$= \frac{6-x}{45}$

Question 12

a) $2x^2 - 2 - y + x^2y$

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

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

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

Lots of students missed the +

b) $5x - 2y = 8$ —①

$2x - y = 5$ —②

rearrange ②

$y = 2x - 5$ —③

Sub ③ into ①

$5x - 2(2x-5) = 8$

$5x - 4x + 10 = 8$

$\boxed{x = -2}$

Sub $x = -2$ into ②

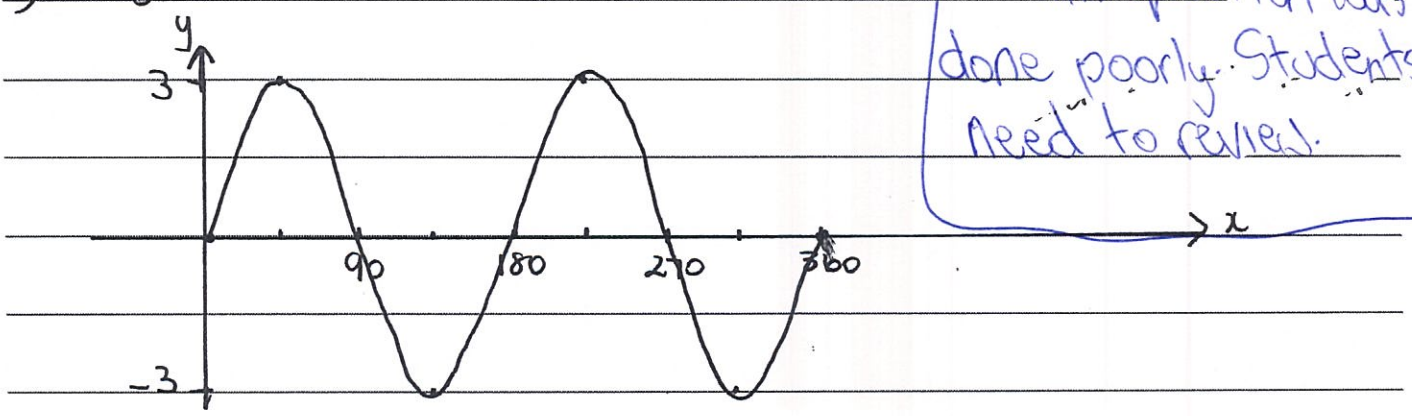
$2(-2) - y = 5$

$-4 - y = 5$

$\boxed{y = -9}$

$\therefore x = -2, \ y = -9$

c) $y = 3\sin 2x \quad 0 \leq x \leq 360$



This question was done poorly. Students need to revise.

d) (i) $d_{AB} = \sqrt{(6-2)^2 + (4-(-2)^2}$

$= \sqrt{4^2 + 6^2}$

$= \sqrt{16+36}$

$= \sqrt{52}$

$= 2\sqrt{13}$

(ii) $m_{AB} = \frac{4-(-2)}{6-2}$ or $\frac{(-2)-4}{2-6}$

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

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

(iii) using pt $(6,4)$, $m = \frac{3}{2}$

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

$y - 4 = \frac{3}{2}(x-6)$

$2(y-4) = 3(x-6)$

$2y - 8 = 3x - 18$

$3x - 2y - 10 = 0$

(iv) $d = \left| \frac{3x(-1) - 2x(3) - 10}{\sqrt{3^2 + (-2)^2}} \right|$

$= \left| \frac{-3-6-10}{\sqrt{13}} \right|$

$= \left| \frac{-19}{\sqrt{13}} \right|$

$= \frac{19}{\sqrt{13}}$

Had to show correct substitution of (-2) not 2.

