Name: ______________________

Teacher: ______________________

Class: ______________________

FORT STREET HIGH SCHOOL

2019
HIGHER SCHOOL CERTIFICATE COURSE
ASSESSMENT TASK 2

Mathematics

Time allowed: 1 ½ Hours
(plus 5 minutes reading time)

Syllabus Outcomes	Assessment Area Description and Marking Guidelines	Questions
H3	Manipulates algebraic expressions involving exponential functions	1, 3
H5	Applies appropriate techniques from the study of calculus, trigonometry & series to solve problems	1, 2, 3
H6	Uses the derivative to determine the features of the graph of a function	3
H9	Synthesises mathematical solutions to harder problems and communicates them in appropriate form	3

Total Marks 54

Attempt Questions 1-3

Question	Total 54	Marks
Q1	/18	
Q2	/17	
Q3	/19	
	Percent	

General Instructions:

- Questions 1 – 3 are to be started in a new booklet.
- The marks allocated for each question are indicated.
- In Questions 1 – 3, show relevant mathematical reasoning and/or calculations.
- Marks may be deducted for careless or poorly arranged work.
- Board – approved calculators may be used.
- Graphs should be at least one third of a page.

Question 1 **Use a SEPARATE writing booklet** **18 marks**

a) Expand and evaluate $\sum_{r=1}^{3} 2r^2 - 7r + 5$. 2

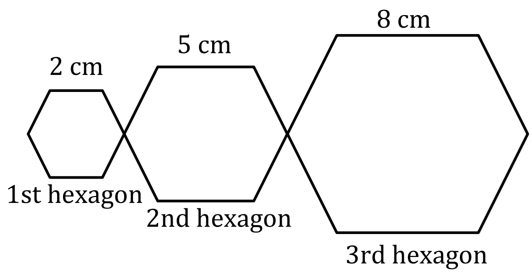
b) The first three terms of a sequence are $-3, 9, -27$.

i) Explain why this sequence is geometric. 1

ii) Find the 8th term in this sequence. 1

iii) Calculate the sum of the first 20 terms of the sequence. 2

c) A wire is used to construct a geometrical design which consists of n regular hexagons with side lengths 2cm, 5cm, 8cm and so on. The diagram below shows the first 3 hexagons of the design.



i) Find the perimeter of the nth hexagon. 2

ii) Show that the total length of the wire is $L = 9n^2 + 3n$. 1

iii) If the total length of the wire is 6m, find the number of hexagons that can be constructed from this length of wire. 2

d) Show that the equation of the tangent to the curve $y = e^{3x-1}$ at the point $P\left(\frac{2}{3}, e\right)$ is $y = e(3x-1)$. 2

e) i) Sketch the curve of $y = e^{2x}$ and the line of $x = 2$ on the same set of axes. 2

ii) Calculate the volume generated when the area between the curve $y = e^{2x}$, the x −axis, the y −axis and the line $x = 2$ is rotated about the x −axis. 3

Question 2 **Use a SEPARATE writing booklet** **17 marks**

a) Find :

i) $\frac{d}{dx}\left(\sin\left(3x^2+4x\right)\right)$ 2

ii) $\int \pi+\sin 3x\,dx$ 2

b) Show that the derivative of $\frac{x}{\cos x}$ is $\sec x\left(1+x\tan x\right)$ 2

c) What is the gradient of the tangent to the curve $f(x)=\tan x$ at the point where $x=\frac{\pi}{6}$? 2

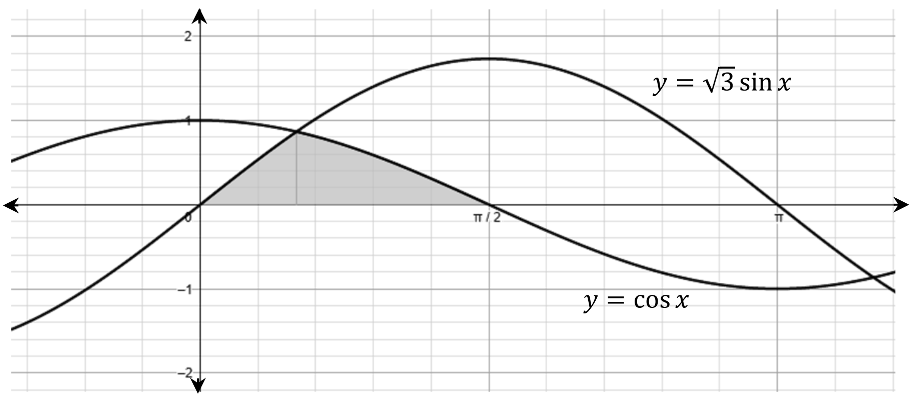
d) Consider the function $y=1+3\sin 2x$.

