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Centripetal Forces: Circular Motion

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LAB #8

- Centripetal Forces:
Circular Motion

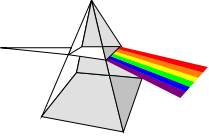
GOALS

- 1 TO TEST THE FACTORS WHICH DETERMINE CENTRIPETAL FORCES REQUIRED FOR CIRCULAR MOTION

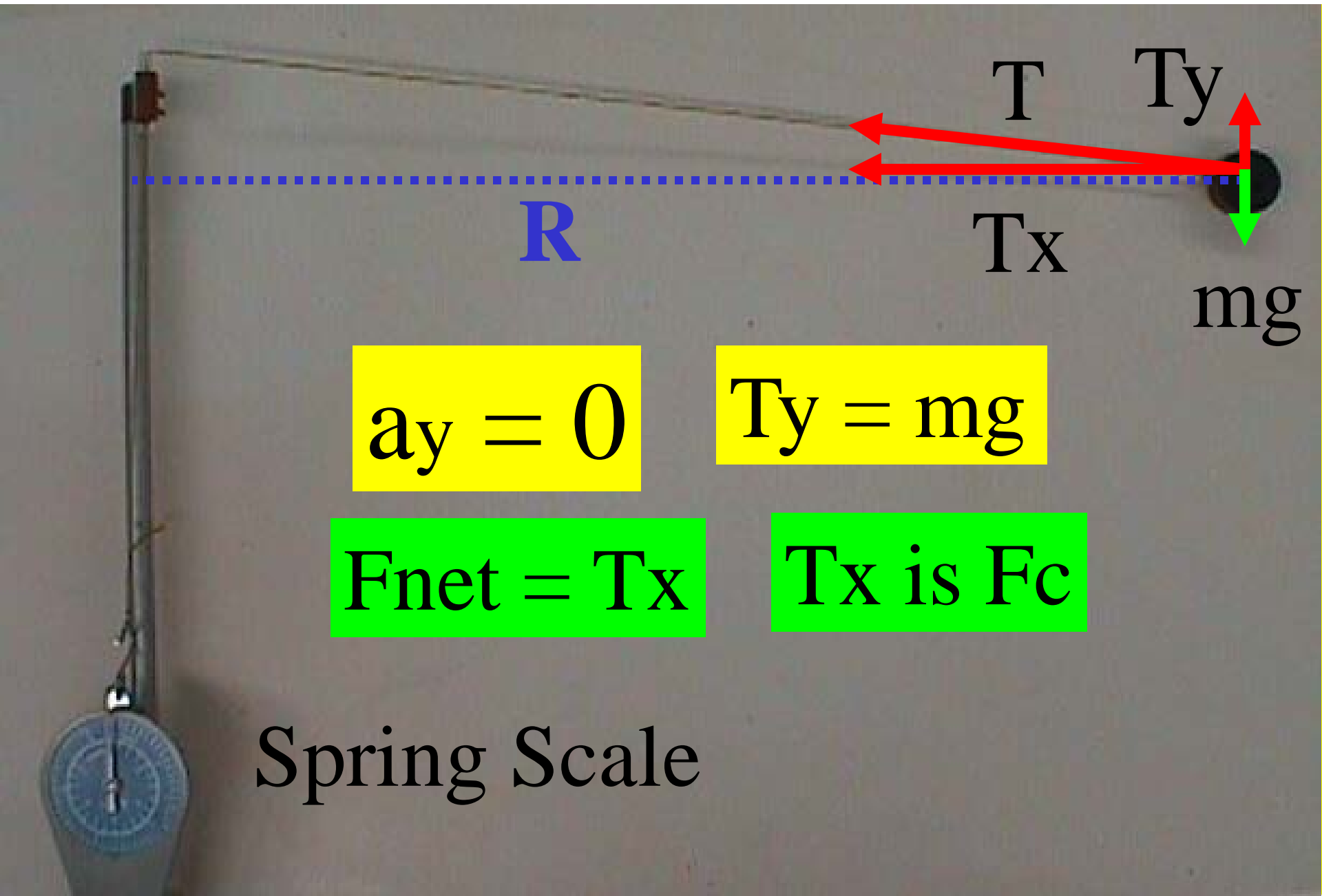
–**F_c** vs SPEED (**V**)

–**F_c** vs MASS (**m**)

–**F_c** vs RADIUS (**r**)



CIRCULAR MOTION: Part 1



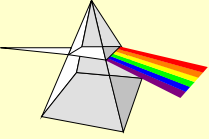
$$a_y = 0$$

$$T_y = mg$$

$$F_{net} = T_x$$

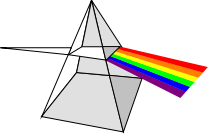
$$T_x \text{ is } F_c$$

Spring Scale



PROCEDURE: Part 1: F_c vs V

- MEASURE CONSTANTS:
 - MASS (m) OF STOPPER
 - RADIUS (r) OF MOTION
- SPIN STOPPER WITH UNIFORM CIRCULAR MOTION.
 - TIME ATLEAST 10 REVOLUTIONS
 - MEASURE F_c WITH SPRING SCALE
- REPEAT WITH ANOTHER UNIFORM SPEED, BUT FASTER.
 - MINIMUM OF 5 TRIALS



