



THE SCHOOL FOR EXCELLENCE (TSFX)
UNITS 3 & 4 MATHEMATICAL METHODS 2018
WRITTEN EXAMINATION 2 – SOLUTIONS

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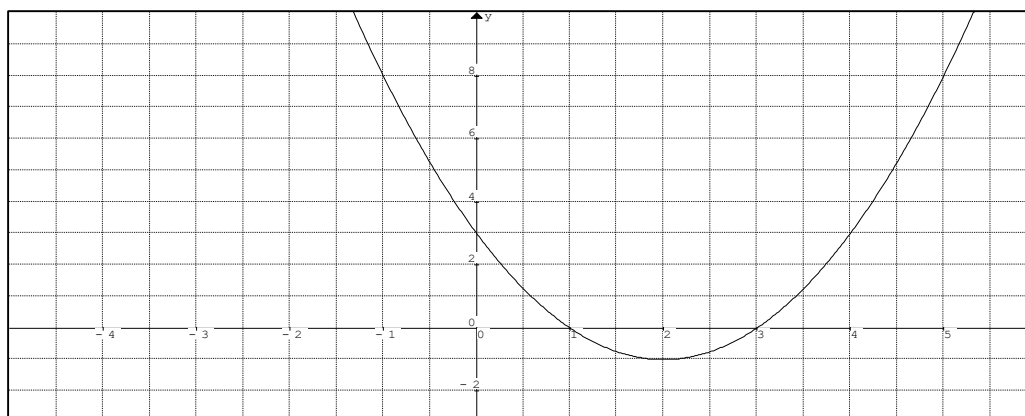
SECTION A

1	2	3	4	5	6	7	8	9	10
D	C	E	C	A	E	C	D	D	E

11	12	13	14	15	16	17	18	19	20
B	D	B	A	A	D	C	D	A	C

QUESTION 1 **Answer is D**

From the graph, $x \in (-\infty, 0]$ for $y \geq 0$.



QUESTION 2 Answer is C

$$f(x) = (x-1)(x+3)P(x) + m(x-1) + n$$

Let $x = 1$: $-10 = (1-1)(1+3)P(1) + m(1-1) + n$
 $n = -10$

Let $x = -3$: $2 = (-3-1)(-3+3)P(-3) + m(-3-1) + n$
 $2 = -4m + n$
 $2 = -4m - 10$
 $m = -3$

QUESTION 3 Answer is E

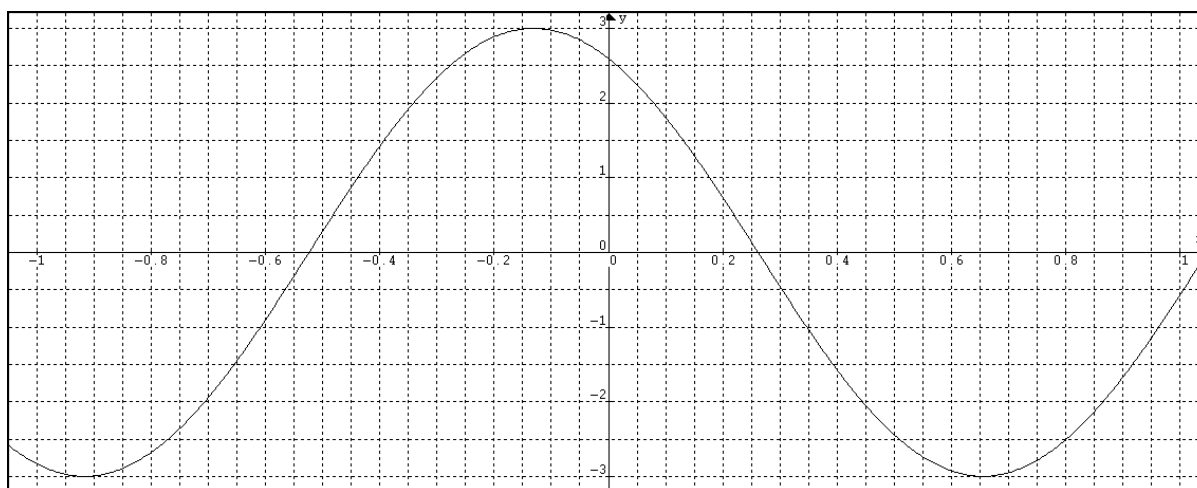
The equations could be written as: $y = -(a+2)x + 3$ and $y = -\frac{a}{2}x + \frac{b}{2}$

Linear equations will have a unique solution if the gradients are **not** equal.

Equating the gradients: $-(a+2) = -\frac{a}{2}$ if $a = -4$.

A unique solution will exist if $a \in \mathbb{R} \setminus \{-4\}$ and b can take any value.

QUESTION 4 Answer is C



The maximum value on the graph occurs at $x = -\frac{\pi}{24}$ and so going any further to the left

would cause the function to not be 1-to-1. Hence the largest value of a is $\frac{\pi}{24}$.

QUESTION 5 Answer is A

$$g(x) = x^3 - 4x$$

Dilation by a factor of 2 from the y -axis: $g_1(x) = \left(\frac{x}{2}\right)^3 - 4\left(\frac{x}{2}\right) = \frac{x^3}{8} - 2x$

Reflection in the y -axis: $g_2(x) = \frac{(-x)^3}{8} - 2(-x) = -\frac{x^3}{8} + 2x$

Translation of 2 units in the negative direction of the x -axis: $g_3(x) = -\frac{(x+2)^3}{8} + 2(x+2)$

Hence $f(x) = 4 + 2x - \frac{(x+2)^3}{8}$.

