Related Rates

Rates "per" ÷

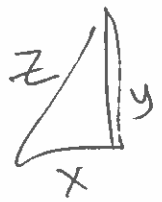
miles per hour $\frac{\text{miles}}{\text{hrs.}}$

dy/dt

Values miles, hrs., degrees

$$\frac{d}{dt} x^2 = 2x \cdot \frac{dx}{dt}$$

Ex $x^2 + y^2 = z^2$ ←



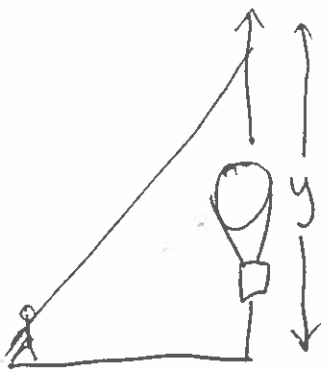
$$\frac{d}{dt} x^2 + y^2 \qquad \frac{d}{dt} z^2$$

$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$$

3 rates $\frac{dx}{dt}$ $\frac{dy}{dt}$ $\frac{dz}{dt}$

3 scales x, y, z

Balloon Problems



y Balloon rising at 10' per sec = $\frac{ft}{sec}$

$\frac{dy}{dt} = 10'$

$\frac{dx}{dt} = 0$

$x^2 + y^2 = z^2$

STAY

Walk Away 2'/sec $\frac{dx}{dt} = 2$

Walk Towards 2'/sec $\frac{dx}{dt} = -2$

$\frac{dz}{dt} = ?$

$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$

$\frac{dy}{dt} = 10$; $\frac{dz}{dt} = ?$

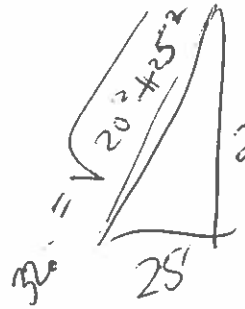
$= 0$

Not walking

At $t = 2$ sec $\rightarrow y = 20'$

At $t = 20$ sec $\rightarrow y = 200'$

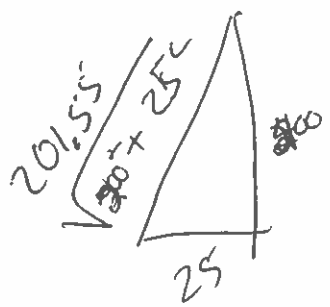
At 2sec



$\frac{y}{z}\frac{dy}{dt} = \frac{20}{32}\cdot 10$

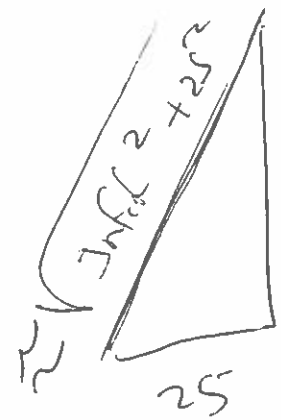
$\frac{dz}{dt} = 6.25'/sec$

At 20sec



$\frac{y}{z}\frac{dy}{dt} = \frac{200}{201.55}\cdot 10$

$\frac{dz}{dt} = 9.92'/sec$



$$\frac{dz}{dt} = \frac{y}{25}\frac{dy}{dt}$$

Infinitely Large

Volume

$$V = \frac{4}{3}\pi r^3$$

$$\frac{dV}{dt} = 1000 \text{ cc per sec}$$

$$\frac{d}{dt}V = \frac{d}{dt}\left(\frac{4}{3}\pi r^3\right)$$

$$\frac{dV}{dt} = 4\pi r^2 \cdot \frac{dr}{dt}$$

At $r = 7$

$$\frac{dr}{dt} = \frac{1000}{4\pi(7)^2}$$

$$= 1.62 \text{ cm/sec}$$

Rates

$\frac{dV}{dt} = 1000 \text{ cc/sec}$

$\frac{dr}{dt} =$

Value

$r = 7\text{cm}$

$$1000 = 4\pi(7)^2 \cdot \frac{dr}{dt}$$

At $r = 100$

$$\frac{dr}{dt} = \frac{1000}{4\pi(100)^2} =$$

$$= .0079 \text{ cm/sec}$$

Selling Balloons

$$\text{Revenue} = P \times S(P)$$

$$R = P \cdot (1000 - P)$$

$$R = 1000P - P^2$$

Derivate d/dt

$$\frac{dR}{dt} = 1000\frac{dP}{dt} - 2P\left(\frac{dP}{dt}\right)$$

$$\boxed{\frac{dR}{dt} = (1000 - 2P)\frac{dP}{dt}}$$

Now

$P = \$1.$

I want Raise Price by $\$.05/\text{wk}$.