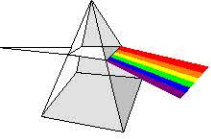
CIRCULAR MOTION

Determine Speed of Mass

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{\text{Circumference}}{\text{Period}}$$

$$\text{Period (T)} = \text{time} / \text{revolution}$$

$$V = \frac{C}{T} = \frac{2\pi r}{T}$$



I.P. CIRCULAR MOTION

Velocity of Circle 1

V_x |M| 2.000 m/s

V_y

V_z

Acceleration of Circle 1

A_x |A| 1.333 m/s²

A_y

A_z

Tension of Rope 3

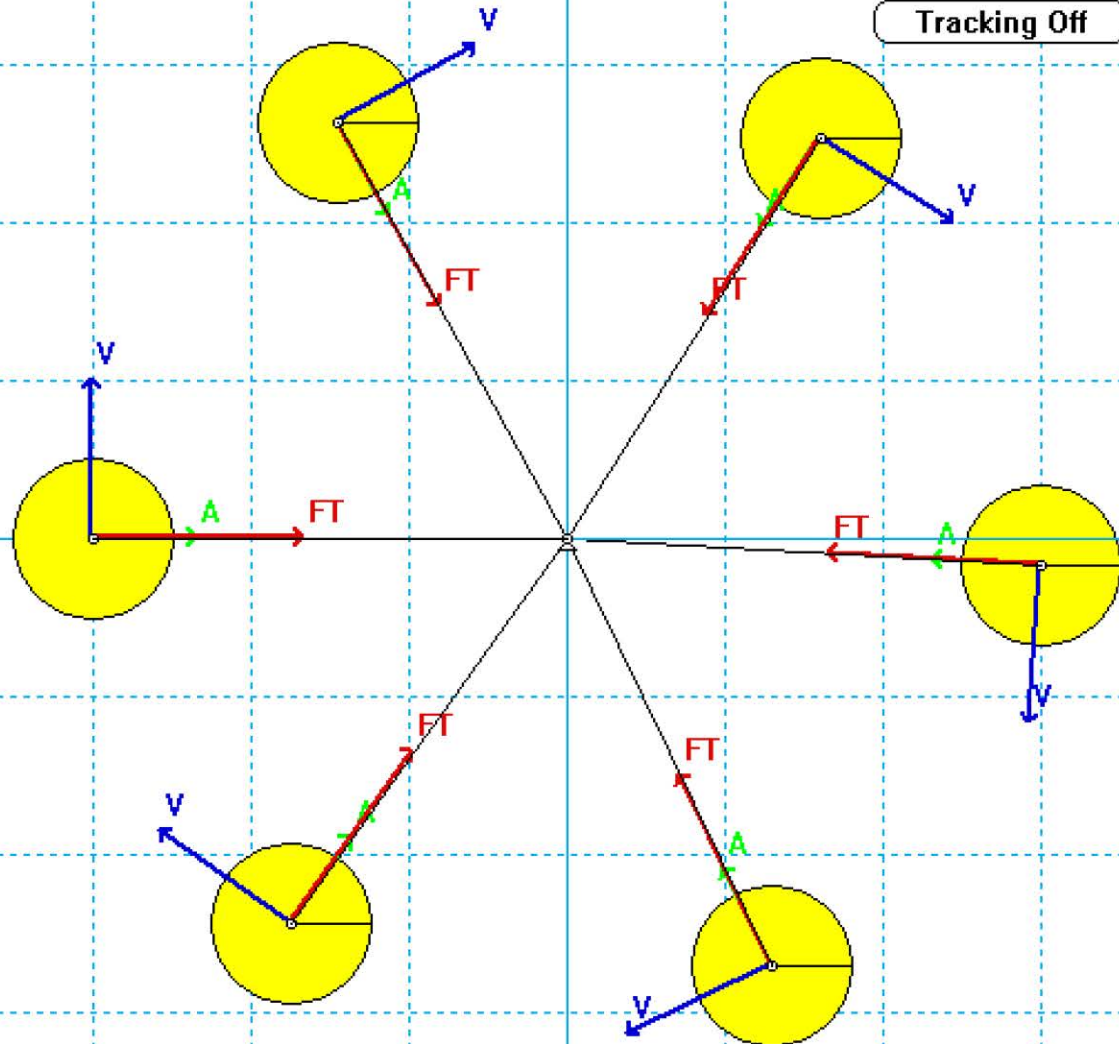
|F| 1.333 N

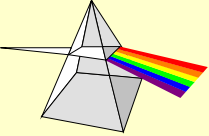
LAB 8: CIRCULAR MOTION

Erase Track

Tracking (Every 32 Frames)

