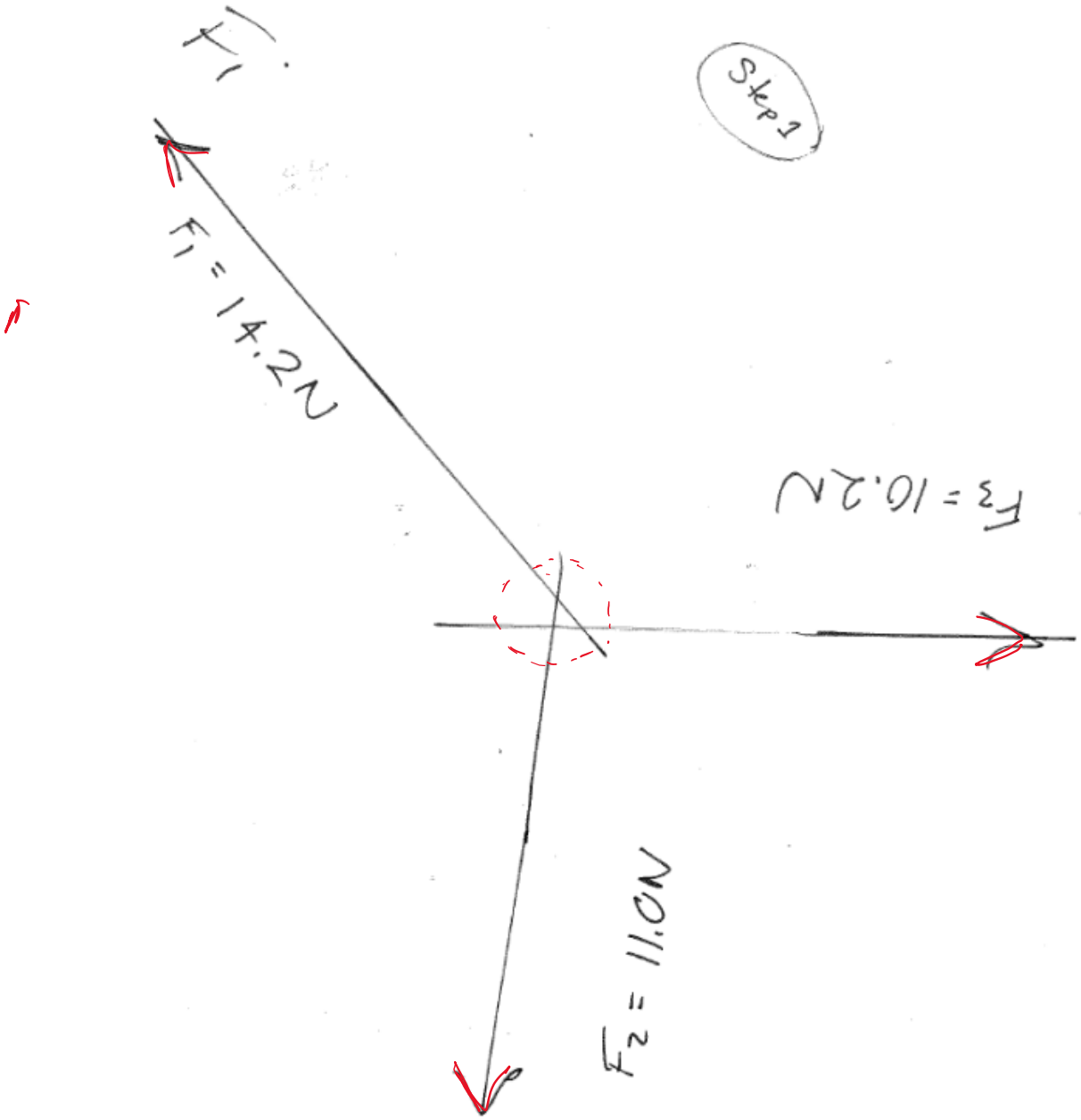
Feb 10, 2021

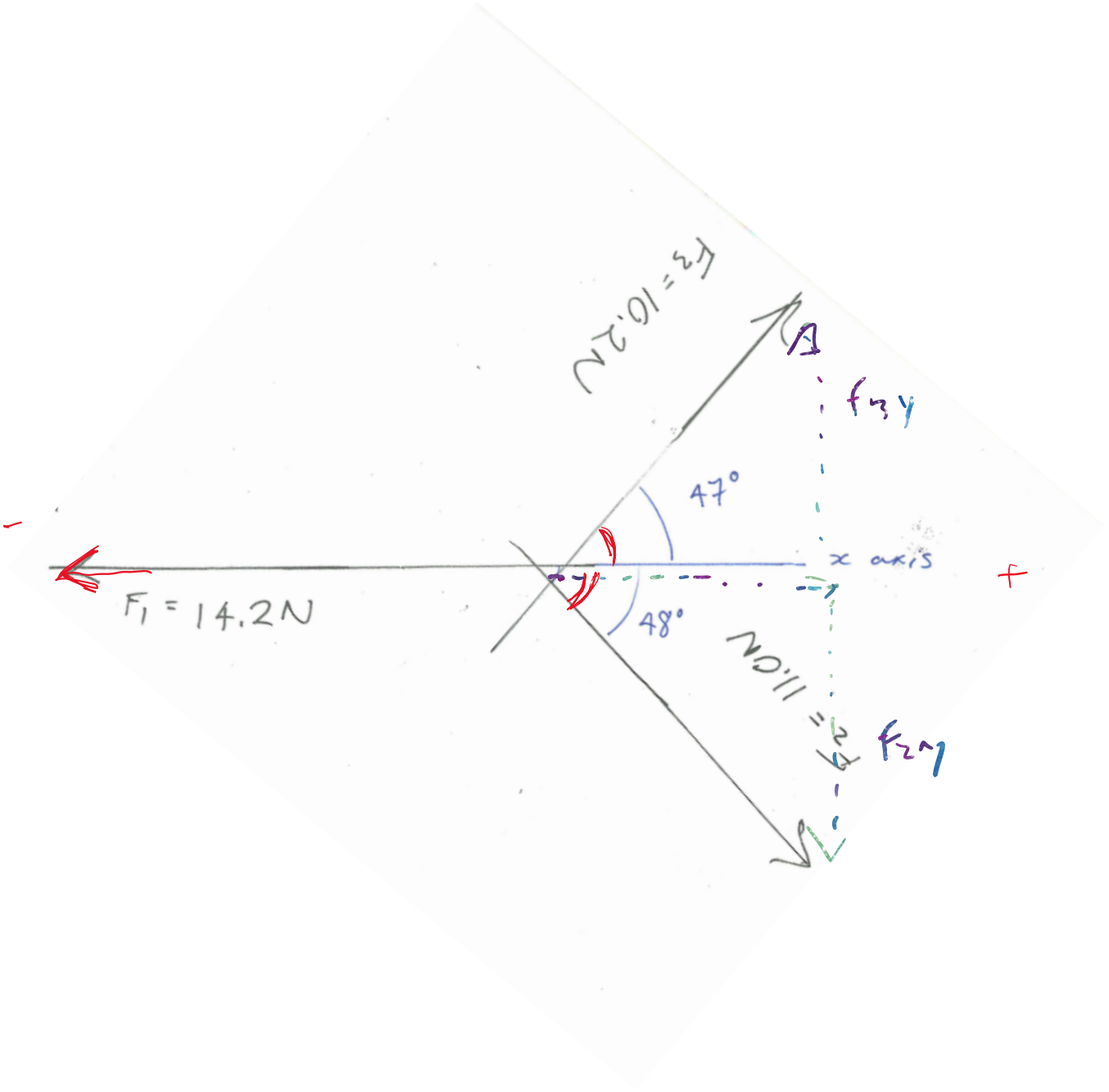
- ***Lab Activity: 2-D Vector addition of forces on a stationary object ΣF = 0N***
- Tutorial on how to do the data analysis: link to video lesson:

https://www.loom.com/share/71e02473d7fd4fada83b73a4d287748a

Example: Ms Bernabei's sample data:



Establish an x-axis, and use a protractor to measure the angle for each force



Step 3: Determine the values of the angles (direction of the forces):

4. **Measure the angles relative to the x-axis:** *Use a protractor* to measure the angles
   - θ_1 = 0° (angle that F_1 makes with the x-axis)
   - θ_2 = 48° (angle that F_2 makes with the x-axis)
   - θ_3 = 47° (angle that F_3 makes with the x-axis)

Step 4: Data Analysis

1. Organize your data in the **data table** below:

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Force Vector	Magnitude (in Newtons)	Magnitude of angle θ (in degrees)	Orientation relative to the x-axis:
F_1			
F_2			
F_3			

Step 4: Data Analysis

1. Organize your data in the **data table** below:

Force Vector	Magnitude (in Newtons)	Magnitude of angle θ (in degrees)	Orientation relative to the x-axis:
F_1	14.2N	0°	along the −x axis
F_2	11.0N	48°	below the +x axis
F_3	10.2N	47°	above the +x axis.

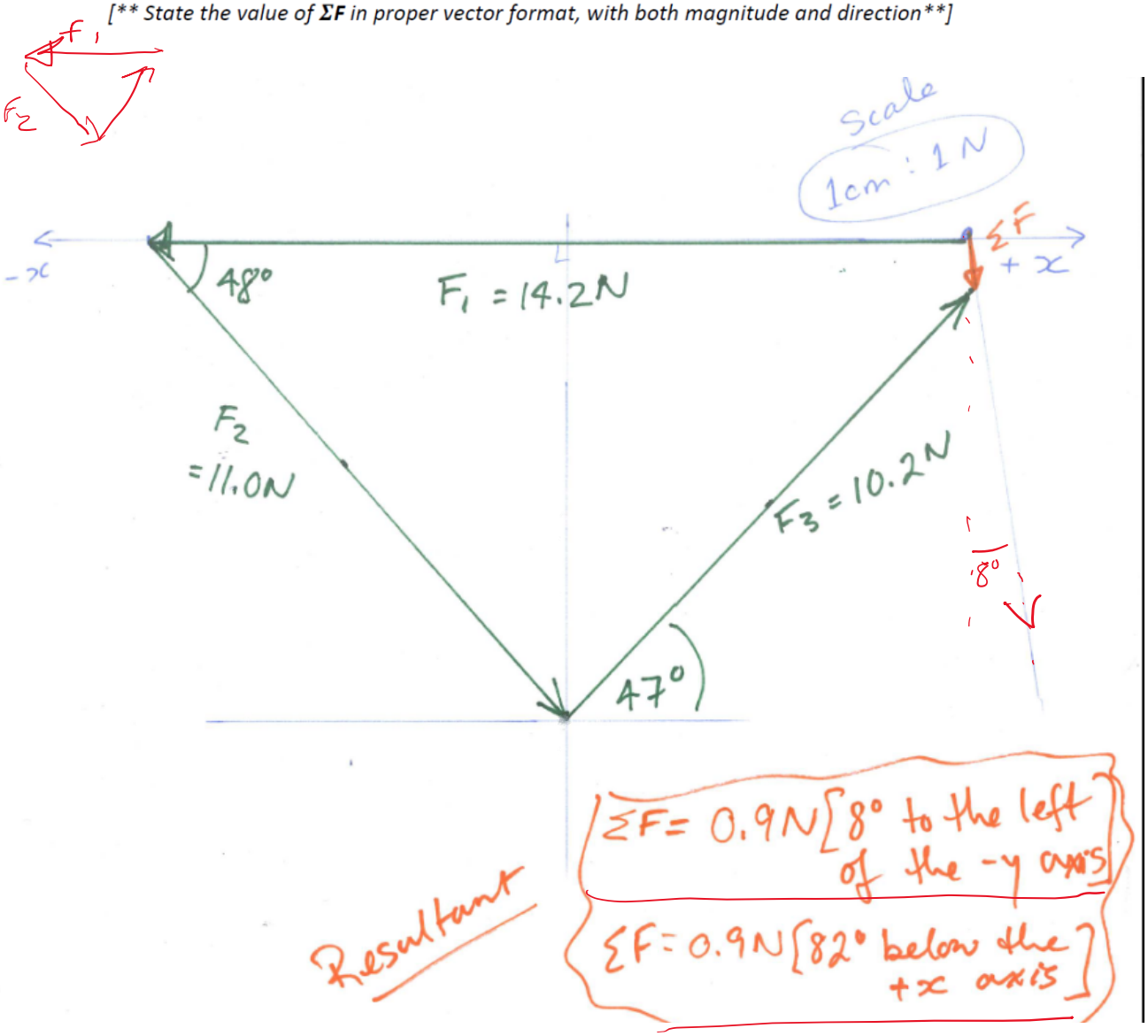
2. **Graphical Method to determine ΣF (i.e. scale diagram):**

