

The Mathematical Association of Victoria

MATHEMATICAL METHODS (CAS) 2012

Trial Written Examination 2 SOLUTIONS

SECTION 1

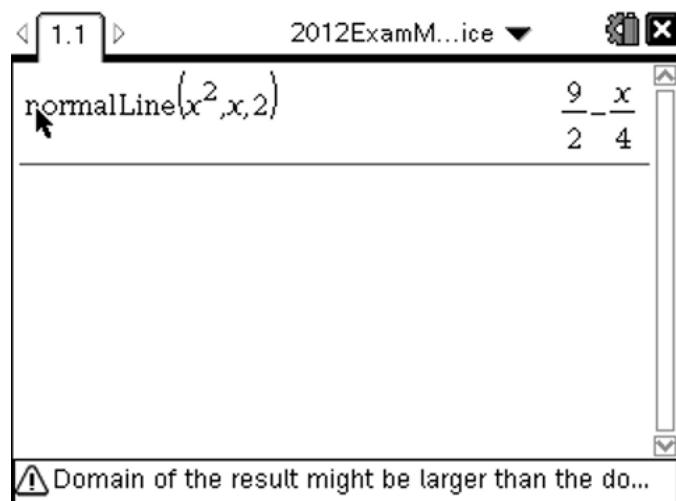
Answers:

1. C 2. B 3. A 4. E 5. B 6. D 7. D 8. C 9. D 10. C 11. A
12. B 13. A 14. E 15. C 16. E 17. B 18. D 19. B 20. E 21. C 22. D

Question 1

$$y = -\frac{x}{4} + \frac{9}{2}$$

$$x + 4y = 18 \quad \text{C}$$



OR

$$g'(x) = 2x, m_t = g'(2) = 4$$

The gradient of the normal $m_n = -\frac{1}{4}$, $g(2) = 4$

$$y = -\frac{x}{4} + c, \text{ at } (2, 4), 4 = -\frac{1}{2} + c, c = \frac{9}{2}$$

$$y = -\frac{x}{4} + \frac{9}{2}$$

$$x + 4y = 18 \quad \text{C}$$

Question 2

$$x^4 + ax^3 + 2x^2 = 0$$

$$x = 0 \text{ or } x = \frac{\sqrt{a^2 - 8} - a}{2} \text{ or } x = \frac{-\sqrt{a^2 - 8} - a}{2}$$

Solve $a^2 - 8 < 0$ so that $x = 0$ is the only solution

$$-2\sqrt{2} < a < 2\sqrt{2}$$

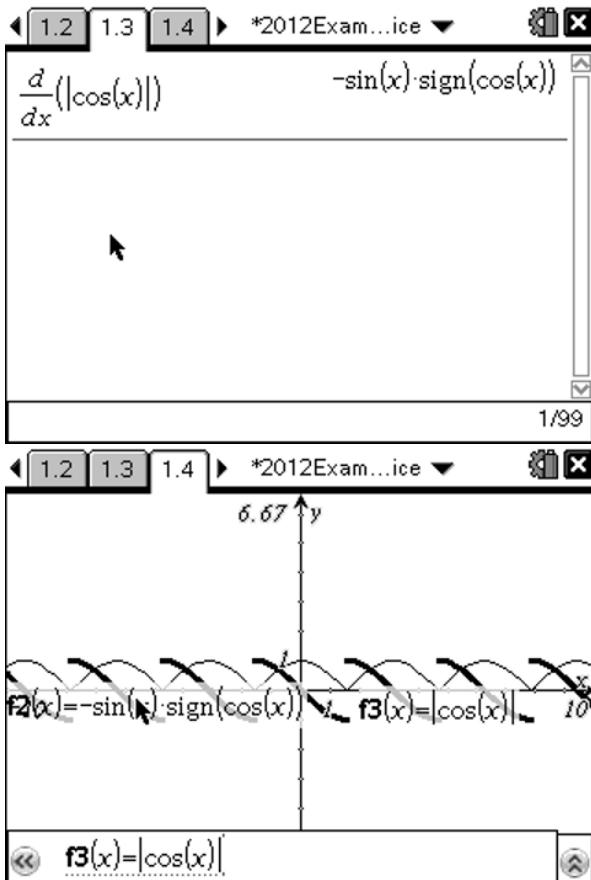
B

Question 3

$$f(x) = |\cos(x)|$$

The graph of f has a sharp point when $\cos(x) = 0$.

$$f'(x) = \begin{cases} -\sin(x) & \text{when } \cos(x) > 0 \\ \text{undefined} & \text{when } \cos(x) = 0 \\ \sin(x) & \text{when } \cos(x) < 0 \end{cases} \quad \mathbf{A}$$

**Question 4**

Option A $f(x) = x^3 - 4x$, $f'(x) = 3x^2 - 4$, two stationary points

Option B $f(x) = x^3 - 4x + 2$, $f'(x) = 3x^2 - 4$, two stationary points

The curve in Option B is a translation of the curve in Option A 2 units up.

Option C $f(x) = (x-2)^3 - 4(x-2)$, $f'(x) = 3(x-2)^2 - 4$, two stationary points

The curve in Option C is a translation of the curve in Option A 2 units to the right.

Option D $f(x) = x^4 + 4x$, $f'(x) = 4x^3 + 4$, one stationary point

Option E $f(x) = (x-2)^3 + 4(x-2)$, $f'(x) = 3(x-2)^2 + 4$, no stationary points **E**

The calculator screen shows the input: $\text{solve}\left(\frac{d}{dx}\left((x-2)^3+4\cdot(x-2)\right)=0, x\right)$. The output is "false".

Question 5

The simultaneous equations $5y = 10x - 3$ and $20x - 10y = 6$ have infinitely many solutions. The equations represent the same straight line. Let $y = \lambda$, $5\lambda = 10x - 3$, $x = \frac{5\lambda + 3}{10}$

$$\left\{ \left(\frac{5\lambda + 3}{10}, \lambda \right) : \lambda \in \mathbb{R} \right\} \quad \mathbf{B}$$

The calculator screen shows the input: $\text{solve}(5 \cdot y = 10 \cdot x - 3 \text{ and } 20 \cdot x - 10 \cdot y = 6, \{x, y\})$. The output is $x = \frac{5 \cdot c1 + 3}{10}$ and $y = c1$.

Question 6

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 0 & -3 \\ 2 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

$$x' = -3y, \quad y = -\frac{x'}{3}$$

$$y' = 2x, \quad x = \frac{y'}{2}$$

$$y = e^{2x+3}, \quad -\frac{x'}{3} = e^{y'+3}$$

$$y = \log_e \left(-\frac{x}{3} \right) - 3, x < 0 \quad \mathbf{D}$$

Question 7

$$g(x) = 1 + 3 \log_e(1 - 2x)$$

$$1 - 2x > 0$$

$$x < \frac{1}{2}$$

The equation of the asymptote is $x = \frac{1}{2}$

The x -axis intercept is $\frac{1}{2} \left(1 - e^{-\frac{1}{3}} \right)$

$$0 = 1 + 3 \log_e(1 - 2x)$$

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

$$e^{-\frac{1}{3}} = 1 - 2x$$

$$x = \frac{1}{2} \left(1 - e^{-\frac{1}{3}} \right)$$

Hence the inverse of g has an asymptote with equation $y = \frac{1}{2}$

and a y -axis intercept at $\frac{1}{2} \left(1 - e^{-\frac{1}{3}} \right)$ **D**