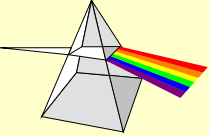
Tracking Off





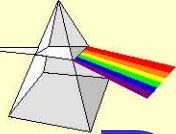
PROCEDURE: Part 2: F_c vs m

- CREATE AN IP SIMULATION OF AN OVERHEAD VIEW OF A MASS ON A FRICTIONLESS SURFACE
 - TURN OFF GRAVITY
 - CREATE MASS
 - ATTACH A ROPE TO MASS OF A GIVEN LENGTH WHICH WILL DETERMINE RADIUS
 - GIVE MASS A TANGENTIAL VELOCITY
 - RECORD CONSTANTS:
 - RADIUS
 - SPEED
 - RUN SIMULATION, RECORD TENSION
 - MEASURE TENSION IN ROPE
 - CHANGE MASS AND REPEAT FOR 8 TRIALS



PROCEDURE: Part 3: F_c vs r

- USE THE SAME IP SIMULATION OF AN OVERHEAD VIEW OF A MASS ON A FRICTIONLESS SURFACE
 - SELECT AND RECORD CONSTANTS:
 - MASS
 - SPEED
 - RUN SIMULATION, RECORD TENSION
 - SHORTEN THE ROPE TO A NEW RADIUS
 - RUN SIMULATION AND RECORD TENSION
 - REPEAT FOR 8 TRIALS



DATA TABLE PART 1: F_c vs V

SAMPLE DATA TABLE: PART 1: F_c vs V

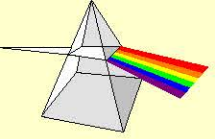
| CONSTANTS: | | MASS (kg) | | R (m) | | |
|------------|------------|-----------|-------|-------------|---------------------|-----------|
| | TIME FOR | PERIOD | | SPEED (m/s) | | SCALE |
| TRIAL | 10 REV (S) | T (s/rev) | C (m) | $V = C/T$ | V^2 (m^2/s^2) | F_c (N) |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |

DATA TABLE PART 2: F_c vs M

- **MAKE YOUR OWN TABLE**
 - **8-10 TRIALS**
 - **INCLUDE CONSTANTS**
 - **INDEPENDENT VARIABLE (WITH UNITS)**
 - **DEPENDENT VARIABLE (WITH UNITS)**

DATA TABLE PART 2: F_c vs r

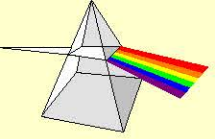
- **MAKE YOUR OWN TABLE**
 - **8-10 TRIALS**
 - **INCLUDE CONSTANTS**
 - **INDEPENDENT VARIABLE (WITH UNITS)**
 - **DEPENDENT VARIABLE (WITH UNITS)**



GRAPH #1: F_c vs V

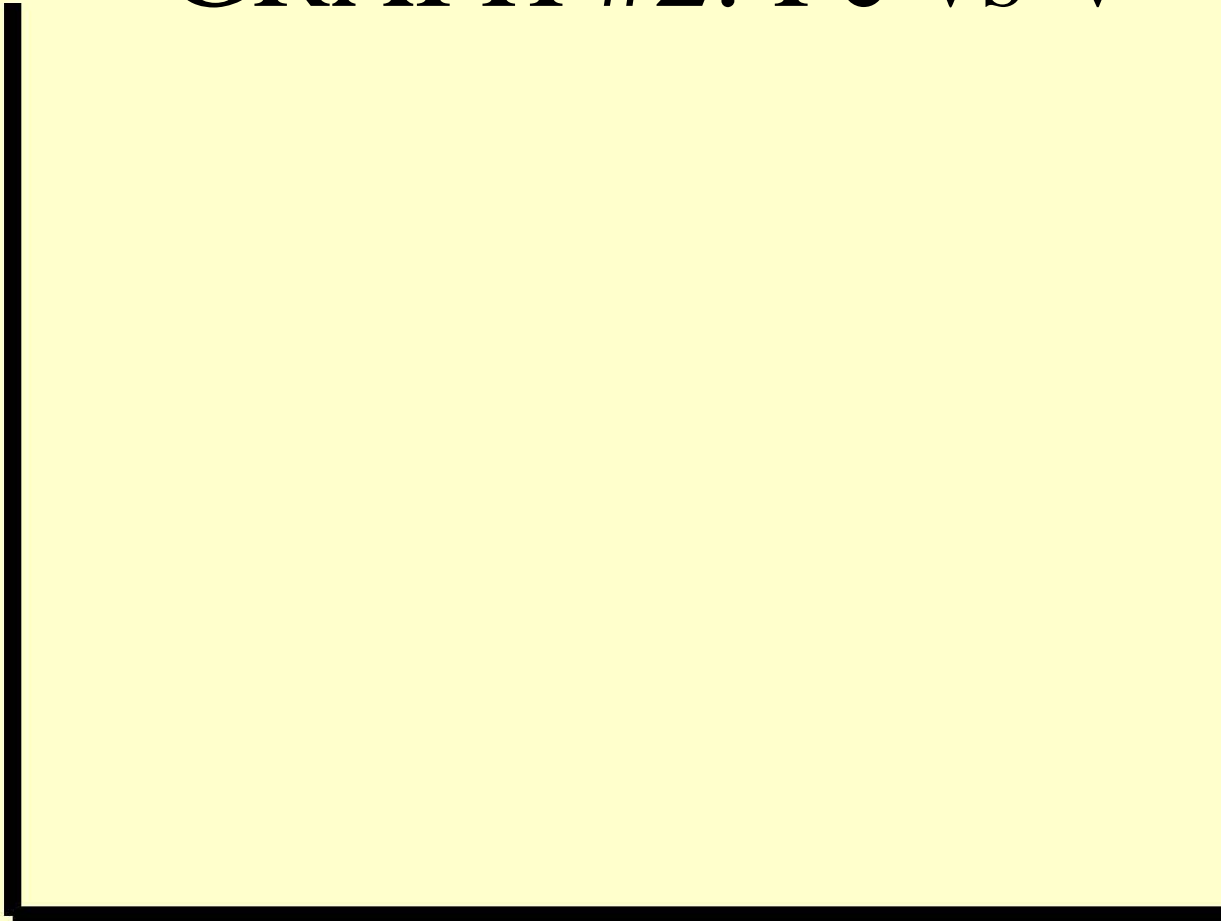
F_c (N)

