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Student Number

**ST PIUS X COLLEGE
CHATSWOOD**

HSC 2020 Stage 6 Year 12

ASSESSMENT TASK #2

30% of School Based Assessment

MATHEMATICS EXTENSION 1

General Instructions

- Working time – 1 hour
- Write using black or blue pen
Black pen is preferred
- Draw diagrams using pencil
- NESA approved calculators may be used
- Marks may be deducted for careless or poorly arranged work
- Show all relevant mathematical reasoning and/or calculations
- Write your Student Number at the top of all pages

Total Marks – 30

Section I – Multiple Choice 4 marks

- Attempt Questions 1 – 4
- Enter responses on the multiple choice answer sheet
- Allow about 10 minutes for this section

Section II – 26 marks

- Attempt Questions 5 – 6
- Show all necessary working
- **Start each question in a SEPARATE booklet**
- Allow about 50 minutes for this section

B L A N K P A G E

SECTION I – Multiple Choice

1 mark per question

4 Marks***Use the multiple choice answer sheet.***

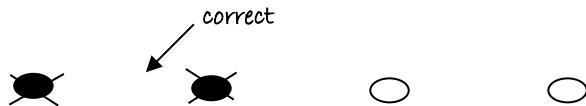
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

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) If $f(x) = \tan^{-1}\left(\frac{1}{x}\right)$, which of the following is $f'(x)$?

(A) $\frac{x^2}{1+x^2}$

(B) $-\frac{1}{1+x^2}$

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

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

2) Which of the following is equivalent to $\sqrt{3} \cos \theta - \sin \theta$?

(A) $2 \cos\left(\theta + \frac{\pi}{3}\right)$

(B) $2 \cos\left(\theta - \frac{\pi}{3}\right)$

(C) $2 \cos\left(\theta + \frac{\pi}{6}\right)$

(D) $2 \cos\left(\theta - \frac{\pi}{6}\right)$

3) Which expression is equivalent to $\int \sin^2 3x \, dx$?

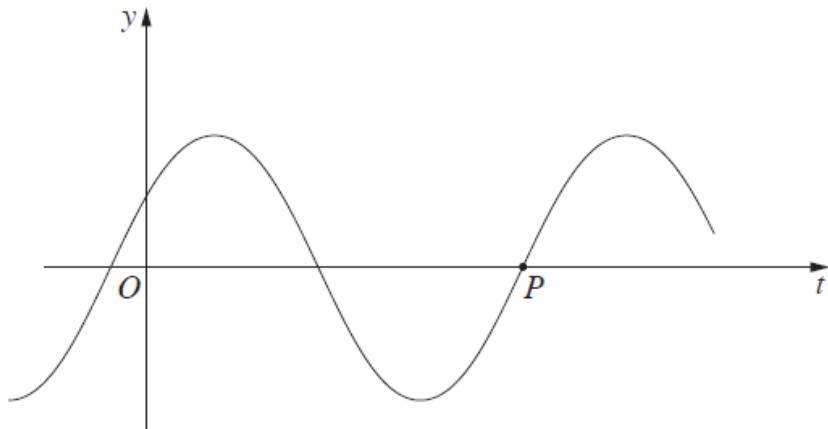
(A) $\frac{1}{2} \left(x + \frac{1}{3} \sin 3x \right) + C$

(B) $\frac{1}{2} \left(x - \frac{1}{3} \sin 3x \right) + C$

(C) $\frac{1}{2} \left(x + \frac{1}{6} \sin 6x \right) + C$

(D) $\frac{1}{2} \left(x - \frac{1}{6} \sin 6x \right) + C$

4) The graph of the function $y = \cos \left(2t - \frac{\pi}{3} \right)$ is shown below.



What are the coordinates of the point P ?

(A) $\left(\frac{5\pi}{12}, 0 \right)$

(B) $\left(\frac{2\pi}{3}, 0 \right)$

(C) $\left(\frac{11\pi}{12}, 0 \right)$

(D) $\left(\frac{7\pi}{6}, 0 \right)$

End of Section I

SECTION II

Question 5 (13 marks)

Start this question in a SEPARATE answer booklet

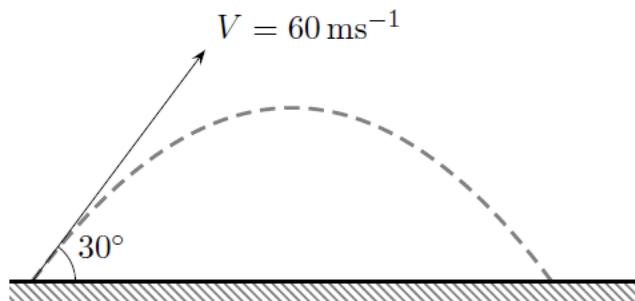
Marks

- a) If $t = \tan \frac{\theta}{2}$, write an expression in terms of t for $\sec \theta + 2 \tan \theta$. 1

- b) Find the following: 1

$$\int \frac{1}{\sqrt{9 - x^2}} dx$$

- c) A projectile is launched from the origin, across a level plain at 30° to the horizontal and at an initial speed of 60 metres/second.



