

MATHEMATICAL METHODS (CAS) 2012

Trial Written Examination 2 SOLUTIONS

SECTION 1

Answers:

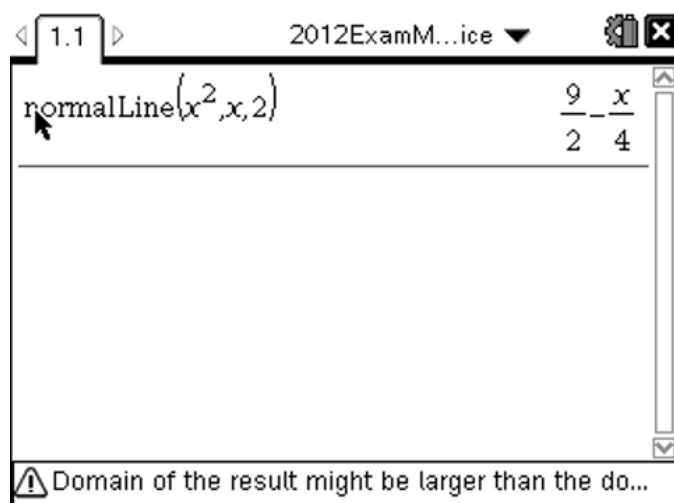
1. C 2. B 3. A 4. E 5. B 6. D 7. D 8. C 9. D 10. C 11. A
12. B 13. A 14. E 15. C 16. E 17. B 18. D 19. B 20. E 21. C 22. D

Question 1

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

$$x + 4y = 18$$

C



OR

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

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

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

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

$$x + 4y = 18$$

C

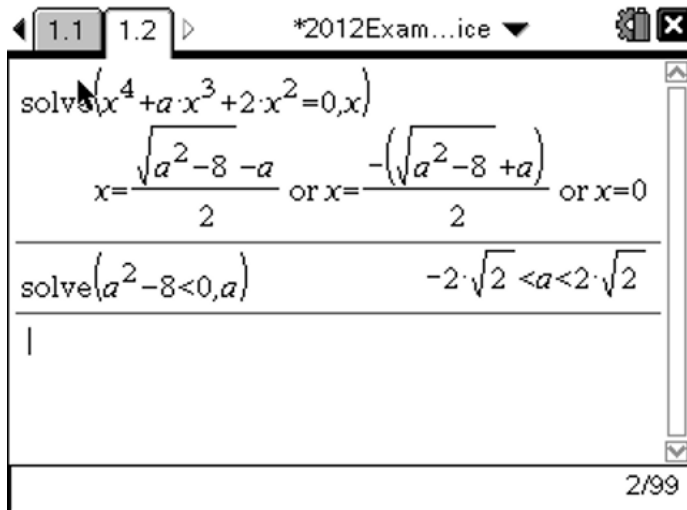
Question 2

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

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

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

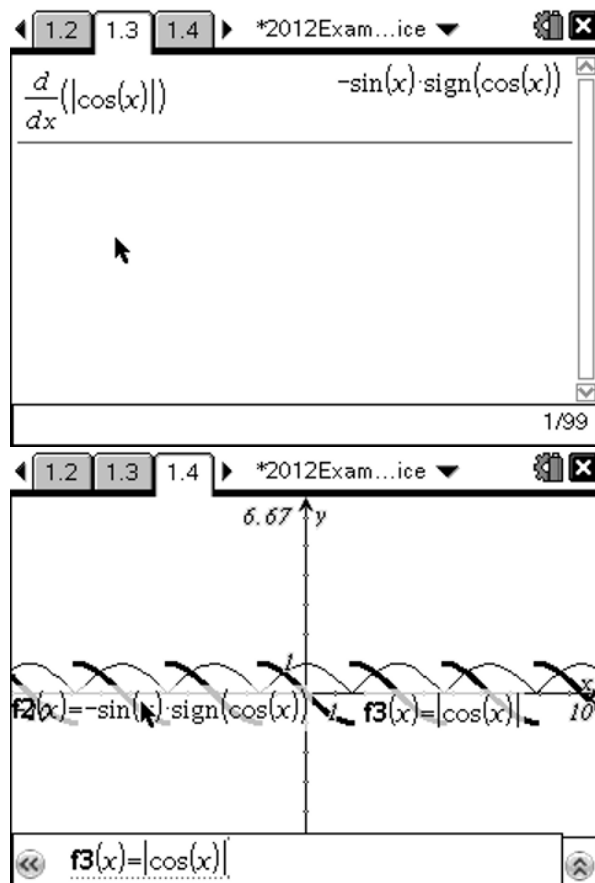
$$-2\sqrt{2} < a < 2\sqrt{2}$$

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

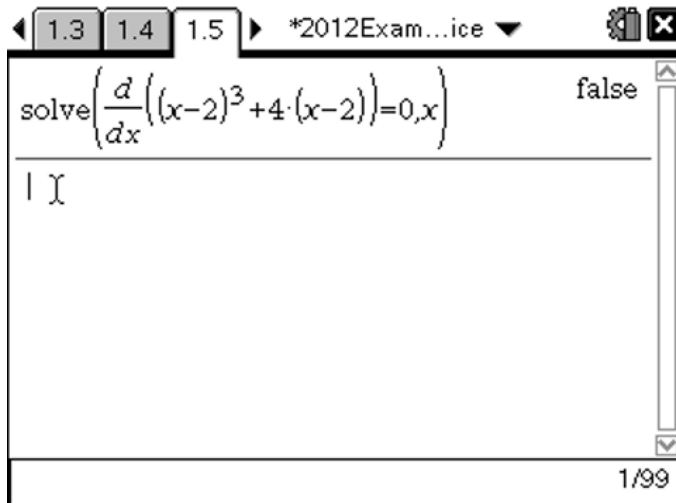
The curve in Option B is a translation of the curve in Option A 2 units up.

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.

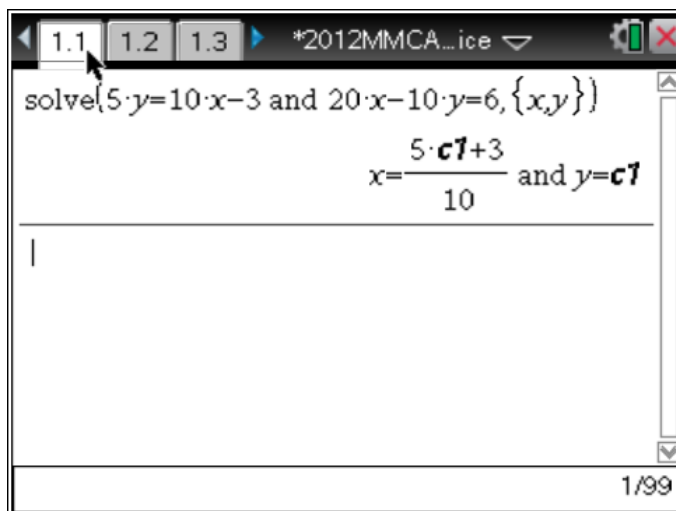
Option D $f(x) = x^4 + 4x$, $f'(x) = 4x^3 + 4$, one stationary point