a. *On a separate sheet of blank paper* draw and label a scale diagram of the vector sum: $\mathbf{F_1} + \mathbf{F_2} + \mathbf{F_3}$

b. *In a different colour* draw the resultant vector (the vector arrow that starts at the tail of F_1 and ends at the head of F_3).

c. *Resultant vector:* Measure the length of the resultant vector and convert that length into its force value in Newtons. Write the value on your vector diagram.

*[** State the value of **ΣF** in proper vector format, with both magnitude and direction**]*



3. **Analytical Methods (components) to determine ΣF:**

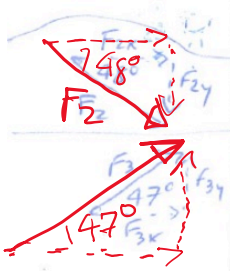
a. **Data table:** Determine and state the x and y components of each vector:

Force Vector	x component	y component
F_1		
F_2		
F_3		
Vector sum:	$\Sigma F_x =$	$\Sigma F_y =$

**** IMPORTANT: Refer to Chapter 1.4 to 1.8 of your textbook for details and examples on vector components!**

a. **Data table:** Determine and state the x and y components of each vector:

Force Vector	x component	y component
F_1	$-14.2\ N$	0
F_2	$11.0 \cos 48° = 7.36\ N$	$-11.0 \sin 48° = -8.1746$
F_3	$10.2 \cos 47° = 6.956$	$10.2 \sin 47° = 7.4598$
Vector sum:	$\Sigma F_x =$ $0.1168\ N$	$\Sigma F_y =$ $-0.7148\ N$



b. Use Pythagorean theorem and trigonometry to calculate the magnitude and direction of ΣF (= vector sum of $\Sigma F_x + \Sigma F_y$)

*[** State the value of ΣF in proper vector format, with both magnitude and direction**]*

$\Sigma F_R = \sqrt{F_x^2 + F_y^2} = ?$ → $\Sigma F = \sqrt{(0.1168)^2 + (0.7148)^2} = 0.72N$

$\theta = \tan^{-1}\left[\frac{F_y}{F_x}\right] = ?$ → $\theta = \tan^{-1}\left[\frac{0.7148}{0.1168}\right] = 80.7°$

equivalent vectors

ΣF = [0.72N [81° below the +x axis]]

= [0.72N [9° to the right of the −y axis]]

% error ≈ % of average force: $[\Sigma F/[(F_1 + F_2 + F_3)/3]] \times 100\%$ = (show calculation)

_____ = _____

% error ≈ % of average force: $[\Sigma F/[(F_1 + F_2 + F_3)/3]] \times 100\%$ = (show calculation)

$= \left[\frac{0.72}{\left(\frac{14.2 + 11 + 10.2}{3}\right)}\right] \times 100\% = 6.1\%$ = _____

1. CONCLUSION: In a short paragraph write a brief *Conclusion*, referencing your experimental

expected value

$\Sigma F = 0\ N$

$$\left[\frac{0.72\ N}{\left(\frac{14.2 + 11 + 10.2}{3}\right)}\right] \times 100\% = 6.1\%$$