Question 8

The domain of $f(x) = \sqrt{ax+b}$ is $\left[-\frac{b}{a}, \infty \right)$

The domain of $g(x) = \sqrt{b-ax}$ is $\left(-\infty, \frac{b}{a} \right]$

The domain of $f+g$ is $\left[-\frac{b}{a}, \frac{b}{a} \right]$

The domain of the derivative of $f+g$ is $\left(-\frac{b}{a}, \frac{b}{a} \right)$ **C**

Question 9

Range: $5 - 1 = 6 \Rightarrow$ amplitude is 3

Graph is reflected in x -axis $\Rightarrow a = -3$

$$\frac{2\pi}{n} = 10$$

$$\text{Period is 10: } n = \frac{\pi}{5}$$

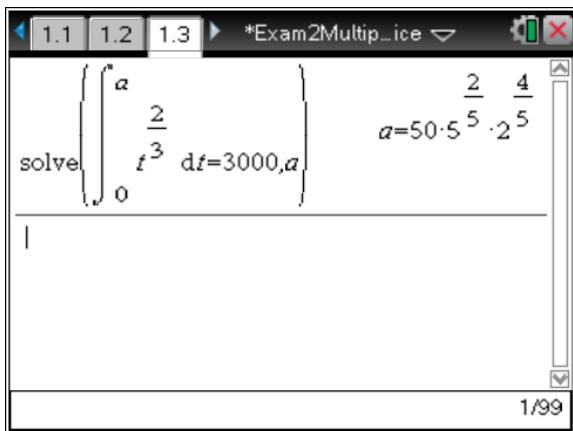
There is a vertical translation of 2 units $\Rightarrow b = 2$ **D**

Question 10

Solve $\int_0^a t^{\frac{2}{3}} dt = 3000$ for a

$$a = 50 \times 20^{\frac{2}{5}} \text{ minutes}$$

C

**OR**

$$\frac{dv}{dt} = -t^{\frac{2}{3}}$$

$$v = -\int t^{\frac{2}{3}} dt$$

$$v = -\frac{3}{5}t^{\frac{5}{3}} + c$$

$$(0, 3000), c = 3000$$

$$v = -\frac{3}{5}t^{\frac{5}{3}} + 3000$$

$$0 = -\frac{3}{5}t^{\frac{5}{3}} + 3000$$

$$t = (5000)^{\frac{3}{5}} = 50 \times 20^{\frac{2}{5}} \text{ minutes}$$

C

Question 11

$$f(x+h) \approx f(x) + hf'(x)$$

$$x = 121, h = -0.1, f(x) = \frac{1}{\sqrt{x}}, f'(x) = -\frac{1}{2}x^{-\frac{3}{2}}$$

$$f(x+h) \approx \frac{1}{\sqrt{121}} - \frac{1}{10} \times \frac{-1}{2(121)^{\frac{3}{2}}} = \frac{1}{\sqrt{121}} + \frac{1}{20(121)^{\frac{3}{2}}} \quad \text{A}$$

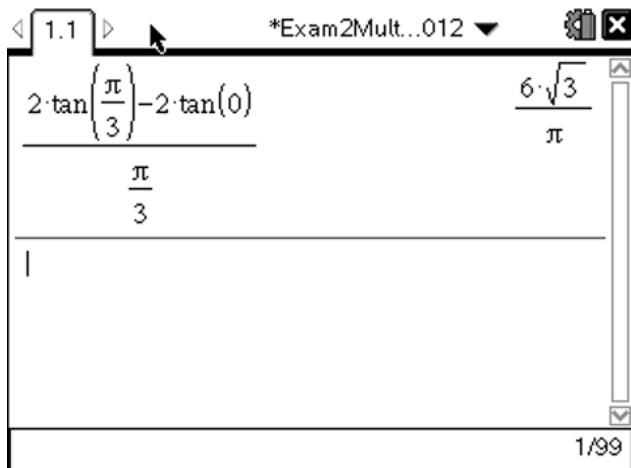
Question 12

$$\text{Average rate of change} = \frac{2 \tan\left(\frac{\pi}{3}\right) - 2 \tan(0)}{\left(\frac{\pi}{3}\right)}$$

$$= \frac{2\sqrt{3}}{\left(\frac{\pi}{3}\right)}$$

$$= \frac{6\sqrt{3}}{\pi}$$

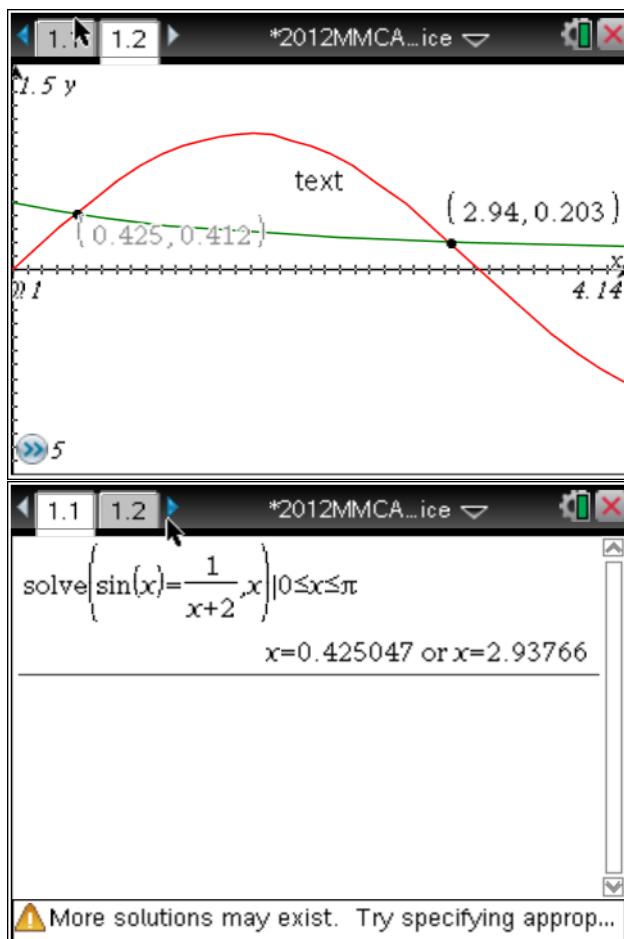
B

**Question 13**

The graphs intersect when $x = 0.425047$ and 2.93766 .

$$\text{Area between curves is given by } \int_{0.425}^{2.938} \left(\sin(x) - \frac{1}{x+2} \right) dx$$

A

**Question 14**

$$\begin{aligned} & 2 \int_1^5 (f(x) + 3) dx \\ &= 2 \int_1^5 (f(x)) dx + 2 \int_1^5 (3) dx \\ &= 2 \times 6 + 2(15 - 3) \end{aligned}$$