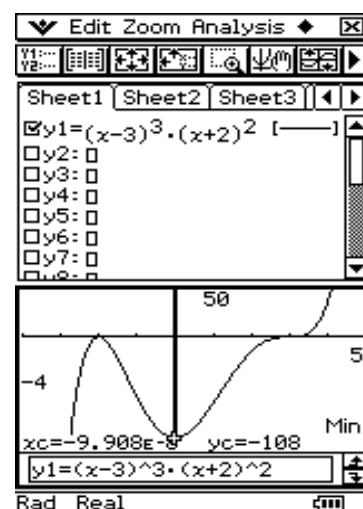
QUESTION 6 Answer is E

The minimum turning point for the graph of $y = (x+2)^2(x-3)^3$ occurs at $(0, -108)$. Therefore, if anything greater than 108 is added to the equation there would only be one x -intercept.

Hence $-p > 108$ and so $p < -108$.

Also, if $p > 0$, the maximum turning point $(-2, 0)$ and stationary point of inflection $(3, 0)$ will be translated down under the x -axis.

Hence $p > 0$ and $p < -108$ satisfy.

**QUESTION 7 Answer is C**

Consider each function in the functional equation $f(x+y) = f(x)f(y)$:

Option A: $f(x) = \log_e(x)$

$$\text{L.H.S.} = \log_e(x+y)$$

$$\text{R.H.S.} = \log_e(x)\log_e(y) \quad \text{L.H.S.} \neq \text{R.H.S.}$$

Option B: $f(x) = e^{(x-1)}$

$$\text{L.H.S.} = e^{(x+y-1)}$$

$$\text{R.H.S.} = e^{(x-1)} \times e^{(y-1)} = e^{(x+y-2)} \quad \text{L.H.S.} \neq \text{R.H.S.}$$

Option C: $f(x) = e^{-x}$

$$\text{L.H.S.} = e^{-(x+y)}$$

$$\text{R.H.S.} = e^{-x} \times e^{-y} = e^{-(x+y)} \quad \text{L.H.S.} = \text{R.H.S.}$$

QUESTION 8 Answer is D

$$f(x) = x^3 g(x) - 3x$$

$$f'(x) = x^3 g'(x) + 3x^2 g(x) - 3$$

$$f'(3) = (3)^3 g'(3) + 3(3)^2 g(3) - 3$$

$$f'(3) = (27)(2) + (27)(-1) - 3$$

$$f'(3) = 54 - 27 - 3 = 24$$

QUESTION 9 Answer is D

$$\text{Average rate of change} = \frac{f(4) - f(2)}{4 - 2} = \frac{60 - 6}{4 - 2} = 27$$

QUESTION 10 Answer is E

The graph of $y = f(x)$ has a stationary point of inflection at $x = 1$ and a local minimum at $x = 6$ so B, C and D are incorrect. A is incorrect as it requires the inclusion at $x = 6$.
The answer is E.

QUESTION 11 Answer is B

$$\int \left(\frac{3}{2x-1} \right) dx = \int \left(\frac{3 \times 2 \times \frac{1}{2}}{2x-1} \right) dx = \frac{3}{2} \int \left(\frac{2}{2x-1} \right) dx = \frac{3}{2} \log_e (2x-1) + c$$

$$\therefore \int_1^k \left(\frac{3}{2x-1} \right) dx = \frac{3}{2} [\log_e (2x-1)]_1^k$$

$$\frac{3}{2} [\log_e (2x-1)]_1^k = \frac{3 \log_e 5}{2}$$

$$\therefore \frac{3}{2} (\log_e (2k-1) - \log_e 1) = \frac{3 \log_e 5}{2}$$

$$\frac{3}{2} \log_e (2k-1) = \frac{3}{2} \log_e 5$$

$$2k-1=5$$

$$k=3$$

QUESTION 12 Answer is D

$$\begin{aligned}
\int_{-1}^3 (4f(x) - 3x) dx &= \int_{-1}^3 (4f(x)) dx - 3 \int_{-1}^3 (x) dx \\
&= 2 \int_{-1}^3 (2f(x)) dx - 3 \left[\frac{x^2}{2} \right]_{-1}^3 \\
&= -2 \int_3^{-1} (2f(x)) dx - 3 \left(\frac{9}{2} - \frac{1}{2} \right) \\
&= -2(-5) - 3(4) \\
&= 10 - 12 = -2
\end{aligned}$$

QUESTION 13 Answer is B

As $\frac{d}{dx}(x \log_e x) = 1 + \log_e x$ then $\int (1 + \log_e x) dx = x \log_e x + c$

$$\int (1) dx + \int (\log_e x) dx = x \log_e x + c$$

$$x + \int (\log_e x) dx = x \log_e x + c$$

$$\int (\log_e x) dx = x \log_e x - x + c$$

QUESTION 14 Answer is A

$$\begin{aligned}
\text{Area} &= \int_0^2 (\sqrt{4-x^2}) dx - \int_0^1 2\sqrt{(1-x)} dx \\
&= \pi - \frac{4}{3} \\
&= \frac{3\pi - 4}{3} \text{ square units.}
\end{aligned}$$

QUESTION 15 Answer is A

The probability that they are all blue is $\frac{5}{8} \times \frac{4}{7} \times \frac{3}{6}$.

The probability that they are all red is $\frac{3}{8} \times \frac{2}{7} \times \frac{1}{6}$.

The probability that they are all the same colour = $\frac{60+6}{8 \times 7 \times 6} = \frac{11}{56}$.

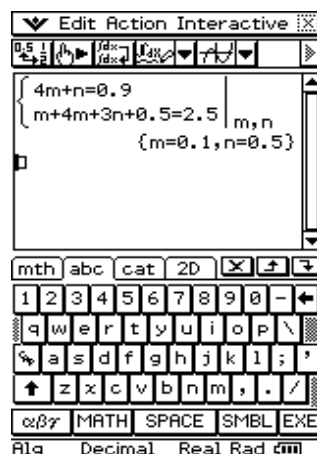
So the probability that they are NOT all the same colour is $1 - \frac{11}{56} = \frac{45}{56}$.

