Stage 1:

1. (a) 
$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{2t - 4}{2} = t - 2$$

(b) 
$$\frac{dy}{dx} = \frac{dy}{dt} = \frac{-1}{2t} = \frac{-1}{2t^3}$$

(c) 
$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{-3t^{-4}}{1} = \frac{-3}{t^4}$$
 JE MATHS

(d) 
$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{6t^2}{\frac{1}{2\sqrt{t}}} = 12t^{\frac{5}{2}}$$

(e) 
$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\frac{1}{2}\sqrt{t}}{\frac{2}{t}} = \frac{1}{4}t^{\frac{3}{2}}$$

JE MATHS

2. (i) 
$$\frac{dx}{dt} = \frac{dx}{du} \cdot \frac{du}{dt}$$
 (let  $u = t + 1$ ,  $x = \frac{u^2}{2}$ )
$$= 2 \cdot \frac{1}{2} u \cdot 1$$

$$= 2 \cdot \frac{1}{2} u \cdot 1$$
$$= t + 1$$

$$\frac{dy}{dt} = \frac{dy}{du} \cdot \frac{du}{dt} \qquad \text{(let } u = t+1, \ y = \frac{u^3}{3}\text{)}$$

$$= 3 \cdot \frac{1}{3}u^2 \cdot 1$$

$$= (t+1)^2 \text{IB MATHS}$$

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{(t+1)^2}{t+1} = t+1$$

$$\text{JE MATHS}$$

JE MATHS

(ii)

$$\frac{dy}{dx}\Big|_{t=-3} = -2$$

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

JE MATHS

JE MATHS

$$y = \frac{(-3+1)^2}{3} = \frac{-8}{3}$$

JE MATHS

JE MATHS

ans: the tangent has a gradient of -2 at  $\left(-2, \frac{-8}{3}\right)$ 

(b)

$$\frac{dy}{dx}\Big|_{t=0} = 1$$

JE MATHS

 $x = \frac{(0+1)^2}{2} = \frac{1}{2}$ 

JE MATHS

$$y = \frac{(0+1)^2}{3} = \frac{1}{3}$$

JE MATHS

$$y = \frac{(0+1)^2}{3} = \frac{1}{3}$$
JB MATHS

JE MATHS

ans: the tangent has a gradient of 1 at  $\left(\frac{1}{2}, \frac{1}{3}\right)$ 

JE MATHS

$$\left. \frac{dy}{dx} \right|_{t=\frac{1}{2}} = \frac{3}{2}$$

JE MATHS

$$x = \frac{(\frac{1}{2} + 1)^2}{2} = \frac{9}{8}$$
JB MATHS

$$y = \frac{(\frac{1}{2} + 1)^2}{3} = \frac{27}{24} = \frac{9}{8}$$

ans: the tangent has a gradient of 1 at  $\left(\frac{9}{8}, \frac{9}{8}\right)_{MATHS}$ 

(iii)

(a) let 
$$\frac{dy}{dx} = 5$$

$$t+1=5$$

t = 4

$$x = \frac{(4+1)^{2}}{2} = \frac{25}{2}$$

JE MATHS

JE MATHS

$$y = \frac{(4+1)^2}{3} = \frac{125}{3}$$

JE MATHS

JE MATHS

ans: the tangent has a gradient of 5 at  $\left(\frac{25}{2}, \frac{125}{3}\right)$ 

(b) let 
$$\frac{dy}{dx} = \tan 135^\circ$$

JE MATHS

$$t+1=-1$$

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

JE MATHS

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

$$JB MATHS$$

JE MATHS

ans: the tangent has a gradient of 5 at  $\left(\frac{1}{2}, \frac{-1}{3}\right)$ 

JE MATHS

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

$$y = (t+1)x - \frac{(t+1)^3}{2} + \frac{(t+1)^3}{3}$$
$$y = (t+1)x - \frac{(t+1)^3}{6}$$