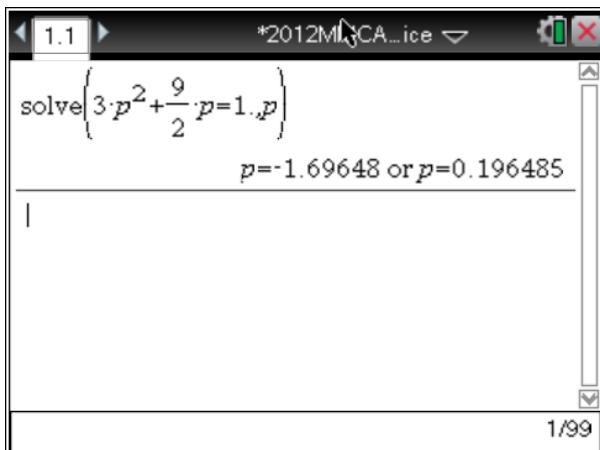
$$= 36$$

E

Question 15

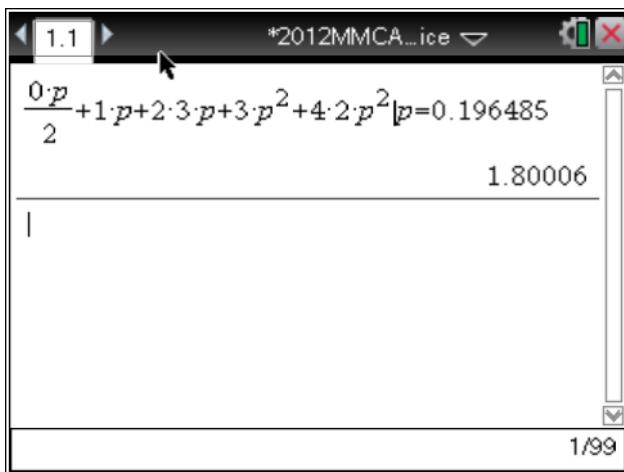
$$\frac{p}{2} + p + 3p + p^2 + 2p^2 = 1$$

$$3p^2 + 4\frac{1}{2}p = 1$$



$$p = 0.196485 \text{ (as } p \in [0,1])$$

$$E(X) = 0 \times \frac{p}{2} + 1 \times p + 2 \times 3p + 3 \times p^2 + 4 \times 2p^2 = 11p^2 + 7p, \text{ and } p = 0.196485$$



$$E(X) = 1.80006$$

$$E(X) = 1.80$$

C

Question 16

Solve $\int_a^2 \left(\frac{3}{16} (4 - x^2) \right) dx = 0.4$ for a

$$a = -3.81043, 0.851437, 2.959$$

Since $0 \leq a \leq 2$

$$a = 0.8514 \text{ correct to 4 decimal places}$$

E

The calculator screen shows the input: $\text{solve} \left\{ \int_{\alpha}^2 \left(\frac{3}{16} \cdot (4-x^2) \right) dx = 0.4, \alpha \right\}$. The output is $\alpha = -3.81043 \text{ or } \alpha = 0.851437 \text{ or } \alpha = 2.959$. The page number 1/99 is visible at the bottom right.

Question 17

Let X be the number of people with blue eyes out of 8.

$$X \sim \text{Bi}(8, 0.36)$$

$$\begin{aligned} \Pr(X = 3 | X < 5) &= \frac{\Pr(X = 3 \cap X < 5)}{\Pr(X < 5)} \\ &= \frac{\Pr(X = 3)}{\Pr(X < 5)} \\ &= \frac{0.28054}{0.970741} \\ &= 0.3181 \end{aligned}$$

B

The calculator screen shows the following inputs and outputs:
 $\text{binomPdf}(8, 0.36, 3) \quad 0.28054$
 $0.28054039182705 \quad 0.318082$
 $\text{binomCdf}(8, 0.36, 0, 4)$
The page number 2/99 is visible at the bottom right.

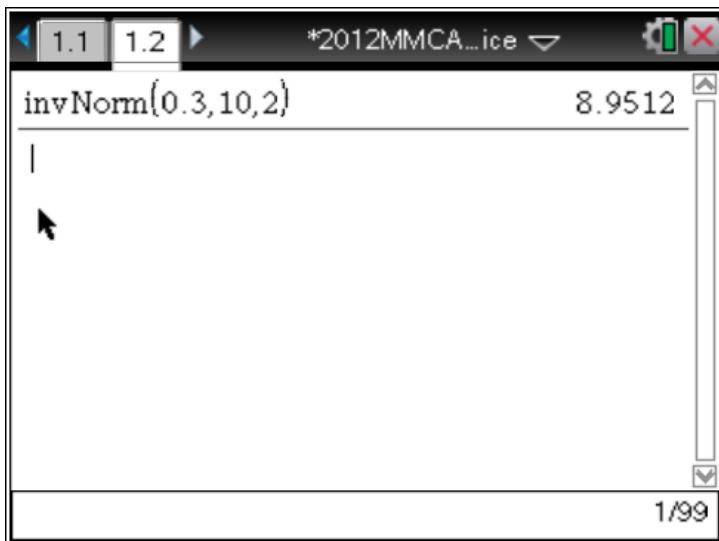
Question 18

$$X \sim N(10, 4)$$

The area under the curve to the left of a is 0.3.

$$A = 8.951 \text{ correct to 3 decimal places}$$

D

**Question 19**

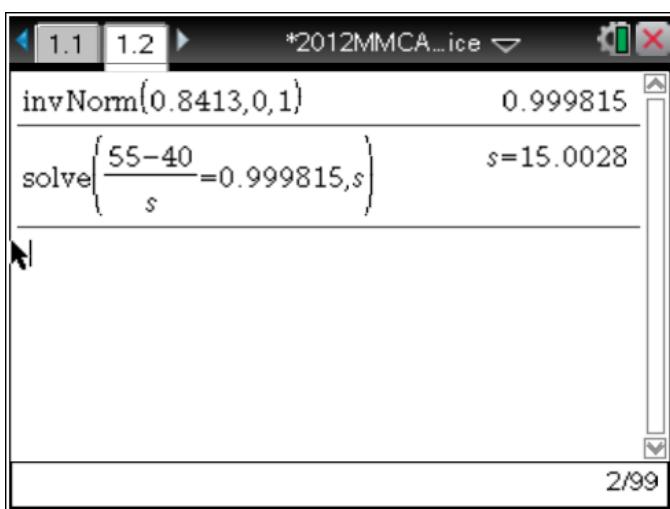
From Standard Normal Curve: $\Pr(Z < a) = 0.8413$

$$a = 0.999815$$

$$\text{Thus } \frac{x - \mu}{\sigma} = 0.999815$$

$$\frac{55 - 40}{\sigma} = 0.999815$$

$$\sigma = 15.0028 \approx 15$$

B**Question 20**

$$-\int_{600}^0 (xf(x))dx = \int_0^{600} (xf(x))dx \quad \mathbf{E}$$

Note The hybrid function can be defined on the calculator if you need to evaluate the expression.

1.2 *2012MMCA...ice

Define $f(x) = \begin{cases} \frac{x}{150000}, & 0 \leq x \leq 500 \\ \frac{1}{50} - \frac{x}{30000}, & 500 < x \leq 600 \end{cases}$

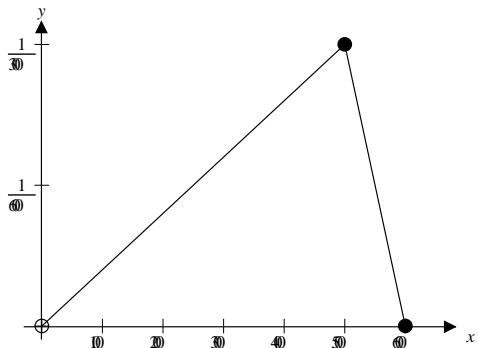
Done

$\int_0^{600} (x f(x)) dx = 366.667$

7/99

OR

$$\begin{aligned} E(X) &= \int_0^{600} (x \times f(x)) dx \\ &= \int_0^{500} \left(x \times \frac{1}{150000} x \right) dx + \int_{500}^{600} \left(x \times \left(\frac{1}{50} - \frac{1}{30000} x \right) \right) dx \\ E(X) &= \frac{1100}{3} = 366 \frac{2}{3} \approx 367 \end{aligned}$$