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

**Question 5**

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

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

**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 $x = \frac{1}{2}$

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

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

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

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

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

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

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

Question 8

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

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

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

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

Question 9

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

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

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

$$\text{Period is } 10:$$

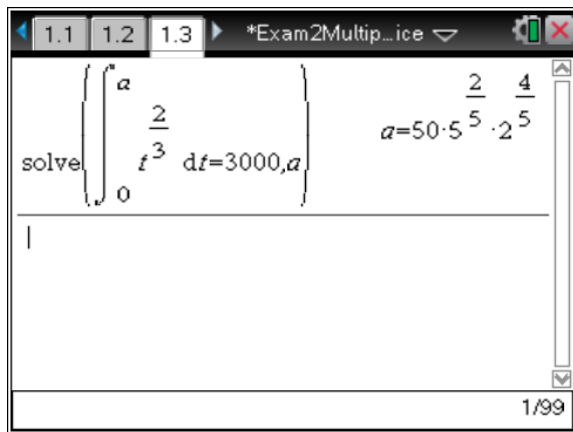
$$n = \frac{\pi}{5}$$

$$\text{There is a vertical translation of 2 units} \Rightarrow b = 2 \quad \mathbf{D}$$

Question 10

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

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

C**OR**

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

$$v = -\int \left(t^{\frac{2}{3}}\right) dt$$

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

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

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

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

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

C**Question 11**

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

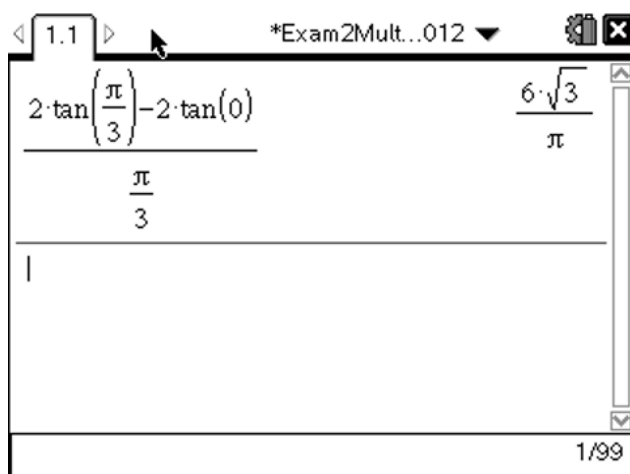
$$x = 121, h = -0.1, f(x) = \frac{1}{\sqrt{x}}, f'(x) = -\frac{1}{2}x^{-\frac{3}{2}}$$

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

A

Question 12

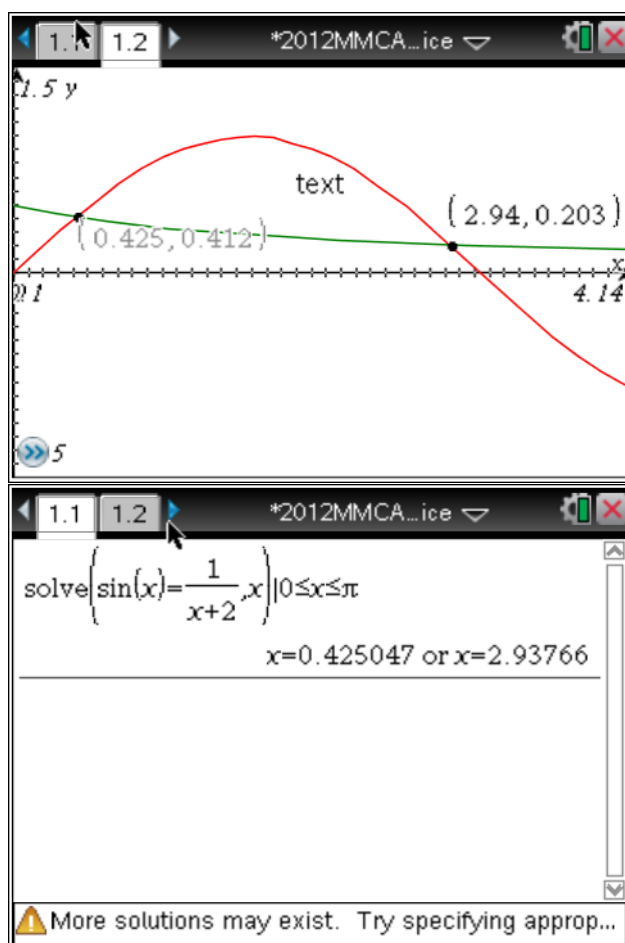
$$\begin{aligned} \text{Average rate of change} &= \frac{2 \tan\left(\frac{\pi}{3}\right) - 2 \tan(0)}{\left(\frac{\pi}{3}\right)} \\ &= \frac{2\sqrt{3}}{\left(\frac{\pi}{3}\right)} \\ &= \frac{6\sqrt{3}}{\pi} \end{aligned}$$

B**Question 13**

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

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

A

**Question 14**

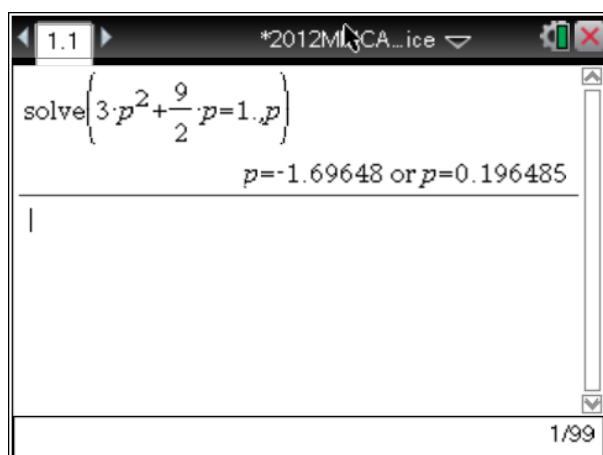
$$\begin{aligned}
 & 2 \int_1^5 (f(x) + 3) dx \\
 &= 2 \int_1^5 f(x) dx + 2 \int_1^5 (3) dx \\
 &= 2 \times 6 + 2(15 - 3)
 \end{aligned}$$

$$= 36 \quad \mathbf{E}$$

Question 15

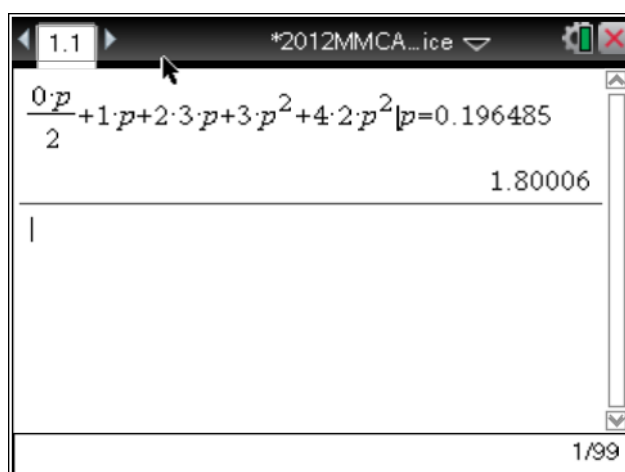
$$\frac{p}{2} + p + 3p + p^2 + 2p^2 = 1$$