JE MATHS

$$y = (t+1)x - \frac{(t+1)^2}{6}$$

JE MATHS

JE MATHS

x-int: 
$$0 = (t+1)x - \frac{(t+1)^3}{6}$$

$$(t+1)x = \frac{(t+1)^3}{6}$$

JE MATHS

JE MATHS

$$x = \frac{(t+1)^2}{6}$$

y-int: 
$$y = (t+1) \cdot 0 - \frac{(t+1)^3}{6}$$
 JE MATHS

JE MATHS

$$y = -\frac{(t+1)^3}{6}$$

JE MATHS

$$area = \frac{1}{2} \left| \frac{(t+1)^3}{6} \right| \cdot \frac{(t+1)^2}{6}$$

JE MATHS

$$= \left| \frac{(t+1)^5}{72} \right| u^2$$

JE MATHS

3. (i)  $_{\text{IS MATHS}}$ 

JE MATHS

$$t = \frac{x}{c}, \quad y = \frac{c}{\frac{x}{c}} = \frac{c^2}{x}$$

JE MATHS

 $\therefore xy = c^2$ 

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\frac{-c}{t^2}}{c} = -\frac{1}{t^2_{ATHS}}$$

JE MATHS

$$y - \frac{c}{t} = -\frac{1}{t^2}(x - ct)$$

$$y = -\frac{1}{t^2}(x - ct)$$

$$JB MATHS$$

JE MATHS

 $y = -\frac{1}{t^2}x + \frac{c}{t} + \frac{c}{t}$ 

$$y = -\frac{1}{t^2}x + \frac{2c}{t}$$

(iii)  $y-int:\frac{2c}{t}$  $0 = \frac{-1}{t^2}x + \frac{2c}{t}$ JE MATHS JE MATHS  $x = \frac{2c}{||\mathbf{r}||} \|\mathbf{r}^{2}|||\mathbf{S}|$ x = 2ctx-int:2ct $area = \frac{1}{2} \cdot 2ct \cdot \frac{2c}{t} = 2c^2 \text{ square units}_{\text{IB MATIS}}$ JE MATHS ∴ area of ∆OAB is constant as T varies (iv)  $M_{AB} = \left(\frac{0 + 2ct}{2}, \frac{\frac{2c}{t} + 0}{2}\right) = (ct, \frac{c}{t}) = T$   $d_{AT} = \sqrt{(ct - 0)^2 + (\frac{2c}{t} - \frac{c}{t})^2}$ JE MATHS JE MATHS JE MATHS  $= \sqrt{c^2 t^2 + \frac{c^2}{t^2}}$   $d_{AT} = d_{BT} \quad \text{(T is midpoint of } \Delta B\text{)}$ JE MATHS  $d_{OT} = \sqrt{c^2 t^2 + \frac{c^2}{c^2}}$ JE MATHS  $\therefore d_{AT} = d_{OT} = d_{BT}$ JE MATHS  $d_{AB} = d_{AT} + d_{BT} = 2d_{OT}$  $\therefore AB = 2OT$ IS MATHS

JE MATHS JE MATHS JE MATHS

JE MATHS

## Stage 2:

1. (a)

$$x = 4 - y^2$$

$$\frac{dx}{dy} = -2y_{\text{THS}}$$

 $\frac{dy}{dx} = \frac{1}{-2y} = \frac{-1}{2\sqrt{4-x}}$ 

JE MATHS (b)