QUESTION 16 Answer is D

Using simultaneous equations for the sum of the probabilities and the mean, $E(X) = 2.5$ gives the values $m = 0.1$ and $n = 0.5$.

$$\begin{aligned} E(X^2) &= m + (4 \times 2m) + 9n + (25 \times 0.1) \\ &= m + 8m + 9n + 2.5 \\ &= 9m + 9n + 2.5 \\ &= 7.9 \end{aligned}$$

$$\begin{aligned} \text{Variance} &= E(X^2) - [E(X)]^2 \\ &= 7.9 - 2.5^2 \\ &= 1.65 \end{aligned}$$

**QUESTION 17 Answer is C**

Binomial: $n = 10, p = 0.7$

Let X = number that gain entry within 6 minutes

$$\Pr(X \geq 8) = 0.3827828$$

$$\Pr(X = 9) = 0.1210608$$

$$\begin{aligned} \Pr(9 \text{ enter} | \geq 8 \text{ enter}) &= \frac{\Pr(9 \text{ enter} \cap \geq 8 \text{ enter})}{\Pr(\geq 8 \text{ enter})} \\ &= \frac{\Pr(9 \text{ enter})}{\Pr(\geq 8 \text{ enter})} \\ &= \frac{0.12106.....}{0.38278.....} = 0.316265 \end{aligned}$$

QUESTION 18 Answer is D

$$\mu = 50 \text{ and } \sigma = 2$$

Required probability is $\Pr(X < 42) + \Pr(X > 54)$

When $X = 42$ then $Z = -4$

When $X = 54$ then $Z = 2$

So the probability is: $\Pr(Z < -4) + \Pr(Z > 2)$

QUESTION 19 Answer is A

$$z_1 = \frac{5 - \mu}{\sigma} \text{ and } z_2 = \frac{8 - \mu}{\sigma}$$

$$\Pr(X < 5) = 0.15$$

$$\Pr\left(z_1 < \frac{5 - \mu}{\sigma}\right) = 0.15 \text{ therefore, } z_1 = -1.03643$$

$$\Pr(X < 8) = 0.70$$

$$\Pr\left(z_2 < \frac{8 - \mu}{\sigma}\right) = 0.70 \text{ therefore, } z_2 = 0.524401$$

$$-1.03643 = \frac{5 - \mu}{\sigma}$$

$$\therefore -1.03643\sigma = 5 - \mu \quad \text{Equation 1}$$

$$0.524401 = \frac{8 - \mu}{\sigma}$$

$$\therefore 0.524401\sigma = 8 - \mu \quad \text{Equation 2}$$

Equation 1 – Equation 2:

$$1.56083\sigma = 3$$

$$\therefore \sigma = 1.92205$$

Substitute $\sigma = 1.92205$ into Equation 1: $\mu = 6.99208$

QUESTION 20 Answer is C

$$p = 0.45$$

A 95% confidence interval gives $z = 1.96$

$$M = 0.01$$

$$M = Z_{\alpha/2} \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}$$

$$0.01 = 1.96 \sqrt{\frac{0.45(1 - 0.45)}{n}}$$

$$n = 9507.96$$

Therefore, 9508 people need to be surveyed.

SECTION B

Marking Legend:

- $\left(A \frac{1}{2} \times 4 \downarrow \right)$ means four answer half-marks rounded **down** to the next integer.
Rounding occurs at the end of a part of a question.
- **M1 = 1 Method mark.**
- **A1 = 1 Answer mark** (it **must** be this or its equivalent).
- **H1 = 1 consequential mark** (**His/Her** mark...correct answer from incorrect statement or slip, arithmetic slip preventing an **A** mark).

QUESTION 1 (18 marks)

a. $S_1 \sim N(60, 2)$
 $\Pr(X < 58) = 0.0786$ **A1**

b. (i)

$$S_2 \sim Bi(n, p) \quad \left\{ \begin{array}{l} 30 = np \\ 5 = np(1-p) \end{array} \right| n, p \quad \left\{ n=36, p=\frac{5}{6} \right\}$$

Giving $n = 36, p = \frac{5}{6}$ **A2**

(ii)

$$\Pr(30 < X < 36) = 0.6067 \quad \text{binomialCDF}\left(30, 36, 36, \frac{5}{6}\right) \quad 0.6067480112$$
A1

(iii) $S_2 \sim Bi\left(n, \frac{5}{6}\right)$ **M1**

$$\Pr(X \geq 2) \leq 0.99$$

$$1 - [\Pr(X = 0) + \Pr(X = 1)] \leq 0.99$$

$$\text{Solve } \Pr(X = 0) + \Pr(X = 1) = 0.01$$

$${}^nC_0 \left(\frac{5}{6}\right)^0 \left(\frac{1}{6}\right)^n + {}^nC_1 \left(\frac{5}{6}\right)^1 \left(\frac{1}{6}\right)^{n-1} = 0.01$$
M1

Gives $n = 4.31$

Maximum number of walks is 5.

solve $\left(\left(\frac{1}{6}\right)^x + x \cdot \left(\frac{1}{6}\right)^{x-1} \cdot \left(\frac{5}{6}\right)^1 = 0.01, x\right)$
 $\{x=-0.1985988325, x=4.308994869\}$

A1

c. (i) $\int_0^3 (0.1) dt + \int_3^9 (a(t-3)^2 + 0.1) dt = 1$

M1

Giving $72a + 0.9 = 1$

$$\therefore a = \frac{1}{720}$$

M1

$\int_0^3 0.1 dt + \int_3^9 a(t-3)^2 + 0.1 dt$
 $72 \cdot a + \frac{9}{10}$
 solve $\left(72 \cdot a + \frac{9}{10} = 1, a\right)$
 $\left\{a = \frac{1}{720}\right\}$

(ii) $E(X) = \int_0^3 t(0.1) dt + \int_3^9 t\left(\frac{1}{720}(t-3)^2 + 0.1\right) dt = 4.8$