i) State the period. 1

ii) State the range of the function. 1

iii) Sketch the graph of $y=1+3\sin 2x$ for $0\le x\le 2\pi$. Show coordinates of turning points. 2

e) The diagram below shows the graphs of the functions $y=\sqrt{3}\sin x$ and $y=\cos x$ between $x=0$ and $x=\pi$.



i) Show that the two graphs intersect at $x=\frac{\pi}{6}$ 2

ii) Hence, find the area of the shaded region in exact form. 3

Question 3 **Use a SEPARATE writing booklet** **19 marks**

a) Consider the function $g(x) = xe^{x+1}$:

i) Show that $g'(x) = (1+x)e^{x+1}$ and $g''(x) = (2+x)e^{x+1}$. 2

ii) Find the coordinates of any stationary points and determine their nature. 2

iii) Find the coordinates of any points of inflexion. 2

iv) Sketch the curve $y = g(x)$ showing all key features. 2

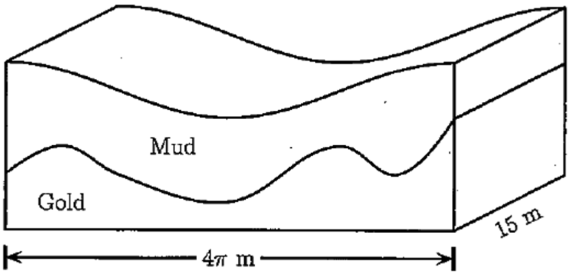
b) Consider the sequence $T_1, T_2, T_3 ....$ with general term T_n. Given that the sum of the first n terms of the sequence is $S_n = \frac{n}{3n+1}$:

i) Evaluate S_1, S_2, S_3 1

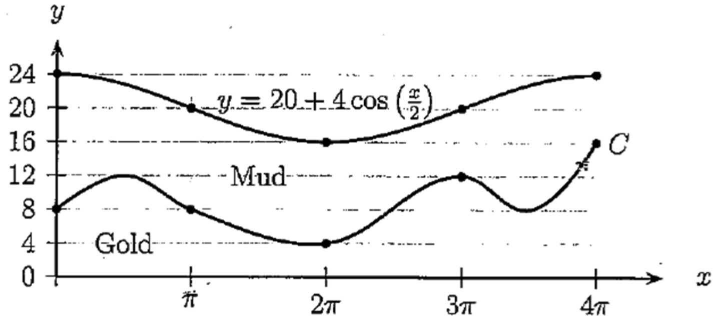
ii) Find the values of T_1, T_2, T_3 2

iii) Find an expression for T_n in terms of n. 2

c) The diagram below shows an amount of gold, which is in the shape of a prism underneath a large amount of mud. The width of the prism is 4π metres and its length is 15 metres.



The graph below shows the cross-section of the prism. The top of the mud is given by the function $y = 20 + 4\cos\left(\frac{x}{2}\right)$ and the top of the gold is shown by the curve, C.



i) Find, by integration, the total area of the cross-section, i.e., the area of both the mud and gold. 2

ii) Using Simpson's Rule with five function values of C, find an estimate for the area of the cross-section of the gold. Leave your answer in terms of π. 3

iii) Find the volume of the mud. Leave your answer in terms of π. 1

END OF THE EXAM PAPER

Year 12 Common Task 2, Term 1 2019 SOLUTIONS

Question 1

a) Expand and evaluate $\sum_{r=1}^{3} 2r^2 - 7r + 5$.