 $\frac{1}{v} = x^{\frac{1}{5}}$ 

 $x = \frac{1}{y^5} = y^{-5}$  $\frac{dx}{dy} = -5y^{-6}$ 

 $\frac{dy}{dx} = \frac{1}{-5y^{-6}} = \frac{1}{-5\sqrt[5]{x^6}}$ (c) JE MATHS

 $\frac{1}{v} = \sqrt[3]{x+1}$ 

 $x = \frac{1}{y^3} - 1$ 

 $\frac{dx}{dy} = -3y^{-4}$ 

 $\frac{dy}{dx} = \frac{1}{-3y^{-4}} = \frac{\int_{0}^{1} MATHS}{-1}$ 

JE MATHS

2. (i)  $y^k = x$ 

$$\frac{dx}{dy} = ky^{k-1}$$

$$\frac{dy}{dx} = \frac{1}{ky^{k-1}} = \frac{1}{k(x^{\frac{1}{k}})^{k-1}} = \frac{1}{ky^{\frac{1-\frac{1}{k}}}} = \frac{1}{k} x^{\frac{1}{k}-1}$$

$$18 \text{ MATHS}$$

JE MATHS

(ii)

let 
$$y = (x^{\frac{1}{k}})^n$$
,  $u = x^{\frac{1}{k}}$ 

JE MATHS

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

$$= n(x^{\frac{1}{k}})^{n-1} \cdot \frac{1}{k} x^{\frac{1}{k}-1} = \frac{n}{k} x^{\frac{n-1}{k}} x^{\frac{1}{k}-1} = \frac{n}{k} x^{\frac{n}{k}-1}$$

JE MATHS

## Stage 3:

1. (a) 
$$y = -3(x^4 - 2x^2 - 1)^{-1}$$

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

$$= 2(4^{14})^{1/2} 2^{1/2} 2^{1/2} (4x^3 - 4x)$$

$$\pm 3(x^{4+5}2x^2-1)^{-2}(4x^3-4x)$$

JE MATHS

JE MATHS

$$=\frac{12x^3-12x}{(x^4-2x^2-1)^2}$$

let 
$$\frac{dy}{dx} = 0$$

JE MATHS

JE MATHS

$$12x^3 - 12x = 0$$

$$x(x^2-1)=0$$

JE MATHS

$$x = 0.1 - 1$$

JE MATHS

when 
$$x = 0$$
,  $y = \frac{-3}{0^4 - 2 \cdot 0^2 - 1} = 3$ 

when 
$$x=1$$
,  $y=\frac{-3}{1^4-2\cdot 1^2-1}=\frac{3}{2}$ 

when 
$$x = \frac{-3}{(-1)^4 - 2 \cdot (-1)^2 - 1} = \frac{3}{2}$$

JE MATHS

ans: 
$$(0,3), (1,\frac{3}{2}), (-1,\frac{3}{2})$$

JE MATHS

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

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

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

JE MATHS

$$=\frac{x-2}{\sqrt{x^2-4x}}$$

let 
$$\frac{dy}{dx} = 0$$

JE MATHS

JE MATHS

$$x-2=0$$

when 
$$x = 2$$
,  $y = \sqrt{2^2 - 4 \cdot 2} = \sqrt{-4}$ 

ans: no point on the curve

2. (a)

$$\frac{dy}{dx} = -(x^2 + 1)^{-2} \cdot 2x = \frac{-2x}{(x^2 + 1)^2}$$

$$\frac{dy}{dx}\Big|_{x=1} = \frac{-2 \cdot 1}{\sqrt{(1^2 + 1)^2}} = \frac{-1}{2}, \quad y = \frac{1}{2}$$

JE MATHS

JE MATHS

$$l_T: y - \frac{1}{2} = 1(x-1) \cdot \frac{-1}{2}$$

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

JE MATHS

JE MATHS

$$l_N: y-\frac{1}{2}=2(x-1)$$

$$y = 2x - \frac{3}{2}$$

JE MATHS

$$(b)$$
$$y^2 = 8 - x$$

X IB MATHS 10 MATHS

$$x = 8 - y^2$$

$$\frac{dy}{dx} = -\frac{1}{2y} = -\frac{1}{2\sqrt{8-x}}$$

JE MATHS

$$dx = 2y = 2\sqrt{8-x}$$

JE MATHS

$$\frac{dy}{dx}\Big|_{x=4} JB = \frac{A^{THS}1}{2\sqrt{4}} = -\frac{1}{4}$$

 $y = \sqrt{8 - 4} = 2$ 

JE MATHS

$$l_T: y-2 = \frac{-1}{4}(x-4)$$

$$y = -\frac{1}{4}x + 3$$

JE MATHS

$$l_N: y-2=4(x-4)$$

$$y = 4x - 14$$

$$y = 4x - 14$$
JB MATHS

JE MATHS

JE MATHS

-	
14	10
	1 a

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$
$$= -(x^2 + k)^{-2} \cdot 2x$$