1.2 *2012MMCA...ice

$\int_0^{500} \frac{x \cdot x}{150000} dx + \int_{500}^{600} \left(x \cdot \left(\frac{1}{50} - \frac{x}{30000} \right) \right) dx = \frac{1100}{3}$

$\frac{1100}{3} = 366.667$

2/99

Question 21

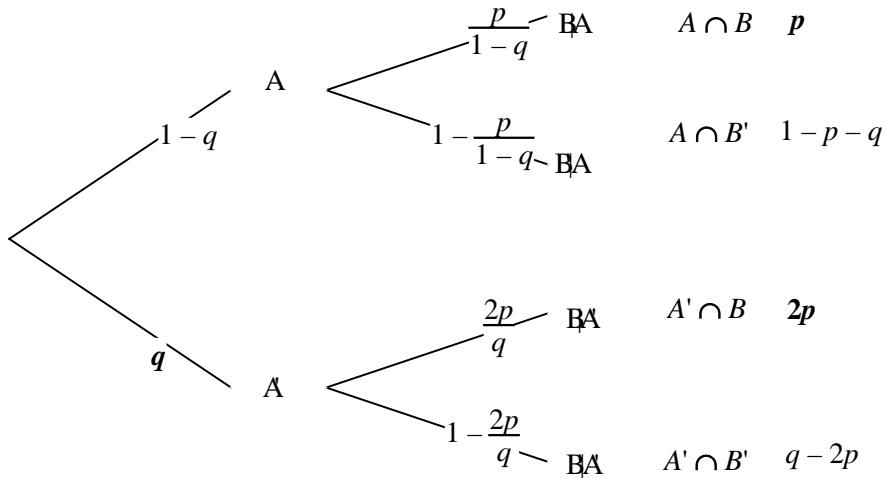
$$\Pr(A \cap B') + \Pr(A \cap B) + \Pr(A') = 1$$

$$\Pr(A \cap B') + p + q = 1$$

$$\Pr(A \cap B') = 1 - p - q$$

C**OR**

Using a tree diagram



$$\text{From tree diagram: } \Pr(A \cap B') = 1 - p - q$$

C**OR**

$$\text{Using a Karnaugh Map: } \Pr(A \cap B') = 1 - p - q$$

C

	A	A'	
B	p	$2p$	$3p$
B'	$1 - p - q$	$q - 2p$	$1 - 3p$
	$1 - q$	Q	1

Question 22

$$V = \frac{1}{3}\pi r^2 h$$

$$\text{Given } 2r = h \Rightarrow r = \frac{h}{2}$$

$$V = \frac{1}{3}\pi \frac{h^3}{4}$$

$$= \frac{\pi h^3}{12}$$

$$\frac{dV}{dh} = \frac{\pi h^2}{4}$$

D

SECTION 2
Solutions to the Extended Answer

Question 1

a.i. $\sin(x) = \frac{h}{PQ}$

$$PQ = \frac{h}{\sin(x)} \quad \mathbf{1A}$$

ii. $QR + 2 \times PQ = 20 \quad (PQ = RS)$

$$\begin{aligned} QR &= 20 - 2 \times \frac{h}{\sin(x)} \\ &= 2 \left(10 - \frac{h}{\sin(x)} \right) \quad \text{as required} \quad \mathbf{1M} \end{aligned}$$

b. i. $PS = QR + 2 \times \frac{h}{\tan(x)}$ **1M**

$$\begin{aligned} &= 20 - \frac{2h}{\sin(x)} + \frac{2h}{\tan(x)} \\ &= 2 \left(10 - \frac{h}{\sin(x)} + \frac{h}{\tan(x)} \right) \end{aligned}$$

ii. Area = $\frac{PS + QR}{2} \times h$ **1M**

$$\begin{aligned} &= \frac{2 \left(10 - \frac{h}{\sin(x)} + \frac{h}{\tan(x)} \right) + 2 \left(10 - \frac{h}{\sin(x)} \right)}{2} \times h \\ &= 20h - \frac{2h^2}{\sin(x)} + \frac{h^2}{\tan(x)} \quad \text{as required} \quad \mathbf{1M} \end{aligned}$$

iii. $A : \left(0, \frac{\pi}{2}\right) \rightarrow R, A(x) = 100 - \frac{50}{\sin(x)} + \frac{25}{\tan(x)}$ **1A**

c. $A'(x) = \frac{50\cos(x) - 25}{\sin^2(x)}$ **1A**

Maximum when $A'(x) = 0$

$$x = \frac{\pi}{3} \text{ as required} \quad \mathbf{1M}$$

The calculator screen shows the derivative of the function and its solution. The top part shows the derivative $\frac{d}{dx} \left(100 - \frac{50}{\sin(x)} + \frac{25}{\tan(x)} \right) = \frac{25 \cdot (2 \cdot \cos(x) - 1)}{(\sin(x))^2}$. Below that, the solve command is used: $\text{solve} \left(\frac{25 \cdot (2 \cdot \cos(x) - 1)}{(\sin(x))^2} = 0, x \right) | 0 \leq x \leq \frac{\pi}{2}$, resulting in $x = \frac{\pi}{3}$. The bottom status bar shows 2/99.

d. i. $A\left(\frac{\pi}{3}\right) = 20h - 2h^2 \times \frac{2}{\sqrt{3}} + h^2 \times \frac{1}{\sqrt{3}}$

$$= 20h - \sqrt{3}h^2 \quad \mathbf{1A}$$

The calculator screen shows the area formula and its derivative. The top part shows the formula $20 \cdot h - \frac{2 \cdot h^2}{\sin(x)} + \frac{h^2}{\tan(x)} | x = \frac{\pi}{3}$. Below that, the derivative is shown as $20 \cdot h - h^2 \cdot \sqrt{3}$. The bottom status bar shows 1/99.

ii. Solve $\frac{dA}{dh} = 0$ **1M** (accept other methods)

$$h = 5.8 \text{ metres} \quad \mathbf{1A}$$

$$A(5.7735) \approx 57.7$$

Maximum area is 57.7 square metres **1A**

1.1 1.2 1.3 *Unsaved

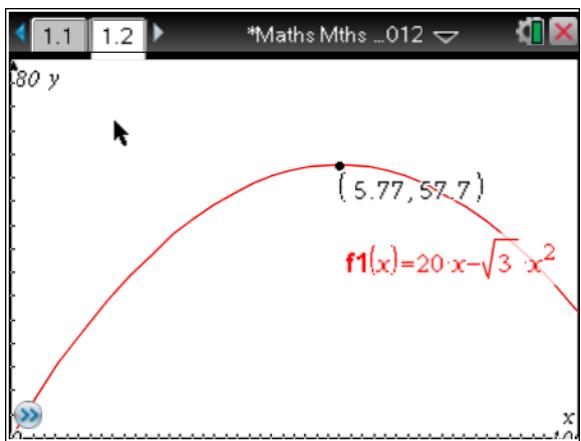
solve $\left(\frac{d}{dh}\left(20\cdot h-h^2\cdot \sqrt{3}\right)=0,h\right)$ $h=\frac{10\cdot \sqrt{3}}{3}$

solve $\left(\frac{d}{dh}\left(20\cdot h-h^2\cdot \sqrt{3}\right)=0,h\right)$ $h=5.7735$

