STUDENT NUMBER/NAME

St Aloysius' College

Year 11 Preliminary Examination

2014

MATHEMATICS (2 Unit)

General Instructions

Reading time – 5 minutes

Working time – 2 hours

- Write using black or blue pen only with diagrams in pencil
- Board approved calculators may be used
- Examination papers must NOT be removed from the examination room
- Attempt all questions

Total marks: 70

Section I:

- 10 objective response questions worth 1 mark each.
- Give your answers on the Section I answer sheet.
- **Only the letter will be considered for marking.**

Section II:

- 4 questions worth 15 marks each consisting of shorter part-questions.
- Attempt all questions.
- Marks for each part are shown in the margin.
- Hand in a booklet for each question, even if not attempted.
- If a second booklet is used place it inside the first.

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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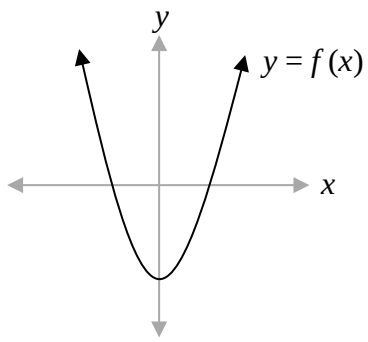
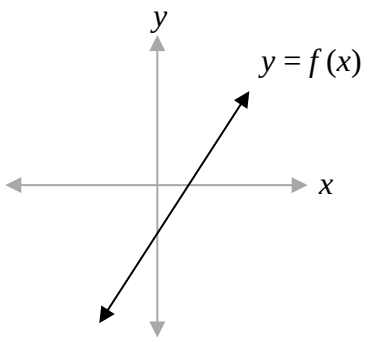
1. Which of the following graphs is NOT a function?

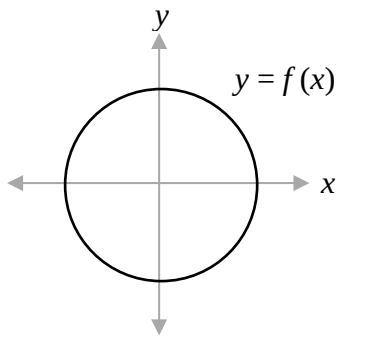
(A)



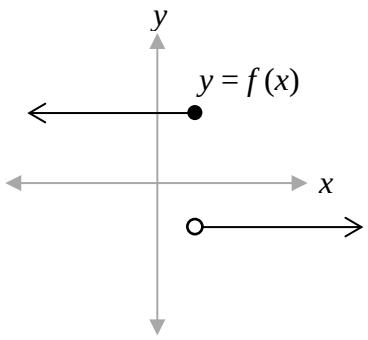
(B)



(C)



(D)



2. What are the domain and range of the function:

$$f(x) = \frac{7}{2x - 8}$$

(A) Domain: $\{\text{all real } x : x \neq 8\}$
Range: $\{\text{all real } y\}$

(B) Domain: $\{\text{all real } x : x \neq 4\}$
Range: $\{\text{all real } y\}$

(C) Domain: $\{x = 4\}$
Range: $\{\text{all real } y : y \neq 0\}$

(D) Domain: $\{\text{all real } x : x \neq 4\}$
Range: $\{\text{all real } y : y \neq 0\}$

3. Solve $\cos\theta = -\frac{\sqrt{3}}{2}, 0 \le \theta \le 360^\circ$.

(A) $\theta = 210^\circ, 330^\circ$

(B) $\theta = 150^\circ, 330^\circ$

(C) $\theta = 150^\circ, 210^\circ$

(D) $\theta = 150^\circ, 210^\circ, 330^\circ$

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

(A) $4h$

(B) $4xh + 4h$

(C) $4x + 4h$

(D) $4x$

5. The line l is tangent to the curve $y = 3x^2$ at the point (3, 27).

What is the gradient of the line l?

(A) $m = 27$

(B) $m = 18$

(C) $m = 432$

(D) $m = 72$

6. Given that $f(x) = ax^2$, solve $f'(x) = f(x)$.

(A) $x = -2$
(B) $x = 0, 2$
(C) $x = -2, 0$
(D) $x = 2$

7. What is the exact value of $\sin 240°$?

(A) $-\frac{1}{2}$

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

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

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

8. Two points *A* and *B* lie on opposite sides of the line *l*. *A* and *B* are equidistant from the line *l*. Which statement is always true?

(A) The line through *A* and *B* is perpendicular to the line *l*.

(B) The line through *A* and *B* is parallel to the line *l*.

(C) The midpoint of *AB* lies on the line *l*.