$$= \frac{\mathbb{E}^{MATH2}x}{(x^2+k)^2}$$

JE MATHS

JE MATHS

$$\left. \frac{dy}{dx} \right|_{x=1} = -\frac{2}{(k+1)^2}$$

JE MATHS

JE MATHS

$$-\frac{1}{2} = -\frac{2}{(k+1)^2}$$

$$(k+1)^2 = 4$$

JE MATHS

$$k+1 = \pm 2$$

$$k=1,-3$$
 JB MATHS

JE MATHS

(b)

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

JE MATHS

$$=\frac{1}{12}(x+k)^{-\frac{1}{2}}\cdot 1$$

JE MATHS

$$=\frac{1}{2\sqrt{x+k}}$$

JE MATHS

$$\left. \frac{dy}{dx} \right|_{x=4} = \frac{1}{2\sqrt{4+k}}$$

$$-m = 2\sqrt{4+k}$$

JE MATHS

$$-2\sqrt{4+k} = -6$$
 IB MATHS

$$\sqrt{4+k}=3$$

$$4 + k = 9$$

$$k = 5$$

JE MATHS

JE MATHS

4. (i)

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$
$$= -(8-x)^{-2} \cdot -1$$

$$= \frac{\mathbb{E} MAT^{HS}}{(8-x)^2}$$

JE MATHS

JE MATHS

$$\left. \frac{dy}{dx} \right|_{x=p} = \frac{1}{\left(8-p\right)^2}$$

JE MATHS

JE MATHS

$$y = \frac{1}{8 - p}$$

$$l_T: y - \frac{1}{8-p} = \frac{1}{(8-p)^2}(x-p)$$

JE MATHS

$$y = \frac{1}{(8-p)^2} x + \frac{18 1^{ATHS}}{8-p} - \frac{p}{(8-p)^2}$$

JE MATHS

$$y = \frac{1}{(8-p)^2}x + \frac{8-2p}{(8-p)^2}$$

JE MATHS

JE MATHS

(a) 
$$0 = \frac{1}{(8-p)^2} \cdot 0 + \frac{8-2p}{(8-p)^2}$$

JE MATHS

$$0 = 8 - 2p$$

p = 4

$$y = \frac{1}{(8-4)^2} x + \frac{8-8}{(8 + 4)^2}$$

$$y = \frac{x}{16}$$

JE MATHS

JE MATHS

(b) 
$$0 = \frac{1}{(8-p)^2} \cdot 10 + \frac{8-2p}{(8-p)^2}$$

$$\frac{-10}{(8-p)^2} = \frac{8-2p}{(8-p)^2}$$
$$-10 = 8-2p$$

JE MATHS

JE MATHS

$$-10 = 8 - 2p$$

2p = 18

JE MATHS

JE MATHS

$$p = 9$$

 $y = \frac{1}{(8-9)^2}x + \frac{8-18}{(8-9)^2}$ 

JE MATHS

y = x - 10 JB MATHS

JE MATHS

## Stage 4:

1. (i)

semicircle:

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{1}{2} \underbrace{16 - x^2}_{16 - x^2} \cdot -2x$$

