



St Aloysius' College

Year 11 Preliminary Examinations

2016

MATHEMATICS

General Instructions

Reading time – 5 minutes

Working time – 2 hours

- Write using black or blue pen only
- 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.

This examination paper is NOT to be removed from the examination room
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. What is the derivative of the expression $6x^4 + 9x^2 - 12x + 9$?

(A) $24x^3 + 18x - 12$

(B) $4x^3 + 2x - 12$

(C) $24x^3 + 18x^2 - 12$

(D) $24x^3 + 18x - 3$

2. What is the domain of the function $f(x) = \sqrt{3x - 2}$?

(A) $-\frac{2}{3} > x > \frac{2}{3}$

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

(C) $x > \frac{2}{3}$

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

3. What is the gradient of the tangent to the curve $y = 4x^2 - 3x + 2$ at the point where $x = 2$?

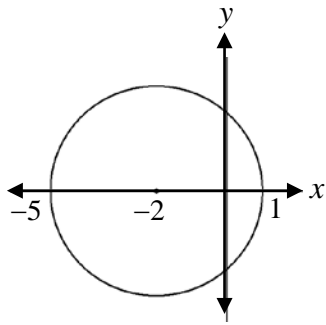
(A) 10

(B) 12

(C) 13

(D) 15

4. What is the equation of the circle shown in the diagram below?



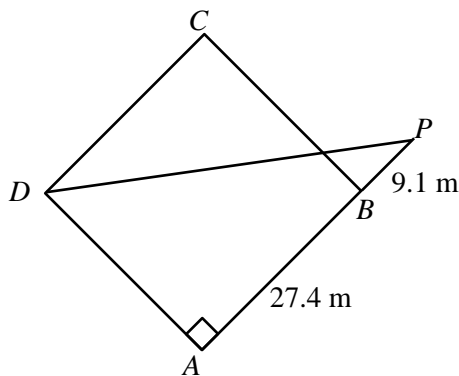
(A) $(x - 2)^2 + y^2 = 9$

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

(C) $(x + 2)^2 + y^2 = 9$

(D) $(x + 2)^2 + y^2 = 3$

5. In baseball, the batter runs around a square whose sides have a length of 27.4 metres, as shown in the diagram. A player is standing at the point P , 9.1 metres from B . ABP is a straight line.



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What is the distance of the player at P from the point D , correct to 1 decimal place?

- (A) 28.8 m
- (B) 29.6m
- (C) 38.7 m
- (D) 45.6 m

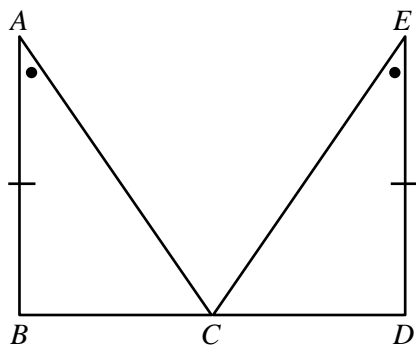
6. What are the x coordinates of the points of intersection of the parabola $y = x^2 + 6x - 3$ and the straight line $y = 2x + 9$?

- (A) $x = -4, 8$
- (B) $x = -6, 2$
- (C) $x = 3, 2$
- (D) $x = -2, 4$

7. If $\cos \alpha = \frac{a}{b}$, where α is an acute angle, what is the value of $\cos(180^\circ + \alpha)$?

- (A) $\frac{\sqrt{b^2 - a^2}}{b}$
- (B) $\frac{a}{b}$
- (C) $-\frac{a}{b}$
- (D) $-\frac{b}{a}$

8. The diagram shows $\triangle ABC$ and $\triangle EDC$. $AB = ED$ and $\angle BAC = \angle DEC$. Which statement below is **not** sufficient to prove that $\triangle ABC$ and $\triangle EDC$ are congruent?



- (A) $BC = CD$
- (B) $AC = EC$
- (C) $\angle ABC = \angle EDC$
- (D) $\angle ACB = \angle ECD$

9. What are the solutions of $\cot \theta = 0$, where $0 \leq \theta \leq 360^\circ$?

- (A) no solutions
- (B) 90° and 270°
- (C) 0° , 180° and 360°
- (D) 45° and 225°

10. An infinite geometric series has a first term of 3 and a limiting sum of $\frac{9}{5}$.

What is the common ratio?

- (A) $-0.\dot{3}$
- (B) $-0.\dot{6}$
- (C) -1.5
- (D) -3.75

End of Section I

Section II

60 marks

Attempt Questions 11 – 14.

Allow about 1 hour and 45 minutes for this section.

Answer each question in a separate writing booklet.