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



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

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



$$E(X) = 1.80006$$

$$E(X) = 1.80$$

C

Question 16

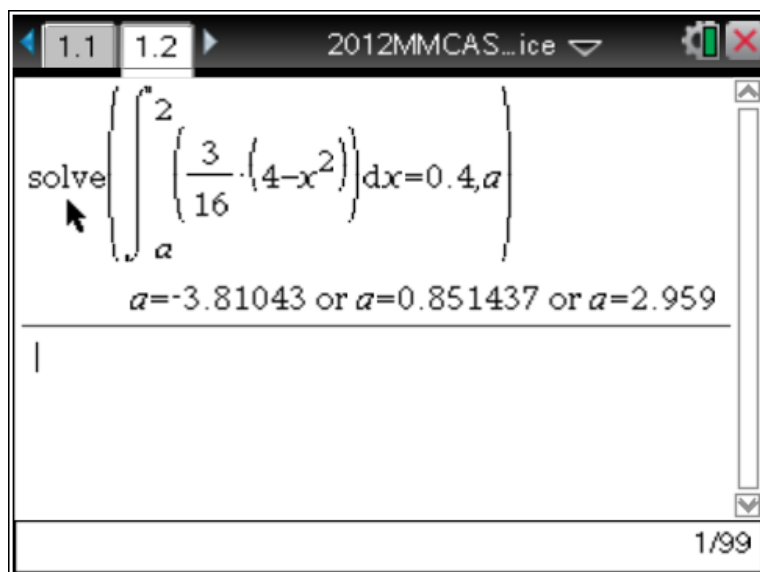
$$\text{Solve } \int_a^2 \left(\frac{3}{16} (4 - x^2) \right) dx = 0.4 \text{ for } a$$

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

$$\text{Since } 0 \leq a \leq 2$$

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

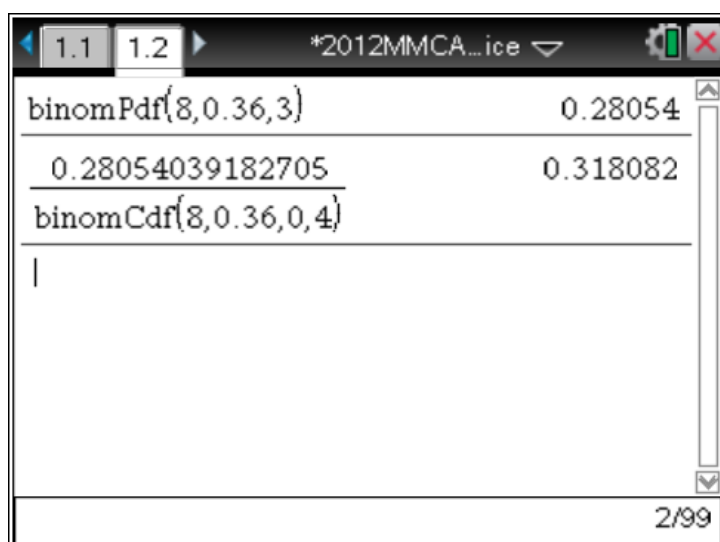
E

**Question 17**

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

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

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

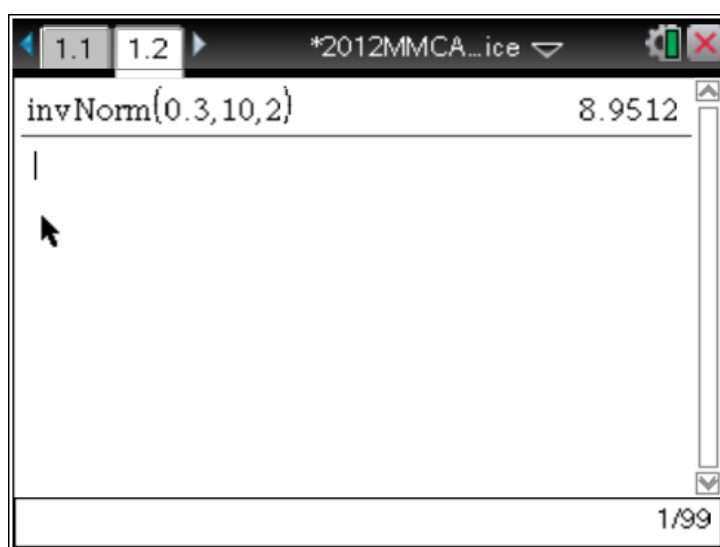
B**Question 18**

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

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

$A = 8.951$ correct to 3 decimal places

D

**Question 19**

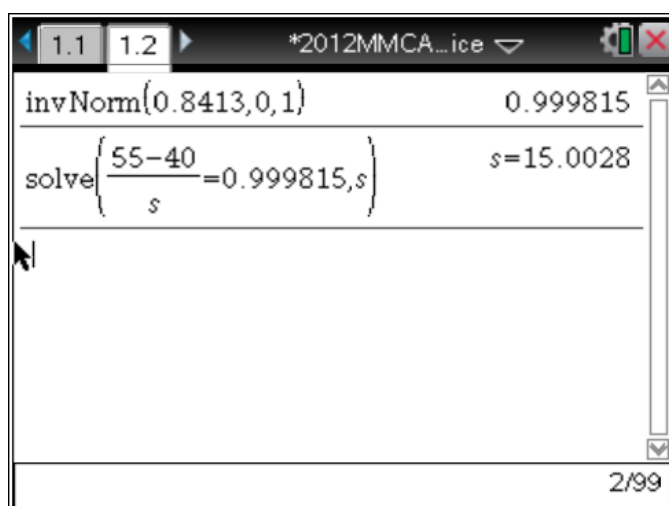
From Standard Normal Curve: $\Pr(Z < a) = 0.8413$

$$a = 0.999815$$

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

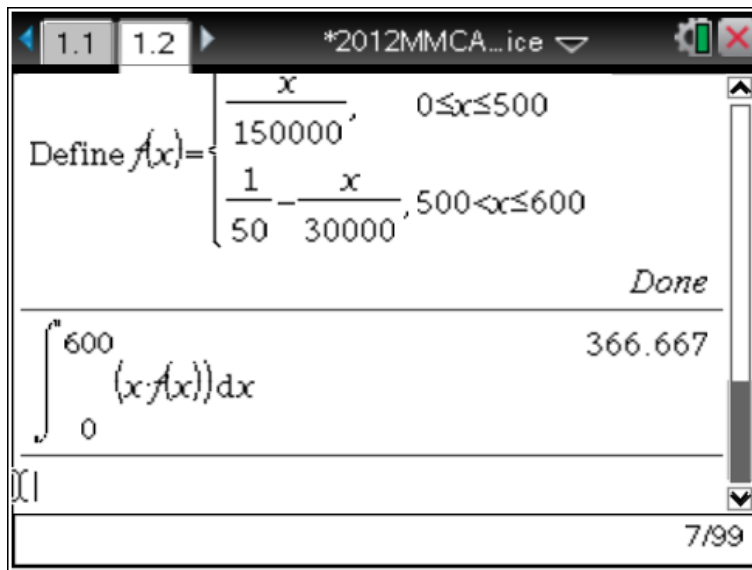
$$\frac{55 - 40}{\sigma} = 0.999815$$

$$\sigma = 15.0028 \approx 15$$

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.

