
Student Number

ST PIUS X COLLEGE
CHATSWOOD

HSC 2020 Stage 6
Year 12

Assessment Task #2

30% of School Based Assessment

MATHEMATICS ADVANCED

General Instructions

- Working time – 60 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 this cover page

Total Marks – 40

Section I – Multiple Choice 4 marks

- Attempt Questions 1 – 4
- Enter responses on the multiple choice answer sheet
- Allow 5 minutes for this section

Section II – 36 marks

- Attempt Questions 5 – 7
- Answer in the writing spaces provided
- Show all necessary working
- Allow 55 minutes for this section

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. What is the derivative of e^{x^3}?

   (A) $3x^2e^{x^3}$

   (B) $3xe^{x^3}$

   (C) $3x^2e^{3x^2}$

   (D) $x^3e^{x^3-1}$

2. The acceleration of a particle moving in a straight line is given by $a = 12t + 6$.
   Initially the particle is at x = 5 metres and its velocity is –36 m/s.

   When is the particle at rest?

   (A) $t = 0$

   (B) $t = 1$

   (C) $t = 2$

   (D) $t = 3$

3. It is given that $\ln a = \ln b - \ln c$, where a, b and $c > 0$.

Which statement is true?

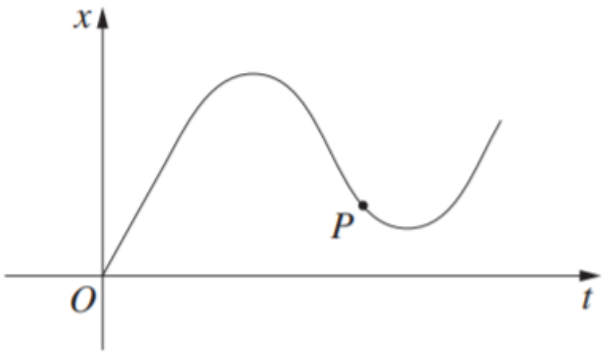
(A) $a = b - c$

(B) $a = \frac{b}{c}$

(C) $\ln a = \frac{b}{c}$

(D) $\ln a = \frac{\ln b}{\ln c}$

4. The graph shows the displacement x of a particle moving along a straight line as a function of time t.



Which statement describes the motion of the particle at the point P?

(A) The velocity is negative, and the acceleration is positive.

(B) The velocity is negative, and the acceleration is negative.

(C) The velocity is positive, and the acceleration is positive.

(D) The velocity is positive, and the acceleration is negative.

End of Section I

Section II **36 Marks**

Attempt Questions 5 to 7
Allow about 50 minutes for this section.

In Questions 5 to 7 your responses should include relevant mathematical reasoning and/or calculations.

Question 5 (12 marks)

Write your solutions in the spaces provided **Marks**

(a) Differentiate:

(i) $y = (e^x - 3)^4$ **1**

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(ii) $f(x) = \tan 5x$ **1**

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(iii) $y = \log_e(\cos x)$ **1**

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(iv) $\dfrac{\sin x}{2x + 1}$ **2**

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(b) Find the gradient of the curve $y = \tan x$ at the point where $x = \frac{\pi}{16}$. **2**
Give your answer to 3 significant figures.

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(c) Find $\int_0^1 (e^{3x} + 1)\, dx$ **2**

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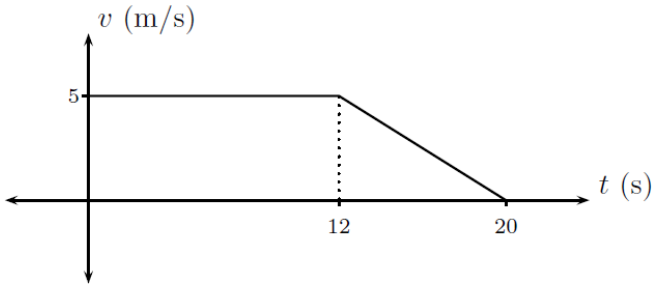
(d) The diagram below shows the velocity-time graph of a particle.