SPEED (m/s)

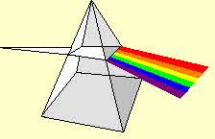


GRAPH #2: F_c vs V

F_c (N)



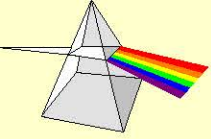
$SPEED^2$ (m^2/s^2)



GRAPH #3: F_c vs MASS

F_c (N)

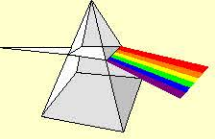
MASS (kg)



GRAPH #4: F_c vs RADIUS

F_c (N)

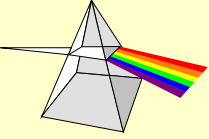
RADIUS (m)



GRAPH #5: F_c vs $1/\text{RADIUS}$

F_c (N)

$1/\text{RADIUS}$ (1/m)



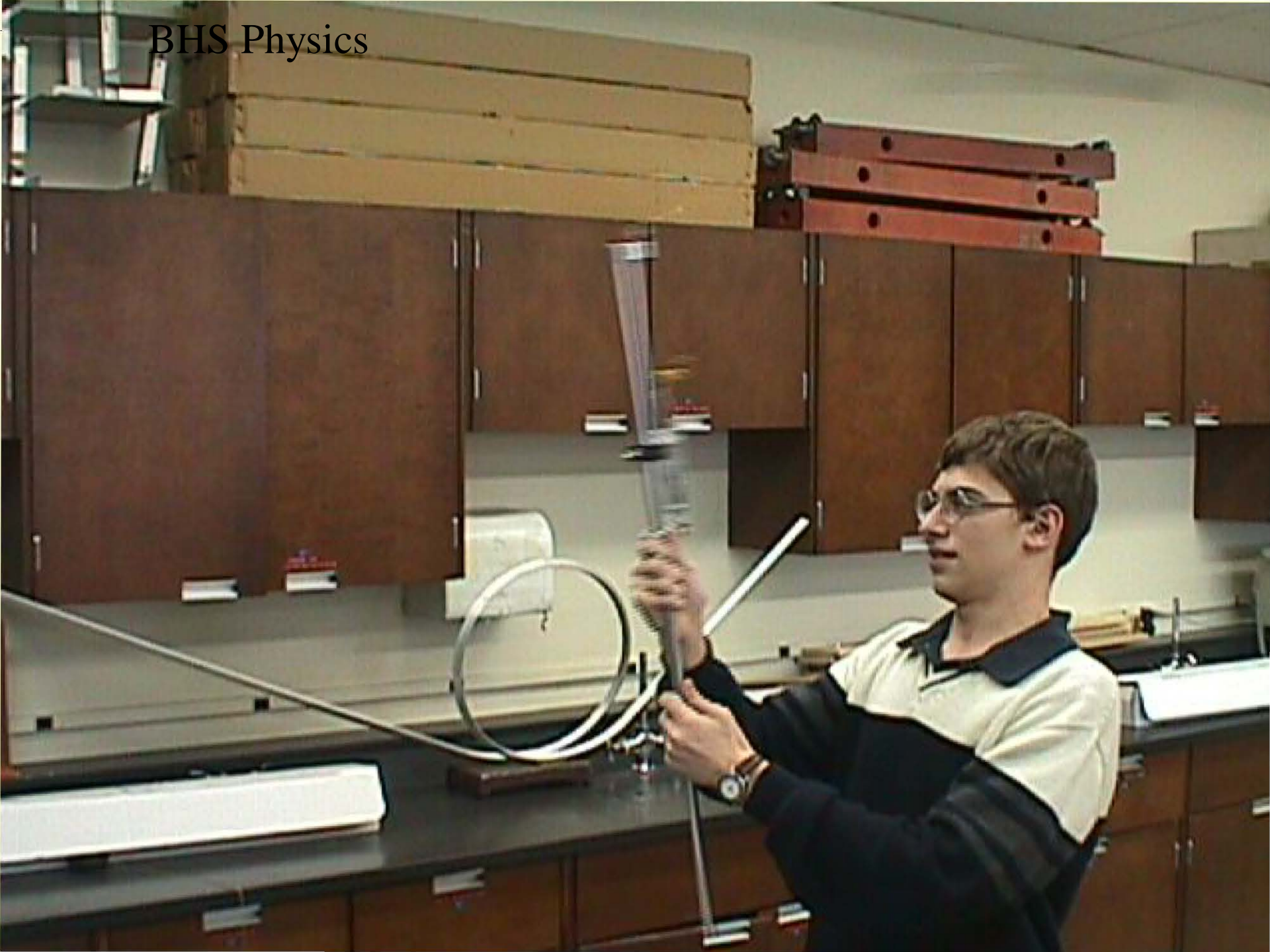
WRITE-UP

- ABSTRACT:
 - BACKGROUND
 - METHOD
- **SKETCH: ENHANCED** I.P. SCREEN DUMP
- DATA TABLES
- GRAPHS
 - TRENDLINES
 - GRAPH ANALYSIS
 - TEXT BOX TO TELL STORY OF **EACH** GRAPH
 - INCLUDE THE SIGNIFICANCE OF SLOPE OF LINEAR TRENDLINES
- CONCLUSION