(D) If a line passing through *A* is parallel to a line passing through *B*, both these lines are parallel to the line *l*.

9. Write the following expression in simplest form, using no negative indices.

$$\frac{(8x)^{-1}}{2^{-6}}$$

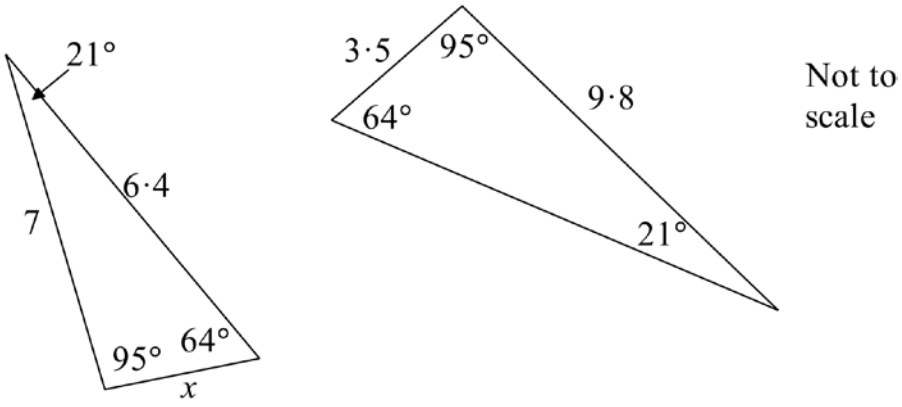
(A) $\frac{8}{x}$

(B) $\frac{512}{x}$

(C) $\frac{1}{8x}$

(D) $\frac{1}{512x}$

10. Calculate the value of x. All measurements are in cm.



(A) 2·5 cm

(B) 6·3 cm

(C) 4·9 cm

(D) 3·2 cm

Section II

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

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

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Question 11 (15 marks) Use a new answer booklet

(a) Evaluate $\sqrt{3.56^2 + (7.06 - 2.01)^2}$ correct to 2 decimal places. **1**

(b) Expand and simplify $3(4x - 7)^2 - (12x - 8x^2)$. **2**

(c) Rationalise the denominator of the expression $\dfrac{3\sqrt{7}}{\sqrt{7} - 2}$. **2**

(d) Simplify $\log_{10} 10 + \log_{12} 2 + \log_{12} 6$ **2**

(e) Evaluate $(3.42 \times 10^{12}) \div (6.79 \times 10^{14})$, expressing your answer in scientific notation correct to 3 significant figures. **2**

(f) Find the exact distance between the points $A(-3, 2)$ and $B(5, -2)$, expressing your answer in simplest form. **2**

(g) Show that the function $f(x) = 3x^5 + 2x$ is an odd function. **2**

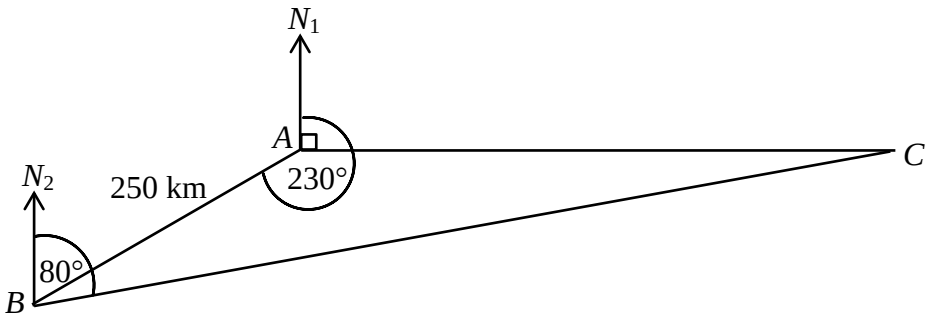
(h) Find the centre and the radius of the circle with equation $x^2 + 4x + y^2 - 2y - 11 = 0$. **2**

End of Question 11

Question 12 (15 marks) Use a new answer booklet

(a) Solve the following equation: $3^{x-1} = \dfrac{3}{\sqrt{27}}$ **2**

(b) The diagram shows the flight path of a plane. The plane flies from Town *A* to Town *B* on a bearing of 230°. The distance between the two towns is 250 km. The plane leaves Town *B* and flies on a bearing of 080° to Town *C*, which is due east of Town *A*.



