
Student Number

ST PIUS X COLLEGE

CHATSWOOD

HSC 2021 Stage 6

Year 12

15 June 2021

ASSESSMENT TASK #3

25% of School Based Assessment

MATHEMATICS EXTENSION 1

General Instructions

- Working time – 50 minutes
- 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 7 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 43 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.

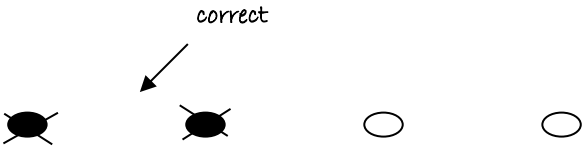
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

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.



Section 1: Multiple Choice

1. The expression $2\sin 3x\cos 2x$ can be rewritten as which of the following?

   (A) $\sin x + \sin 5x$

   (B) $\sin 5x - \sin x$

   (C) $\cos x + \sin 5x$

   (D) $\cos 5x - \sin x$

2. What is the primitive of $-\tan x$ with respect to the variable x?

(A) $\ln|\sin x|+c$

(B) $-\ln|\sin x|+c$

(C) $\ln|\cos x|+c$

(D) $-\ln|\cos x|+c$

3. The domain of the function $y=4\cos^{-1}\left(1-\frac{x}{3}\right)$ is which of the following?

(A) $0\le x\le 4\pi$

(B) $-2\pi\le x\le 2\pi$

(C) $-6\le x\le 0$

(D) $0\le x\le 6$

4. Sean wants to find the solution to $3\cos x-2\sin x=2$ by using the t results. The equation he will hope to solve is which of the following?

(A) $4t^2-5t+3=0$

(B) $5t^2+4t-1=0$

(C) $3t^2-4t+1=0$

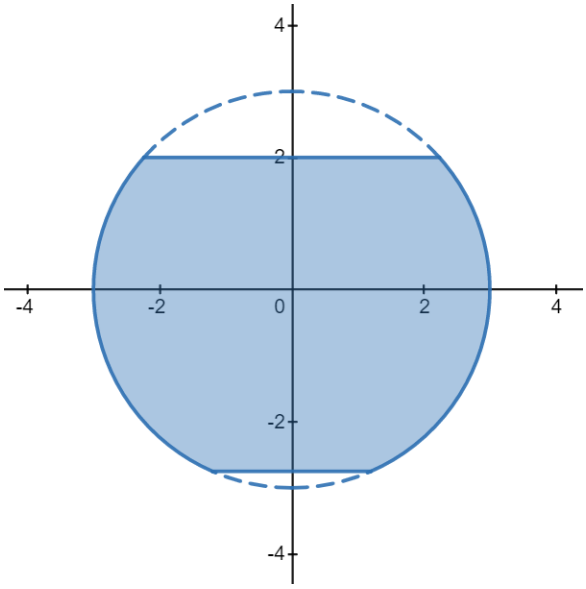
(D) $t^2+5t-3=0$

End of Section 1

Section 2: Answer each question in its own booklet

Question 5 **13 marks**

a) The curve $x^2 + y^2 = 9$ is rotated around the y axis from $y = -2.75$ to $y = 2$. **3**



Find the volume of the solid of revolution formed, giving your answer correct to 2 decimal places.

b) A particle is fired from an origin O across level ground **3**
with initial velocity $24ms^{-1}$ at an angle of projection θ.
You may assume that the Cartesian equation of the path is

$$y = -\frac{x^2}{115.2}\tan^2\theta + x\tan\theta - \frac{x^2}{115.2}$$

Find, correct to the nearest minute, the angles of projection for the particle to hit a target at (40, 10).

Question 5 continues over the page…

c) A curve is given as $y = 5\sin x - 12\cos x$.

(i) Find R and α when this curve is written as $y = R\sin(x+\alpha)$. **2**

Give α in radians correct to 4 decimal places.