A1

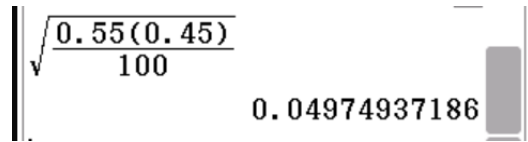
Define $f(t) = \begin{cases} 0.1, & 0 \leq t < 3 \\ \frac{1}{720} \cdot (t-3)^2 + 0.1, & 3 \leq t \leq 9 \end{cases}$
 $\int_0^9 t \cdot f(t) dt$
 done
 4.8

d. (i) $E(\hat{P}) = p = 0.55$

$$sd(\hat{P}) = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{0.55(1-0.55)}{100}}$$

$$\therefore sd(\hat{P}) = 0.0497$$

1M 1A



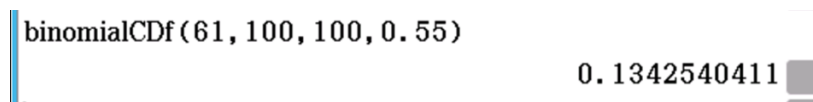
Handwritten calculation: $\sqrt{\frac{0.55(0.45)}{100}} = 0.04974937186$

(ii) $X \sim Bi(100, 0.55)$

1M

$$\Pr(X > 60) = \Pr(X \geq 61) = 0.1343$$

1A



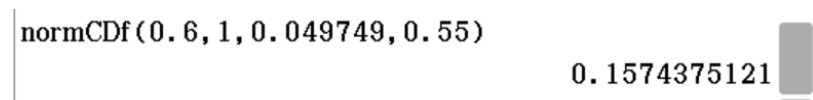
Handwritten calculation: $\text{binomialCDF}(61, 100, 100, 0.55) = 0.1342540411$

(iii) $Y \sim N(0.55, 0.0497...^2)$

1M

$$\Pr(X > 60) = 0.157$$

1A



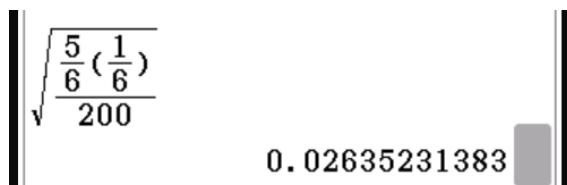
Handwritten calculation: $\text{normCDF}(0.6, 1, 0.049749, 0.55) = 0.1574375121$

e. From part b (i) $S_2 \sim Bi\left(n, \frac{5}{6}\right)$

$$E(\hat{P}) = p = \frac{5}{6}$$

$$sd(\hat{P}) = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{\frac{5}{6}\left(1-\frac{5}{6}\right)}{200}} = 0.02635$$

1M



Handwritten calculation: $\sqrt{\frac{\frac{5}{6}(\frac{1}{6})}{200}} = 0.02635231383$

$$95\% \text{ CI} = (\mu - 1.96\sigma \leq X \leq \mu + 1.96\sigma)$$

$$95\% \text{ CI} = (\mu - 1.96\sigma, \mu + 1.96\sigma) = \left(\frac{5}{6} - 1.96 \times 0.02635, \frac{5}{6} + 1.96 \times 0.02635 \right)$$

$$\text{CI} = (0.781687\dots, 0.884979\dots)$$

$$\text{CI} = (0.78, 0.88)$$

1A

$$\begin{array}{l} \frac{5}{6} - 1.96(0.02635) \\ 0.7816873333 \\ \frac{5}{6} + 1.96(0.02635) \\ 0.8849793333 \end{array}$$

OR USING STATISTICS ON CAS: CI = (0.78, 0.89)

$$\frac{5}{6} \times 200 = 166.6666667 = 167$$

C-Level 0.95 x 167 n 200 << Back ☐ Help Next >> OnePropZInt	Lower 0.7835579 Upper 0.8864421 $\hat{p}$ 0.835 n 200 << Back ☐ Help OnePropZInt
--	--

$$\frac{5}{6} \times 200 = 166.6666667 = 166$$

OR IF USED $\frac{5}{6} \times 200$. CI = (0.78, 0.88)

C-Level 0.95 x 166 n 200 << Back ☐ Help Next >> OnePropZInt	Lower 0.7779409 Upper 0.8820591 $\hat{p}$ 0.83 n 200 << Back ☐ Help OnePropZInt
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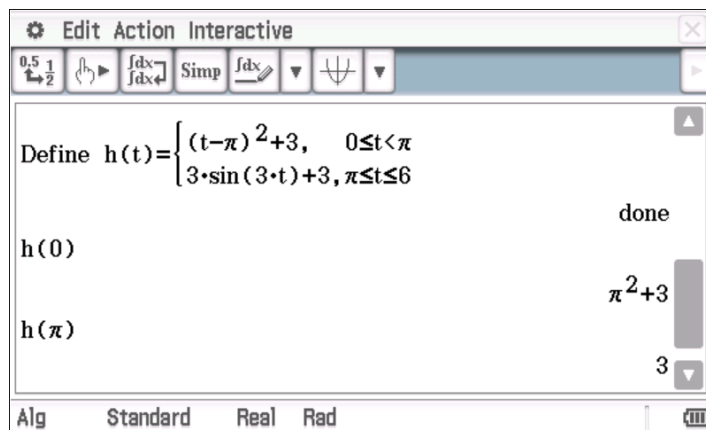
QUESTION 2 (18 marks)

a. (i) $h(0) = \pi^2 + 3$

1A

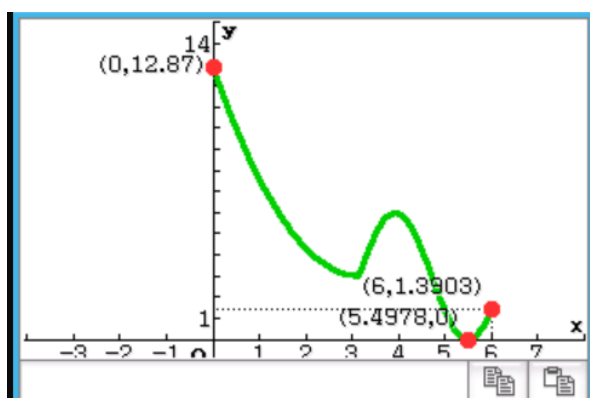
(ii) $h(\pi) = 3$

1A



(iii) $\{t : h(t) = 0\}$ is in the second section when $t = \frac{7\pi}{4}$.

