2025 VCE Specialist Mathematics 2 (NHT) external assessment report

This report provides sample answers or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

Section A – Multiple-choice questions

Question	Correct answer	Comments
1	D	
2	B	
3	C	
4	C	
5	B	
6	A	
7	C	
8	B	
9	C	
10	B	
11	D	
12	C	
13	B	
14	B	
15	C	
16	B	
17	A	
18	A	
19	D	
20	C	

Section B

Question 1a

$R\backslash\{-1,1\}$

Question 1b.i

$f(x)=x+a+\dfrac{x(a+1)+(a+3)}{(x-1)(x+1)}$

$\dfrac{x(a+1)+(a+3)}{(x-1)(x+1)}=\dfrac{A}{x-1}+\dfrac{B}{x+1}$

$x(a+1)+(a+3)=A(x+1)+B(x-1)$

Let $x=-1$, then $2=-2B$, $B=-1$

Let $x=1$, then $2a+4=2A$, $A=a+2$

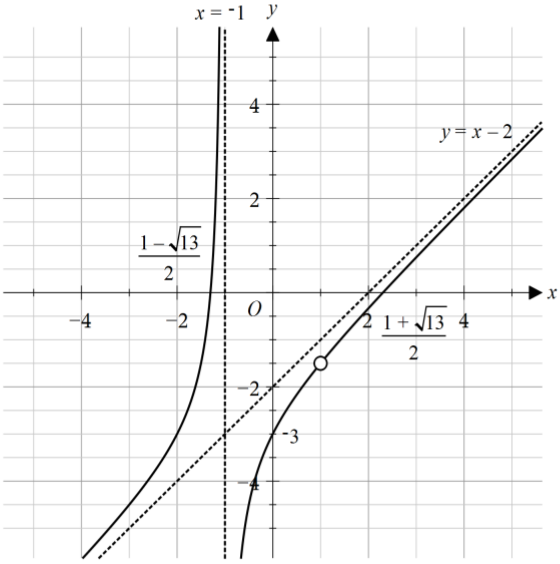
$g(x)=\dfrac{a+2}{x-1}-\dfrac{1}{x+1}$ as required.

Question 1b.ii

$f'(x)=1-\dfrac{a+2}{(x-1)^2}+\dfrac{1}{(x+1)^2}$, if $a=-2$, $f'(x)=1+\dfrac{1}{(x+1)^2}$

so $0=1+\dfrac{1}{(x+1)^2}$, which has no real solutions for *x*.

Question 1c



Question 1d.i

$$f''(x) = \frac{2(a+2)}{(x-1)^3} + \frac{(-2)}{(x+1)^3} \quad \text{OR} \quad f''(x) = \frac{2(a+2)}{(x-1)^3} - \frac{2}{(x+1)^3}$$

Question 1d.ii

If $a=-2$ $\quad f''(x) = -\frac{2}{(x+1)^3},\ 0 = -\frac{2}{(x+1)^3}$ has no real solutions

If $a=-1$ $\quad f''(x) = \frac{2}{(x-1)^3} - \frac{2}{(x+1)^3},\ 0 = \frac{2}{(x-1)^3} - \frac{2}{(x+1)^3}$

$\frac{2}{(x-1)^3} = \frac{2}{(x+1)^3},\ (x-1)^3 = (x+1)^3,\ x-1 = x+1,$ has no real solutions

