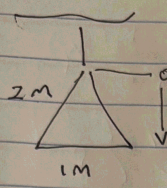
Pt. 1

# MATH

## Exponential growth/decay

Quiz recap

①




$F = \int_a^b [\rho g] h(x) w(x) dx$

$\int 9810(x+1)\left(\frac{x}{2}\right)$

22 890 N

②

$y = x^2$ $[0,3]$

$m_y \int_0^3 x(x^2)dx$ $\frac{x^4}{4}\Big|_0^3$ $\frac{81}{4}$

$M = \int_0^3 x^2 dx = 9$

$m_x \int_0^3 \frac{(x^2)^2}{2} dx = \frac{x^5}{10}\Big|_0^3 = \frac{243}{10}$

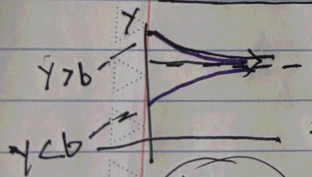
$\left(\frac{9}{4}, \frac{27}{10}\right)$ $\left(2.25, 2.7\right)$

③ $y' = 2y^2x$ $y(1) = -\frac{1}{3}$

$\int \frac{1}{y^2} dy = \int 2x dx$ $-\frac{1}{y} = x^2 + C$

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

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




K<0

y=b is a stable equilibrium

## Exponetial Growth/decay

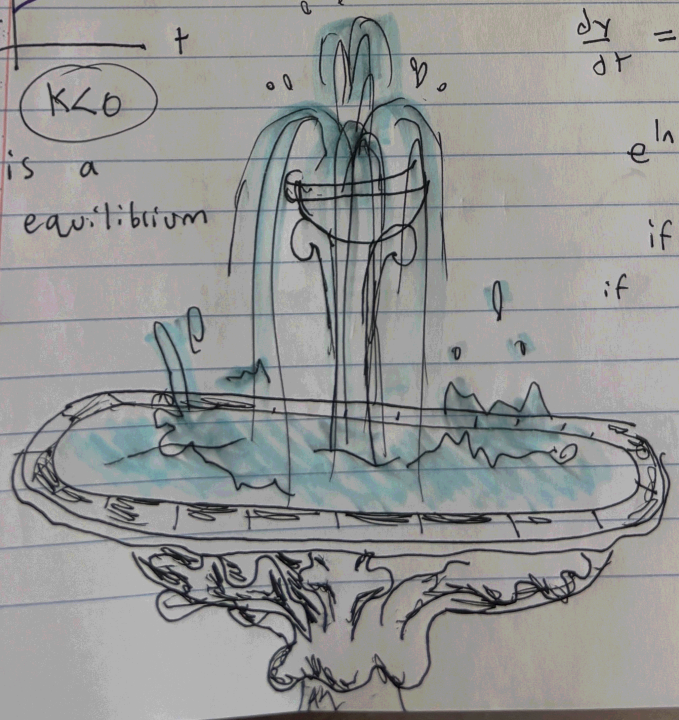
$\frac{dy}{dt} = ky$ $\int \frac{1}{y} dy = \int k dt$

$e^{\ln y} = e^{kt+C}$ $y = Ce^{kt}$

if k is positive its Growth

if k is negitive its decay

$\frac{dy}{dt} = k(y-b) \rightarrow \int \frac{1}{y-b} dy = \int k dt$



4.2

# MATH

## Exponential Growth/Decay

### Newtons Law of cooling

$\frac{dy}{dt} = -k(y - T_0)$ $y$ = temp of object

$T_0$ = Temp of surroundings

$\int \frac{1}{y - T_0} dy = \int -k\,dt$

$\ln|y - T_0| = -kt + C$

$e \qquad\qquad e$

$y - T_0 = Ce^{-kt}$

$y(?) = 20$

$20 = 5 + 95e^{-0.05465t}$

$t = 34.18$ mins

EXP 1 coffee

100°C

Office: 5°C

10 minutes Coffee is 60°C

30 minutes? 23.4°C

$\frac{dy}{dt} = -k(y - T_0)$

$y = T_0 + Ce^{-kt}$

$T_0 = 5°$ $y(0) = 100°$

$y(10) = 60°$

$y(?) = 20$

$y = 5 + Ce^{-kt}$

$100 = 5 + Ce^{-k(0)} \rightarrow C = 95$

$y = 5 + 95e^{-kt}$

$60 = 5 + 95e^{-k10}$ $k = 0.05465$

$y = 5 + 95e^{-0.05465t}$

Pt. 3

# MATH

EXP 2 murder

Midnight: 80° F  2AM: 75° F

Surroundings: 60° F  $\frac{dy}{dt} = -k(y - T_0)$

$y = 60 + Ce^{-kt}$  $y = T_0 + Ce^{-kt}$

time 0 = midnight  $t = 2$ = 2AM

$80 = 60 + C$  $C = 20$  $75 = 60 + 20e^{-k2}$

$k = 0.1438$  $y = 60 + 20e^{-0.1438t}$

Time of death $y = 98.6$

$t_0 = -4.57$ HR so 7:30 ish

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EXP 3 Laundry ball  70° F

1 min: 50° F  Surroundings: ? $T_0$

2 min: 40° F  $y(0) = 70$

$y(1) = 50$

$y(2) = 40$

$70 = T_0 + C$

$50 = T_0 + Ce^{-k}$

$40 = T_0 + Ce^{-2k}$

$\frac{70 - T_0 = Ce^{-k}}{50 - T_0 = Ce^{-k}}$

$\frac{70 - T_0}{50 - T_0} = e^{-k}$

$\frac{50 - T_0 = Ce^{-k}}{40 - T_0 = Ce^{-2k}}$

$\frac{50 - T_0}{40 - T_0} = \frac{e^{-k}}{e^{-2k}} = e^{k}$

$\frac{70 - T_0}{50 - T_0} = \frac{50 - T_0}{40 -$

$T_0 = 30$