1A



only 1 root found

$\text{solve}(3 \cdot \sin(2 \cdot t) + 3 = 0 \mid \pi \leq t \leq 6, t)$

$\left\{ t = \frac{7 \cdot \pi}{4} \right\}$

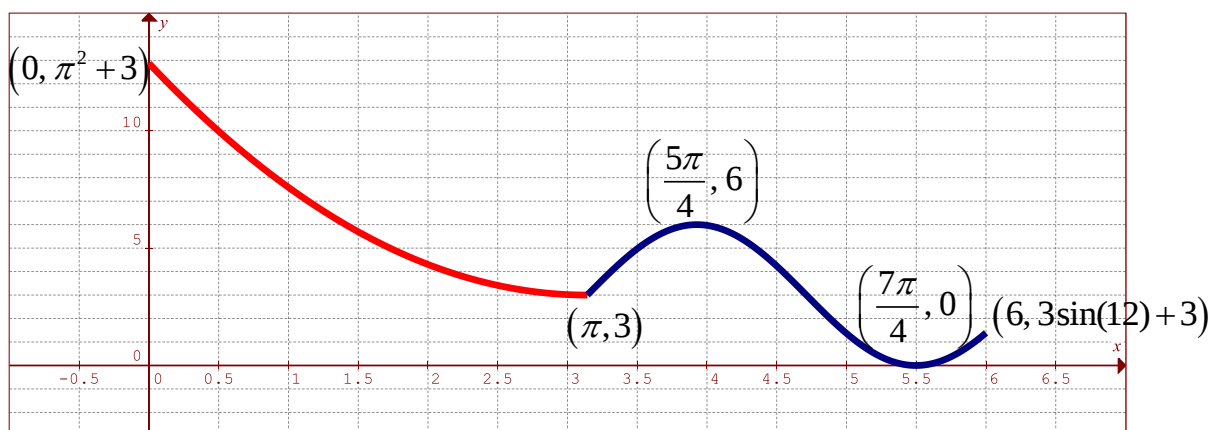
b. (i) Yes because all points exist for $0 \leq t < 6$. In particular, the two sections of the graph meet at the point $(\pi, 3)$.

2A

(ii) Cusp at $(\pi, 3)$, Differentiable for $t \in (0, \pi) \cup (\pi, 6)$

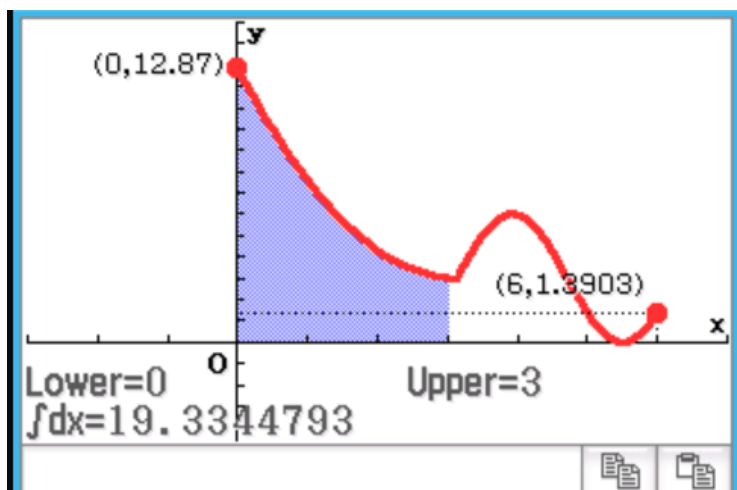
1A

c.



0.5 marks for each of the following: X intercept, Y intercept, coordinates of the endpoint, point of contact, maximum stationary point, shape. Round down to the nearest integer.

d. (i)



1A

$$(ii) \text{ Area} = \int_0^3 h(t) dt = \int_0^3 ((t-\pi)^2 + 3) dt$$

$$= \left[\frac{(t-\pi)^3}{3} + 3t \right]_0^3$$

1M

$$= \left(\frac{(3-\pi)^3}{3} + 9 \right) - \left(\frac{(0-\pi)^3}{3} + 0 \right)$$

$$= \frac{(3-\pi)^3}{3} + \frac{\pi^3}{3} + 9$$

1M

(iii) Six equal width strips, width of each strip 0.5 units.

$$\text{Let } f(t) = (t - \pi)^2 + 3$$

$$\text{Left endpoint approximation} = \frac{1}{2} \left(f(0) + f\left(\frac{1}{2}\right) + f(1) + f\left(\frac{3}{2}\right) + f(2) + f\left(\frac{5}{2}\right) \right)$$

1M

$$\left| \frac{1}{2} (f(0) + f\left(\frac{1}{2}\right) + f(1) + f\left(\frac{3}{2}\right) + f(2) + f\left(\frac{5}{2}\right)) \right|$$

21.9218683

$$\text{Left endpoint approximation} = 21.922$$

1A

This approximation overestimates the area found in **part (ii)** because this section of the graph is concave up so each rectangle overestimates the area.

e. (i) For $h(t) = \begin{cases} (t - \pi)^2 + 3, & 0 \leq t < \pi \\ 3\sin(2t) + 3, & \pi \leq t \leq 6 \end{cases}$

$$\text{For a continuous function: Average value} = \frac{1}{6-0} \int_0^6 (f(t)) dt$$