(ii) Find the values of x over the domain $0 \le x \le \pi$ for which this curve first attains its maximum and minimum value. **2**

d) Find $\int_0^{\pi} \cos^2 \frac{x}{4} dx$ **3**

End of Question 5

Question 6 *Start a new booklet for this question* **13 marks**

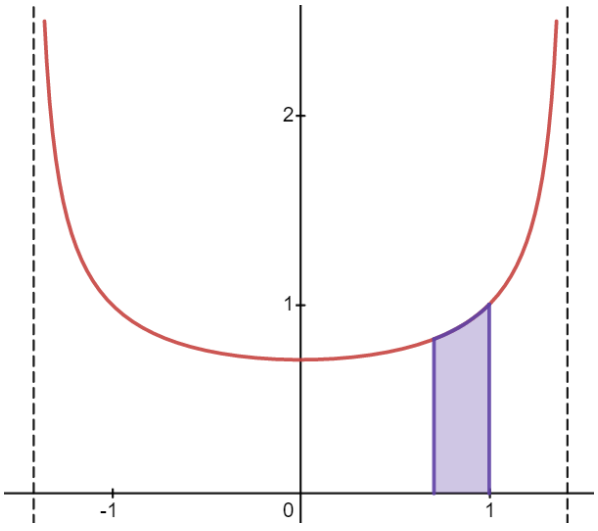
a) (i) Use the addition identities to show $\cos x = \sin\left(x + \frac{\pi}{2}\right)$. **1**

(ii) Describe the transformation by which the curve $y = \sin x$ can be mapped to $y = \cos x$. **1**

b) (i) Show, using the quotient rule, that $\frac{d}{dx}\tan x = \sec^2 x$. **1**

(ii) Hence find $\int_0^{\frac{\pi}{4}} \tan^2 x dx$. **2**

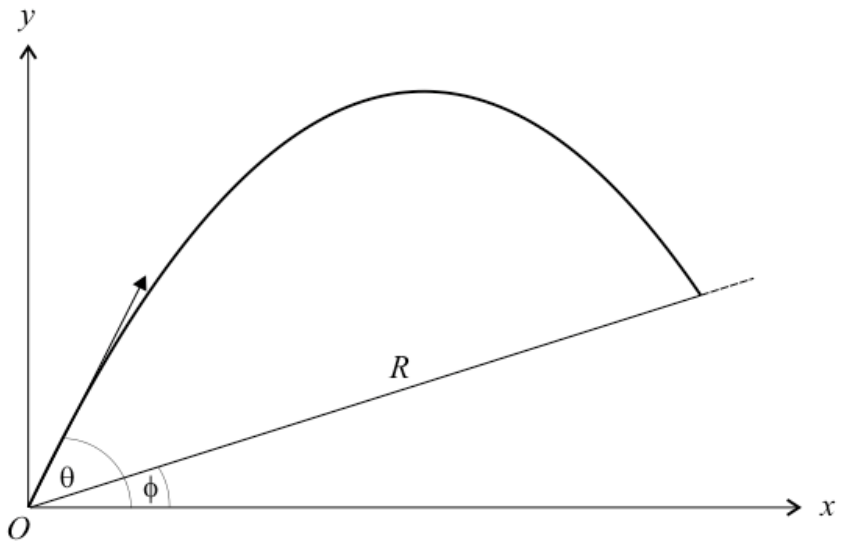
c) Consider the curve $y = \frac{1}{\sqrt{2 - x^2}}$ shown below: **2**



Find the EXACT area between the curve, the x-axis and the lines $x = \frac{1}{\sqrt{2}}$ and $x = 1$ in the 1st quadrant.

Question 6 continues over the page…

d) The diagram below shows a projectile fired from the bottom of a ramp. The projectile is launched at a speed of v m/s at an angle of θ to the horizontal. The ramp is inclined at an angle of ϕ to the horizontal such that $\phi < \theta < 90°$.



You may assume that the equation of the projectile's path is

$$y = x\tan\theta - \frac{gx^2\sec^2\theta}{2v^2}$$

(i) Show that $R = x\sec\phi$. **1**

(ii) The equation of the ramp is $y = (\tan\phi)x$. **2**

Show that the projectile lands at a distance R upon the ramp, where

$$R = \frac{2v^2}{g}(\tan\theta - \tan\phi)\cos^2\theta\sec\phi$$

(iii) Show that $\frac{dR}{d\theta} = \frac{2v^2}{g}\sec^2\phi\cos(2\theta - \phi)$ for fixed v and ϕ. **2**

(iv) Hence find the value of θ for which R is a maximum. **1**

End of Task

Student Number

Mathematics Extension 1 – Multiple Choice Questions Answer Sheet

Attempt all questions:

Question	**1**	A ⬭	B ⬭	C ⬭	D ⬭
	2	A ⬭	B ⬭	C ⬭	D ⬭
	3	A ⬭	B ⬭	C ⬭	D ⬭
	4	A ⬭	B ⬭	C ⬭	D ⬭