Instructor:	Frank Secretain
Course:	Math 7
Date:	October 16, 2025
Assessment:	Test 2
Time allowed:	110 minutes
Devices allowed:	Pencil, pen, eraser, calculator
Notes from instructor:	Be neat. Show your work where needed. Box final answers.
Marks allocated:	4 question worth 20 marks
Percentage of final grade:	20% of final grade

Formula Sheet

Order of Operations

$$ac + bc = c(a+b)$$

exponent rules

$$a^n a^m = a^{n+m} \qquad (a^n)^m = a^{nm} \qquad (ab)^n = a^n b^n$$

$$a^0 = 1 \qquad a^{-n} = \frac{1}{a^n} \qquad a^{\frac{n}{m}} = \sqrt[m]{a^n}$$

logarithmic rules

$$\log_b(b^x) = x \qquad b^{\log_b a} = a \qquad \log_b x = \frac{\log(x)}{\log(b)}$$

$$\log(xy) = \log(x) + \log(y) \qquad \log(x/y) = \log(x) - \log(y)$$

Forms of a 1st order polynomial

$$y = ax + b$$

Forms of a 2nd order polynomial

$$y = ax^2 + bx + c$$ (expanded form)

$$y = a(x-h)^2 + k$$ (vertex form)

$$y = a(x-m)(x-n)$$ (factored form)

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$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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$$\frac{d}{dx} f(x) = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

Rules of differentiation

$$\frac{\mathrm{d}}{\mathrm{dx}}(fg) = \frac{\mathrm{d}(f)}{\mathrm{dx}} g + f \frac{\mathrm{d}(g)}{\mathrm{dx}}$$

(product rule)

$$\frac{\mathrm{d}}{\mathrm{dx}}\left(\frac{f}{g}\right) = \frac{\frac{\mathrm{d}(f)}{\mathrm{dx}} g - f \frac{\mathrm{d}(g)}{\mathrm{dx}}}{g^2}$$

(quotient rule)

$$\frac{\mathrm{d}}{\mathrm{dx}}(f(g)) = \frac{\mathrm{d}(f)}{\mathrm{dx}} \frac{\mathrm{d}(g)}{\mathrm{dx}}$$

(chain rule)

Derivatives of select functions

$$\frac{d}{dx}(ax^n) = anx^{n-1}$$

$$\frac{d}{dx}(sin(x)) = cos(x)$$

$$\frac{d}{dx}(cos(x)) = -sin(x)$$

$$\frac{d}{dx}(tan(x)) = \frac{1}{(cos(x))^2}$$

$$\frac{d}{dx}(a^x) = a^x ln(a)$$

$$\frac{d}{dx}(log_a x) = \frac{1}{xln(a)}$$

Integrals of select functions

$$\int ax^n dx = \left\{ \begin{array}{ll} \frac{a}{n+1} x^{n+1} & , n \neq -1 \\ ln(|x|) & , n = -1 \end{array} \right\}$$ (polynomials)

$$\int sin(ax)dx = -\frac{1}{a} cos(ax)$$

$$\int cos(ax)dx = \frac{1}{a} sin(ax)$$ (trigonometry)

$$\int tan(ax)dx = ln(|sec(x)|)$$

$$\int a^x dx = \frac{1}{ln(a)} a^x$$ (exponentials)

$$\int ln(x)dx = xln(x) - x$$

(5 marks) You run 410 m North, 230 m at 15^0 North of East and 220 m at 10^0 East of South. How far are you from where you started?

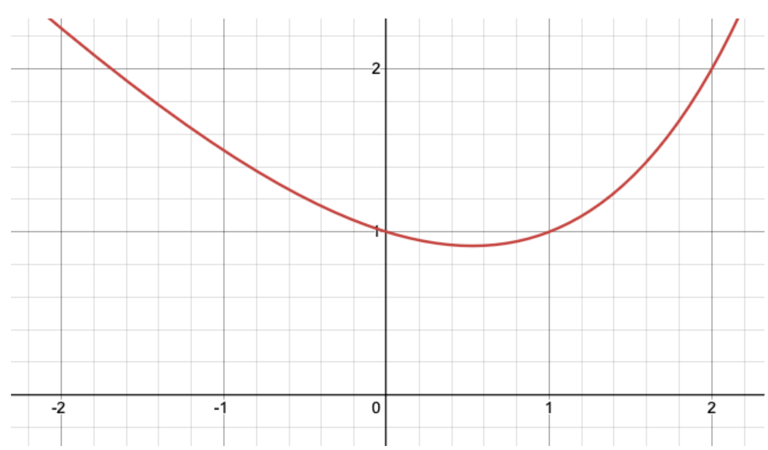
(5 marks) Convert to Polar form:

$$z = (2+i)(2i-3)$$

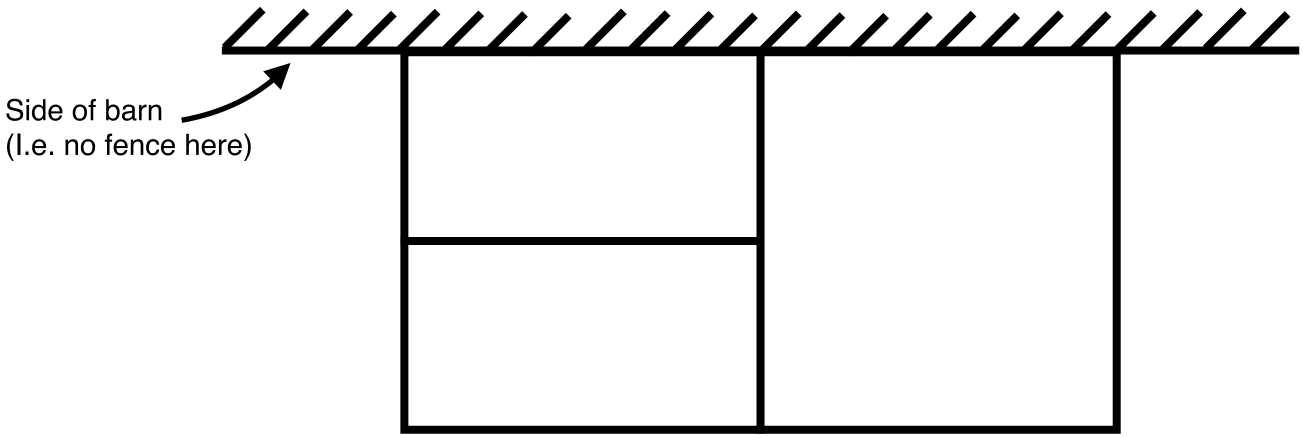
$$z = \frac{2+i}{2i-3}$$

(5 marks) Determine the tangent line at x=1 for the following function. Plot the tangent line on the plot.

$$y = 2^x - x$$



(5 marks) Given 100 meters of fencing determine the maximum area of the proposed enclosure.



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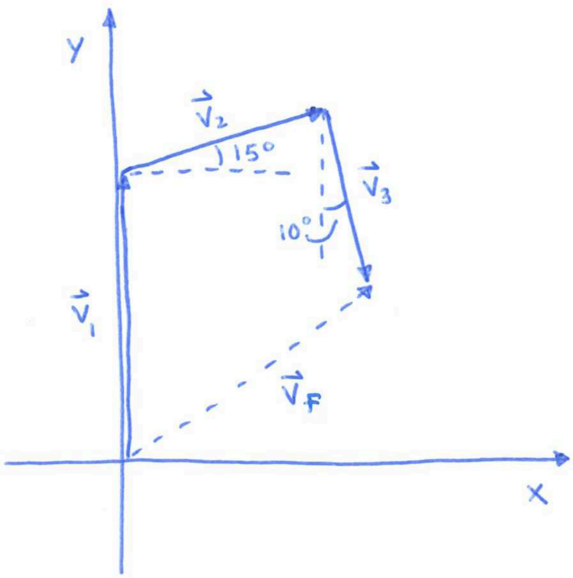
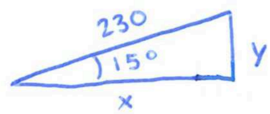
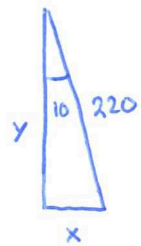