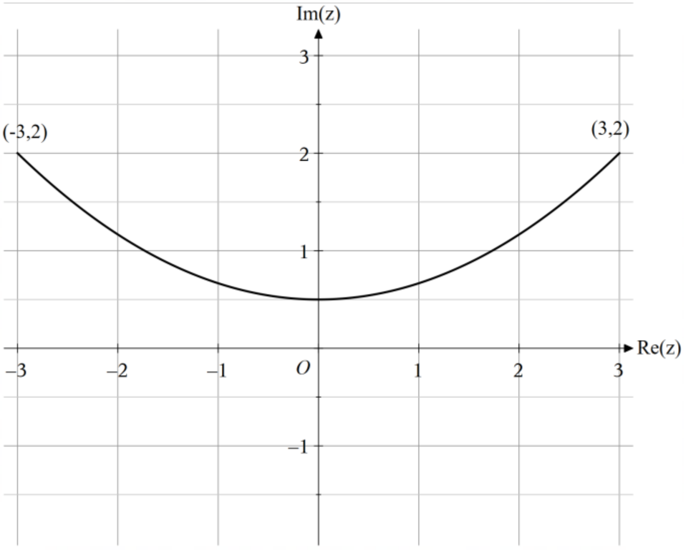
Question 2a

$$\sqrt{x^2+(y-2)^2} = y+1$$

$$x^2+y^2-4y+4 = y^2+2y+1$$

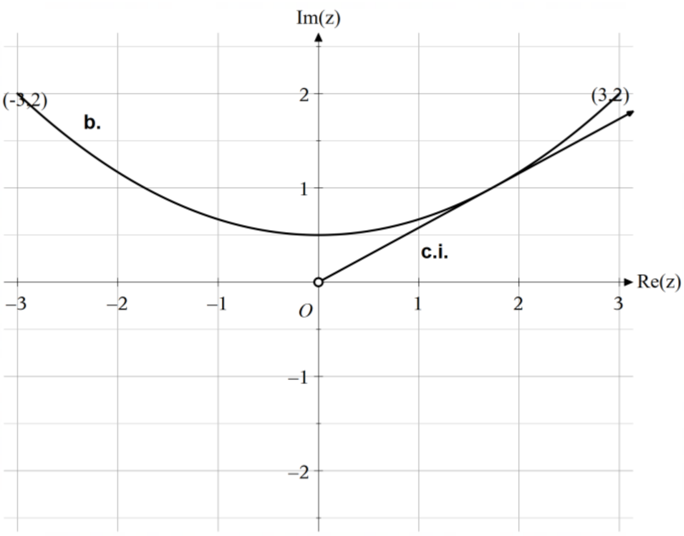
$x^2+3=6y$ as required.

Question 2b



Question 2c.i

Tangential ray from the origin.



Question 2c.ii

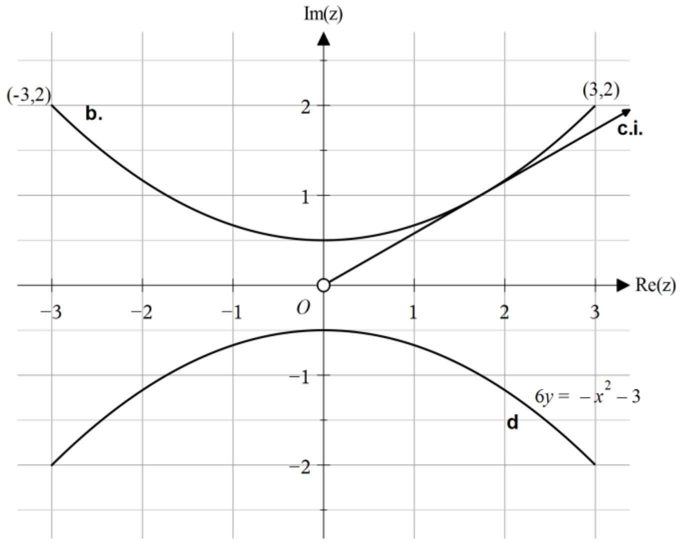
$$y = \frac{1}{\sqrt{3}}x,\ \ x > 0$$

Question 2c.iii

$$\sqrt{3} + i$$

Question 2d

The graph of $6y = x^2 + 3$ reflected across x-axis with consistent equation.