$20\cdot h-\frac{2\cdot h^2}{\sin(x)}+\frac{h^2}{\tan(x)}|x=\frac{\pi}{3}$ and $h=\frac{10\cdot \sqrt{3}}{3}$

57.735

6/99



1.2 1.3 1.4 *Unsaved

fMax $\left(20\cdot h-\frac{2\cdot h^2}{\sin(x)}+\frac{h^2}{\tan(x)},h\right)|x=\frac{\pi}{3}$

$h=5.7735$

$20\cdot h-\frac{2\cdot h^2}{\sin(x)}+\frac{h^2}{\tan(x)}|x=\frac{\pi}{3}$ and $h=5.7735$

57.735

16/99

Question 2

a. i. Solve $k + 0.3(0.7 + 0.7^2 + 0.7^3 + 0.7^4 + 0.7^5) = 1$ for k **1M**

$$k = 0.417649 = 0.418 \text{ correct to 3 decimal places as required} \quad \mathbf{1M}$$

The calculator screen shows the following input and output:

```

1.1 *Unsaved
k+sum(0.3*(0.7)^x|x={1,2,3,4,5})
k+0.582351
solve(k+0.582351=1,k)
k=0.417649
2/99

```

ii. $\Pr(x \leq 3) \approx 0.418 + 0.3(0.7 + 0.7^2 + 0.7^3)$ **1M**

$$= 0.878 \text{ correct to 3 decimal places} \quad \mathbf{1A}$$

The calculator screen shows the following input and output:

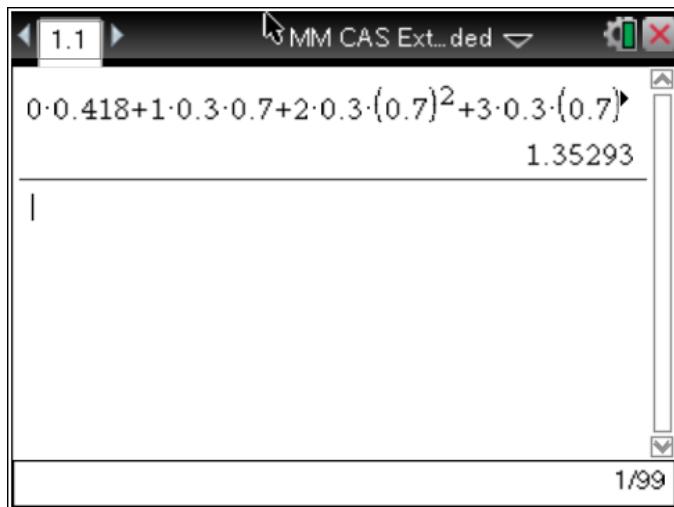
```

1.1 1.2 1.3 *Maths Mths ...012
sum(0.3*(0.7)^x|x={1,2,3})+0.418 0.8779
1/99

```

b. $E(X) = 0 \times 0.418 + 1 \times 0.3 \times 0.7 + 2 \times 0.3 \times 0.7^2 + 3 \times 0.3 \times 0.7^3 + 4 \times 0.3 \times 0.7^4 + 5 \times 0.3 \times 0.7^5$

$= 1.35$ correct to 2 decimal places **1A**

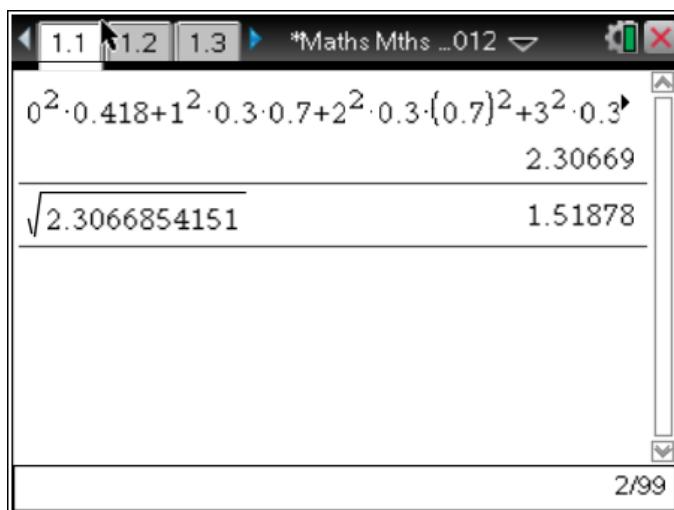


ii.

$$\text{Var}(X) = (0^2 \times 0.418 + 1^2 \times 0.3 \times 0.7 + 2^2 \times 0.3 \times 0.7^2 + 3^2 \times 0.3 \times 0.7^3 + 4^2 \times 0.3 \times 0.7^4 + 5^2 \times 0.3 \times 0.7^5) - (1.3529...)^2$$
1M

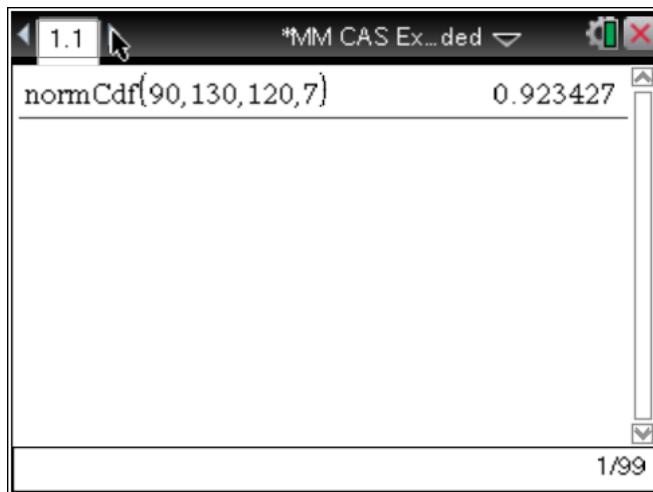
$$\text{Var}(X) \approx 2.3066$$

$$\text{SD}(X) = \sqrt{\text{Var}(X)} \approx \sqrt{2.3067} \approx 1.5187 = 1.52 \text{ correct to 2 decimal places}$$
1A



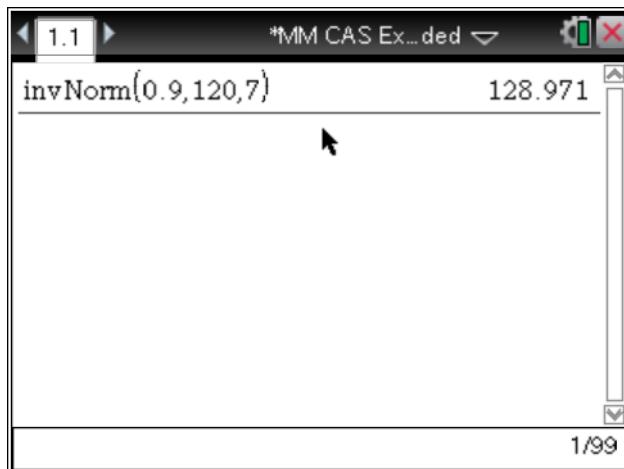
c. i. $\Pr(90 < X < 130) = 0.9234$ correct to 4 decimal places