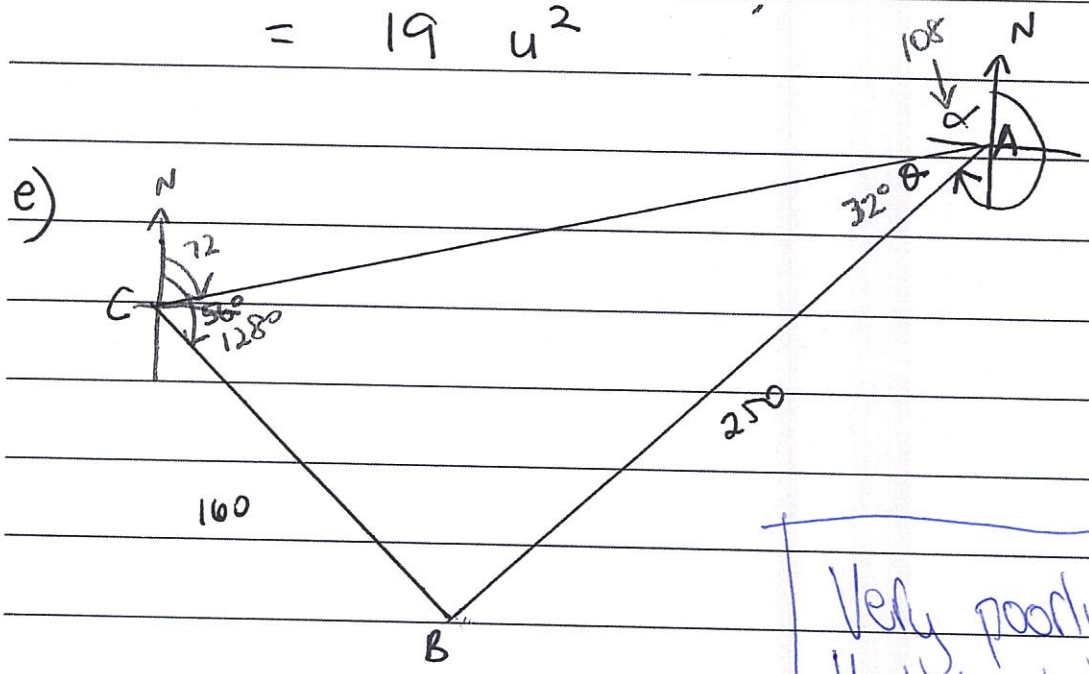
(v) $A = \frac{1}{2}bh$

$= \frac{1}{2} \times \frac{19}{\sqrt{13}} \times \sqrt{52}$

$= \frac{1}{2} \times \frac{19}{\sqrt{13}} \times 2\sqrt{13}$

$= 19 \ u^2$

e)



$\angle ACB = 56°$

let $\angle BAC = \theta$

$\frac{\sin\theta}{160} = \frac{\sin 56}{250}$

$\sin\theta = \frac{160 \sin 56}{250}$

$\therefore \theta = 32°$

Very poorly answered. Had to have some form of reasoning. Didn't have to be a complete reason, as shown below. However, in future exams full reasoning will be expected.

$\angle \alpha + 72 = 180$ (co-interior $\angle$s)

$\angle \alpha = 108°$

$\therefore$ The bearing of B from A = $360 - 32 - 108$

$= 220°T$

Question 13

a) $f(x) = x^2 - 4x + 8$

$f(x+h) = (x+h)^2 - 4(x+h) + 8$

$= x^2 + 2xh + h^2 - 4x - 4h + 8$

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

$$= \lim_{h \to 0} \frac{x^2 + 2xh + h^2 - 4x - 4h + 8 - (x^2 - 4x + 8)}{h}$$

$$= \lim_{h \to 0} \frac{x^2 + 2xh + h^2 - 4x - 4h + 8 - x^2 + 4x - 8}{h}$$

$$= \lim_{h \to 0} \frac{2xh + h^2 - 4h}{h}$$

$$= \lim_{h \to 0} \frac{h(2x + h - 4)}{h}$$

$$= \lim_{h \to 0} 2x + h - 4$$

$= 2x + 0 - 4$

$= 2x - 4$

* for (b) must show $\frac{dy}{dx}$ or similar - only. perahaps once

(b) (i) $y = (x^2 - 3)(x - 4)$

$u = x^2 - 3$, $u' = 2x$, $v = x - 4$, $v' = 1$

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

$= x^2 - 3 + 2x^2 - 8x$

$= 3x^2 - 8x - 3$

(ii) $y = \sqrt{x} + \frac{1}{x^2}$

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

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

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

mark not deducted for not rewriting with positive indices
· alot of students left solution with $\frac{1}{2\sqrt{x}} \pm \frac{2}{x^3}$ deducted.