LAB #8

DATA
ANALYSIS

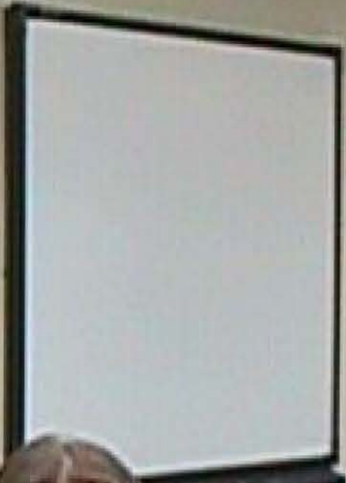


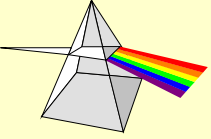




THINK

$$F_c = \frac{mv^2}{r}$$



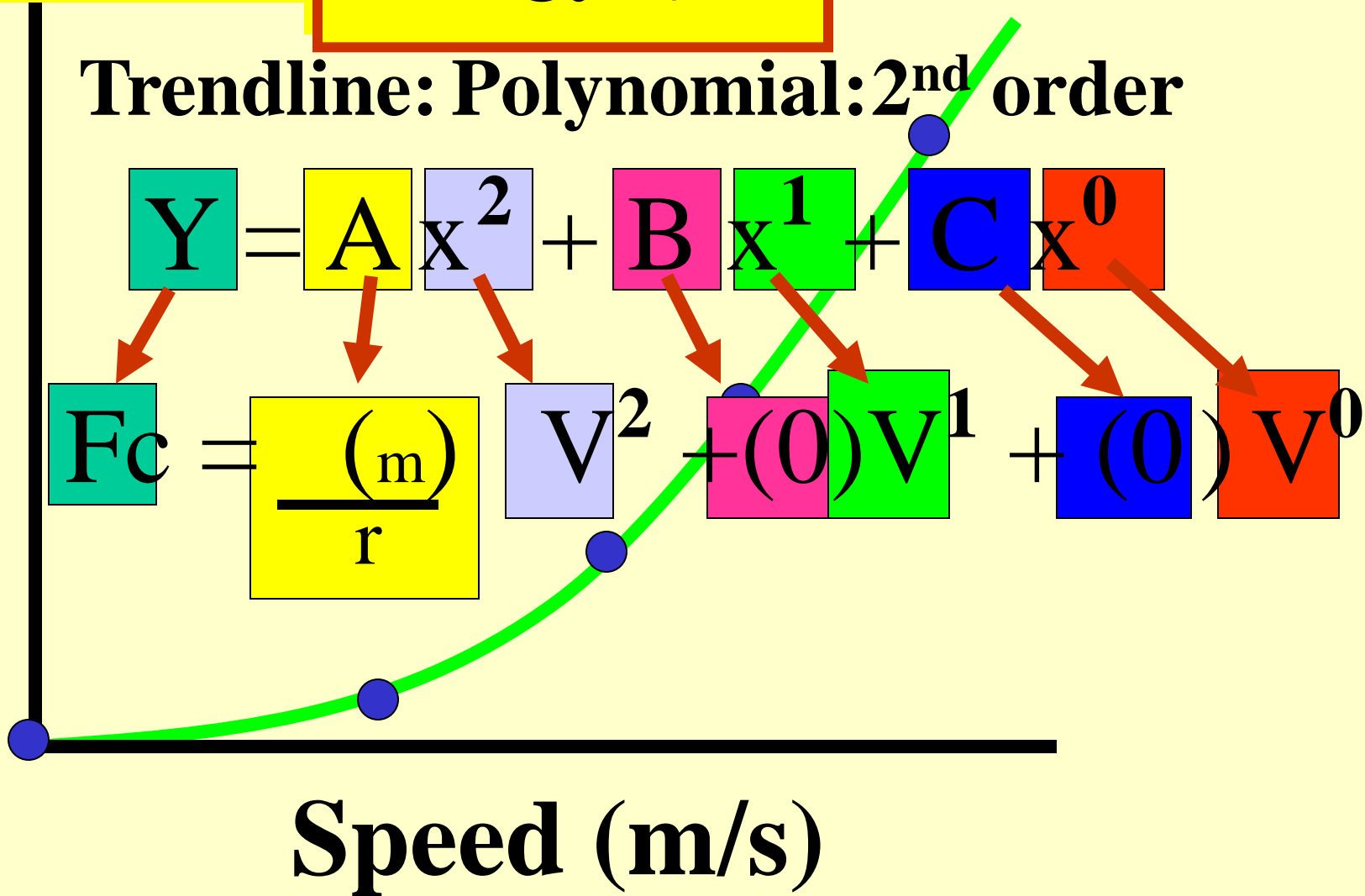


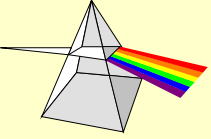
GRAPH #1: F_c vs V_o

Relationship: $F_c \propto V^2$

Trendline: Polynomial: 2nd order

F_c (N)