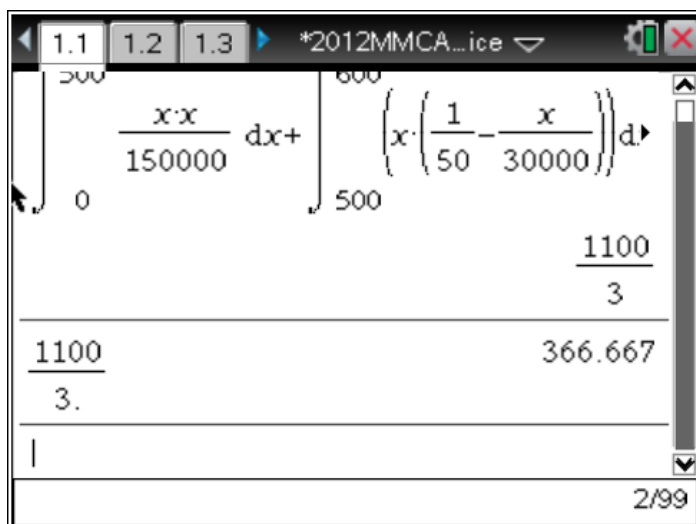
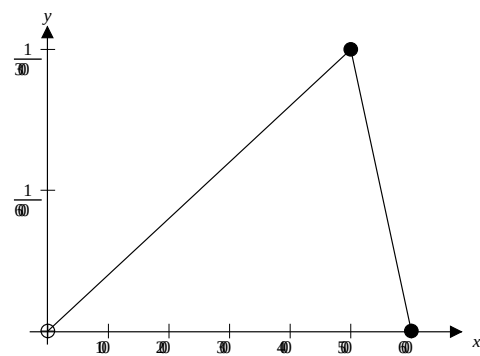


OR

$$E(X) = \int_0^{600} (x \cdot f(x)) dx$$

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

$$E(X) = \frac{1100}{3} = 366\frac{2}{3} \approx 367$$

**Question 21**

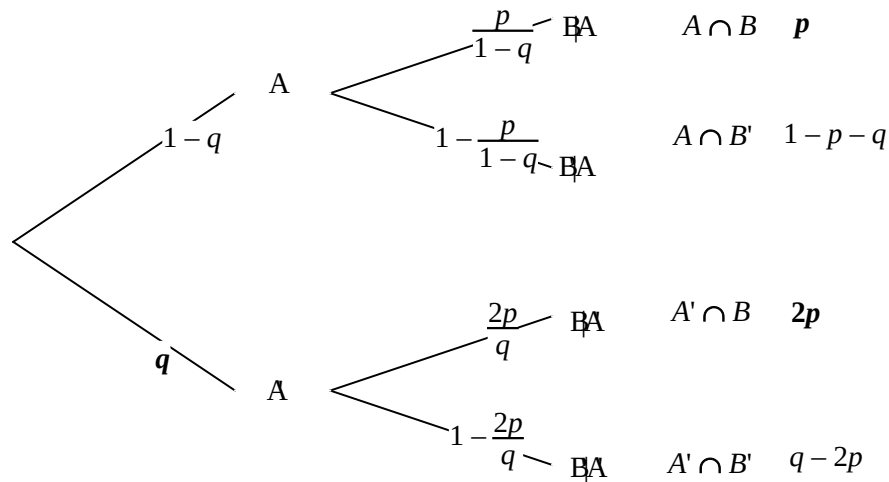
$$\Pr(A \cap B') + \Pr(A \cap B) + \Pr(A') = 1$$

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

$$\Pr(A \cap B') = 1 - p - q \quad \mathbf{C}$$

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. $PS = QR + 2 \times \frac{h}{\tan(x)} \quad \mathbf{1M}$

$$= 20 - \frac{2h}{\sin(x)} + \frac{2h}{\tan(x)} \quad \mathbf{1A}$$

$$= 2 \left(10 - \frac{h}{\sin(x)} + \frac{h}{\tan(x)} \right)$$

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

$$= \frac{2 \left(10 - \frac{h}{\sin(x)} + \frac{h}{\tan(x)} + 10 - \frac{h}{\sin(x)} \right)}{2} \times h$$

$$= 20h - \frac{2h^2}{\sin(x)} + \frac{h^2}{\tan(x)} \quad \text{as required} \quad \mathbf{1M}$$

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

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

Maximum when $A'(x) = 0$

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

A screenshot of a CAS calculator interface. The top bar shows tabs 1.1 and 1.2, and a status bar indicates '*Unsaved'. The main display area shows the derivative of the function from the previous step: $\frac{d}{dx} \left(100 - \frac{50}{\sin(x)} + \frac{25}{\tan(x)} \right) = \frac{25 \cdot (2 \cdot \cos(x) - 1)}{(\sin(x))^2}$. Below this, the equation is set to zero and solved for x: $\text{solve} \left(\frac{25 \cdot (2 \cdot \cos(x) - 1)}{(\sin(x))^2} = 0, x \right) | 0 \leq x \leq \frac{\pi}{2}$, resulting in $x = \frac{\pi}{3}$. The bottom status bar shows '2/99'.

$$\begin{aligned} \text{d. i. } A\left(\frac{\pi}{3}\right) &= 20h - 2h^2 \times \frac{2}{\sqrt{3}} + h^2 \times \frac{1}{\sqrt{3}} \\ &= 20h - \sqrt{3}h^2 \end{aligned} \quad \mathbf{1A}$$

A screenshot of a CAS calculator interface. The top bar shows tabs 1.1, 1.2, and 1.3, and a status bar indicates '*Unsaved'. The main display area shows the expression for A(x) with x = pi/3 substituted: $20 \cdot h - \frac{2 \cdot h^2}{\sin(x)} + \frac{h^2}{\tan(x)} | x = \frac{\pi}{3}$. The result is simplified to $20 \cdot h - h^2 \cdot \sqrt{3}$. The bottom status bar shows '1/99'.

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

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

$$A(5.7735) \approx 57.7$$

Maximum area is 57.7 square metres $\mathbf{1A}$

1.1 1.2 1.3 *Unsaved

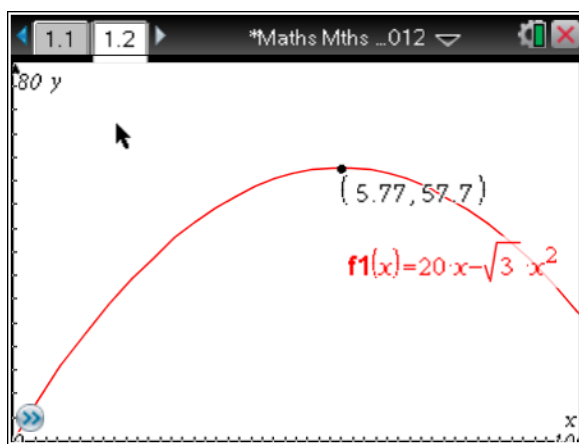
$$\text{solve}\left(\frac{d}{dh}\left(20 \cdot h - h^2 \cdot \sqrt{3}\right) = 0, h\right) \quad h = \frac{10 \cdot \sqrt{3}}{3}$$