Solution

$$\sum_{r=1}^{3} 2r^2 - 7r + 5 = \left(2(1) - 7(1) + 5\right) + \left(2(4) - 7(2) + 5\right) + \left(2(9) - 7(3) + 5\right)$$
$$= 0 - 1 + 2$$
$$= 1$$

Criteria	Marks
• Provides correct solution	**2**
• Provides correct expansion	**1**
Comments: Mostly done well	

b) The first three terms of a sequence are $-3,\ 9,\ -27$.

i) Explain why this sequence is geometric.

Solution

$$\frac{T_2}{T_1} = \frac{9}{-3} = -3$$
$$\frac{T_3}{T_2} = \frac{-27}{9} = -3$$
$$\therefore \text{ Since } \frac{T_2}{T_1} = \frac{T_3}{T_2} \text{ then the sequence is geometric}$$

Criteria	Marks
• Provides correct solution	**1**
Comments: Mostly done well	

ii) Find the 8th term in this sequence.

Solution

$T_n = ar^{n-1}$

$T_8 = -3 \times -3^7$

$= 6561$

Criteria	Marks
• Provides correct solution	**1**
Comments: Mostly done well	

iii) Calculate the sum of the first 20 terms of the sequence.

Solution

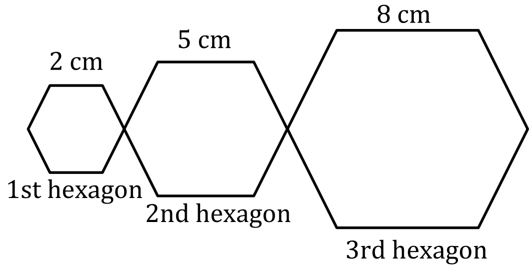
$$S_n = \frac{a(r^n - 1)}{r-1}$$

$$S_{20} = \frac{-3\left(-3^{20} - 1\right)}{-3-1}$$

$\therefore S_{20} = 2615088300$

Criteria	Marks
• Provides correct solution	**2**
• Correctly substitute into S_n	**1**
Comments: Mostly done well. Make sure you are careful with negatives and putting brackets into your calculator.	

c) A wire is used to construct a geometrical design which consists of n regular hexagons with side lengths 2cm, 5cm, 8cm and so on. The diagram below shows the first 3 hexagons of the design.



i) Find the perimeter of the nth hexagon.

Solution

Perimeter of 1^{st} hexagon $= 6 \times 2 = 12$

Perimeter of 2^{nd} hexagon $= 6 \times 5 = 30$

Perimeter of 3^{rd} hexagaon $= 6 \times 8 = 48$

Hence, it's an arithmetic progression with common difference of 18.

Perimeter of n^{th} hexagon:

$$P_n = a + (n-1)d$$
$$= 12 + (n-1) \times 18$$
$$\therefore P_n = 18n - 6$$

Criteria	Marks
• Provides correct solution	**2**
• Sets up correct equation for the nth term	**1**
Comments: Some answers were left unsimplified. Usually better to write your formula for n in simplified form.	

ii) Show that the total length of the wire is $L = 9n^2 + 3n$.

Solution

Total length is an arithmetic sum:

$$L_n = \frac{n}{2}\left(2a + (n-1)d\right)$$

$$= \frac{n}{2}\left(2 \times 12 + (n-1) \times 18\right)$$

$$\therefore L_n = 9n^2 + 3n$$

Criteria	Marks
• Provides correct solution	**1**
Comments: Make sure you know how to set out proofs or questions where you are given the final answer. Your algebra still needs to be convincing.	

iii) If the total length of the wire is 6m, find the number of hexagons that can be constructed from this length of wire.

Solution

$$L_n = 9n^2 + 3n$$

$$600 = 9n^2 + 3n$$

$$9n^2 + 3n - 600 = 0$$

$$3n^2 + n - 200 = 0$$

$$n = \frac{-1 \pm \sqrt{1 - 4(3)(-200)}}{2(3)}$$

$$n = -\frac{50}{6} \quad \text{and} \quad n = \frac{48}{6} = 8$$

$$n = -\frac{50}{6} \quad \text{rejected since} <0$$

$\therefore$ The number of hexagons is 8

Criteria	Marks
• Provides correct solution	**2**
• Correctly obtains both solutions for n	**1**
Comments: Be careful with units, it wanted 600cm, not 6cm. Otherwise done mostly well. Nearly everyone recognised that n<0 is not possible.	

d) Show that the equation of the tangent to the curve $y = e^{3x-1}$ at the point $P\left(\frac{2}{3}, e\right)$ is $y = e(3x-1)$.