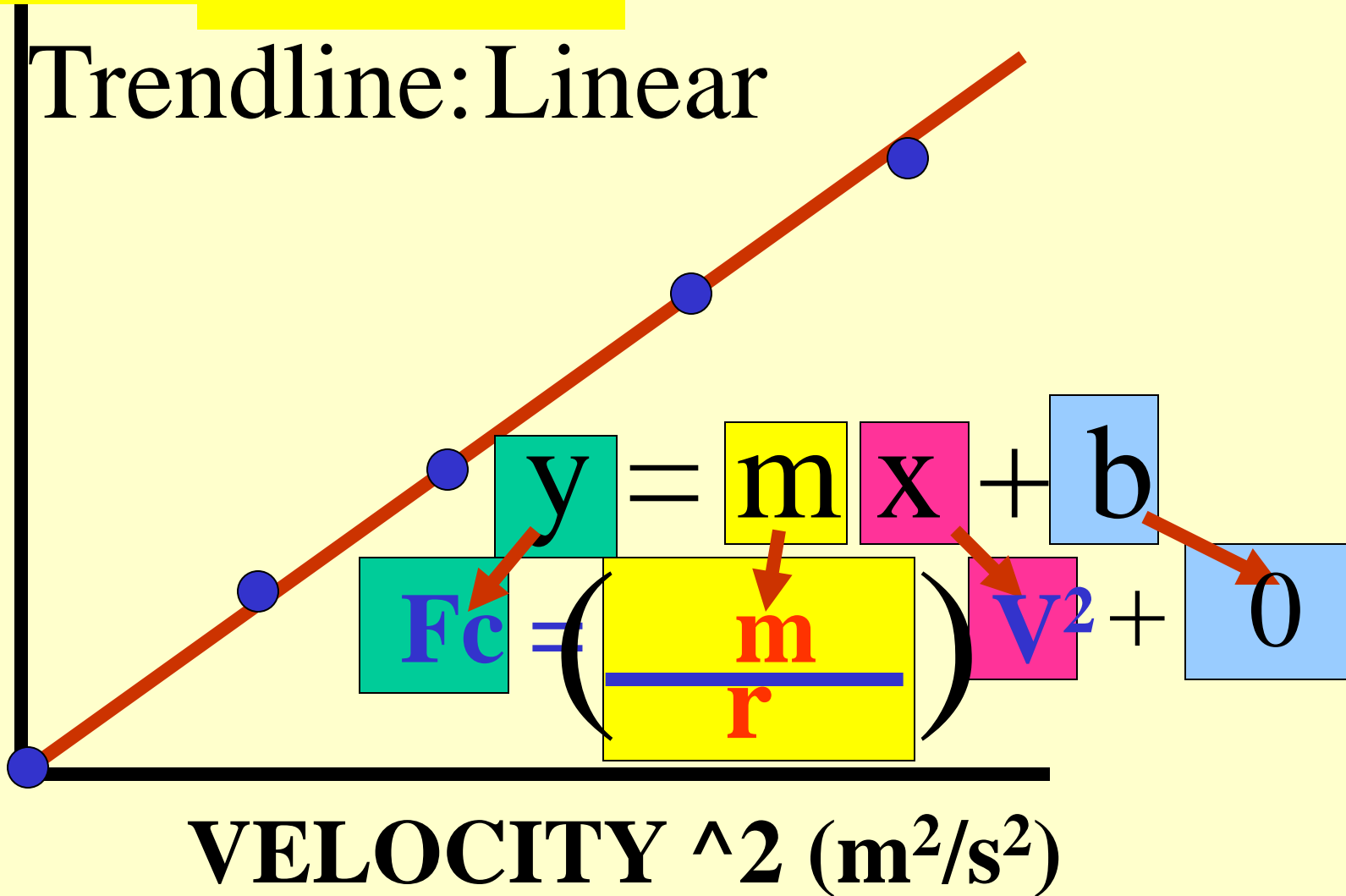


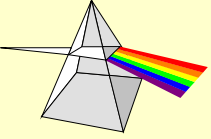
GRAPH #2: F_c vs. V^2

Relationship: $F_c \propto V^2$