(iii) $y = \frac{x}{7-3x}$

$u = x$
$u' = 1$
$v = 7-3x$
$v' = -3$

$\frac{dy}{dx} = \frac{(1)(7-3x) - (x)(-3)}{(7-3x)^2}$

$= \frac{7-3x+3x}{(7-3x)^2}$

$= \frac{7}{(7-3x)^2}$

(c) $y = 6x^2 - x + 2$

$\frac{dy}{dx} = 12x - 1$

at $x = 1$,

$\frac{dy}{dx} = 12(1) - 1$

$= 11$

$\therefore m = 11$

$m_{normal} = \frac{-1}{11}$

$y = 6(1)^2 - 1 + 2$

$= 6 - 1 + 2$

$= 7$

pt $(1, 7)$ and $m_n = \frac{-1}{11}$

$y - 7 = \frac{-1}{11}(x - 1)$

$11y - 77 = -x + 1$

$x + 11y - 78 = 0.$

d) $y = x^3 - 3x^2$

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

$m = -3$

$\therefore \frac{dy}{dx} = -3$

$-3 = 3x^2 - 6x$

$3x^2 - 6x + 3 = 0$

$3(x^2 - 2x + 1) = 0$

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

$\therefore (x-1)^2 = 0$

$x = 1$

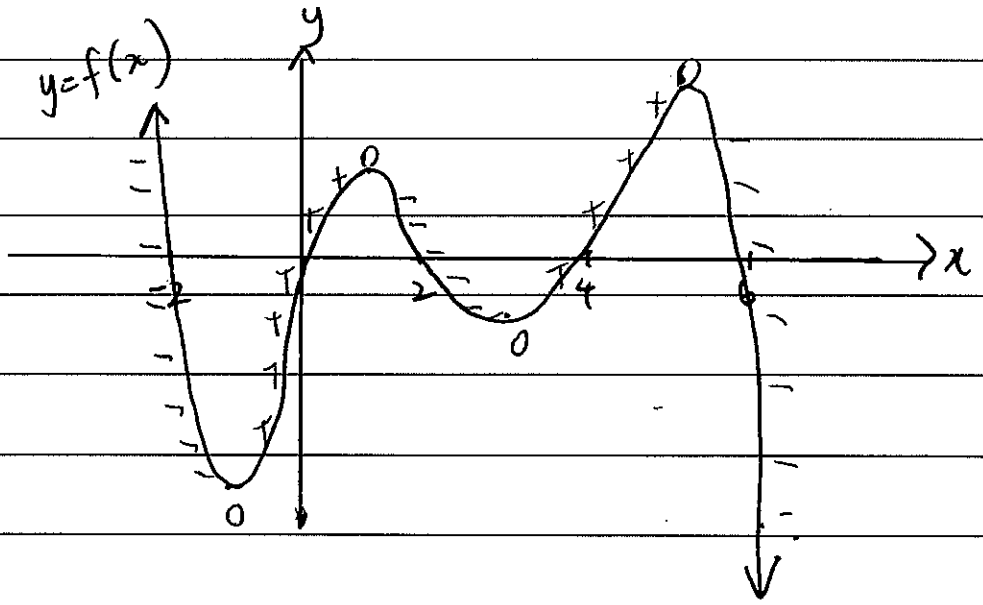
when $x = 1$, $y = 1^3 - 3(1)^2$

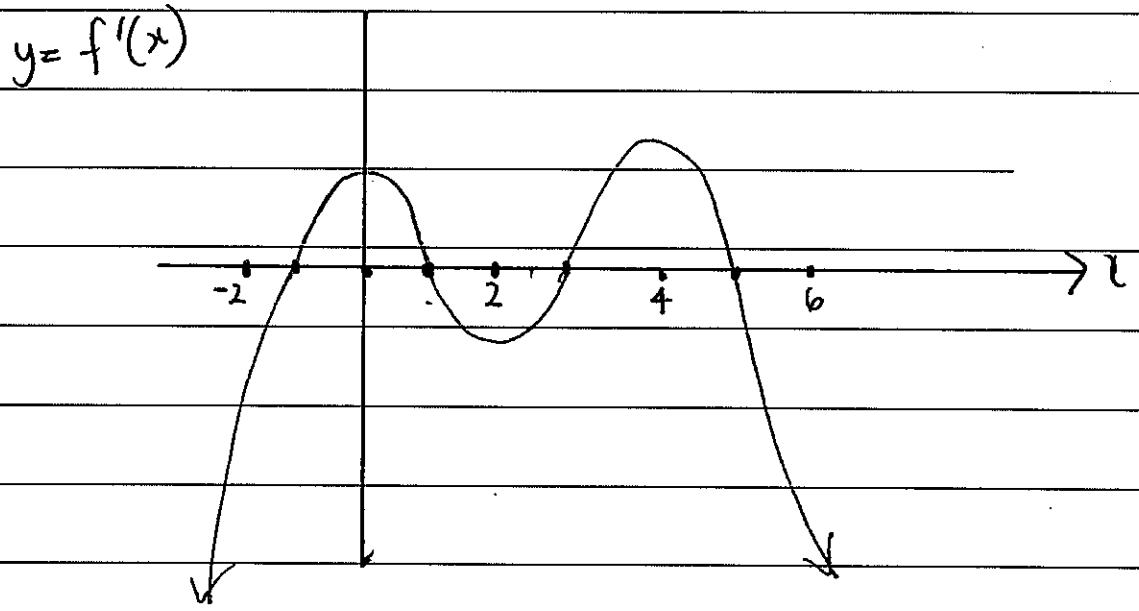
$= 1 - 3$

$= -2$

point $A(1, -2)$

(e)

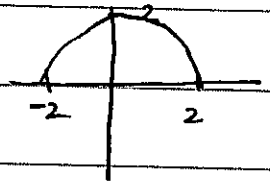




* This question was done poorly

Question 14.

(a) $f(x) = \sqrt{4 - x^2}$



$\therefore$ Domain : $-2 \leq x \leq 2$

Range : $0 \leq y \leq 2$

(b) $f(x) = \dfrac{x^2}{x-1}$

$\therefore f(-x) = \dfrac{(-x)^2}{(-x)-1}$

$= \dfrac{x^2}{-x-1}$

$= -\dfrac{x^2}{x+1}$ $\neq f(x)$

$\neq -f(x)$

$\therefore$ neither odd nor even

needed to show in working.