$x = 230\cos(15)$
$= 222.16$
$y = 230\sin(15)$
$= 59.53$



$x = 220\sin(10)$
$= 38.20$
$y = 220\cos(10)$
$= 216.66$

$$\vec{V}_1 = 0\,\hat{x} + 410\,\hat{y}$$

$$\vec{V}_2 = 222.16\,\hat{x} + 59.53\,\hat{y}$$

$$+\ \vec{V}_3 = 38.20\,\hat{x} - 216.66\,\hat{y}$$

$$\vec{V}_F = 260.36\,\hat{x} + 252.87\,\hat{y}$$

$$|\vec{V}_F| = \sqrt{(260.36)^2 + (252.87)^2}$$

$$= 362.95$$

$$\boxed{|\vec{V}_F| = 363 \text{ m}}$$

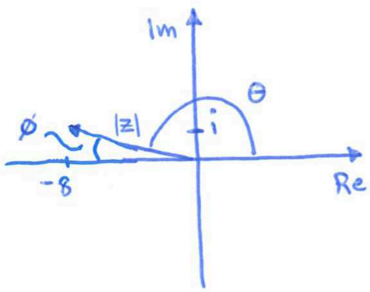
(5 marks) Convert to Polar form:

$$z = (2+i)(2i-3)$$

$= 4i - 6 + 2i^2 - 3i$

$= -6 + 2[-1] + i$

$= -8 + i$



$|z| = \sqrt{(-8)^2 + (1)^2} = 8.06$

$\phi = \tan^{-1}\left(\frac{1}{8}\right) = 7.13°$
$= 0.12$ rads

$\theta = \pi - 0.12 = 3.02$ rads

so

$$\boxed{z = 8.06\, e^{3.02i}}$$

$$z = \frac{2+i}{2i-3}$$

$= \dfrac{(2+i)(2i+3)}{(2i-3)(2i+3)}$

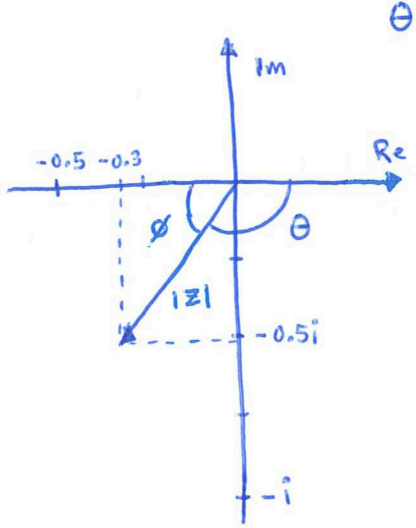
$= \dfrac{4i + 6 + 2i^2 + 3i}{4i^2 + \cancel{6i} - \cancel{6i} - 9}$

$= \dfrac{6 + 2[-1] + 7i}{4[-1] - 9}$

$= \dfrac{4 + 7i}{-13}$

$= -\dfrac{4}{13} - \dfrac{7}{13}i$

$= -0.308 - 0.538i$



$|z| = \sqrt{(-0.308)^2 + (-0.538)^2}$
$= 0.620$

$\phi = \tan^{-1}\left(\frac{0.538}{0.308}\right) = 60.2°$
$= 1.05$ rad

$\theta = -\pi + 1.05 = -2.09$ rads

so

$$\boxed{z = 0.620\, e^{-2.09i}}$$

(5 marks) Determine the tangent line at x=1 for the following function. Plot the tangent line on the plot.

$$y = 2^x - x$$

$$y\Big|_{x=1} = 2^{[1]} - [1] = 1$$

$\frac{d}{dx}$

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

$$\frac{dy}{dx}\Big|_{x=1} = 2^{[1]} \ln(2) - 1 = 0.386$$

Equation of the line:

$y = ax + b$

sub slope:

$y = [0.386]x + b$

sub (1, 1) point:

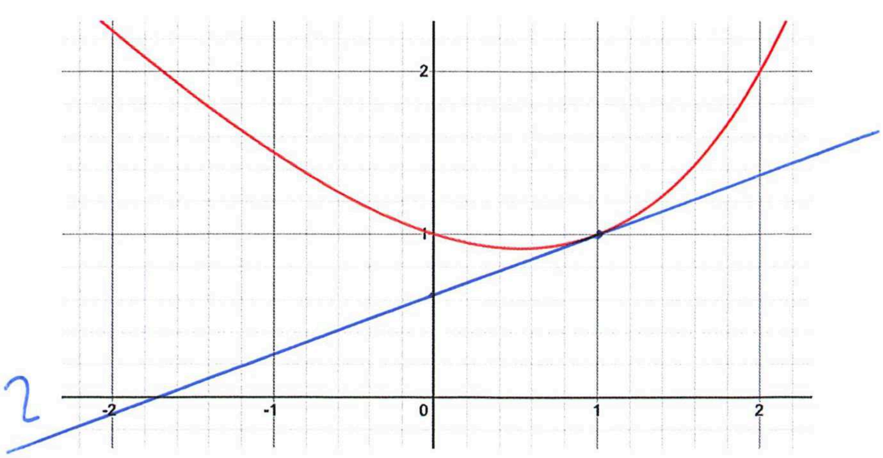
$[1] = 0.386[1] + b$

$b = 0.614$

so

$$\boxed{y = 0.386x + 0.614}$$

y=0.386x + 0.614



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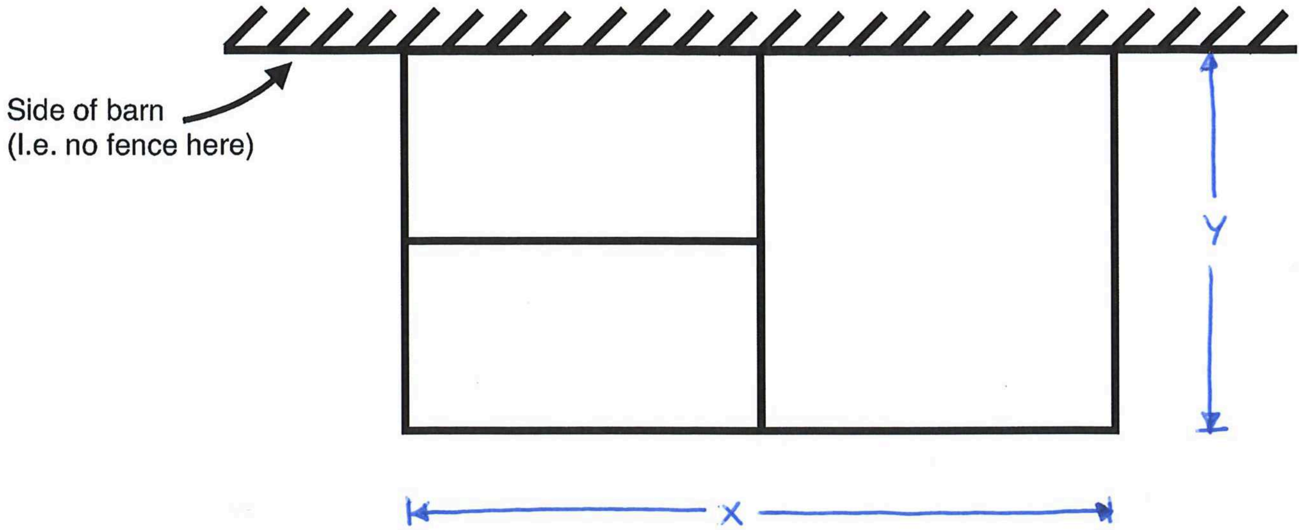

$$A = xy \qquad (1)$$

$$P = 1.5x + 3y = 100 \qquad (2)$$

solve for x in (2):

$$x = \frac{100 - 3y}{1.5} = 66.\bar{6} - 2y \qquad (2a)$$

sub (2a) into (1)

$$A = \left[66.\bar{6} - 2y\right]y$$

$$A = 66.\bar{6}y - 2y^2$$

$$\frac{dA}{dy} = 66.\bar{6} - 4y = 0 \quad {}^{max}/_{min}$$

$$y = 16.\bar{6}$$

$$x = 33.\bar{3}$$

$$A = 555.\bar{5}$$

$$\boxed{A = 556\ m^2}$$

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(5 marks) You run 810 m East, 250 m at 35^0 North of East and 220 m at 40^0 West of North. How far are you from where you started?