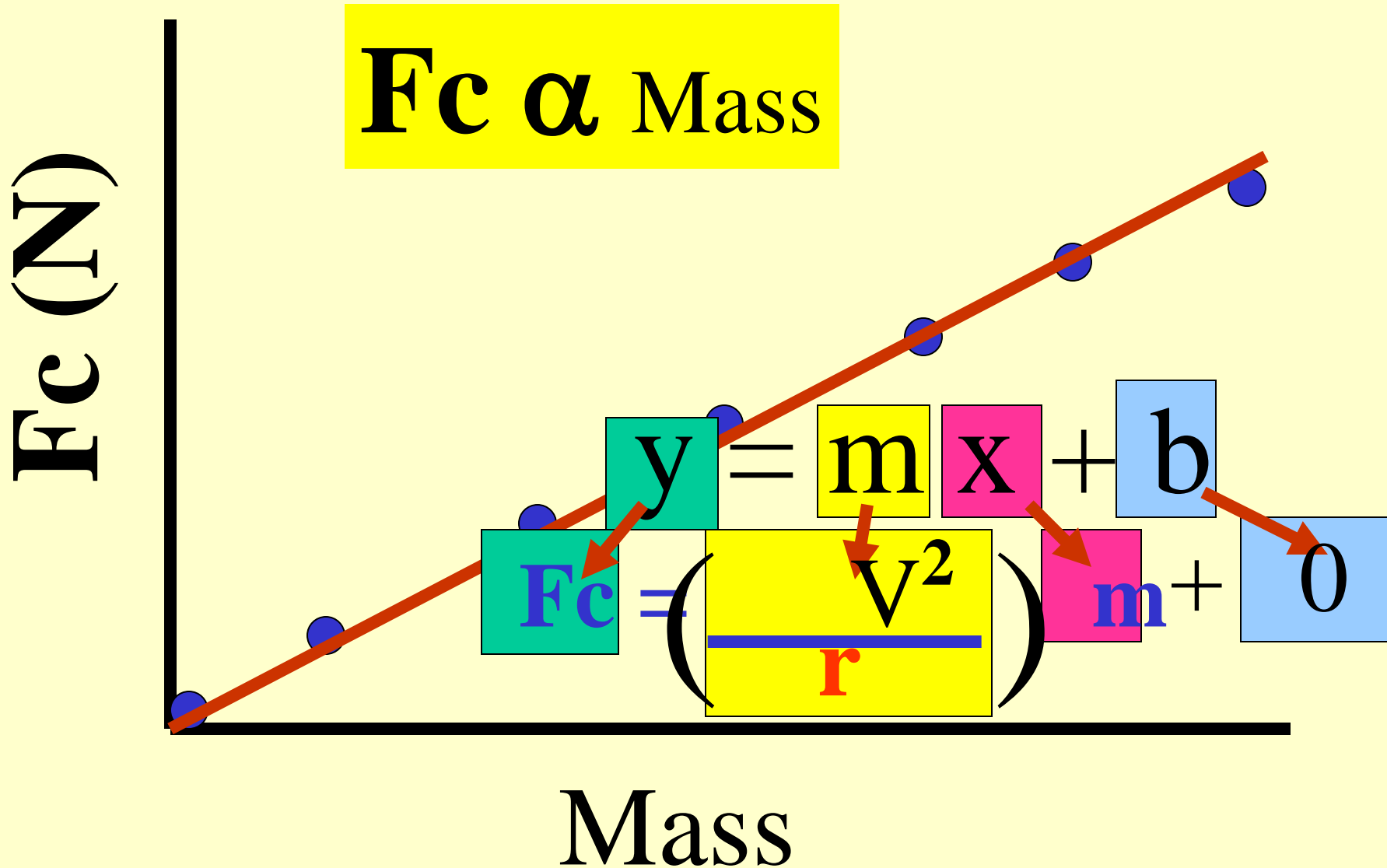
Trendline: Linear

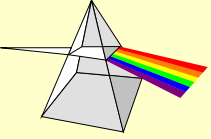
F_c (N)