1M

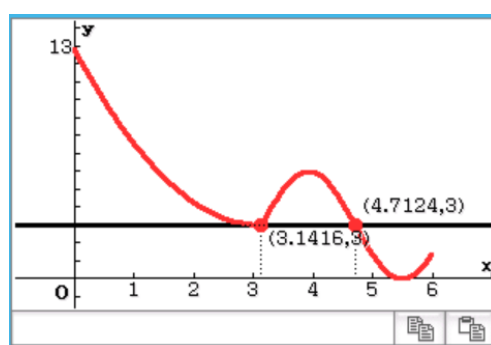
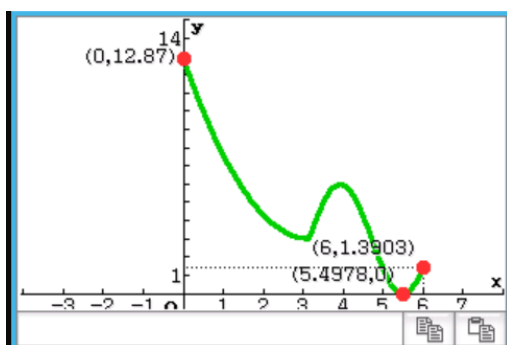
$$= \$476,000 \text{ to nearest } \$1000$$

1A

The screenshot shows a TI-Nspire calculator window with the following content:

- Define** $f(t) = \begin{cases} (t - \pi)^2 + 3, & 0 \leq t < \pi \\ 3 \cdot \sin(2t) + 3, & \pi \leq t \leq 6 \end{cases}$
- done**
- $\int_0^6 \frac{1}{6} \cdot (f(t)) dt$
- 4.761607437**
- At the bottom, the mode is set to **Alg**, and the unit is set to **Rad**.

(ii) Equation of horizontal line in graphs: $y = 3$



Equation of horizontal line in graphs: $y = 3$

Solve $h(t) < 3$:

Gives the section: $6 - 4.7124 = 1.2876$

1.2876 proportion of 6 months

1M

Answer = 21.46%

To nearest % = 21%

1A

QUESTION 3 (11 marks)

$v(t) = a \sin\left(\frac{5\pi}{3}(t + \beta)\right) + c$ with $v(t)$ in km/hr , t in hours and a, β, c are real constants.

a. Range = $[0, 120]$, giving amplitude = 60.

Period = $\frac{2\pi}{\frac{5\pi}{3}} = \frac{6}{5}$ so for the graph to rise from $v = 0$ to $v = 120$ with less than one

cycle, the graph must be reflected over the t -axis giving $a = -60$. **1M**

Vertical translation will be 60 giving $c = 60$, so $c + a = 0$ **1M**

b. $v(t) = -60 \sin\left(\frac{5\pi}{3}(t + \beta)\right) + 60$

Find β such that $v(0) = 0$

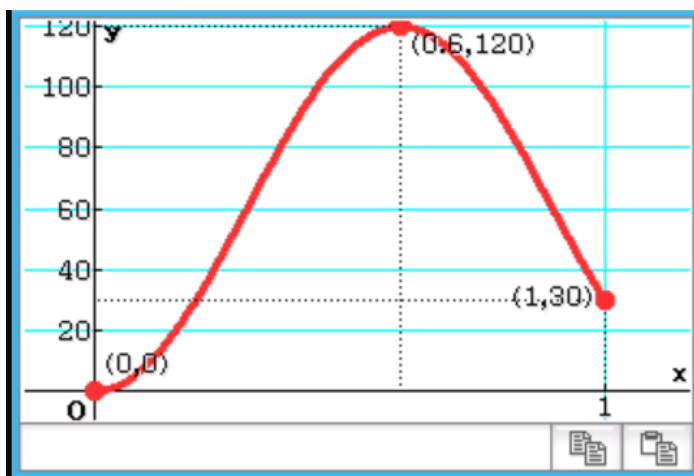
$$0 = -60 \sin\left(\frac{5\pi\beta}{3}\right) + 60$$

$$\therefore \sin\left(\frac{5\pi\beta}{3}\right) = 1$$

$$\Rightarrow \frac{5\pi\beta}{3} = \frac{\pi}{2}$$

Giving $\beta = \frac{3}{10}$ as required **1M**

We now have $v(t) = -60 \sin\left(\frac{5\pi}{3}\left(t + \frac{3}{10}\right)\right) + 60$



c. $x(t) = \int \left(-60 \sin \left(\frac{5\pi}{3} \left(t + \frac{3}{10} \right) \right) + 60 \right) dt$ 1M

$$= 60 \times \frac{3}{5\pi} \cos \left(\frac{5\pi}{3} \left(t + \frac{3}{10} \right) \right) + 60t + c$$

$$= \frac{36}{\pi} \cos \left(\frac{5\pi}{3} \left(t + \frac{3}{10} \right) \right) + 60t + c$$
 1M

$t = 0, x = 0$ gives:

$$0 = \frac{36}{\pi} \cos \left(\frac{5\pi}{3} \left(\frac{3}{10} \right) \right) + c$$

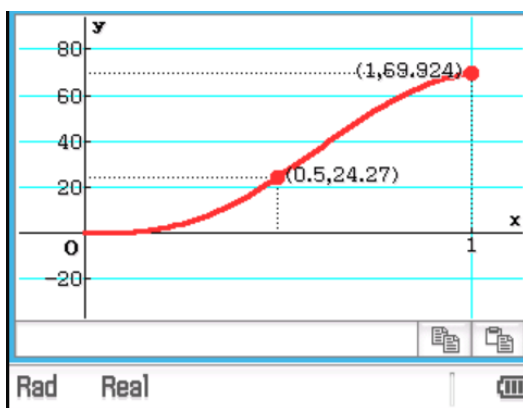
$$\therefore 0 = \frac{36}{\pi} \cos \left(\frac{\pi}{2} \right) + c \therefore c = 0$$

So $x(t) = \frac{36}{\pi} \cos \left(\frac{5\pi}{3} \left(t + \frac{3}{10} \right) \right) + 60t$ 1A