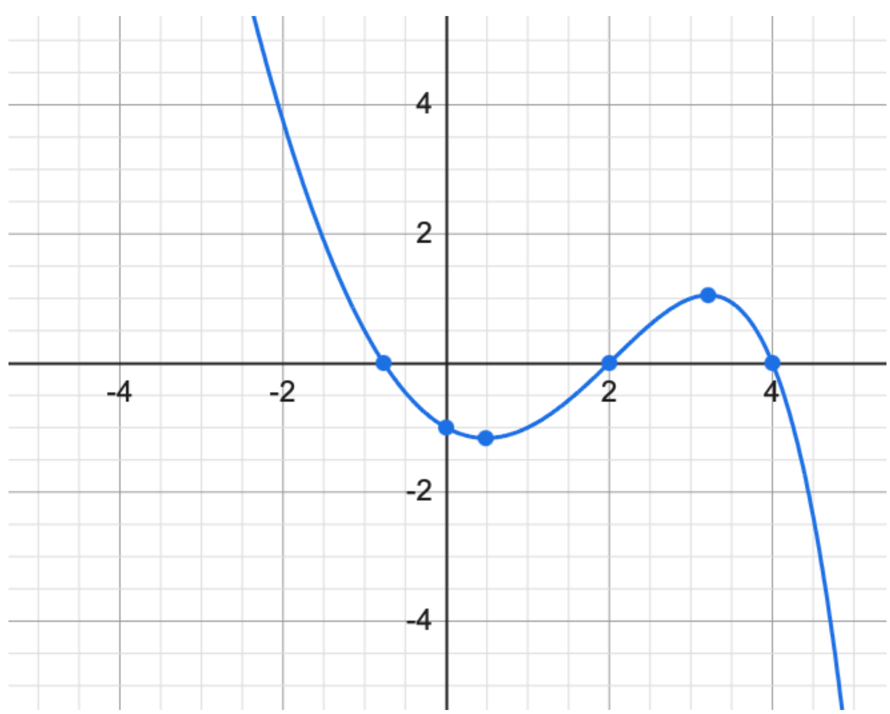
(5 marks) Convert to Polar form:

$$z = 3 + 5i$$

$$z = \frac{3 - i}{1 - i}$$

(5 marks) Determine the tangent line at x=3 for the following function. Plot the tangent line on the plot.

$$y = x^2 - 2^x$$



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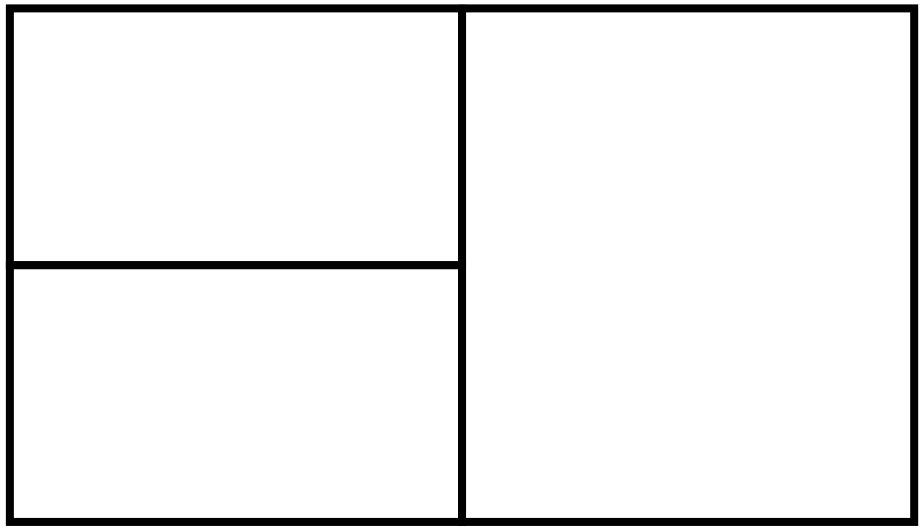

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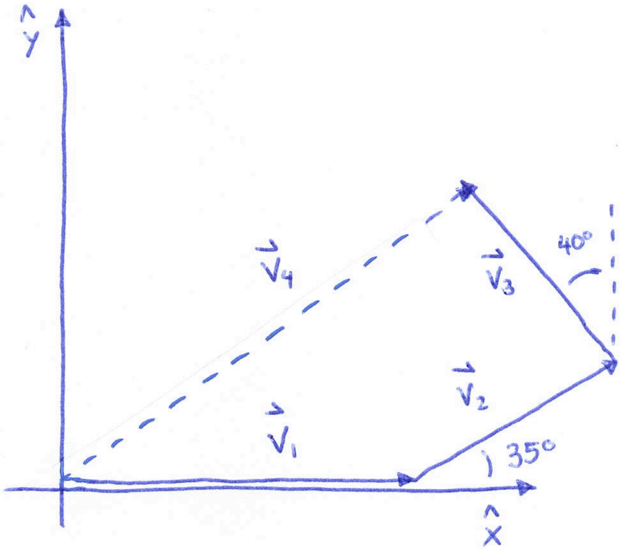
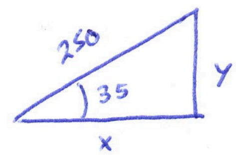
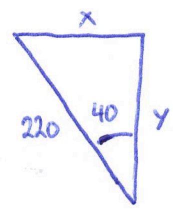