1A



ii. $\Pr(X > a) = 0.1$

$a \approx 128.97 = 129$ minutes to the nearest minute **1A**



iii. $\Pr(X > 126 | 90 < X < 130)$

$$= \frac{\Pr(126 < X < 130)}{\Pr(90 < X < 130)} \quad \mathbf{1M}$$

$$\approx \frac{0.119119...}{0.923427...}$$

$$= 0.1290 \text{ correct to 4 decimal places as required} \quad \mathbf{1M}$$

1.1	*MM CAS Ex...ded
normCdf(126,130,120,7)	0.119119
normCdf(90,130,120,7)	0.923427
0.1191191487553	0.128997
0.92342711458099	
	3/99

d. i. $E(C) = 34 + 1.25 \times 120 = \184 **1A**

ii. $\text{Var}(C) = 1.25^2 \times 49$
 $= 76.5625$ **1A**

$\text{SD}(C) = \sqrt{\text{Var}(C)} = \8.75 **1A**

1.1	*MM CAS Ex...ded
34+1.25·120	184.
(1.25) ² ·49	76.5625
$\sqrt{76.5625}$	8.75
	3/99

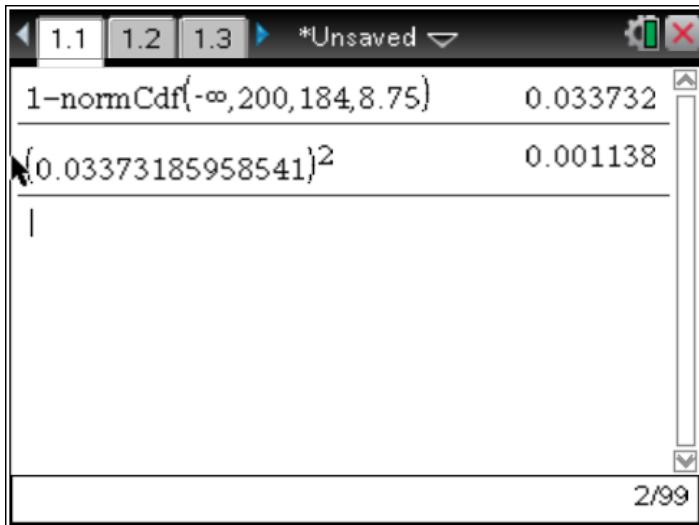
iii. $184 - 2 \times 8.75 \leq C \leq 184 + 2 \times 8.75$ **1M**

$\$166.50 \leq C \leq \201.50 **1A**

iv. $\Pr(C > 200) \approx 0.03373$ OR

$\Pr(C > 200) = 1 - \Pr(C < 200) \approx 1 - 0.966268 \approx 0.03373$ **1M**

For two months $\approx 0.033732 \times 0.033732 = 0.0011$ correct to 4 decimal places **1A**

**Question 3**

- a. $f : (-\infty, 2] \rightarrow R$, where $f(x) = (x - 2)^2 + 1$

Let $y = (x - 2)^2 + 1$.

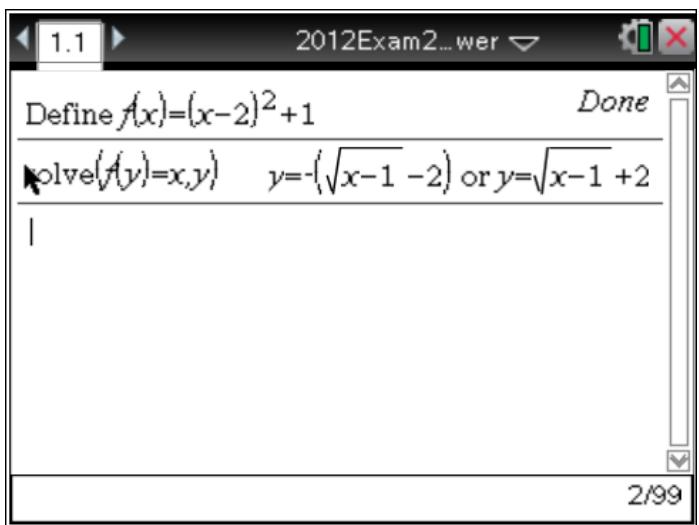
Inverse: swap x and y **1M**

$$x = (y - 2)^2 + 1$$

$$y = -\sqrt{(x - 1)} + 2 \text{ due to the domain of } f$$

$$f^{-1} : [1, \infty) \rightarrow R, \text{ where } f^{-1}(x) = -\sqrt{(x - 1)} + 2$$

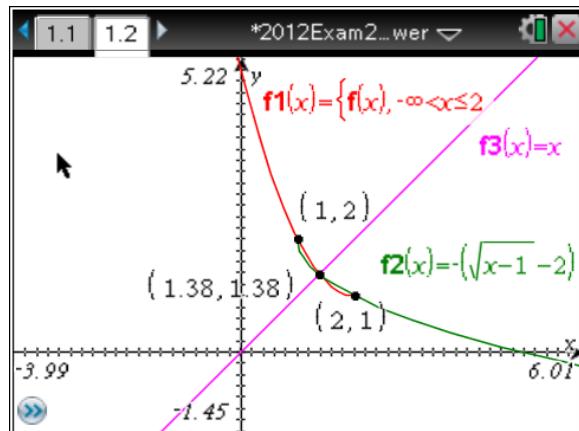
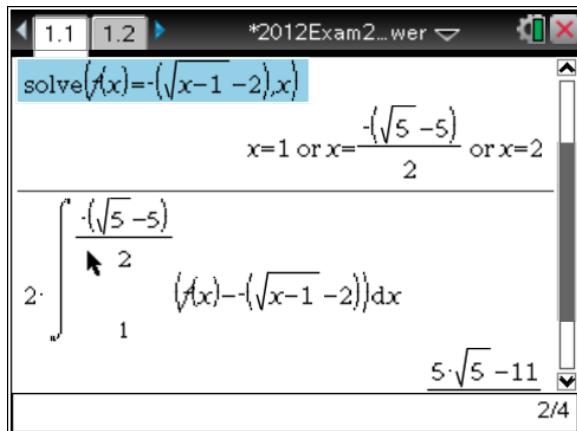
1A Domain 1A Rule



b. Solve $f(x) = f^{-1}(x)$

$$x=1 \text{ or } x=\frac{-\sqrt{5}+5}{2} \text{ or } x=2 \quad \mathbf{1M}$$

Area $2 \times \int_1^2 (f(x) - f^{-1}(x)) dx \quad \mathbf{1A}$



c. 0, 1 or 3 solutions

Any 2 correct $\mathbf{1A}$

All correct $\mathbf{2A}$

d. Cross sectional area $= \frac{5\sqrt{5}-11}{3} \div 2$

$$= \frac{5\sqrt{5}-11}{6}$$

$$\begin{aligned} \text{Volume} &= \frac{5\sqrt{5}-11}{6} \times 2 \\ &= \frac{5\sqrt{5}-11}{3} \text{ m}^3 \quad \mathbf{1A} \end{aligned}$$

e. $\frac{dV}{dt} = -2 \log_e(t+1) \text{ cm}^3/\text{min} \quad \mathbf{1M}$

$$\begin{aligned} V &= -\int (2 \log_e(t+1)) dt \\ &= -2(t+1) \log_e(t+1) + 2(t+1) + c, \quad \left(0, \frac{100^3(5\sqrt{5}-11)}{3}\right) \mathbf{1M} \end{aligned}$$

$$V = -2(t+1) \log_e(t+1) + 2(t) + \frac{100^3(5\sqrt{5} - 11)}{3}$$

Solve $0 = -2(t+1) \log_e(t+1) + 2(t) + \frac{100^3(5\sqrt{5} - 11)}{3}$ for t **1M**