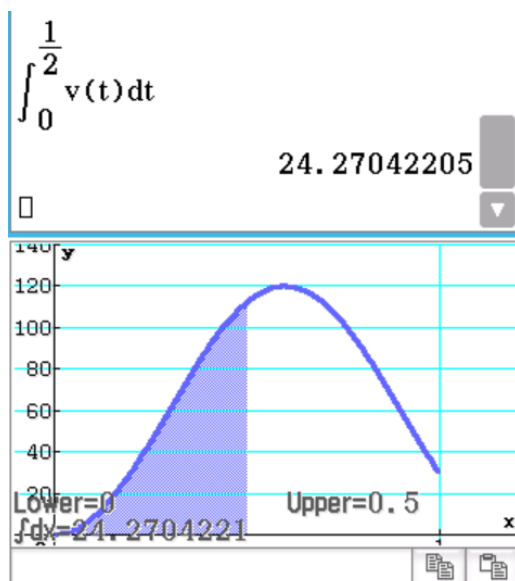
Or from CAS giving a correct but different form:

$$\int v(t) dt = \frac{60 \cdot t \cdot \pi - 36 \cdot \sin \left(\frac{5 \cdot t \cdot \pi}{3} \right)}{\pi}$$

d.



using displacement graph



or using velocity graph

2A

Geoff has travelled 24.3 km halfway through his one hour trip.

1A

e. Solve $v(t) = 100$

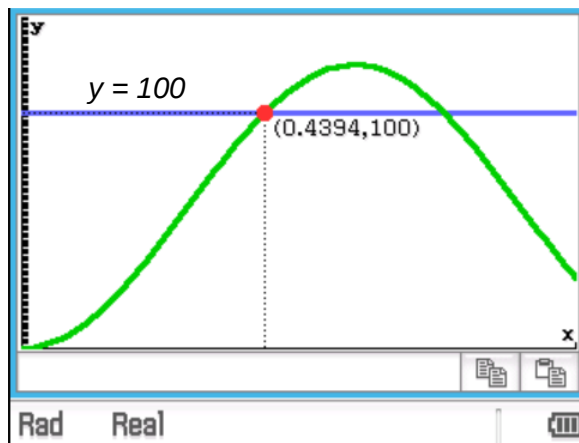
Maximum is at $t = 0.6$

Gives by symmetry: $2 \times (0.6 - 0.4394)$
 $= 0.3212$ hour.

1M

To the nearest minute: 19 minutes

1A



QUESTION 4 (13 marks)

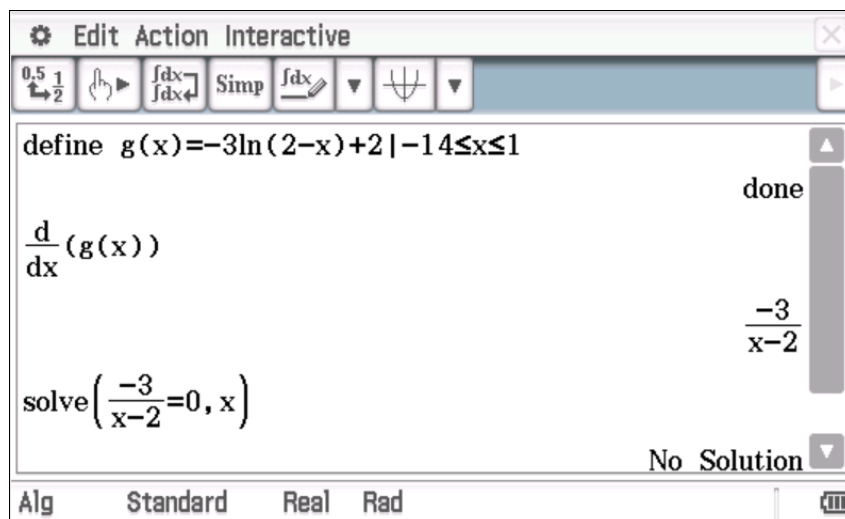
Let $g: [-14, 1] \rightarrow \mathbb{R}, g(x) = -3\log_e(2-x) + 2$

a. (i) $g'(x) = -\frac{3}{x-2}$

1A

Solve $g'(x) = 0$ for stationary point(s) gives no solution.

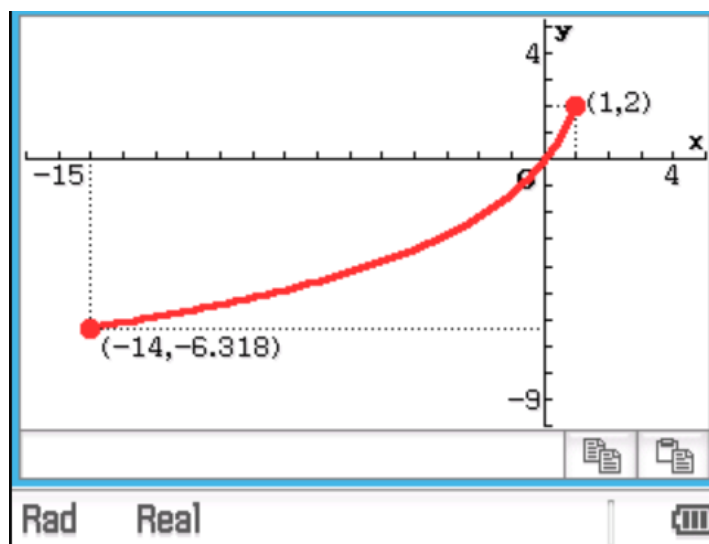
1A



(ii) From the graph the maximum point is at the endpoint at $x = 1$.