JE MATHS

JE MATHS

$$=\frac{-x}{\sqrt{16-x^2}}$$

W MATHS

JE MATHS

$$y - \sqrt{16 - t^2} = \frac{-t}{\sqrt{16 - t^2}} (x - t)$$

$$y = \frac{-t}{\sqrt{16 - t^2}} (x - t) + \sqrt{16 - t^2}$$

JE MATHS

semi ellipse: JB MATHS

 $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$ 

IE MATHS

$$= \frac{1}{2}k(16-x^2)^{-\frac{1}{2}} \cdot -2x$$

JE MATHS

$$\#\frac{MA^{+}xk}{\sqrt{16-x^2}}$$

JE MATHS

$$y - k\sqrt{16 - t^2} = \frac{-tk}{\sqrt{16 - t^2}} (x - t)$$
 MATHS

$$y = \frac{-tk}{\sqrt{16 - t^2}} (x - t) + k\sqrt{16 - t^2}$$

JE MATHS

JE MATHS

JE MATHS

JE MATHS

(ii)

semicircle:

$$0 = \frac{-t}{\sqrt{16 - t^2}} (x - t) + \sqrt{16 - t^2}$$

$$t(x-t) = 16 - t^2$$

JE MATHS

JE MATHS

$$tx-t^2=16-t^2$$

$$tx = 16$$

$$x = \frac{16}{t}$$
, x-int:  $\frac{16}{t}$ 

JE MATHS

JE MATHS

semi ellipse:

$$0 = \frac{-tk}{\sqrt{16 - t^2}} (x - t) + k\sqrt{16 - t^2}$$

JE MATHS

$$tk(x-t) = k(16 \# t^{\boxtimes})^{\text{ATHS}}$$

JE MATHS

$$tx-t^2=16-t^2$$

$$tx = 16$$

JE MATHS

$$x = \frac{16}{t}$$
, x-int:  $\frac{16}{t}$ 

ans: the two tangents meet at the x-axis (same x-intercept)

JE MATHS

(iii)

$$A(\frac{16}{t},0)$$
,  $OA = \frac{16}{t}$ 

JE MATHS

$$B(4,0)$$
,  $OB = 4$ 

C(t,0), OC = t

JE MATHS

$$LHS = OB^{2} = 4^{2} + 16 = \frac{16}{t} \cdot t = OA \cdot OC = RHS$$

JE MATHS

JE MATHS

## 2. (i) $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$ $=2a(x-h)\cdot 1$ =2ax-2ahlet $\frac{dy}{dx} = m$ 2ax = 2ah + m

JE MATHS

JE MATHS

$$2ax - 2ah = m$$

$$2ax = 2ah + m$$

$$x = h + \frac{m}{2a}$$

JE MATHS

JE MATHS

$$y = a(h + \frac{m}{2a} - h)^2 + k$$

$$=\frac{m^2}{4a}+k$$

JE MATHS

$$P(h + \frac{m}{2a}, \frac{m^2}{4a} + \frac{\text{JB MATHS}}{k})$$

JE MATHS

let 
$$\frac{dy}{dx} = -m$$

JE MATHS

$$2ax-2ah=-m$$

$$2ah = 2ax_{\overline{13}} m$$

$$2ah = 2ax - m$$
$$x = h - \frac{m}{2a}$$

JE MATHS

$$y = a(h - \frac{m}{2a} - h)^2 + k$$

JE MATHS

$$=\frac{m^2}{4a}+k$$

$$Q(h - \frac{m}{2a}, \frac{m^2}{4a} + k)$$
JB MATHS

JE MATHS

JE MATHS

JE MATHS

(ii)

tangent at 
$$P(h+\frac{m}{2a},\frac{m^2}{4a}+k)$$
:

tangent at 
$$Q(h-\frac{m}{2a},\frac{m^2}{4a}+k)$$
:

$$y - \frac{m^2}{4a} |A| = m(x - h - \frac{m}{2a})$$

$$y = \frac{m^2}{4a} - k = m(x - h + \frac{m}{2a})$$

$$y = mx - mh - \frac{m^2}{2a} + \frac{m^2}{4a} + k$$
 1)

$$y = -mx + mh - \frac{m^2}{2a} + \frac{m^2}{4a} + k$$
 2)