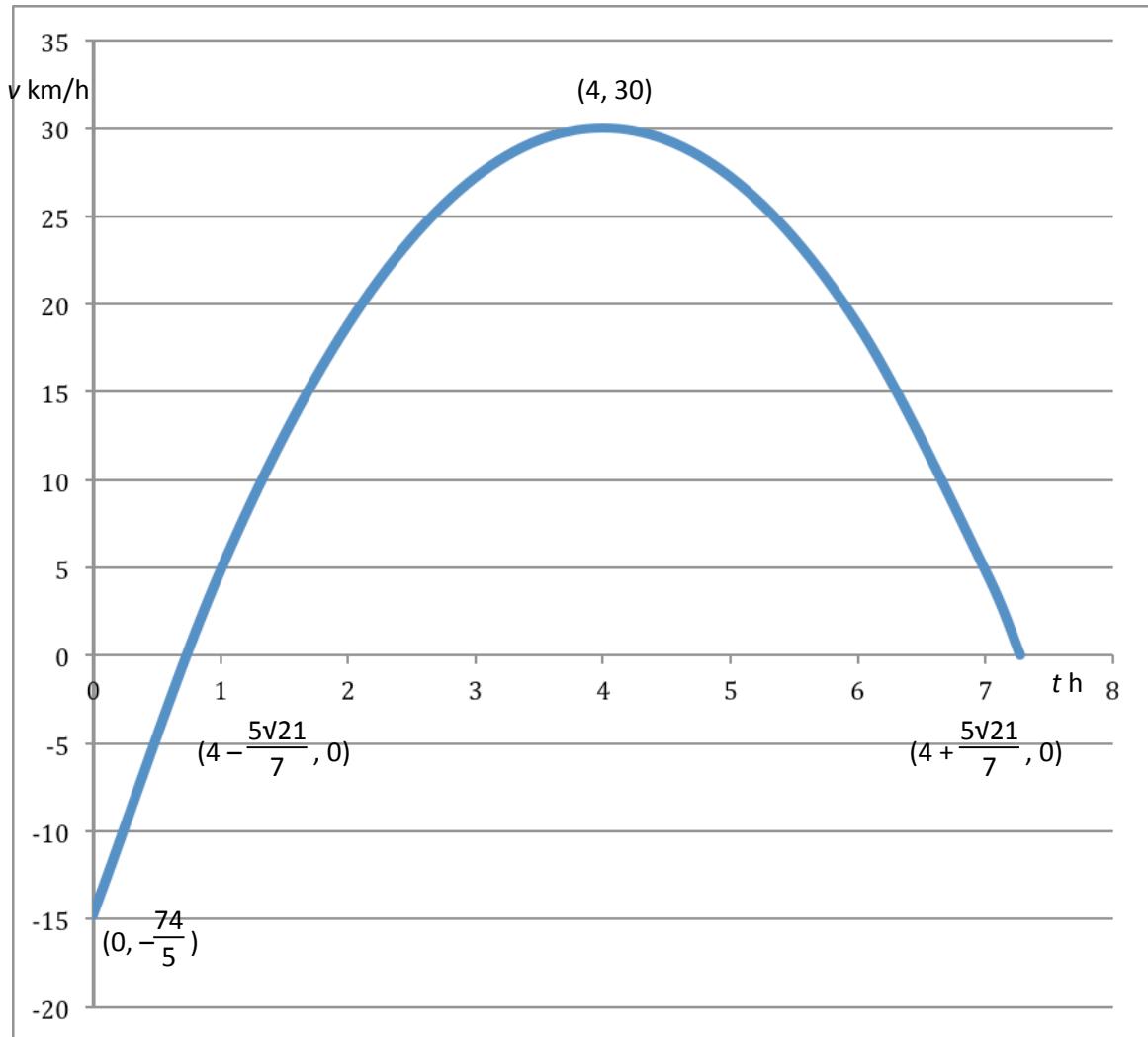
$t = 4105$ minutes to the nearest minute **1A**

OR

$$\frac{dV}{dt} = -2 \log_e(t+1) \text{ cm}^3/\text{min} \quad \mathbf{1M}$$

Solve $\int_0^a 2(\log_e(1+t))dt = \frac{100^3(5\sqrt{5} - 11)}{3}$ for a . **1A terminals, 1A equation**

$t = 4105$ minutes to the nearest minute **1A**

Question 4**a.**Shape **1A**Correct coordinates **1A**Turning point $(4, 30)$

$$x\text{-axis intercepts } \left(-\frac{5}{7}\sqrt{21} + 4, 0\right) \left(\frac{5}{7}\sqrt{21} + 4, 0\right)$$

$$y\text{-axis intercept } (0, -\frac{74}{5})$$

$$\mathbf{b. } v(t) = -\frac{14}{5}(t-4)^2 + 30$$

$$x(t) = \int \left(-\frac{14}{5}(t-4)^2 + 30 \right) dt \quad \mathbf{1M}$$

$$= -\frac{14(t-4)^3}{15} + 30t + c,$$

when $t = 0, x = 0$

$$c = -\frac{896}{15}$$

$$x(t) = -\frac{14(t-4)^3}{15} + 30t - \frac{896}{15} \quad \mathbf{1A}$$

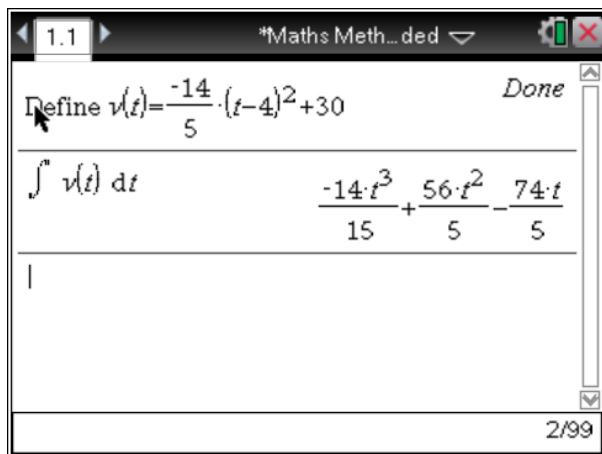
OR

$$x(t) = \int \left(-\frac{14}{5}(t-4)^2 + 30 \right) dt \quad \mathbf{1M}$$

$$x(t) = -\frac{14}{15}t^3 + \frac{56}{5}t^2 - \frac{74}{5}t + c$$

when $t = 0, x = 0$, hence $c = 0$

$$x(t) = -\frac{14}{15}t^3 + \frac{56}{5}t^2 - \frac{74}{5}t \quad \mathbf{1A}$$



$$\text{c.i. } v(t) = -\frac{14}{5}(t-4)^2 + 30$$

Solve $v(t) = 0$ for t

$$t = -\frac{5}{7}\sqrt{21} + 4 \quad \mathbf{1M}$$

$$x\left(-\frac{5}{7}\sqrt{21} + 4\right) \approx -5.1987 \text{ km}$$

Tasmania rides 5199 m to the nearest metre

1A

OR

Solve $v(t) = 0$ for t

$$t = -\frac{5}{7}\sqrt{21} + 4 \quad \mathbf{1M}$$

$$\text{distance} = - \int_0^{-\frac{5}{7}\sqrt{21}+4} (v(t)) dt \approx 5.1987$$