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

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

57.735

6/99



1.2 1.3 1.4 *Unsaved

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

$h = 5.7735$

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

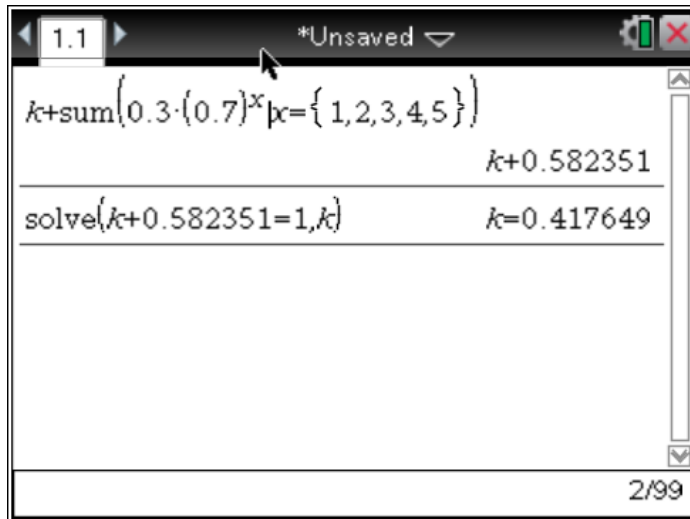
57.735

16/99

Question 2

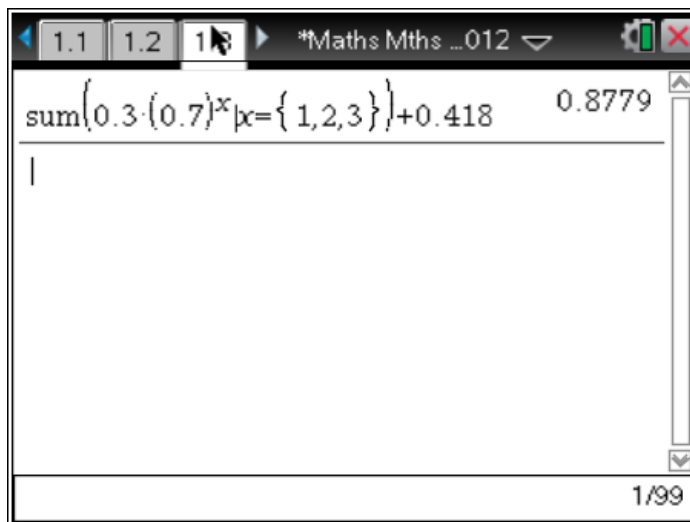
a. i. Solve $k + 0.3(0.7 + 0.7^2 + 0.7^3 + 0.7^4 + 0.7^5) = 1$ for k **1M**

$k = 0.417649 = 0.418$ correct to 3 decimal places as required **1M**

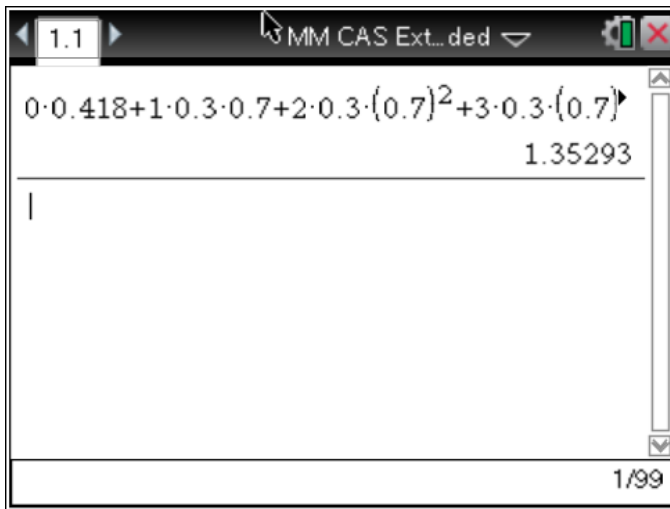


ii. $\Pr(x \leq 3) \approx 0.418 + 0.3(0.7 + 0.7^2 + 0.7^3)$ **1M**

$= 0.878$ correct to 3 decimal places **1A**



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**

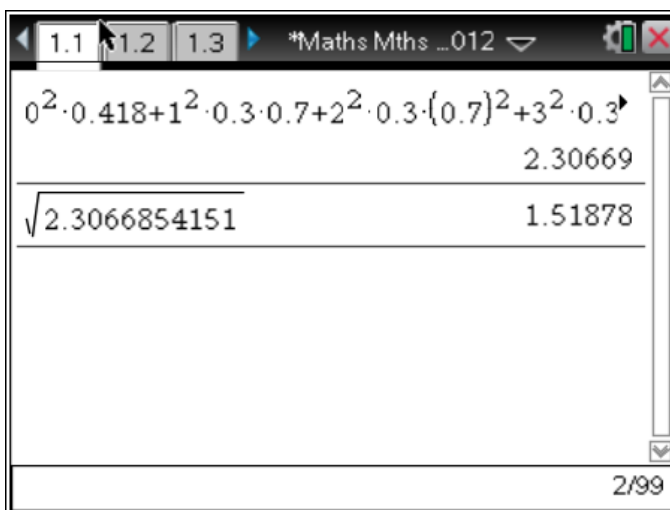


ii.

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

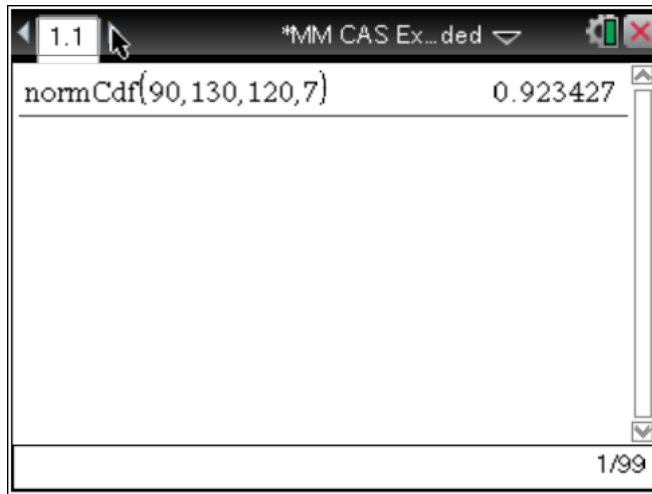
$$\text{Var}(X) \approx 2.3066$$

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



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

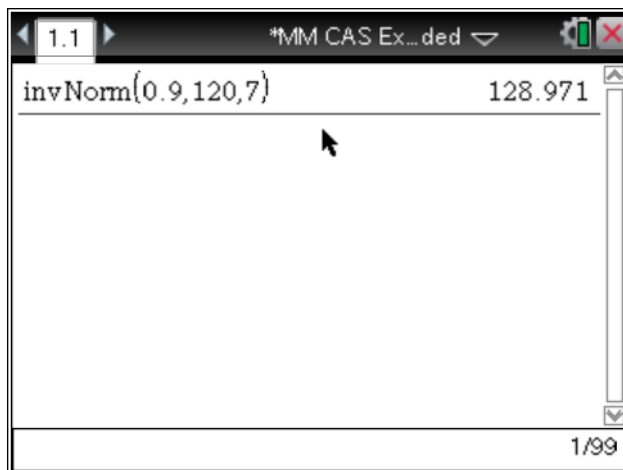
1A



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

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

1A



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

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

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

$= 0.1290$ correct to 4 decimal places as required **1M**

normCdf(126,130,120,7)	0.119119
normCdf(90,130,120,7)	0.923427
$\frac{0.1191191487553}{0.92342711458099}$	0.128997
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**

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

$34 + 1.25 \cdot 120$	184.
$(1.25)^2 \cdot 49$	76.5625
$\sqrt{76.5625}$	8.75
3/99	

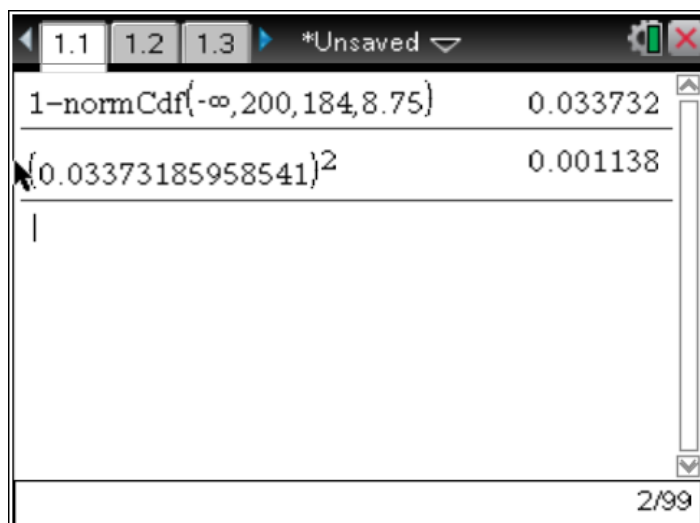
iii. $184 - 2 \times 8.75 \leq C \leq 184 + 2 \times 8.75$ **1M**