Question 2e.i

$c = -\frac{2}{5},\ d = \frac{4}{5}$

Question 2e.ii

$$A = \int_0^3 \left(\frac{1}{2}x + \frac{1}{2}\right) - \left(\frac{x^2}{6} + \frac{1}{2}\right) dx$$

$$A = \frac{3}{4}$$

Question 3a

$\frac{dv}{dx} = \sec^2 x,\ v = \tan x,\quad u = \sec x,\ \frac{du}{dx} = \sec x \tan x$

$I_3(x) = \sec x \tan x - \int \tan^2 x \sec x \ dx$ (apply parts)

$I_3(x) = \sec x \tan x - \int (\sec^2 x - 1) \sec x \ dx$

$I_3(x) = \sec x \tan x - I_3(x) + I_1(x)$

use trig identity and put in terms of $I_1(x)$ and $I_3(x)$

$$I_3(x) = \frac{1}{2}\sec x \tan x + \frac{1}{2} I_1(x)$$

Question 3b

$$V = \pi \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} x^2 \sec x \, dx$$

$$V = 1.6$$

Question 3c

15 000

Question 3d.i

$$\int_{500}^{7500} \frac{20}{N\left(1 - \frac{N}{15000}\right)} dN \quad \text{or} \quad \int_{500}^{7500} \frac{1}{0.05N\left(1 - \frac{N}{15000}\right)} dN$$

$$\text{or} \quad \int_{500}^{7500} \frac{-300000}{N(N - 15000)} dN$$

Question 3d.ii

67.3

Question 3e

$\frac{dN}{dt} = 0.05 \times 7500 \times \left(1 - \frac{7500}{15000}\right) = 187.5$ which $\neq 0$, so non-stationary

$\frac{d^2N}{dt^2} = \frac{N}{400}\left(1 - \frac{7500}{7500}\right)\left(1 - \frac{7500}{15000}\right) = 0$ for both of these

Take $N = 7000$ (say) $\frac{d^2N}{dt^2} = \frac{7000}{400}\left(1 - \frac{7000}{7500}\right)\left(1 - \frac{7000}{15000}\right) > 0$ i.e. $\left(\frac{28}{45} > 0\right)$

Take $N = 8000$ (say) $\frac{d^2N}{dt^2} = \frac{8000}{400}\left(1 - \frac{8000}{7500}\right)\left(1 - \frac{8000}{15000}\right) < 0$ i.e. $\left(-\frac{28}{45} < 0\right)$

Question 4a

$x = 2 - 5\cos t,\ \ y = 1 - 6\sin t$

$$\frac{(x-2)^2}{25} + \frac{(y-1)^2}{36} = 1$$

Question 4b

$$\int_0^5 \sqrt{25\sin^2 t + 36\cos^2 t}\, dt$$

$= 27.4$

Question 4c

$$\underset{\sim}{r}_{\mathrm{R}}(t) = \int (at+20)\underset{\sim}{i} + (bt+30)\underset{\sim}{j} + (ct^2+2t)\underset{\sim}{k}\ dt$$

$$\underset{\sim}{r}_{\mathrm{R}}(t) = \left(\frac{1}{2}at^2 + 20t\right)\underset{\sim}{i} + \left(\frac{1}{2}bt^2 + 30t\right)\underset{\sim}{j} + \left(\frac{1}{3}ct^3 + t^2\right)\underset{\sim}{k} + \underset{\sim}{c}$$

$t = 0,\ \underset{\sim}{r} = 20\underset{\sim}{i} + 30\underset{\sim}{j} \Rightarrow \underset{\sim}{c} = 20\underset{\sim}{i} + 30\underset{\sim}{j}$

$$\underset{\sim}{r}_{\mathrm{R}}(t) = \left(\frac{a}{2}t^2 + 20t + 20\right)\underset{\sim}{i} + \left(\frac{b}{2}t^2 + 30t + 30\right)\underset{\sim}{j} + \left(\frac{c}{3}t^3 + t^2\right)\underset{\sim}{k}$$ as required.