$-f(x) = -\left[\dfrac{x^2}{x-1}\right]$

$= \dfrac{x^2}{1-x}$

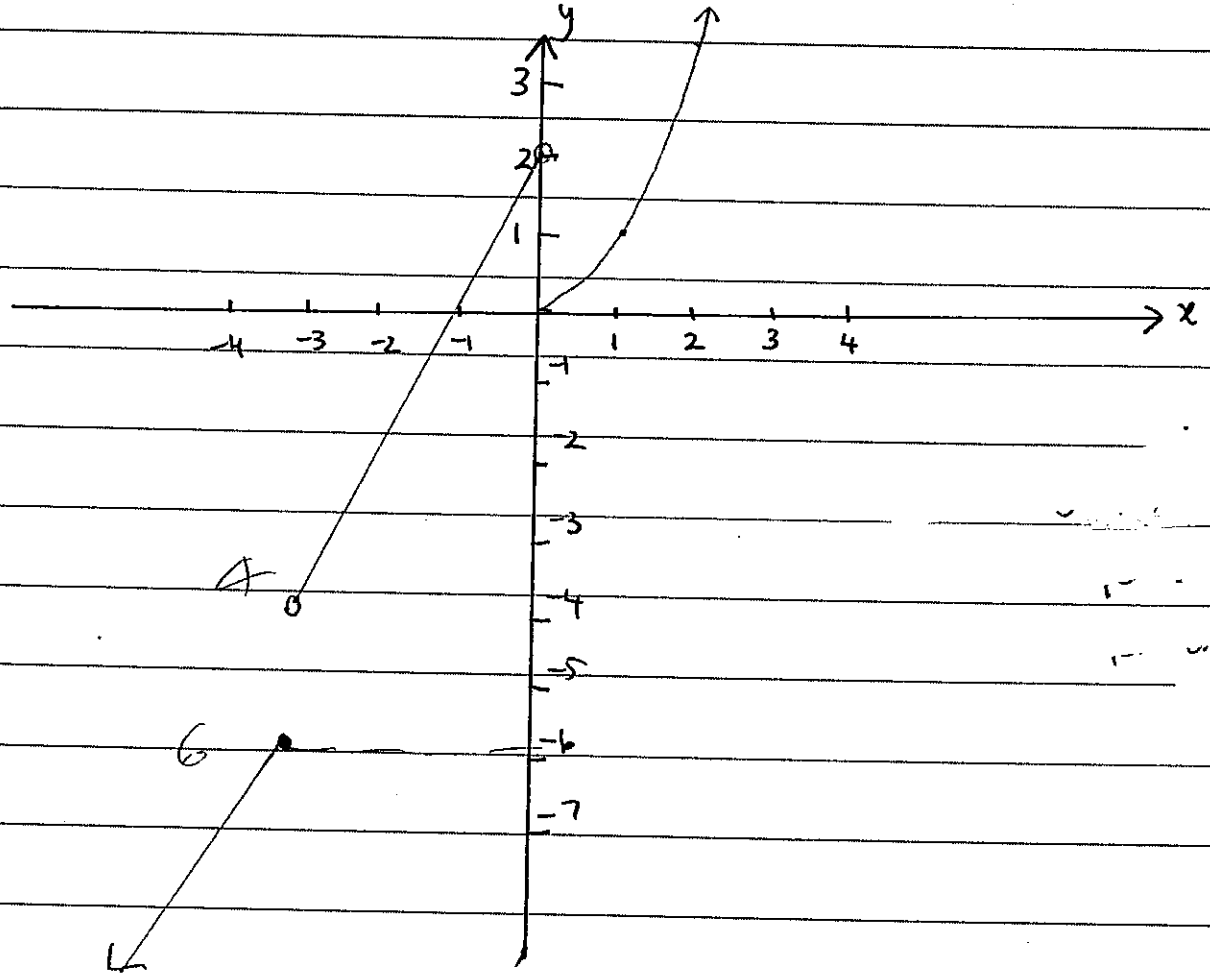
(c) (1) $f(2) + f(-2) + f(-5)$

$= 2^2 + [2\times(-2)+2] + [(-5)-3]$

$= 4 + (-2) + (-8)$ ← e.f.m if only 1 error in this line.

$= -6$

c (ii)



(d) $f(x) = \frac{x}{2x^2+b}$

$f(-1) = \frac{-1}{2(-1)^2+b}$

$= \frac{-1}{2+b}$

$f(1) = \frac{1}{2(1)^2+b}$

$= \frac{1}{2+b}$

As $f(-1) = f(1)$ then

$\frac{-1}{2+b} = \frac{1}{2+b}$

$-(2+b) = 2+b$

$-2-b = 2+b$

$-4 = 2b$

$b = -2.$

Q14

(e) $\lim_{x\to p} \frac{x-p}{x^2-p^2} = 2p$

$= \lim_{x\to p} \frac{x-p}{(x-p)(x+p)}$

$= \lim_{x\to p} \frac{1}{x+p}$

$= \frac{1}{p+p}$

$= \frac{1}{2p}$

$\therefore \frac{1}{2p} = 2p$

$4p^2 = 1$

$p^2 = \frac{1}{4}$

$p = \pm\frac{1}{2}$

Students received no marks for correct answer $p = \pm\frac{1}{2}$ when they found $\lim_{x\to p} \frac{1}{x+p} = 2p$ then $\lim_{x\to p} 1 = 2p(x+p)$

(f) $x+y+1 > 0$ and $y \leq 1-x^2$