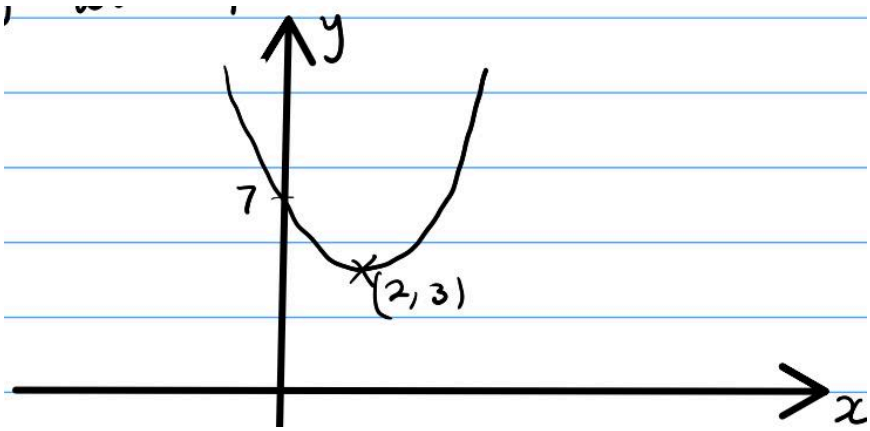
**1** (a) $t = x - 2$ **M1**

$$\begin{aligned} y &= (x-2)^2 + 3 \\ &= x^2 - 4x + 4 + 3 \\ &= x^2 - 4x + 7 \end{aligned}$$

**A1** **A1**

(b) min point at $(2, 3)$ **B1**

crosses y at 7 **B1**




**B1**

**(Total for question 1 is 6 marks)**

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**2** crosses x when $y = 0$

$$\begin{aligned} 0 &= t^2 - 5 \\ t &= \sqrt{5} \quad (\text{not } -\sqrt{5} \text{ as } t > -1) \\ x &= \ln(\sqrt{5} + 1) \\ &= 1.174 \quad (1.174, 0) \end{aligned}$$

**B1**

crosses y when $x = 0$

$$\begin{aligned} 0 &= \ln(t+1) \\ t &= 0 \\ y &= -5 \quad (0, -5) \end{aligned}$$

**B1**

**(Total for question 2 is 2 marks)**

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**3** $x - 5 = 2\cos\theta \Rightarrow \frac{x-5}{2} = \cos\theta$

$y - 3 = 2\sin\theta \Rightarrow \frac{y-3}{2} = \sin\theta$

Using $\cos^2\theta + \sin^2\theta = 1$:

$$\frac{(x-5)^2}{4} + \frac{(y-3)^2}{4} = 1$$

$$(x-5)^2 + (y-3)^2 = 4$$

M1

centre $(5, 3)$ A1

radius = 2 A1

**(Total for question 3 is 3 marks)**

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**4** (a) $x(t+1) = 3 - 2t \Rightarrow tx + x = 3 - 2t \Rightarrow t(x+2) = 3 - x \Rightarrow t = \frac{3-x}{x+2}$ M1

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

M1

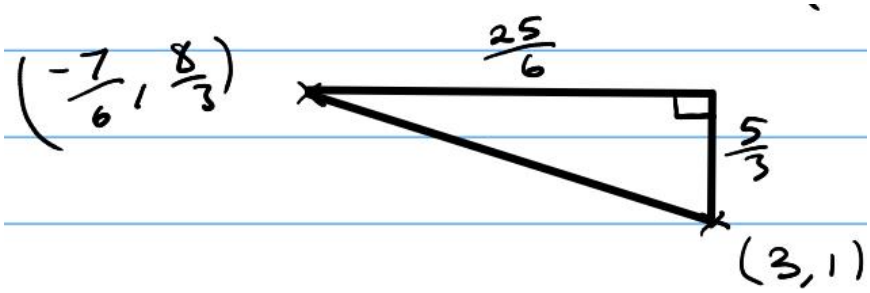
$$y = \frac{9 - 3x + x + 2}{5} = \frac{-2x + 11}{5} = -\frac{2}{5}x + \frac{11}{5}$$

A1

in the form $y = mx + c$ ∴ straight line.