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

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

Inverse: swap x and y

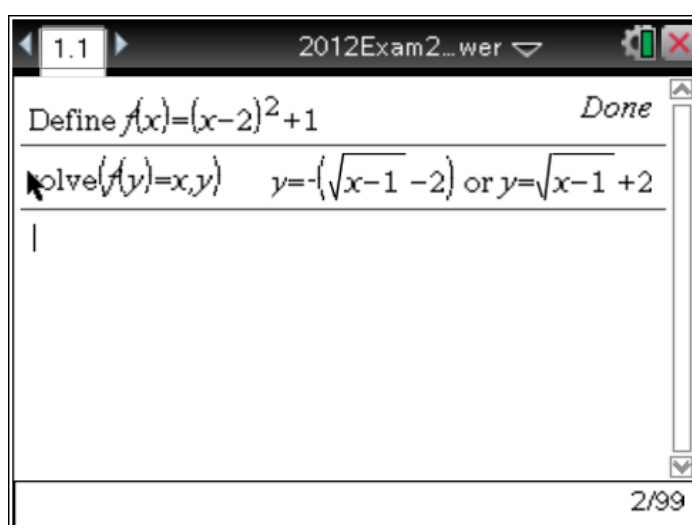
1M

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

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

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

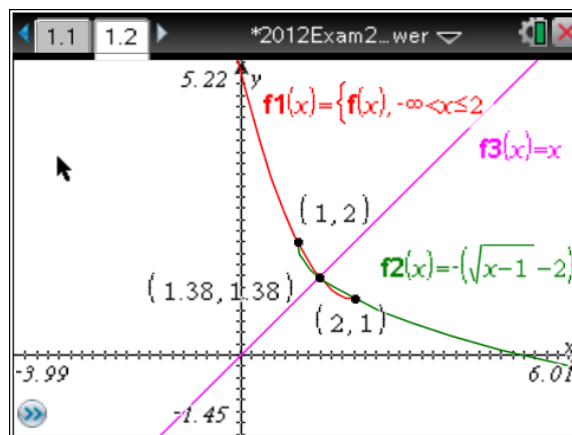
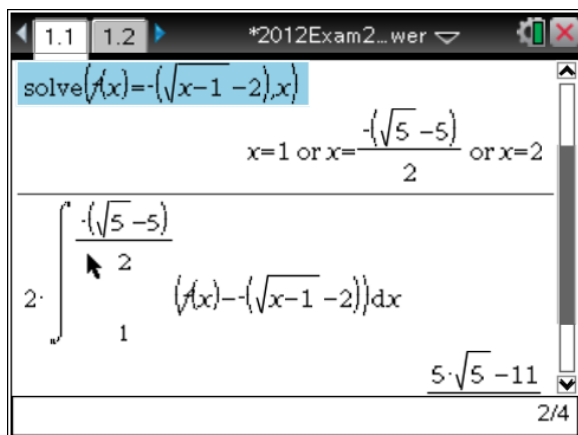
1A Domain 1A Rule



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

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

$$\text{Area} = 2 \times \int_1^{\frac{-\sqrt{5}+5}{2}} (f(x) - f^{-1}(x)) dx \quad \mathbf{1A}$$