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

Question 11 (15 marks)

- (a) Evaluate $\sqrt{\frac{3^2 - 1}{4^3 + 1}}$ correct to 1 decimal place. **1**
- (b) Find the gradient of a line that is perpendicular to the line $3x - y + 1 = 0$. **2**
- (c) Evaluate $(1.3 \times 10^{-10}) \div (5.5 \times 10^{-4})$, expressing your answer in scientific notation correct to 3 significant figures. **1**
- (d) Find the exact roots of the equation $2x^2 - 4x + 1 = 0$. **2**
- (e) Solve $|3a - 5| < 4$. **2**
- (f) Factorise $3x^3 - 8x^2 + 4x$. **2**
- (g) Rationalise the denominator of $\frac{2 + \sqrt{2}}{1 + \sqrt{2}}$. **2**
- (h) Solve $2\log_a x - \log_a 4 = 2\log_a 8$ **3**

End of Question 11

Question 12 (15 marks) Start a new booklet

- (a) The points A and B have coordinates $(3, 8)$ and $(-2, -4)$ respectively.
- (i) Find the equation of the line that is parallel to AB and that cuts the y -axis at $y = -3$. Give your answer in general form. 3
 - (ii) Find the midpoint of AB . 2
 - (iii) Find the length of AB . 2
 - (iv) Using your answers to (ii) and (iii), find the equation of the circle that has AB as a diameter. 1
 - (v) Show that the point $(4, 8)$ lies outside this circle. 1
- (b) For the arithmetic sequence
- $2, 7, 12, 17, \dots\dots\dots$
- (i) Find a formula for the n th term 2
 - (ii) Find the 27th term 1
 - (iii) Find the sum of the first 27 terms 1
- (c) On a number plane, shade the region given by $x \geq 0$, $y \geq 0$ and $y \leq 4 - x$. 2

End of Question 12

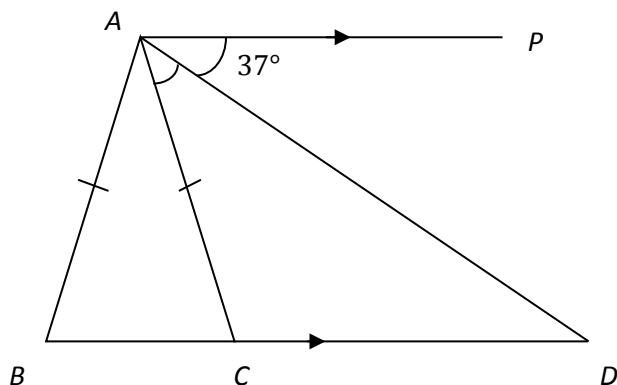
Question 13 (15 marks) Start a new booklet

- (a) What is the value of $\sum_{r=1}^5 (4r + 1)$? **1**
- (b) Find the exact value of $\sin 240^\circ$ **2**
- (c) Show that $\frac{\tan \theta \sec \theta}{1 + \tan^2 \theta} = \sin \theta$ **3**
- (d) Find the equation of the normal to the curve $y = x^4 + 2x^2 - 14$ at the point where $x = 2$. **3**
- (e) Find the coordinates of the point on the curve $y = (2x - 3)^2$ where the tangent is parallel to the line $y = 4x - 1$. **2**
- (f) The third term of a geometric series is $\frac{3}{2}$ and the sixth term is 12.
- (i) Find the first term and the common ratio. **2**
- (ii) Find the tenth term **1**
- (iii) Find the sum of the first 10 terms **1**

End of Question 13

Question 14 (15 marks) Start a new booklet

- (a) In the diagram, $\triangle ABC$ is an isosceles triangle with $AB = AC$. AD bisects $\angle PAC$ and meets BC produced at D . AP is parallel to BD . $\angle PAD = 37^\circ$



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Copy or trace this diagram into your writing booklet.

- | | | |
|------|---|----------|
| (i) | Find $\angle ACD$ | 1 |
| (ii) | Hence find, giving reasons, $\angle BAC$ | 2 |
| | | |
| (b) | Show that $\frac{d}{dx} [3x^2(4x-1)^3] = 6x(10x-1)(4x-1)^2$. | 2 |
| | | |
| (c) | Differentiate $\frac{\sqrt{x}-1}{\sqrt{x}+1}$, giving your answer as a single fraction in surd form. | 3 |

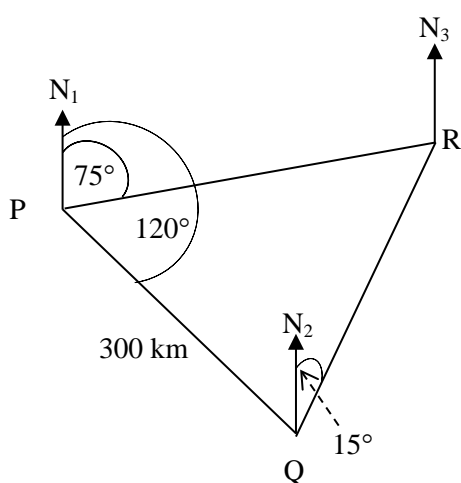
Question 14 continues over the page

Question 14 Continued

- (d) A cruise ship leaves port P on a bearing of 120° . It sails at a speed of 30 km/h. After travelling for 300 km, the cruise ship stops at the point Q for one hour.

It then travels on a bearing of 15° and sails at a speed of 42 km/h.

A container ship leaves the port P on a bearing of 075° . It sails at a speed of 25 km/h. The paths of the container ship and the cruise ship meet at the point R .



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SCALE**

Copy the diagram clearly into your answer booklet

- (i) Show that $\angle PRQ = 60^\circ$. **1**
- (ii) Use the sine rule to show that the length of PR , to the nearest kilometre is 335km. **2**
- (iii) Use the cosine rule to show that the length of QR , to the nearest kilometre is 245km. **1**
- (iv) The cruise ship leaves port P at 8.30 a.m. At what time should the container ship leave P if the two ships are to be at point R at the same time? **3**

End of paper