Solution

$y = e^{3x-1}$

$\frac{dy}{dx} = 3e^{3x-1}$

when $x = \frac{2}{3}$ $\frac{dy}{dx} = 3e$

Hence gradient of the tangent $=3e$

Equation of tangent:

$$y - e = 3e\left(x - \frac{2}{3}\right)$$

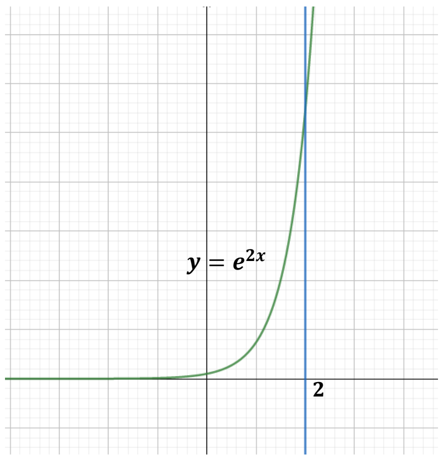
$$y - e = 3ex - 2e$$

$$y = 3ex - e$$

$$\therefore y = e(3x-1) \text{ as req'd}$$

Criteria	Marks
• Provides correct solution	**2**
• Obtains gradient of the tangent	**1**
Comments: Remember to sub in $x = \frac{2}{3}$ to get the gradient before using $y - y_1 = m(x - x_1)$.	

e) i) Sketch the curve of $y = e^{2x}$ and the line of $x = 2$ on the same set of axes.



Criteria	Marks
• Provides correct solution	**2**
• Obtains correct graph of $y = e^{2x}$ or $x = 2$	**1**
Comments: Mostly done well	

ii) Calculate the volume generated when the area between the curve $y = e^{2x}$, the x −axis, the y −axis and the line $x = 2$ is rotated about the x −axis.

Solution

$$V = \pi \int y^2 dx$$
$$= \pi \int_0^2 \left(e^{2x}\right)^2 dx$$
$$= \pi \int_0^2 e^{4x} dx$$
$$= \pi \left[\frac{e^{4x}}{4}\right]_0^2$$
$$= \frac{\pi}{4}\left[e^8 - e^0\right]$$
$$\therefore V = \frac{\pi}{4}\left(e^8 - 1\right)\text{units}^3$$

Criteria	Marks
• Provides correct solution	**3**
• Obtains correct primitive	**2**
• Sets up correct integral	**1**
Comments: Don't forget about you π halfway through the question. $(e^{2x})^2 = e^{4x}$ not e^{2x^2}. The integral should be from 0 to 2 Better to leave your answer in exact form rather than as a decimal. $\int e^{4x} dx = \frac{e^{4x}}{4}$ not $\frac{e^{5x}}{5}$, With exponentials you don't need to +1.	

Question 2

a) Find :

i) $\frac{d}{dx}\left(\sin\left(3x^2+4x\right)\right)$

Solution

$y=\sin\left(3x^2+4x\right)$ let $u=3x^2+4x$

$y=\sin u$ $\frac{du}{dx}=6x+4$

$\frac{dy}{du}=\cos u$

$$\frac{dy}{dx}=\frac{dy}{du}\times\frac{dy}{dx}$$

$$=\cos u\times(6x+4)$$

$$\therefore\frac{dy}{dx}=(6x+4)\cos\left(3x^2+4x\right)$$

Criteria	Marks
• Provides correct solution	**2**
• Attempts to find the derivative using chain rule or by inspection	**1**

Comments:
Many students did not place a grouping symbol around $(6x+4)$

ii) $\int \pi+\sin 3x\,dx$

Solution

$$\int \pi+\sin 3x\,dx=\pi x-\frac{\cos 3x}{3}+C$$

Criteria	Marks
• Provides correct solution	**2**
• Obtains correct integral without the constant	**1**