c. 0, 1 or 3 solutions

Any 2 correct $\mathbf{1A}$

All correct $\mathbf{2A}$

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

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

$$\text{Volume} = \frac{5\sqrt{5}-11}{6} \times 2$$

$$= \frac{5\sqrt{5}-11}{3} \text{ m}^3 \quad \mathbf{1A}$$

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

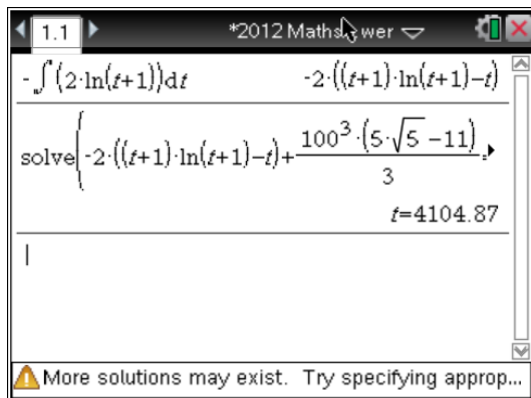
$$V = -\int (2 \log_e(t+1)) dt$$

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

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

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**

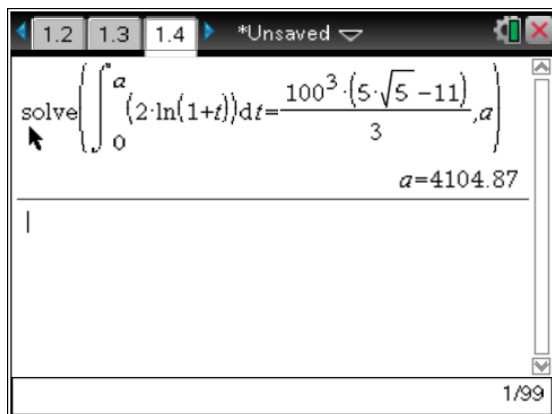


OR

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

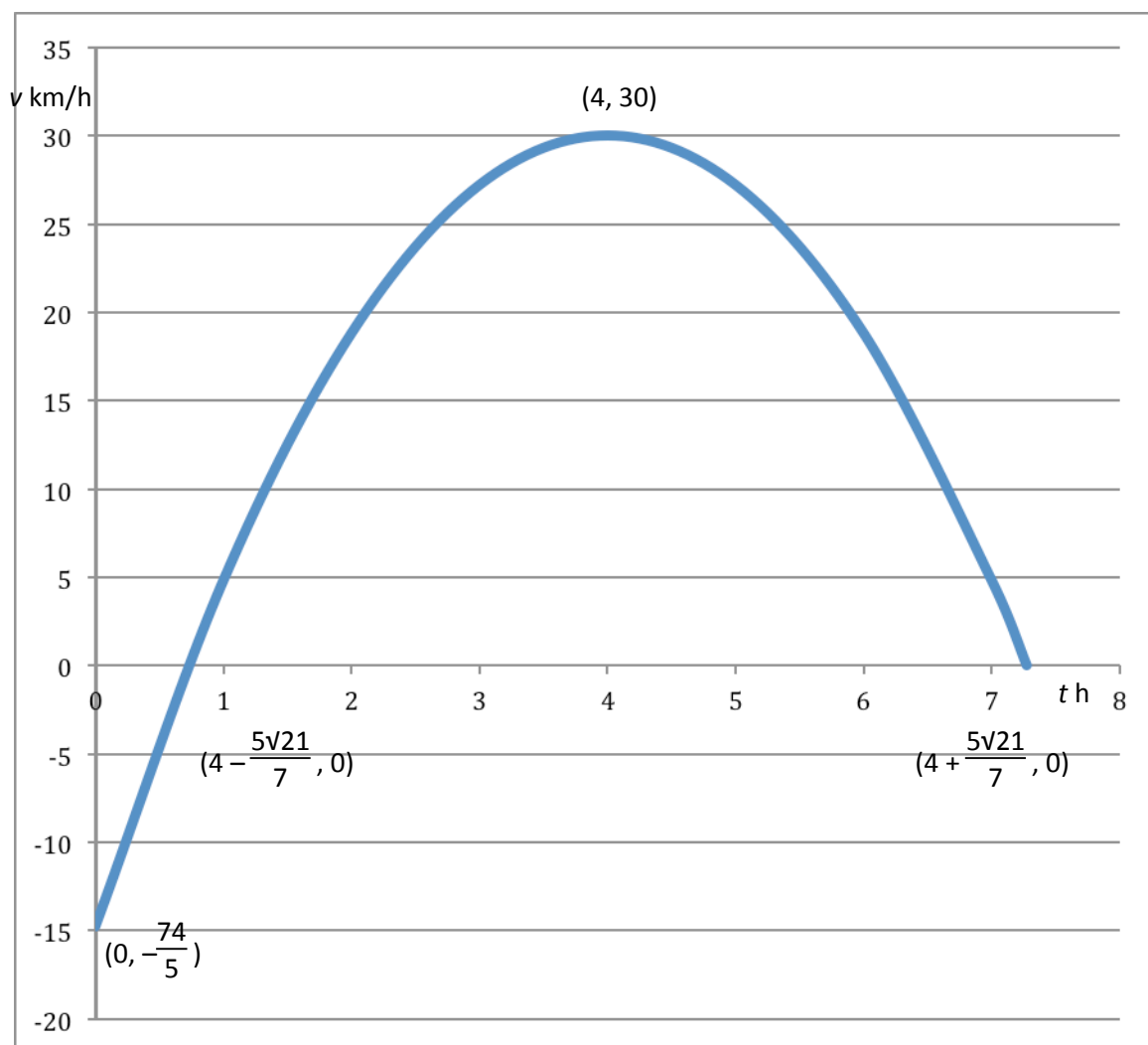
Solve $\int_0^a 2(\log_e(1+t))dt = \frac{100^3(5\sqrt{5}-11)}{3}$ for a . **1A** terminals, **1A** equation

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



Question 4

a.



Shape **1A**

Correct coordinates **1A**

Turning point $(4, 30)$

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

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

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 $t = 0, x = 0$

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

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

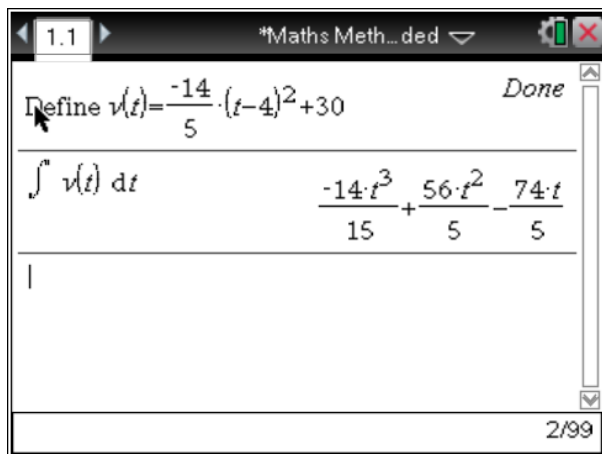
OR

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

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

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

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



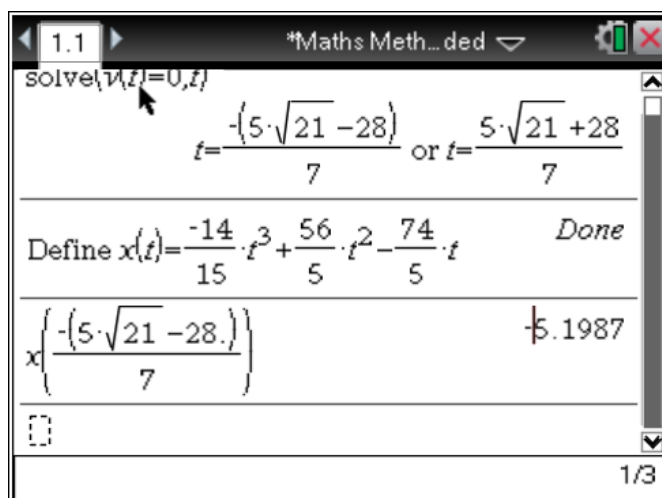
c.i. $v(t) = -\frac{14}{5}(t-4)^2 + 30$

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

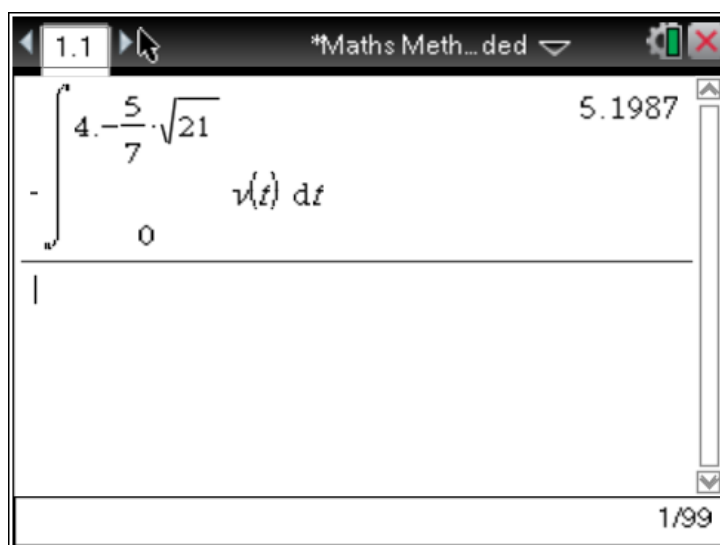
1A**OR**Solve $v(t) = 0$ for t

$$t = -\frac{5}{7}\sqrt{21} + 4$$

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

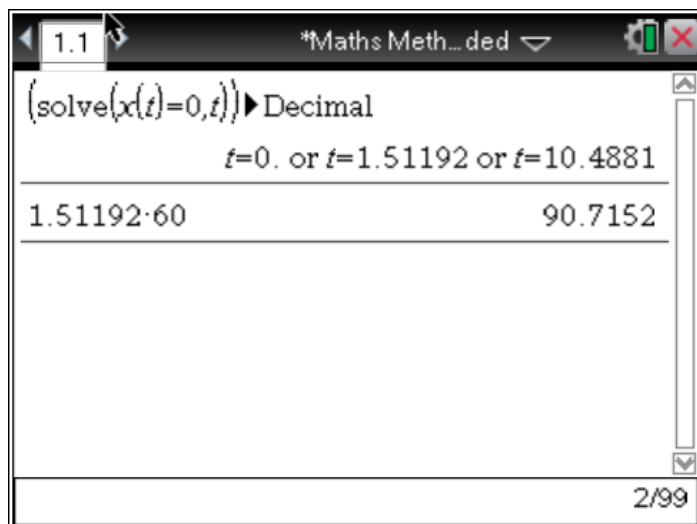
ii. Solve $x(t) = 0$

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

$$\approx 91 \text{ min}$$

10:31 am

1A



OR

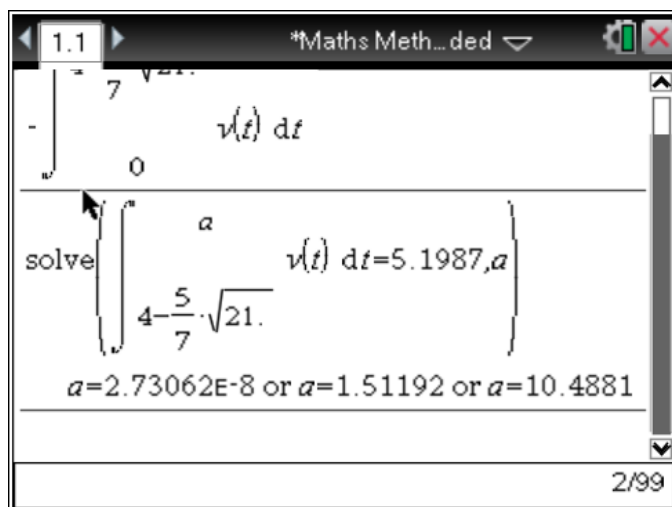
Solve $\int_{-5/7\sqrt{21}+4}^a (v(t)) dt = 1.51192...$ for a