1) and 2): intersection of tangents THS

IR MATHS

$$2y = -\frac{m^2}{a} + \frac{m^2}{2a} + 2k$$

$$y = \frac{-m^2}{4a} + k$$

normal at 
$$P(h + \frac{18}{2a}, \frac{m^2}{4a} + k)$$
:

normal at 
$$Q(h-\frac{m}{2a},\frac{m^2}{4a}+k)$$
:

$$y - \frac{m^2}{4a} - k = -\frac{1}{m}(x - h - \frac{m}{2a})$$

$$\lim_{x \to \infty} \frac{m^2}{4a} - k = \frac{1}{m} (x - h + \frac{m}{2a})$$

$$y = \frac{18 \cdot 10^{ATHS} \cdot h}{m} + \frac{1}{2a} + \frac{m^2}{4a} + k \cdot 3$$

$$y = \frac{1}{m}x - \frac{h}{m} + \frac{1}{2a} + \frac{m^2}{4a} + k^{\text{MATHS}}$$

3) and 4): intersection of tangents

JE MATHS

$$2y = \frac{1}{a} + \frac{m^2}{2a} + 2k$$

$$y = \frac{1}{2a} + \frac{m^2}{4a} + k$$

$$d_{PQ} = h + \frac{m}{2a} - h + \frac{m}{2a} = \frac{m}{a}$$

length of vertical diagonal:

$$\frac{1}{2a} + \frac{m^2}{4a} + k + \frac{m^2}{4a} - k = \frac{1}{2a} + \frac{m^2}{2a} = \frac{m^2 + 1}{2a}$$

$$area = \frac{1}{2} \cdot \frac{m}{a} \cdot \frac{m^2 + 1}{2a} = \frac{m(1 + m^2)}{4a^2}$$

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$
$$= 2a(x-h) \cdot 1$$

$$=2a(x^{\lfloor \frac{S}{2}}h)$$

JE MATHS

JE MATHS

$$y - \lceil a(t-h)^2 + k \rceil = 2a(t-h)(x-k)$$

$$y = 2a(t-h)x - 2at^{2} + 2ath + a(t-h)^{2} + k$$

JE MATHS

$$y = 2a(t-h) - 2at^2 + 2ath + at^2 - 2ath + ah^2 + k$$

$$y = 2a(t-h) - at^2 + ah^2 + k$$

JE MATHS

$$y = 2a(t-h)x - at^{2} + ah^{2} + k$$

$$0 = 2a(t-h) \cdot 0 - at^2 + ah^2 + k$$

JE MATHS

$$at^2 = ah^2 + k$$

JE MATHS

$$t^2 = h^2 + \frac{k}{a_1}$$

$$\int_{\Omega} \frac{1}{a_2} dx$$

JE MATHS

(iii)

(ii)

JE MATHS y-coordinate of P:

 $v = ax^2 - 2axh + h^2a + k$ 

$$y = 2a(t-h) \cdot h - at^2 + ah^2 + k$$

$$AOS: x = \frac{-(-2ah)}{2a} = h$$
$$d_T = |t - h|$$

$$y = 2ath - 2ah^{2} - at^{2} + ah^{2} + k$$
$$y = -at^{2} + 2ath - ah^{2} + k$$

$$d_{T} = \left| t - h \right|^{\text{JB MP}}$$

$$y = -at^2 + 2ath - ah^2 + k$$

$$(d_T)^2 = (t-h)^2$$
 2)

$$y = -a(t-h)^2 + k$$

$$d_{VP} = \left| k_{A} \left[ \frac{1}{2} a(t-h)^2 + k \right] \right|$$

$$=|a|(t-h)^2 \quad 1)$$

JE MATHS

1) and 2): 
$$\frac{d_{VP}}{(d_T)^2} = \frac{|a|(t-h)^2}{(t-h)^2} = |a|$$

:. VP is proportional.