Comments:
Some students did not supply the constant or integrate π successfully

b) Show that the derivative of $\dfrac{x}{\cos x}$ is $\sec x(1+x\tan x)$

Solution

$$y' = \frac{vu' - uv'}{v^2}$$

$u = x \qquad v = \cos x$

$u' = 1 \qquad v' = -\sin x$

$$\begin{aligned} y' &= \frac{\cos x \times 1 - x(-\sin x)}{\cos^2 x} \\ &= \frac{\cos x}{\cos^2 x} + \frac{x\sin x}{\cos^2 x} \\ &= \frac{1}{\cos x} + \frac{x\tan x}{\cos x} \\ &= \sec x + x\tan x \sec x \\ &= \sec x(1 + x\tan x) \quad \text{as req'd} \end{aligned}$$

Criteria	Marks
• Provides correct solution	**2**
• Attempts to use quotient rule, or equivalent	**1**
Comments: Use of the quotient rule was well done. Many students failed to split $\dfrac{\sin x}{\cos^2 x}$ into $\sec x \tan x$	

c) What is the gradient of the tangent to the curve $f(x) = \tan x$ at the point where $x = \frac{\pi}{6}$?

Solution

$$\begin{aligned} f(x) &= \tan x \\ f'(x) &= \sec^2 x \\ f'\left(\frac{\pi}{6}\right) &= \sec^2\left(\frac{\pi}{6}\right) \\ &= \left(\frac{2}{\sqrt{3}}\right)^2 \end{aligned}$$

$$\therefore \text{Gradient} = \frac{4}{3}$$

Criteria	Marks
• Provides correct solution	**2**
• Obtains correct derivative	**1**
Comments: The derivative was well done. Many students had difficulty calculating the gradient	

d) Consider the function $y = 1 + 3\sin 2x$.

i) State the period.

Solution

$$\text{Period } = \frac{2\pi}{n} = \frac{2\pi}{2}$$

$\therefore$ The period $= \pi$

Criteria	Marks
• Provides correct answer	1
Comments: Well attempted.	

ii) State the range of the function.

Solution

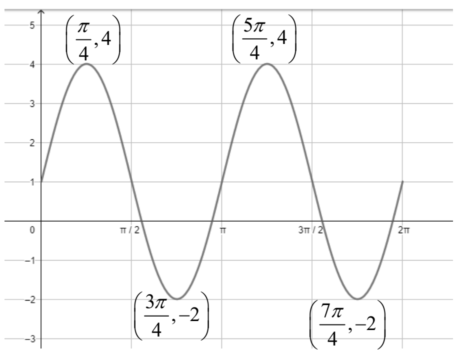
Amplitude =3 and graph is translated 1 unit up

$\therefore$ Range $= -2 \le y \le 4$

Criteria	Marks
• Provides correct answer	1
Comments: A few students did not calculate the period or range successfully	

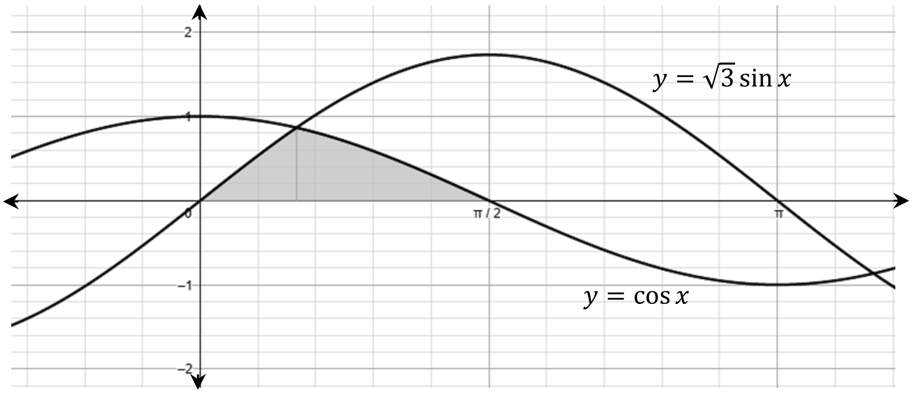
iii) Sketch the graph of $y = 1 + 3\sin 2x$ for $0 \le x \le 2\pi$. Show coordinates of turning points.