(i) What does the particle do after 12 seconds? **1**

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(ii) Find the distanced travelled in the first 20 seconds. **2**

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Question 6 (12 marks)

Write your solutions in the spaces provided **Marks**

(a) Find the exact value of the following: **2**

$$\int_0^{\frac{\pi}{8}} \sec^2(2x)\ dx$$

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(b) Find the equation of the normal to the curve $y = x\ln x$ at the point where $x = 1$. **3**

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(c) Find the following integral: **2**

$$\int \frac{6x}{x^2 + 6}\ dx$$

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(d) A swimming pool contains 30 000 litres of water. When a draining valve is opened, the volume V in litres of water in the swimming pool changes at a variable rate given by

$$\frac{dV}{dt} = -900 + 18t$$

where t is the time in seconds after opening the valve. Once the water stops flowing, the valve automatically shuts off.

(i) When does the water stop flowing? **1**

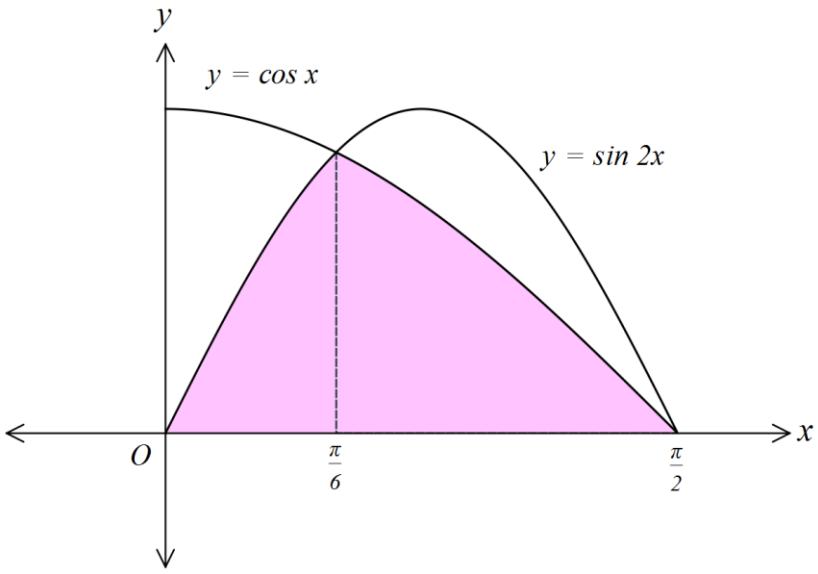
(ii) Use integration to find the volume V of water in the swimming pool at time t. **2**

(iii) When the valve automatically shuts off, how much water remains in the pool? **2**

Question 7 (12 marks)

Write your solutions in the spaces provided **Marks**

(a) **3**



The diagram shows the graphs of the functions $y = \cos x$ and $y = \sin 2x$ between $x = 0$ and $x = \frac{\pi}{2}$. The two graphs intersect at $x = \frac{\pi}{6}$ and $x = \frac{\pi}{2}$.

Calculate the exact area of the shaded region.

(b) The displacement of a particle moving along the x-axis is given by

$$x = t + \log_e(3t + 1)$$

where t is the time in seconds and x is measured in centimetres (cm).

(i) Show that the particle never comes to rest. **2**

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(ii) Where is the particle after the 3rd second? **1**

Give your answer correct to 1 decimal place.

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(iii) Write down an expression for the acceleration of the particle. **1**

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(iv) Is the particle slowing down or speeding up for $t > 0$? **1**

Give reasons to support your answer.

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(c) The displacement of an object at time t seconds is given by:

$$x = e^{-2t} + 3e^{-t} + 2t$$

(i) Find an expression for the velocity of the object. **1**

(ii) Hence find the time the object comes to rest. **3**

End of Task

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Student Number

Mathematics Advanced – 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 ⬭