$\frac{dP}{dt} = +\$50$

$P = \$1\,550$

$\frac{dR}{dt} = -\$5/\text{wk}$

Rate

$\frac{dR}{dt} =$ (Chg Revenue)

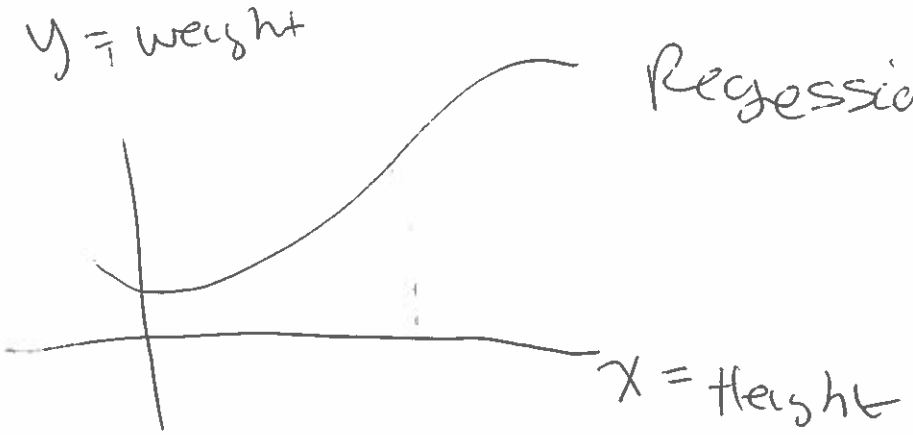
$\frac{dP}{dt} =$ (Changing Price)

Values

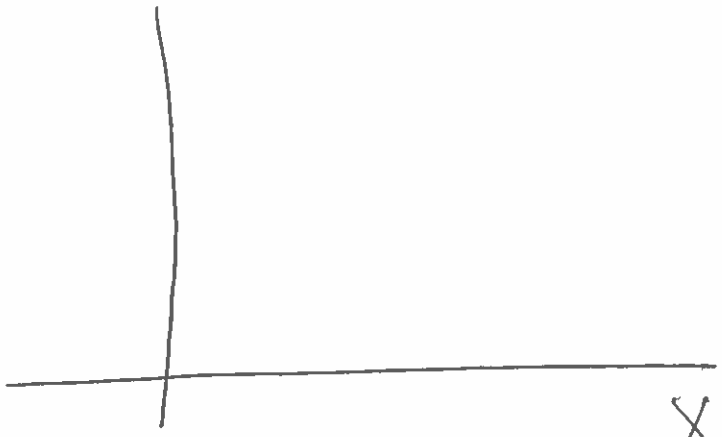
$P =$ (Price)

$\frac{dR}{dt} = (1000 - 2(1)) \cdot \frac{.05}{\text{wk}}$

$= \$49.90/\text{wk}$



$\frac{dX}{dt} = +.01''/\text{wks.}$



$\frac{dX}{dt} - \text{time}/\text{time}$

$Y_1 =$ regtn

$\frac{dy}{dt} = (\text{regeq})' \cdot \frac{dx}{dt}$

$\$/\text{year} \cdot \text{yrs}/\text{day}$

$$y = (3x)^{8x}$$

$$\ln y = \ln 3x^{8x}$$

$$\ln y = 8x \cdot \ln 3x$$

$$\frac{d}{dx} \ln y = \frac{d}{dx} 8x \cdot \ln(3x)$$

$$\frac{1}{y} \frac{dy}{dx} = 8x \cdot \frac{1}{3x} 3 + \ln(3x) \cdot 8$$

$$\frac{dy}{dx} = y \left[8 + 8 \ln(3x) \right]$$

$$= (3x)^{8x} \left[8 + 8 \ln(3x) \right]$$

GROUP NAME: WHO PARASITES

Date: 3/6

Student Names (First and Last)

Speaker/Presenter: Jenna

Writer/Prep: kathleen

Leader/Collaborator: Cathryn

Independant Variable (x-axis): years

Dependant Variable (y-axis): steroids in food in babies (ppm)

Conclusion (in words):

The rate of change in food in babies is decreasing by 21.05 ppm per year

Supporting Work:

SINREG

$y_1 = a * \sin(bx+c)+d$

$a = 51.49869637$

$b = .4431990559$

$C = -2.666224053$

$d = 147.0192513$

X	Y_1	Y_2
0	123.45	-20.29
10	197.54	-4.422
14	127.11	-21.05

74.09 ppm

-15.868

$Y_2 = nDeriv(Y_1, X, X)$

L_1	L_2
.01	122
3	100
6	143
9	200
12	170

-21.05 ppm / yr

GROUP NAME: International Avengers II ANTI FLUFFY PONIES

Date: 03/06/2014

Student Names (First and Last)

Speaker/Presenter: Ahmed & June

Writer/Prep: Ahmed & June

Leader/Collaborator: Tyler.

Independant Variable (x-axis): Salary Per K.

Dependant Variable (y-axis): Crime rate

Conclusion (in words):

At 70K per year if your salary is increasing by 2K per year your chance of committing a crime is increasing by 4.35% per year!