$x = 250\cos(35)$
$= 204.79$
$y = 250\sin(35)$
$= 143.39$



$x = 220\sin(40)$
$= 141.41$
$y = 220\cos(40)$
$= 168.53$

$$\vec{V}_1 = 810\,\hat{x} + 0\,\hat{y}$$
$$\vec{V}_2 = 204.79\,\hat{x} + 143.39\,\hat{y}$$
$$+\ \vec{V}_3 = -141.41\,\hat{x} + 168.53\,\hat{y}$$

$$\vec{V}_F = 873.38\,\hat{x} + 311.92\,\hat{y}$$

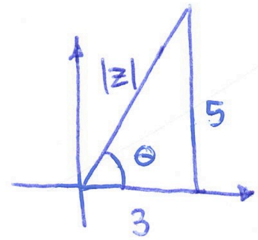
$$|\vec{V}_F| = \sqrt{(873.38)^2 + (311.92)^2}$$

$$|\vec{V}_F| = 927.41$$

$$\boxed{|\vec{V}_F| = 927\text{ m}}$$

(5 marks) Convert to Polar form:

$$z = 3 + 5i$$



$$\boxed{z = 5.83\, e^{1.03i}}$$

$|z| = \sqrt{3^2 + 5^2} = 5.83$

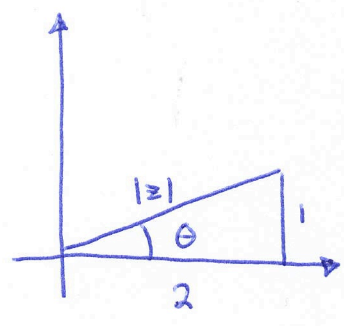
$\theta = \tan^{-1}\left(\frac{5}{3}\right) = 59.0°$

$= 1.03$ rads

$$z = \frac{3 - i}{1 - i}$$

$$z = \frac{(3-i)(1+i)}{(1-i)(1+i)} = \frac{3 + 3i - i + 1}{1 + i - i + 1} = \frac{4 + 2i}{2} = 2 + i$$

$$\boxed{z = 2.24\, e^{0.46i}}$$



$|z| = \sqrt{2^2 + 1^2} = \sqrt{5} = 2.24$

$\theta = \tan^{-1}\left(\frac{1}{2}\right) = 26.6°$

$= 0.46$ rads

(5 marks) Determine the tangent line at x=3 for the following function. Plot the tangent line on the plot.

$$y = x^2 - 2^x$$

$$y\Big|_{x=3} = [3]^2 - 2^3$$

$$= 1$$

$$\frac{dy}{dx} = 2x - \ln(2)\, 2^x$$

$$\frac{dy}{dx}\Big|_{x=3} = 2[3] - \ln(2)\, 2^3$$

$$= 0.45 = a$$

line equation:

$y = ax + b$

sub. slope @ $x = 3$

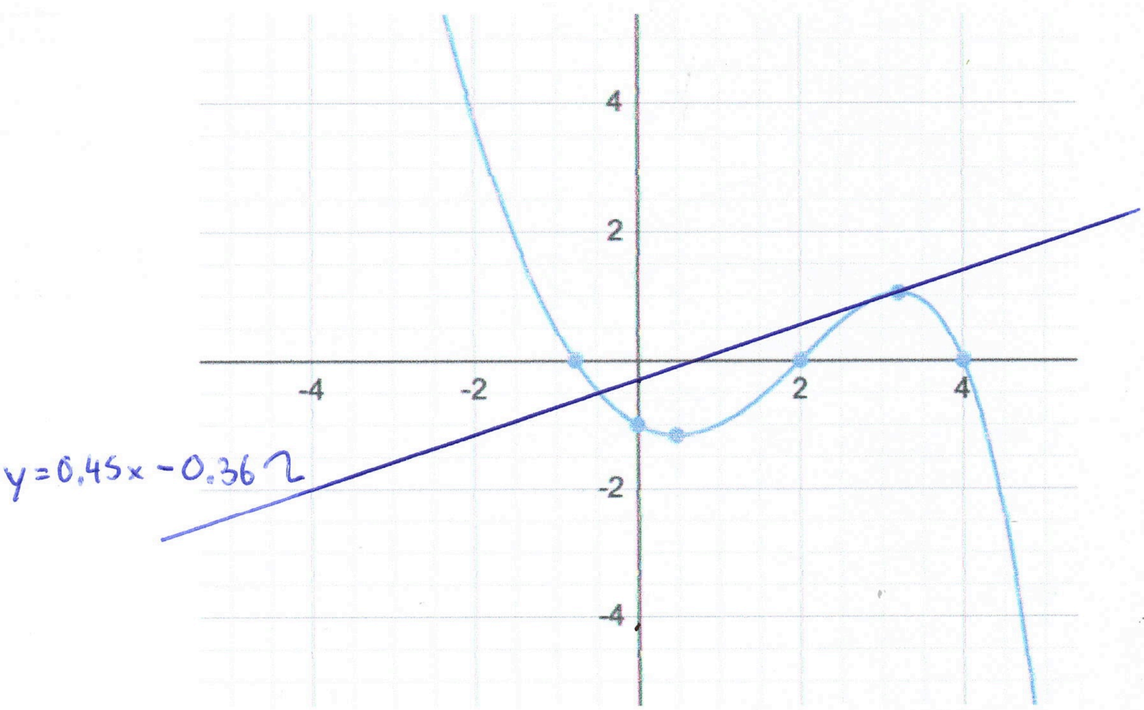
$y = [0.45]\, x + b$

sub point $(3,1)$ solve for b:

$b = [1] - 0.45[3]$

$= -0.36$

$$\boxed{y = 0.45x - 0.36}$$



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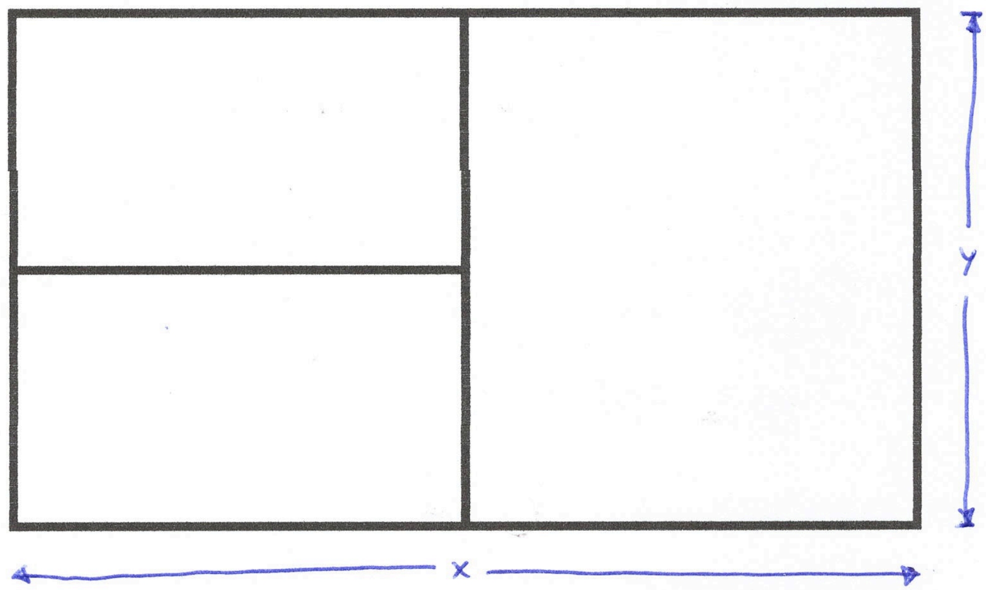

$A = xy \qquad (1)$

$P = 2.5x + 3y = 100 \qquad (2)$

solve for y in (2)

$$y = \frac{100 - 2.5x}{3} \qquad (2a)$$

sub (2a) into (1)

$$A = x\left[\frac{100 - 2.5x}{3}\right]$$

$$= \frac{100}{3}x - \frac{2.5}{3}x^2$$

Take derivative and set to zero for max/min

$$\frac{dA}{dx} = \frac{100}{3} - \frac{5}{3}x = 0 \quad \text{max/min}$$

$$x = \frac{100}{5} = 20$$

$$y = \frac{100 - 2.5[20]}{5} = 16.\bar{6}$$

max area:

$$A = [20][16.\bar{6}]$$

$$= 333.\bar{3}$$

$$\boxed{A_{max} = 333 \text{ m}^2}$$