With $g = 10 \text{ ms}^{-2}$, the displacement equations of motion are given by:

$$x = 30\sqrt{3}t \quad \text{and} \quad y = 30t - 5t^2 \quad (\text{Do NOT prove this.})$$

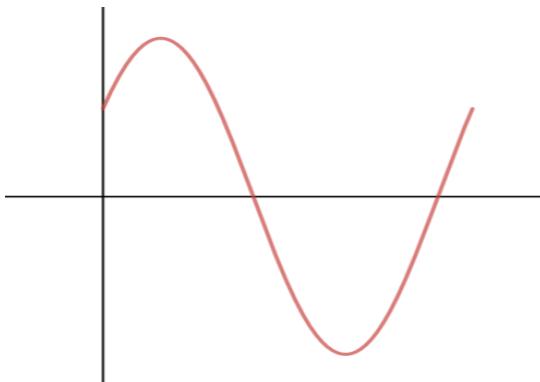
- (i) Find the maximum height of the particle. 2

- (ii) Find the speed of the particle one second after it is launched. 2

- d) Use the substitution $u = x + 1$ to evaluate the following integral: 3

$$\int_0^1 \frac{x}{\sqrt{x+1}} dx$$

- e) Consider the graph $y = 3 \sin x + 2 \cos x$ for $0^\circ \leq x \leq 360^\circ$ shown below.



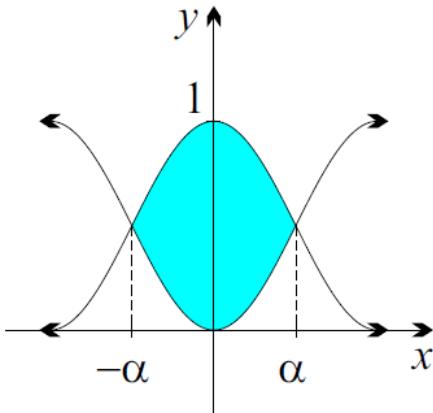
- (i) Write $y = 3 \sin x + 2 \cos x$ in the form $y = R \sin(x + \beta)$, where $R > 0$ and $0^\circ < \beta < 90^\circ$. 2

Give R as an exact value and β correct to the nearest degree.

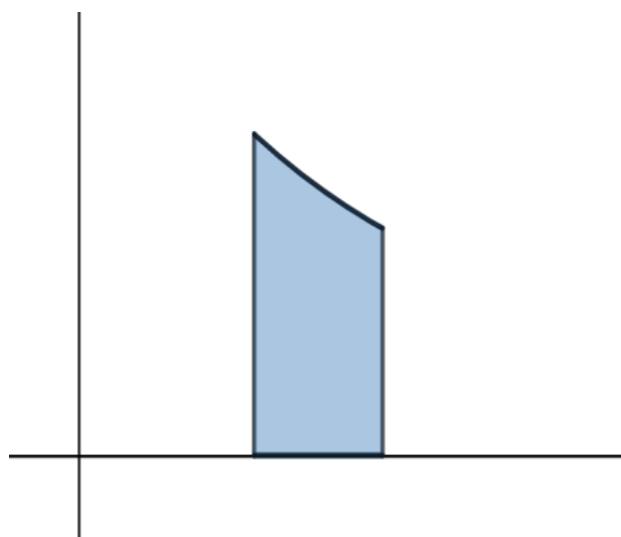
- (ii) Hence solve the equation $3 \sin x + 2 \cos x = 1$ for $0^\circ \leq x \leq 360^\circ$, giving your answers correct to the nearest degree. 2

Question 6 (13 marks)*Start this question in a SEPARATE answer booklet***Marks**

- a) The graph below shows the curves $y = \cos^2 x$ and $y = \sin^2 x$.



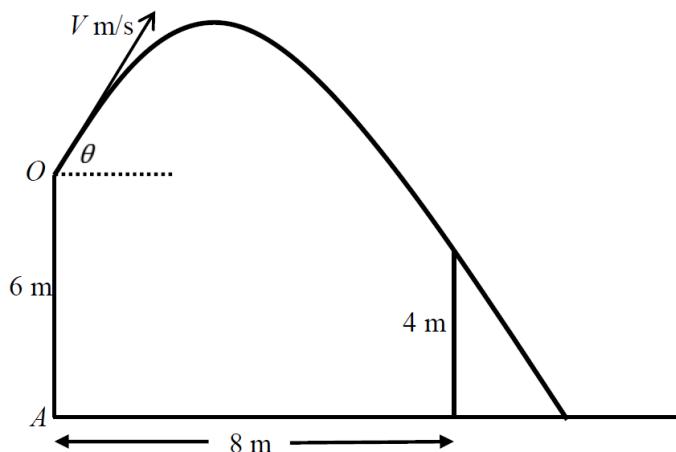
- (i) Find the value of α . 1
- (ii) Find the area of the shaded region in the graph. 2
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- b) The region between the curve $y = \frac{3}{\sqrt{1+4x^2}}$ and the x -axis between $x = \frac{1}{2}$ and $x = \frac{\sqrt{3}}{2}$ is shown below. 3



Find the exact volume of the solid of revolution formed when the shaded area is rotated about the x -axis.

- c) A projectile is fired from a point O , which is 6 metres above horizontal ground, with initial velocity V m/s, at an angle of θ to the horizontal.

There is a thin vertical post 4 metres high and 8 metres horizontally away from point A , directly below O , as shown in the diagram below.



The equations of motion are given by:

$$x = Vt \cos \theta$$

$$y = Vt \sin \theta - 4.9t^2$$

Do NOT prove this.

- (i) If the projectile just passes over the top of the vertical post after exactly 2 seconds of motion, show that $\tan \theta = 2.2$ 2
- (ii) Show that the projectile hits the ground approximately 0.3 seconds after it passes over the vertical post. 3
- (iii) Find the angle that the projectile makes with the ground when it strikes the ground, giving your answer correct to the nearest degree. 2

End of Task

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Mathematics Extension 1 – Multiple Choice Questions Answer Sheet

Attempt all questions:

Question	1	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
	2	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
	3	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
	4	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>