Solution



Criteria	Marks
• Provides correct sketch	2
• Provides curve with correct shape	1
Comments: Well attempted.	

e) The diagram below shows the graphs of the functions $y = \sqrt{3}\sin x$ and $y = \cos x$ between $x = 0$ and $x = \pi$.



i) Show that the two graphs intersect at $x = \frac{\pi}{6}$

Solution

$$\sqrt{3}\sin x = \cos x$$

$$\frac{\sqrt{3}\sin x}{\cos x} = 1$$

$$\frac{\sin x}{\cos x} = \frac{1}{\sqrt{3}}$$

$$\tan x = \frac{1}{\sqrt{3}}$$

$$x = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$$

$$\therefore x = \frac{\pi}{6} \quad \text{as req'd}$$

Criteria	Marks
• Provides correct solution	**2**
• Obtained correct tan ratio or equivalent	**1**
Comments: Well attempted. Some students substituted $\frac{\pi}{6}$ into the functions. This was acceptable.	

ii) Hence, find the area of the shaded region in exact form.

Solution

$$A=\int_0^{\frac{\pi}{6}}\sqrt{3}\sin x\ dx+\int_{\frac{\pi}{6}}^{\frac{\pi}{2}}\cos x\ dx$$

$$=\left[-\sqrt{3}\cos\right]_0^{\frac{\pi}{6}}+\left[\sin x\right]_{\frac{\pi}{6}}^{\frac{\pi}{2}}$$

$$=-\sqrt{3}\left(\cos\frac{\pi}{6}-\cos 0\right)+\left(\sin\frac{\pi}{2}-\sin\frac{\pi}{6}\right)$$

$$=-\sqrt{3}\left(\frac{\sqrt{3}}{2}-1\right)+\left(1-\frac{1}{2}\right)$$

$$=-\frac{3}{2}+\sqrt{3}+1-\frac{1}{2}$$

$$\therefore A=\sqrt{3}-1\text{ units}^2$$

Criteria	Marks
• Provides correct solution	**3**
• Uses correct limits when finding the integral	**2**
• Obtains correct integral of the form $\int\sqrt{3}\sin x dx+\int\cos x dx$ or equivalent	**1**
Comments: Many students did not set up the correct integral with the correct terminals and in some cases this simplified the problem. Subsequently they only gained one mark for an attempted integration.	

Question 3

a) Consider the function $g(x)=xe^{x+1}$:

i) Show that $g'(x)=(1+x)e^{x+1}$ and $g''(x)=(2+x)e^{x+1}$.

Solution

$$g(x)=xe^{x+1}$$

$$g'(x)=e^{x+1}+xe^{x+1}$$

$$\therefore g'(x)=(1+x)e^{x+1}\quad as\ req'd$$

$$g''(x)=e^{x+1}+e^{x+1}+xe^{x+1}$$

$$=2e^{x+1}+xe^{x+1}$$

$$g''(x)=(2+x)e^{x+1}\quad as\ req'd$$

Criteria	Marks
• Provides correct solution	**2**
• Obtains correct first or second derivative	**1**
Comments: Mostly well done, some students did not apply the product rule correctly.	

ii) Find the coordinates of any stationary points and determine their nature.

Solution

Stationary points occur when $g'(x) = 0$

i.e. $(1+x)e^{x+1} = 0, \quad e^{x+1} \neq 0$

Hence, $1 + x = 0$

$\therefore\ x = -1$

$$g''(-1) = (2-1)e^{-1+1}$$
$$= 1 \times e^0$$
$$= 1$$
$$> 0 \ \therefore \text{it's a minimum}$$

$g(-1) = -1$

$\therefore$ S.P is a minimum at $(-1,-1)$

Criteria	Marks
• Provides correct solution	**2**
• Obtains correct x and y coordinates for the stationary point	**1**
Comments: Mostly well done. Some students did not calculate the y-value of the stationary point.	

iii) Find the coordinates of any points of inflexion.