(i) Show that $\angle BAC = 140°$. **1**

(ii) Find $\angle ABC$. **1**

(iii) If the plane flies at an average speed of 180 km/h, how long will it take to fly from Town *C* to Town *A*? Answer to the nearest hour **3**

(c) Factorise fully: $8x^3 - 512b^3$ **2**

(d) A function is defined by the rule: $f(x) = \begin{cases} x-3 & x \le -3 \\ 2x+2 & -3 < x < 0 \\ x^2 & x \ge 0 \end{cases}$

(i) find: $f(-5) + f(-2) + f(2)$ **1**

(ii) find: $f(p^2)$ **1**

(iii) Sketch the above function **2**

(e) Solve for *x*, $\log_7\left(\dfrac{x-4}{x-1}\right) = 2$ **2**

End of Question 12

Question 13 (15 marks) Use a new answer booklet

(a) Differentiate the following functions with respect to x

(i) $f(x) = 5x^4 - 3x^2 + 3$ **1**

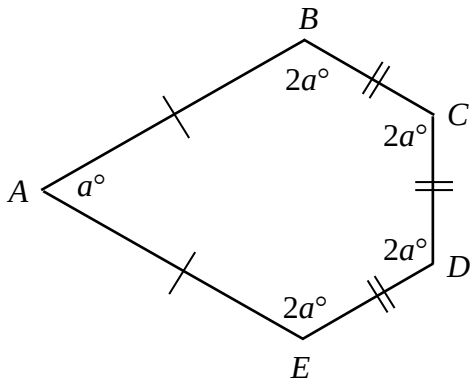
(ii) $f(x) = -x^{\frac{3}{2}}$ **1**

(iii) $f(x) = x\sqrt{x-2}$ **2**

(iv) $f(x) = (x+2)^3(2x+1)$ **3**

(b) (i) Find the angle sum of a pentagon. **1**

(ii) The diagram shows a pentagon $ABCDE$. $AB = AE$ and $BC = CD = DE$. Find the value of a. **1**



(iii) In the above diagram, $BC = CD = (x + 1)$ cm and $BD = \sqrt{15}$ cm. Find the value of x. **3**

(c) Shade the region bounded by the intersection **3**

$$y \leq \frac{1}{2}x^2 - 2 \text{ and } y \leq \frac{1}{2}x + 1.$$

End of Question 13

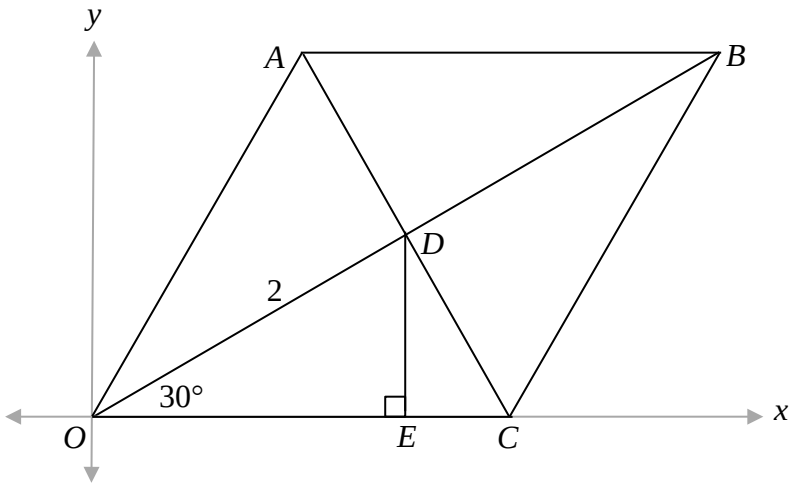
Question 14 (15 marks) Use a new answer booklet

(a) (i) Given $y = \dfrac{x^2 + 2x - 8}{x^2 + 4x}$, use algebra to simplify the equation and then show that: $\dfrac{dy}{dx} = \dfrac{2}{x^2}$ **2**

(ii) Find the gradient and angle of inclination of the curve in part (a) (i) above when $x = 3$. Give your answer to the nearest minute. **2**

(iii) Find the equation of the normal to the curve in part (a) (i) above when $x = 3$. **3**

(b) The diagram shows the rhombus *OABC*. The diagonals *OB* and *AC* intersect at the point *D*. The diagonal *OB* makes an angle of 30° with the positive *x*-axis. The length of *OD* is 2 units. *DE* is perpendicular to the *x*-axis at the point *E*.



(i) By considering the triangle *ODE*, or otherwise, show that the coordinates of the point *D* are $\left(\sqrt{3}, 1\right)$. **1**

(ii) Show that the coordinates of the point *C* are $\left(\dfrac{4\sqrt{3}}{3}, 0\right)$ **2**

(iii) Find, in exact form, the coordinates of the point *A*. **2**

(iv) Find the equation of the line *BC*. **3**

End of Examination