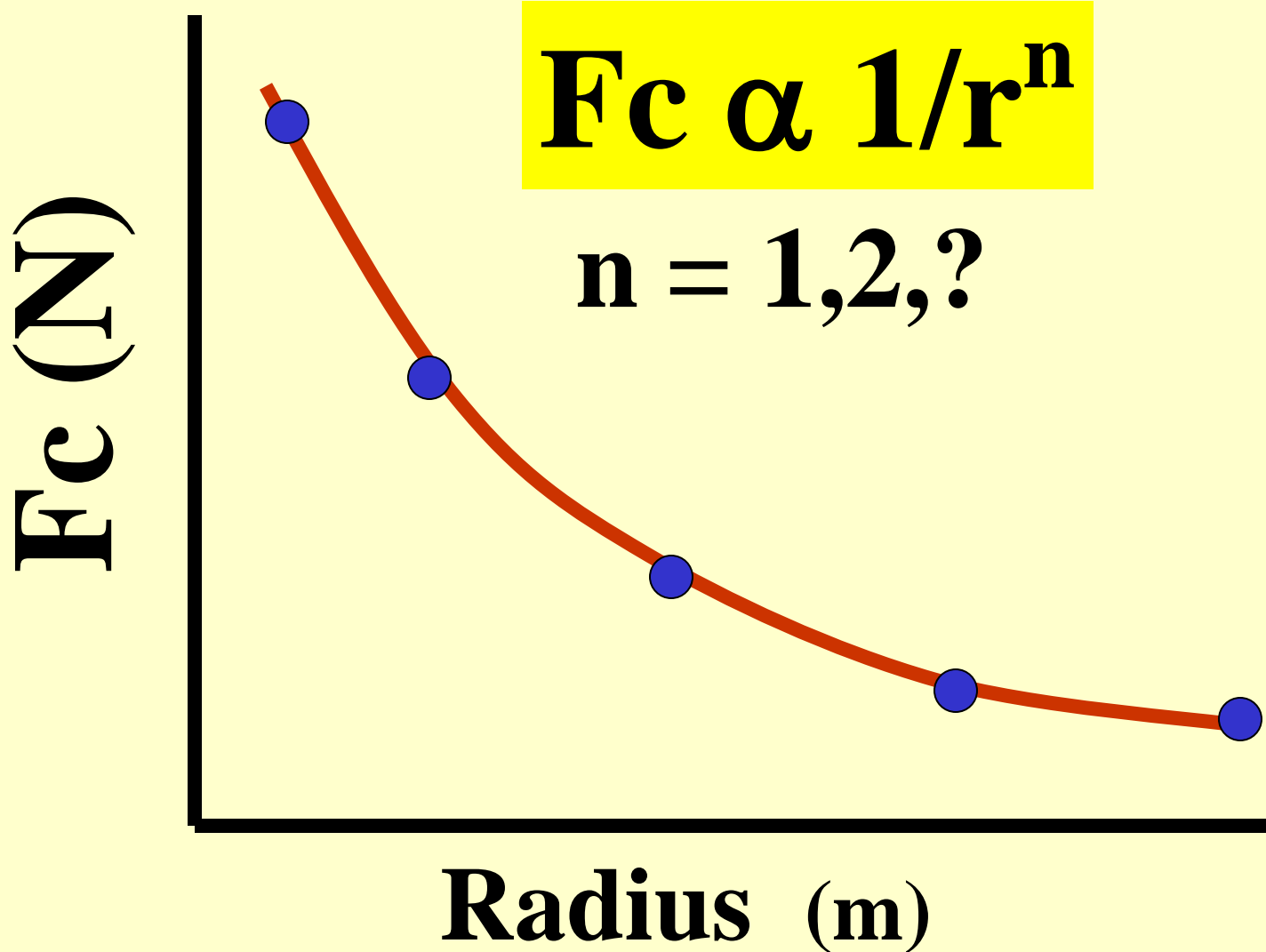


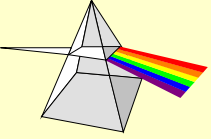
GRAPH #3: F_c vs Mass





GRAPH #4: F_c vs Radius





GRAPH #4: F_c vs $1/r$