Solution

Point of inflexion occurs when $g''(x) = 0$

i.e. $(2+x)e^{x+1} = 0, \quad e^{x+1} \neq 0$

Hence, $2 + x = 0$

$\therefore\ x = -2$

when $x = -3$ $g''(-3) = -e^{-2} < 0$

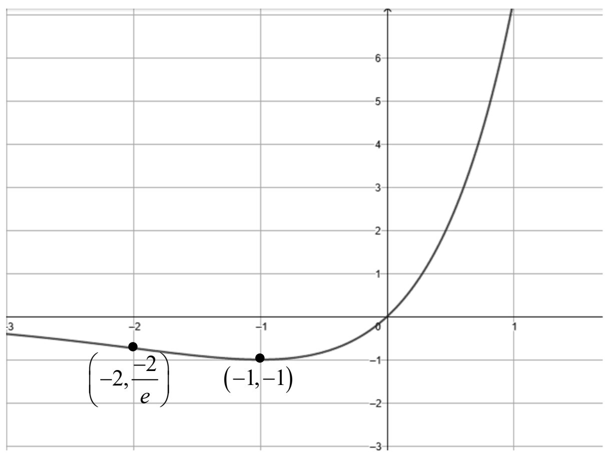
when $x = -1$ $g''(-1) = 1 > 0$

$\therefore$ There is a point of inflexion at $\left(-2, -\dfrac{2}{e}\right)$

Criteria	Marks
• Provides correct solution	**2**
• Obtains correct value for x when solving $g''(x) = 0$	**1**
Comments : Most students correctly solved $g''(x) = 0$, however it is necessary to check this is in fact a point of inflexion by checking for a change in concavity to the right and left of $x = -2$	

iv) Sketch the curve $y = g(x)$ showing all key features.

Solution



Criteria	Marks
• Provides correct sketch	**2**
• Provides curve with correct shape	**1**
Comments: Students should take care when drawing graphs. Diagrams should be 1/3 of a page and all necessary features need to be shown.	

b) Consider the sequence $T_1, T_2, T_3 ....$ with general term T_n. Given that the sum of the first n terms of the sequence is $S_n = \frac{n}{3n+1}$:

i) Evaluate S_1, S_2, S_3

Solution

$S_1 = \frac{1}{4}$ $\quad S_2 = \frac{2}{7}$ $\quad S_3 = \frac{3}{10}$

Criteria	Marks
• Provides correct answers	**1**
Comments: Very well done.	

ii) Find the values of T_1, T_2, T_3

Solution

$$T_n = S_n - S_{n-1}$$

$$T_1 = S_1 = \frac{1}{4}$$

$$T_2 = S_2 - S_1$$

$$= \frac{2}{7} - \frac{1}{4} \quad \therefore T_2 = \frac{1}{28}$$

$$T_3 = \frac{3}{10} - \frac{3}{7} \quad \therefore T_3 = \frac{1}{70}$$

Criteria	Marks
• Provides correct solution	**2**
• Recognises nth term $= S_n - S_{n-1}$	**1**
Comments: Very well done.	

iii) Find an expression for T_n in terms of n.

Solution

$$T_n = S_n - S_{n-1}$$

$$= \frac{n}{3n+1} - \left(\frac{n-1}{3(n-1)+1}\right)$$

$$= \frac{n(3n-2)-(n-1)(3n+1)}{(3n+1)(3n-2)}$$

$$\therefore T_n = \frac{1}{(3n+1)(3n-2)}$$

Alternate solution

$$\frac{1}{4} + \frac{1}{28} + \frac{1}{70}$$

$$T_2 - T_1 = -\frac{2}{14} \quad T_3 - T_2 = -\frac{13}{140}$$

$$T_3 = \frac{1}{4} - \frac{3}{14} - \frac{13}{140}$$

$$T_n = \frac{1}{4} + \left(-\frac{3}{14} - \frac{3}{140} - \ldots - \frac{3}{14\times 10^{n-1}}\right)$$

$$= \frac{1}{4} + S_{n-1} \text{ (where } r = \frac{1}{10} \text{ and } a = -\frac{3}{14})$$

$$T_n = \frac{1}{4} + \frac{a\left(1-r^{n-1}\right)}{1-r}$$

$$T_n = \frac{1}{4} - \frac{\frac{3}{14}\left(1-\left(\frac{1}{10}\right)^n\right)}{1-\frac{1}{10}}$$

$$= \frac{1}{4} - \frac{\frac{3}{14}\left(1-\left(\frac{1}{10}\right)^n\right)}{\frac{9}{10}}$$

