③ $x = 3t$ $\quad y = 1 - t$

$v_x = 3$ $\quad v_y = -1$

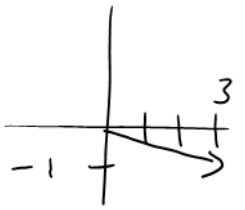
@ $t = 4$: $v_x = 3$ $\quad v_y = -1$

$$v = \sqrt{3^2 + (-1)^2}$$

$$\approx 3.16 \text{ m/s}$$

$$\theta = \tan^{-1}\left(\frac{-1}{3}\right) \quad (+180°?)$$

$$\approx -18.4° \text{ or } 341.6°$$



(5) $x = t(2t+1)^2$

$v_x = t\left[2(2t+1)(2)\right] + (2t+1)^2(1)$

@ $t = 0.5$: $v_x = 0.5\,[\,8\,] + 4$

$= 8$

$y = \dfrac{6}{\sqrt{4t+3}}$

$= 6(4t+3)^{-1/2}$

$v_y = -3(4t+3)^{-3/2}(4)$

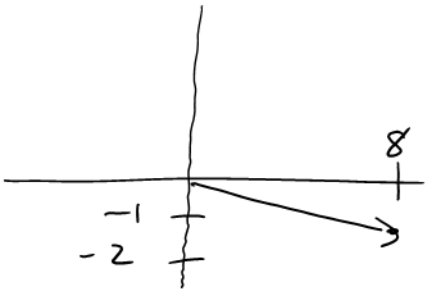
@ $t = 0.5$: $v_y = -3(5)^{-3/2}(4)$

≈ -1.0733

$v \approx \sqrt{8^2 + (-1.0733)^2}$

≈ 8.07 m/s

$\theta \approx \tan^{-1}\left(\dfrac{-1.0733}{8}\right)$ $(+180°?)$



$\theta \approx -7.64°$ or $352.36°$

(11) $y = 2.0 + 0.80x - 0.20x^2$

$$\frac{dy}{dt} = \frac{dy}{dx}\frac{dx}{dt}$$

$$\frac{dy}{dt} = (0.80 - 0.40x)\frac{dx}{dt}$$

$$v_y = (0.80 - 0.40x)\, v_x$$

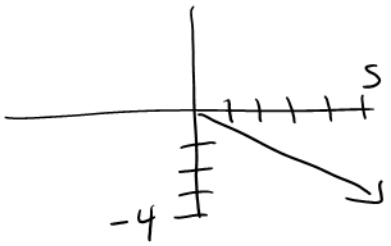
Given $x = 4.0$ and $v_x = 5.0$

$$v_y = (0.80 - 0.40(4.0))(5.0)$$
$$= -4.0$$

$$v = \sqrt{5.0^2 + (-4.0)^2}$$

$$\approx 6.4 \text{ m/s}$$

$$\theta = \tan^{-1}\left(\frac{-4.0}{5.0}\right) \quad (+180°?)$$



$$\approx -39° \text{ or } 321°$$

(13) $x = 0.20t^2$ $\quad y = -0.10t^3$

$v_x = 0.40t$ $\quad v_y = -0.30t^2$

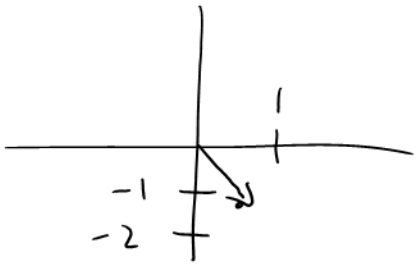
$a_x = 0.40$ $\quad a_y = -0.60t$

@ $t = 2.0$: $\quad a_x = 0.40$ $\quad a_y = -1.2$

$$a = \sqrt{0.40^2 + (-1.2)^2}$$

$$\approx 1.3 \quad m/min^2$$

$$\theta = \tan^{-1}\left(\frac{-1.2}{0.40}\right) \quad (+180°?)$$



$\theta \approx -71°$ or $288°$

(17) $x = 10\left(\sqrt{1+t^4} - 1\right)$ $\quad y = 40t^{3/2}$

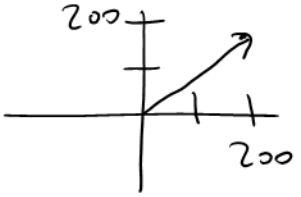
$v_x = 10\left[\frac{1}{2}(1+t^4)^{-1/2}(4t^3)\right]$ $\quad v_y = 60t^{1/2}$

@ $t = 10.0$: $\quad v_x \approx 199.99$ $\quad v_y \approx 189.74$

$v \approx \sqrt{199.99^2 + 189.74^2}$

≈ 276 m/s

$\theta \approx \tan^{-1}\left(\frac{189.74}{199.99}\right)$ (+180°?)