(b) when $t = 0, x = 3, y = 1 \Rightarrow (3, 1)$

when $t = 5, x = -\frac{7}{6}, y = \frac{8}{3} \Rightarrow (-\frac{7}{6}, \frac{8}{3})$ M1




$$\text{length of segment} = \sqrt{\left(3 - (-\frac{7}{6})\right)^2 + \left(1 - \frac{8}{3}\right)^2}$$

$$= \sqrt{\left(\frac{25}{6}\right)^2 + \left(-\frac{5}{3}\right)^2}$$

$$= \frac{5\sqrt{29}}{6} \quad (\text{or } 4.49)$$

A1

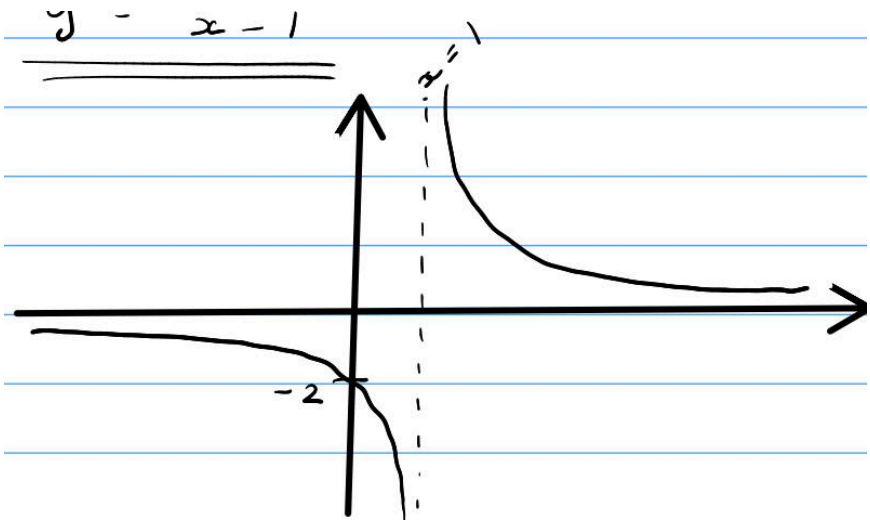
**(Total for question 4 is 5 marks)**

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**5** (a) $t = x - 1$ **M1**

$y = \frac{2}{x-1}$ **A1**

(b)




Vertical asymptote at $x = 1$ **B1**

Horizontal asymptote at $y = 0$ **B1**

Crosses $y$ at $(0, -2)$ **B1**

**(Total for question 5 is 5 marks)**

**6**

(a) Using $\tan^2 t + 1 = \sec^2 t$:

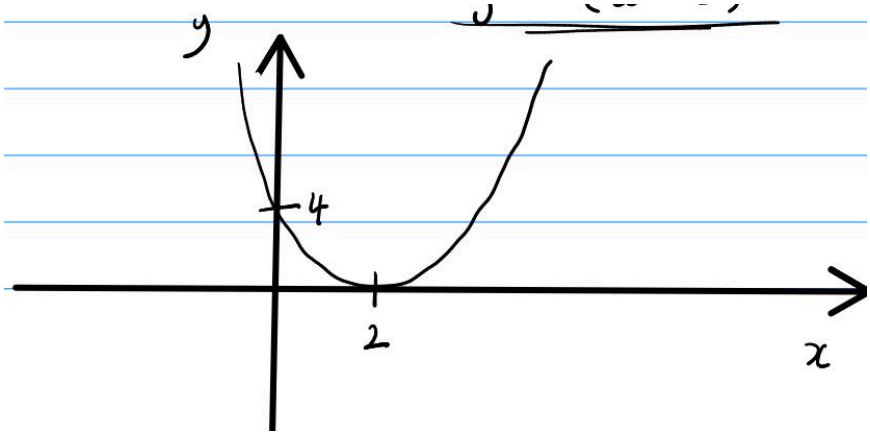
$(x-2)^2 = \tan^2 t$ and $y + 1 = \sec^2 t$ **M1**

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

$y = (x-2)^2$ **A1**

Domain: $x \in \mathbb{R}$ **B1**

(b)




Vertex at $(2, 0)$ **B1**

y-intercept at $(0, 4)$ **B1**

Correct parabola shape **B1**

**(Total for question 6 is 6 marks)**

**7**

(a) $\cos t = \frac{x+1}{2} \Rightarrow \cos^2 t = \frac{(x+1)^2}{4}$

$\sin^2 t = \frac{y-3}{4}$ **M1**

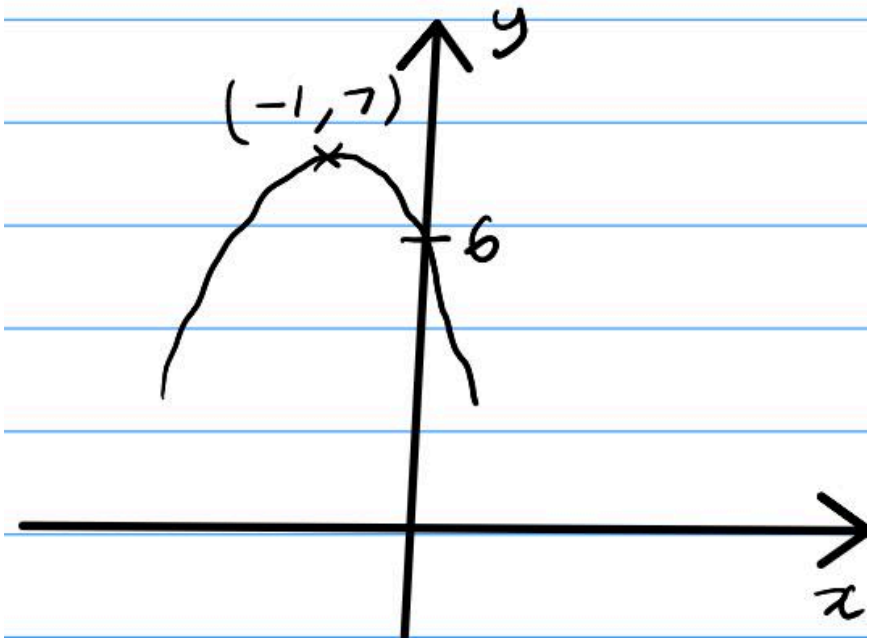
Using $\cos^2 t + \sin^2 t = 1$:

$\frac{(x+1)^2}{4} + \frac{y-3}{4} = 1 \Rightarrow (x+1)^2 + y - 3 = 4$

$y = 7 - (x+1)^2$ **A1**

Domain: $-3 \leq x \leq 1$ (since $-1 \leq \cos t \leq 1$) **B1**

(b)




Max point at $(-1, 7)$ **B1**

Endpoints at $(-3, 6)$ and $(1, 6)$ **B1**

Correct inverted parabola segment **B1**

**(Total for question 7 is 6 marks)**

**8**

(a) $\cos t = \frac{x-3}{2}$

$y = 2 + 4(2\cos^2 t - 1)$ **M1**

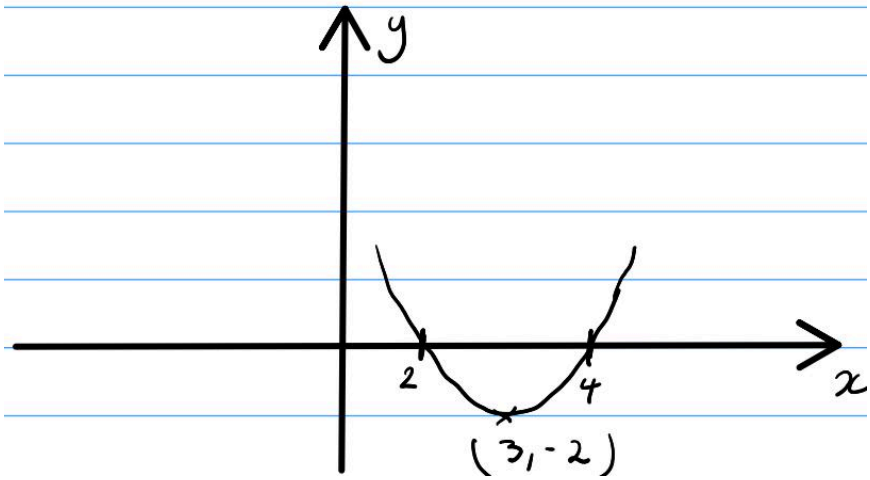
$y = 2 + 4(2(\frac{x-3}{2})^2 - 1)$

$y = 2 + 4(2\frac{(x-3)^2}{4} - 1) = 2 + 2(x-3)^2 - 4$

$y = 2(x-3)^2 - 2$ **A1**

Domain: $1 \leq x \leq 5$ (since $-1 \leq \cos t \leq 1$) **B1**

(b)




Vertex at $(3, -2)$ **B1**

Roots at $x = 2$ and $x = 4$ **B1**

Endpoints at $(1, 6)$ and $(5, 6)$ **B1**

**(Total for question 8 is 6 marks)**

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**9**

$\frac{x^2}{36} = \cos^2 t$ and $\frac{y^2}{20} = \sin^2 t \Rightarrow \frac{x^2}{36} + \frac{y^2}{20} = 1$ **M1**

$x^2 = 25 - y^2$ **M1**

$\frac{25-y^2}{36} + \frac{y^2}{20} = 1 \Rightarrow 5(25 - y^2) + 9y^2 = 180$

$125 - 5y^2 + 9y^2 = 180 \Rightarrow 4y^2 = 55 \Rightarrow y^2 = \frac{55}{4}$ **M1**

$y = \pm\frac{\sqrt{55}}{2}$ **A1**

$x^2 = 25 - \frac{55}{4} = \frac{45}{4} \Rightarrow x = \pm\frac{3\sqrt{5}}{2}$ **A1**

Coordinates: $\left(\frac{3\sqrt{5}}{2}, \frac{\sqrt{55}}{2}\right), \left(\frac{3\sqrt{5}}{2}, -\frac{\sqrt{55}}{2}\right), \left(-\frac{3\sqrt{5}}{2}, \frac{\sqrt{55}}{2}\right), \left(-\frac{3\sqrt{5}}{2}, -\frac{\sqrt{55}}{2}\right)$ **A1**

**(Total for question 9 is 6 marks)**

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