Question 4d

$$2 - 5\cos 10 = \frac{a}{2}\times 10^2 + 20\times 10 + 20$$

$$1 - 6\sin 10 = \frac{b}{2}\times 10^2 + 30\times 10 + 30$$

$$\frac{c}{3}\times 10^3 + 10^2 = 0$$

$a = -4.3,\quad b = -6.5,\quad c = -0.3$

Question 4e

Initial position of drone is $\underset{\sim}{r}_0 = 20\underset{\sim}{i} + 30\underset{\sim}{j}$

$\left|\underset{\sim}{r}_D(t) - \underset{\sim}{r}_0\right| = \left|(2 - 5\cos(t) - 20)\underset{\sim}{i} + (1 - 6\sin(t) - 30)\underset{\sim}{j}\right|$

$D = \sqrt{(2 - 5\cos t - 20)^2 + (1 - 6\sin t - 30)^2}$

$t = 4.2$

Question 5a

$a\underset{\sim}{i} - 4\underset{\sim}{j} - 4\underset{\sim}{k} = m\left(-3\underset{\sim}{i} - 4\underset{\sim}{j} - 2\underset{\sim}{k}\right) + n\left(2\underset{\sim}{i} + 3\underset{\sim}{j} + 2\underset{\sim}{k}\right)$

$a = -3m + 2n, \quad -4 = -4m + 3n, \quad -4 = -2m + 2n$

Solving second two equations gives $m = -2, \quad n = -4$, which gives $a = -2$

Question 5b.i

$-32\underset{\sim}{i} + 32\underset{\sim}{j} - 16\underset{\sim}{k}$

Question 5b.ii

Using normal, equation to plane is $-32x + 32y - 16z = d$

substitute point $T(2,3,2)$ $\quad -32\times 2 + 32\times 3 - 16\times 2 = d, \quad d = 0$

so $-32x + 32y - 16z = 0$, which simplifies to $2x - 2y + z = 0$

Question 5c

$\overrightarrow{TS} = 3\underset{\sim}{i} + \underset{\sim}{j} - 4\underset{\sim}{k}$

$\left(u^2\underset{\sim}{i} + 9u\underset{\sim}{j} + 3\underset{\sim}{k}\right).\left(3\underset{\sim}{i} + \underset{\sim}{j} - 4\underset{\sim}{k}\right) = 0 \qquad$ use $\overrightarrow{TS}$. normal $= 0$

$3u^2 + 9u - 12 = 0, \quad u^2 + 3u - 4 = 0$

$u = -4, \quad u = 1$

Question 5d

Direction of line through T and S is $3\underset{\sim}{i}+\underset{\sim}{j}-4\underset{\sim}{k}$, or could be negative of this

$\overrightarrow{QT}=5\underset{\sim}{i}+7\underset{\sim}{j}+4\underset{\sim}{k}$ vector spanning Q to a point on the line

$\overrightarrow{QT}\cdot\frac{1}{\sqrt{26}}\left(3\underset{\sim}{i}+\underset{\sim}{j}-4\underset{\sim}{k}\right)=\frac{6}{\sqrt{26}}$ scalar resolute along line

$d^2=\left(5^2+7^2+4^2\right)-\left(\frac{6}{\sqrt{26}}\right)^2=\frac{1152}{13}$ (or could use perpendicular resolute)

$d=\frac{\sqrt{1152}}{\sqrt{13}}=\frac{24\sqrt{26}}{13}$

Question 6a

$a=1.1$

Question 6b

$T\sim N\left(16,1.5^2\right)$

$\Pr\left(T>20\right)=0.0038$

Question 6c

CI is $\left(166.9,171.1\right)$

Question 6d

$200\times0.99=198$

Question 6e

Width of CI is $2\times2.5758\times\frac{10}{\sqrt{150}}$

$2\times2.5758\times\frac{10}{\sqrt{150}}\times0.4=2\times2.5758\times\frac{10}{\sqrt{n}}$

$n=938$

Question 6f

$H_0 : \mu = 3200$, $H_1 : \mu > 3200$

Question 6g

$p = 0.0131$

Question 6h

Yes, as $p < 0.05$

Question 6i

Right tail 5% cut-off for $\bar{L}$ is 3274

$\Pr\left(\bar{L} < 3274 \mid \mu = 3350\right) = 0.046$