Tasmania rides 5199 m to the nearest metre

1A

ii. Solve $x(t)=0$

$$t \approx 1.51192 \text{ h}$$

$\approx 91 \text{ min}$

10:31 am

1A

(solve($x(t)=0, t$)) ► Decimal
 $t=0. \text{ or } t=1.51192 \text{ or } t=10.4881$
 $1.51192 \cdot 60 \quad 90.7152$

OR

Solve $\int_{-5/7\sqrt{21}+4}^a v(t) dt = 1.51192\dots$ for a

$$t \approx 1.51192 \text{ h}$$

$\approx 91 \text{ min}$

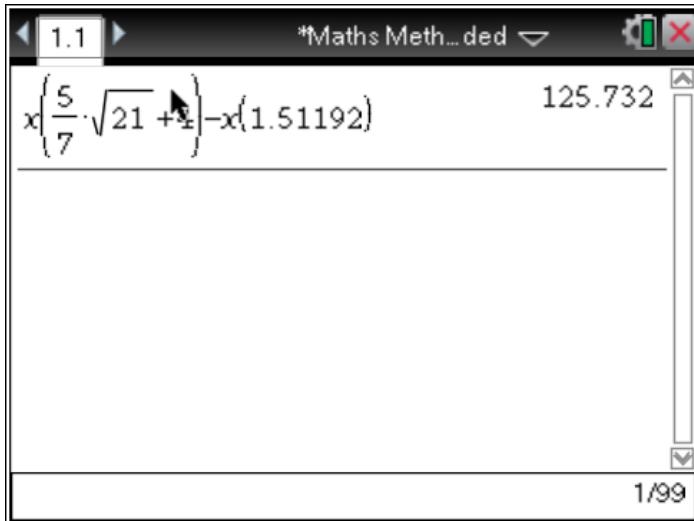
10:31 am

1A

$\int_0^a \sqrt{t} dt$
 $\text{solve} \left\{ \int_0^a \sqrt{t} dt = 5.1987, a \right\}$
 $a=2.73062 \cdot 10^{-8} \text{ or } a=1.51192 \text{ or } a=10.4881$

iii. Distance $\approx x\left(\frac{5}{7}\sqrt{21} + 4\right) - x(1.51192\dots)$ **1M**

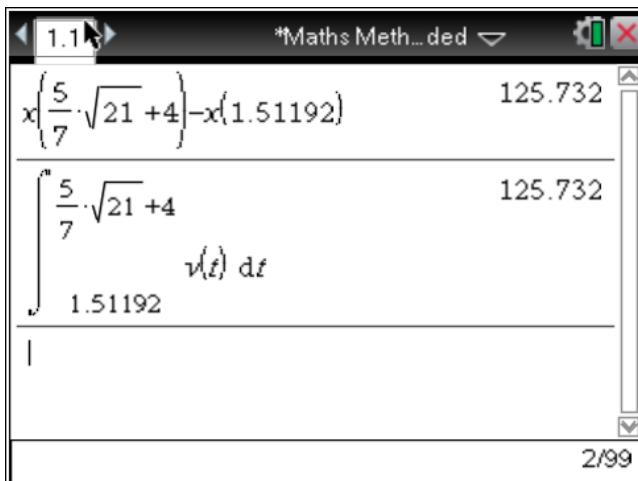
= 126 km to the nearest kilometre **1A**



OR

Distance $\approx \int_{1.51192\dots}^{\frac{5}{7}\sqrt{21}+4} (v(t)) dt$ **1M**

= 126 km to the nearest kilometre **1A**



iv. Average velocity = $\frac{\text{displacement}}{\text{change in time}}$ **1M**

$$\approx \frac{125.732...}{\left(\frac{5}{7}\sqrt{21} + 4\right) - 1.51192...}$$

= 21.8 km/h correct to one decimal place

1A

OR

$$\text{Average value of } v \approx \frac{1}{\left(\frac{5}{7}\sqrt{21} + 4\right) - 1.51192...} \int_{1.51192...}^{\frac{5}{7}\sqrt{21}+4} (v(t)) dt \quad \mathbf{1M}$$

= 21.8 km/h correct to one decimal place

1A

d. Distance between Strathton and Coram is approximately 125.732... km.

First checkpoint is at approximately $\frac{125.732...}{3} = 41.9107\dots$ km from Strathton. **1M**

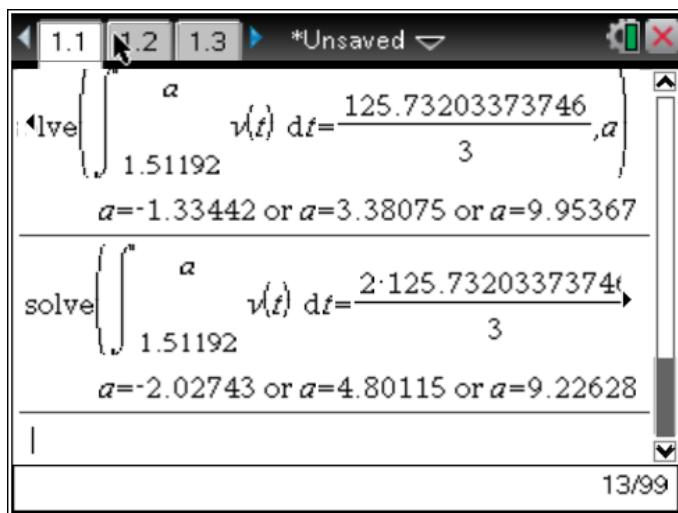
Second checkpoint is at approximately $\frac{2 \times 125.732...}{3} = 83.8213\dots$ km from Strathton.

Time to reach first checkpoint: solve for a : $\int_{1.5119\dots}^a v(t) dt = \frac{125.732...}{3}$. **1M**

$$a \approx 3.3807\dots \text{ hrs} \Rightarrow 12.23 \text{ pm} \quad \mathbf{1A}$$

Second checkpoint: $\int_{1.5119\dots}^a v(t) dt = \frac{2 \times 125.732...}{3}$

$$a \approx 4.8011\dots \text{ hrs} \Rightarrow 1.48 \text{ pm} \quad \mathbf{1A}$$



OR

Distance between Strathton and Coram is approximately 125.732... km.

First checkpoint is at approximately $\frac{125.732...}{3} = 41.9107\dots$ km from Strathton. **1M**

Second checkpoint is at approximately $\frac{2 \times 125.732...}{3} = 83.8213\dots$ km from Strathton.

Time to reach first checkpoint: solve for a : $x(a) \approx \frac{125.732...}{3}$. **1M**

$$a \approx 3.3807\dots \text{ hrs} \Rightarrow 12.23 \text{ pm} \quad \mathbf{1A}$$

Second checkpoint: $x(a) \approx \frac{2 \times 125.732...}{3}$

$a \approx 4.8011\dots$ hrs $\Rightarrow 1.48$ pm

1A

The screenshot shows the TI-Nspire CX CAS calculator interface. The top menu bar has tabs 1.1, 1.2, and 1.3 selected. A status bar at the top right says "*Unsaved". The main workspace displays two solve commands:

$\text{solve}\left(x(a)=\frac{125.73203373746}{3}, a\right)$
 $a=-1.33442 \text{ or } a=3.38075 \text{ or } a=9.95367$

$\text{solve}\left(x(a)=\frac{2 \cdot 125.73203373746}{3}, a\right)$
 $a=-2.02743 \text{ or } a=4.80115 \text{ or } a=9.22628$

Below the workspace, there is a table with two rows:

0.38075·60	22.845
0.80115·60	48.069

A vertical scroll bar is visible on the right side of the workspace.