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

$$\approx 91 \text{ min}$$

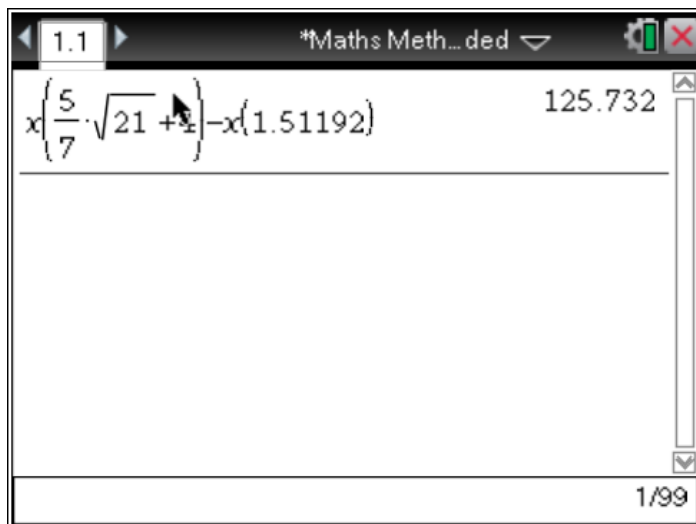
10:31 am

1A



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

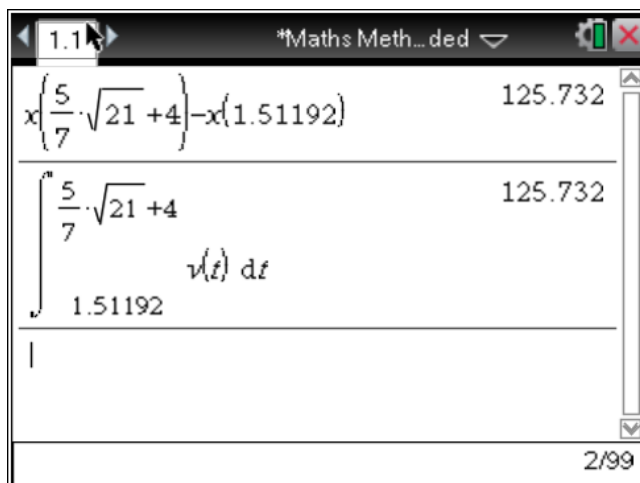
= 126 km to the nearest kilometre **1A**



OR

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

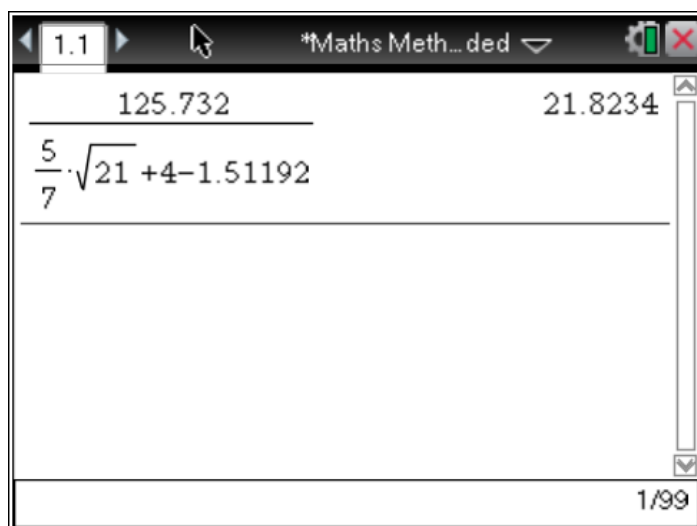
= 126 km to the nearest kilometre **1A**



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

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

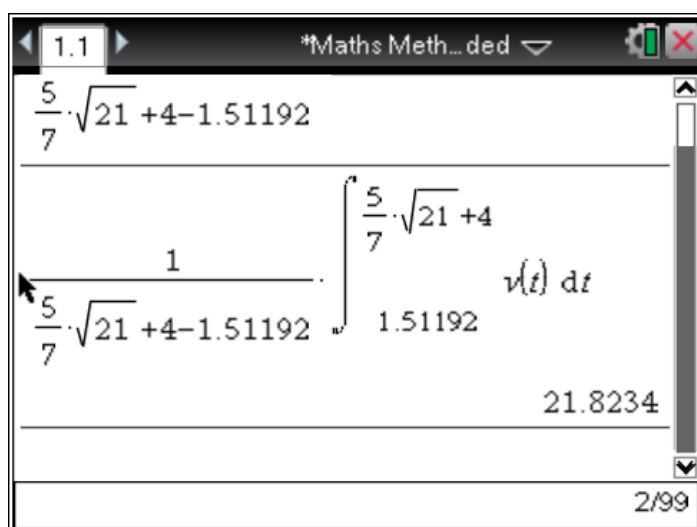
= 21.8 km/h correct to one decimal place **1A**



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 $\frac{125.732...}{3} = 41.9107... \text{ km}$ from Strathton. **1M**

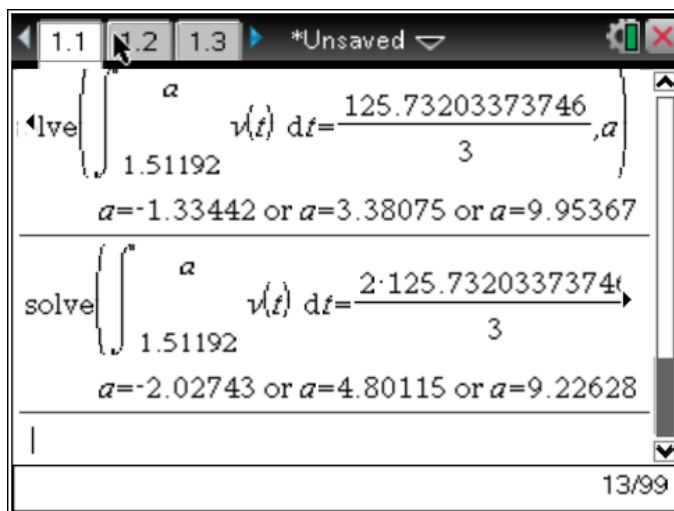
Second checkpoint is at approximately $\frac{2 \times 125.732...}{3} = 83.8213... \text{ km}$ from Strathton.

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

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

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

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



OR

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

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

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

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

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

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

$$a \approx 4.8011... \text{ hrs} \Rightarrow 1.48 \text{ pm}$$

1A