1A

b. (i)



Endpoints = $(-14, -12\log_e(2) + 2)$ and $(1, 2)$

x-intercept $\left(-e^{\frac{2}{3}} + 2, 0\right)$

y-intercept $(0, -3\log_e(2) + 2)$

2A

(ii) Endpoints = $(-14, -12\log_e(2)+2)$ and $(1, 2)$

$$\text{Gradient} = \frac{-12\log_e(2)+2-2}{-14-1} = \frac{-12\log_e(2)}{-15} = \frac{4\log_e(2)}{5}$$

$$\text{Equation of line: } y-2 = \frac{4\log_e(2)}{5}(x-1)$$

$$y = \frac{4\log_e(2)}{5}x - \frac{4\log_e(2)}{5} + 2$$

1A

c.
$$\text{Area} = \int_{-14}^1 \left(\frac{4\log_e(2)}{5}x - \frac{4\log_e(2)}{5} + 2 \right) - (-3\log_e(2-x) + 2) dx$$

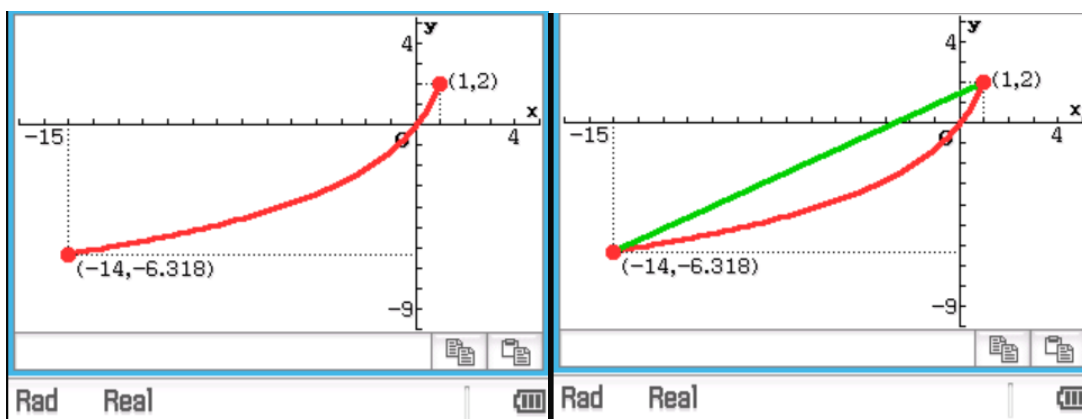
$$\text{Area} = \int_{-14}^1 \left(\frac{4\log_e(2)}{5}x - \frac{4\log_e(2)}{5} + 3\log_e(2-x) \right) dx$$

1M

$$\text{Area} = 25.7009 = 25.7 \text{ units}^2$$

1A

- d. (i) The coordinates on the $g(x)$ graph that illustrate the mean value theorem.



These connect at the points $M(-14, -12\log_e(2) + 2)$ and $N(1, 2)$

From **part b (ii)** gradient MN straight = $\frac{4\log_e(2)}{5}$ 1M

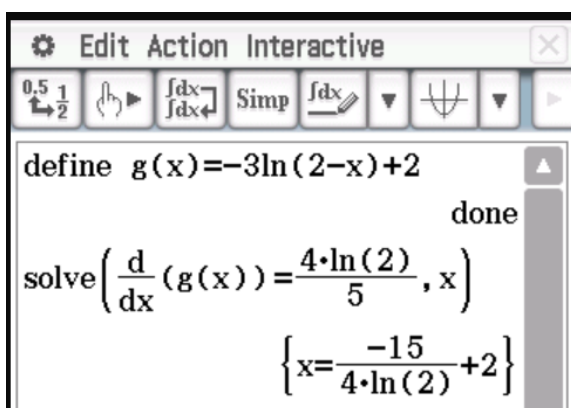
Equation MN curved: $g(x) = -3\log_e(2-x) + 2$

$$\therefore g'(x) = -\frac{3}{x-2}$$

Equate $\frac{4\log_e(2)}{5} = -\frac{3}{x-2}$ 1M

$$\text{to get } x = \frac{-15}{4\ln(2)} + 2$$

Coordinates on MN curved = $\left(\frac{-15}{4\ln(2)} + 2, -3\ln\left(\frac{15}{4\ln(2)} + 2 \right) \right)$ 1A



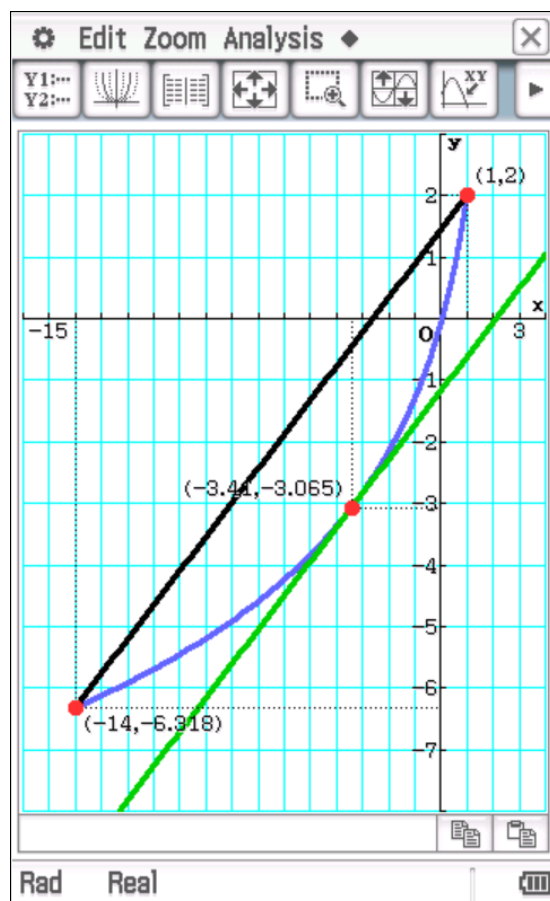
(ii) At $x = \frac{-15}{4\ln(2)} + 2$

Equation of tangent: $y = 0.554x - 1.174$

1A

$$\text{tanLine}\left(g(x), x, -\frac{15}{4\ln(2)} + 2\right)$$

$$0.5545177444 \cdot x - 1.173841771$$



1A