$$= \frac{1}{4} - \frac{5}{21}\left(1-\left(\frac{1}{10}\right)^{n-1}\right)$$

$$= \frac{1}{4} - \frac{5}{21}\left(1-\frac{1}{10^{n-1}}\right)$$

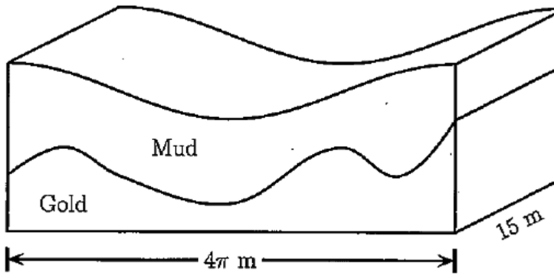
$$= \frac{1}{4} - \frac{5}{21}\left(\frac{10^{n-1}-1}{10^{n-1}}\right)$$

$$= \frac{1}{4} - \frac{5\left(10^{n-1}-1\right)}{21\times 10^{n-1}}$$

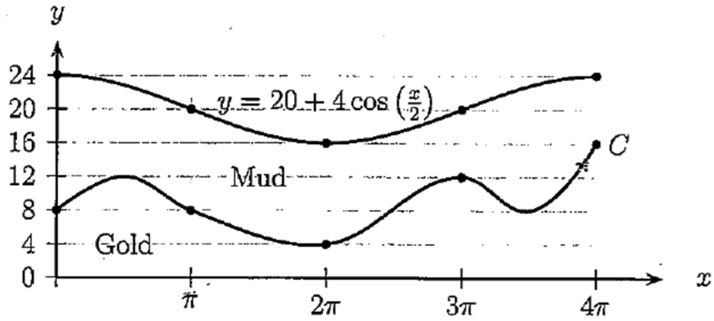
$$T_n = \frac{1}{4} - \frac{5\left(10^{n-1}-1\right)}{21\times 10^{n-1}}$$

Criteria	**Marks**
• Provides correct solution	**2**
• Attempts to simplify $\frac{n}{3n+1} - \left(\frac{n-1}{3(n-1)}\right)$ or equivalent	**1**
Comments: This part follows on from part ii), many students did not see this connection and attempted to solve by using arithmetic and geometric series formulas.	

c) The diagram below shows an amount of gold, which is in the shape of a prism underneath a large amount of mud. The width of the prism is 4π metres and its length is 15 metres.



The graph below shows the cross-section of the prism. The top of the mud is given by the function $y = 20 + 4\cos\left(\frac{x}{2}\right)$ and the top of the gold is shown by the curve, C.



i) Find, by integration, the total area of the cross-section, i.e., the area of both the mud and gold.

Solution

$$A = \int_0^{4\pi} 20 + 4\cos\left(\frac{x}{2}\right)dx$$

$$= \left[20x + 8\sin\left(\frac{x}{2}\right)\right]_0^{4\pi}$$

$$= \left(20 \times 4\pi + \sin\left(\frac{4\pi}{2}\right) - 0\right)$$

$$\therefore A = 80\pi \ m^2$$

Criteria	Marks
• Provides correct solution	**2**
• Obtains correct integral of $20x + 8\sin\left(\frac{x}{2}\right)$	**1**
Comments: Mostly well done. Some students substituted incorrect integral bounds.	

ii) Using Simpson's Rule with five function values of C, find an estimate for the area of the cross-section of the gold. Leave your answer in terms of π.

Solution

$$h = \frac{4\pi - 0}{4} = \pi$$

x	0	π	2π	3π	4π
$f(x)$	8	8	4	12	16

$$A \approx \frac{\pi}{3}\{8 + 16 + 2\times 4 + 4\times(8+12)\}$$

$$\therefore A \approx \frac{112\pi}{3}\text{m}^2$$

Criteria	Marks
• Provides correct solution	**3**
• Obtains correct values for interval width and for the function values	**2**
• Attempts to use Simpson's rule to find an approximation of the area	**1**
Comments: Mostly well done. Students need to take care when using Simpsons rule from the reference sheet as this is a single application.	

iii) Find the volume of the mud. Leave your answer in terms of π.

Solution

$$V = \left(80\pi - \frac{112\pi}{3}\right)\times 15$$
$$= 640\text{m}^3$$

Criteria	Marks
• Provides correct solution	**1**
Comments: Mostly well done.	