$\theta \approx 43.5°$

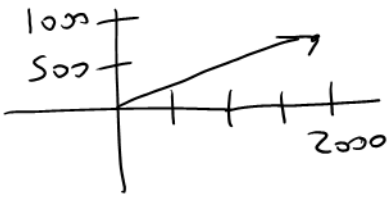
$v_x = 10\left[\frac{1}{2}(1+t^4)^{-1/2}(4t^3)\right]$ $\quad v_y = 60t^{1/2}$

@ $t = 100$: $\quad v_x \approx 2000.0$ $\quad v_y = 600$

$v \approx \sqrt{2000.0^2 + 600^2}$

$= 2090$ m/s (to 3 significant digits)

$\theta \approx \tan^{-1}\left(\frac{600}{2000.0}\right)$ (+180°?)



$\theta \approx 16.7°$

(19) $y = 3.00 + x^{-1.50}$

$$\frac{dy}{dt} = \frac{dy}{dx}\frac{dx}{dt}$$

$$\frac{dy}{dt} = \left(-1.50\,x^{-2.50}\right)\frac{dx}{dt}$$

$$v_y = -1.50\,x^{-2.50}\,v_x$$

Given $v_x = 1.20$ and $t = 0.500$

Find x : $x = (\text{initial position}) + v_x(t)$

$= 1.00 + 1.20(0.500)$

$= 1.60$

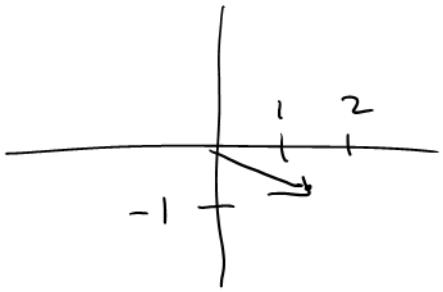
$$v_y = -1.50\,(1.60)^{-2.50}(1.20)$$

$$\approx -0.55587$$

$$v \approx \sqrt{1.20^2 + (-0.55587)^2}$$

$$\approx 1.32 \text{ cm/s}$$

$$\theta \approx \tan^{-1}\left(\frac{-0.55587}{1.20}\right) \quad (+180°?)$$



$\theta \approx -24.9°$ or $335.1°$

(21) From Exercise (17):

$$v_x = 10\left[\tfrac{1}{2}(1+t^4)^{-1/2}(4t^3)\right]$$

$$= (20t^3)(1+t^4)^{-1/2}$$

$$v_y = 60t^{1/2}$$

$$a_y = 30t^{-1/2}$$

$$a_x = (20t^3)\left[-\tfrac{1}{2}(1+t^4)^{-3/2}(4t^3)\right] + (1+t^4)^{-1/2}(60t^2)$$

@ $t = 10.0$: $a_x \approx -39.994 + 59.997$

$$\approx 20.003$$

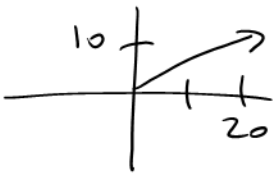
$$a_y \approx 9.4868$$

$$a \approx \sqrt{20.003^2 + 9.4868^2}$$

$$\approx 22.1 \text{ m/s}^2$$

$$\theta \approx \tan^{-1}\left(\frac{9.4868}{20.003}\right) \quad (+180°?)$$

$$\approx 25.4°$$



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(21) Cont'd $a_y = 30t^{-1/2}$

$$a_x = 20t^3\left[-\tfrac{1}{2}(1+t^4)^{-3/2}(4t^3)\right] + (1+t^4)^{-1/2}(60t^2)$$

@ $t=100$: $a_x \approx -40.000 + 60.000$

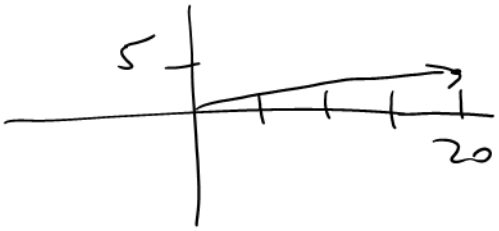
≈ 20.000

$a_y = 3$

$a \approx \sqrt{20.000^2 + 3^2}$

$\approx 20.2 \ m/s^2$

$\theta \approx \tan^{-1}\left(\frac{3}{20.000}\right)$ $(+180°?)$



$\theta \approx 8.53°$