Supporting Work:

70	Y_1	Y_2
	.13575	.00435
1001	.8114428	-.0033829

$Y = ax^3 + bx^2 + cx + d$

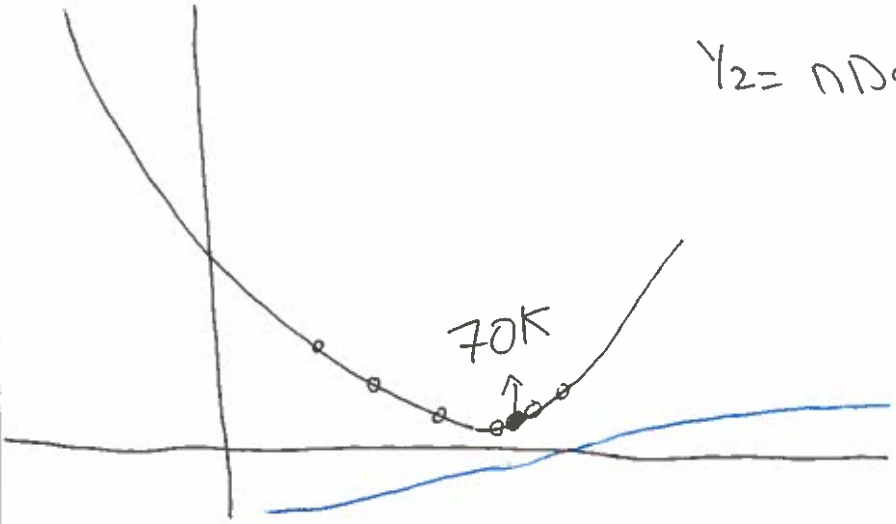
$a = 4.166666\,7E^{-7}$

$b = 1.107\ldots E^{-4}$

$c = -.019\ldots$

$d = .812$

$Y_2 = nDeriv(Y_1, X, X)*2$



GROUP NAME: Fluffy Ponies

Date: 3/6/14

Student Names (First and Last)

Speaker/Presenter: Milton

Writer/Prep: Courtney

Leader/Collaborator: Tyler

Independant Variable (x-axis): Income

Dependant Variable (y-axis): Crime rate

Conclusion (in words):

At ~~$40K~~ /year, if your salary is increasing by $2K per year then your chance of committing a crime ~~increasing~~ decreasing by ~~1.35%~~. 1.72% per year.

Supporting Work:

$y_1 = 4.166.. \times 10^{-7} x^3 + 1.107.. \times 10^{-4} x^2 - .0195.. x + .812$

$y_2 = nDeriv(y_1, x, x)$

X	y_1	y_2
70	~~.1355~~	.00435
40	.23771	-.0172

GROUP NAME:

Date: 3/6/14

Independant Variable (x-axis): Years

Dependant Variable (y-axis): [illegible]

Student Names (First and Last)

Speaker/Presenter: Mich[illegible]

Writer/Prep: Ch[illegible]

Leader/Collaborator: C[illegible]

Conclusion (in words): [illegible] increasing by 29.69 per day year. At Jan 2, 2010 the [illegible] level [illegible] down [illegible] 1.40E[illegible] per day per year. Overall the [illegible] increased by 26[illegible] per day per year between 2000 [illegible] 2010

Supporting Work: $y = ax^3 + bx^2 + cx + d$ (Cubic [illegible])

a = 0.[illegible]

b = [illegible]45[illegible]

c = [illegible]29[illegible]14[illegible]

d = [illegible]

X	Y_1	Y_2
0.0027[illegible]	1?[illegible]	-29.69
9125	-4.E11	-1.2E8
9[illegible]	-2.[illegible]E5	[illegible]

X	Y
200[illegible]	1??
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	170[illegible]
[illegible]	

GROUP NAME: Turkish Durrish?

Date: 3/6

Student Names (First and Last)

Speaker/Presenter: Jason

Writer/Prep: Dallen

Leader/Collaborator:

Independant Variable (x-axis): Years

Dependant Variable (y-axis): Tuition Prices

Conclusion (in words): In the year 2014 tuition is rising at $25,452 dollars per Semester.

Supporting Work:

$Y_1 = 2820.509... * 1.014...^{\wedge} X$

$Y_2 = nDeriv(Y_1, X, X)$

X	Y_1	Y_2
14	3464.7	50.906

$$\frac{50.906}{2} = 25.452...$$

GROUP NAME: Porter's minions

Date: mar. 16, 2013

Student Names (First and Last)

Speaker/Presenter: Kero

Writer/Prep: Jann

Leader/Collaborator: Daniella

Independant Variable (x-axis): years

Dependant Variable (y-axis): $ tuition

Conclusion (in words):

In 2015 tuition is going down $.02 a day

Supporting Work:

$y_1 = -2.04\ldots x^4 + 97.91\ldots x^3 + -1733.95\ldots x^2 + 13477.08\ldots x + -35573.99\ldots$

$y_2 =$ nDeriv (y_1, x, x)

X	y_1	y_2
15	3551	-10.42

$-10.42 * \frac{1}{365} = \$-.02\ldots$ / day