Laboratory 3 Force table and Vector Addition of Forces

PRE-LABORATORY ASSIGNMENT

1. Scalars are physical quantities that can be completely specified by their **magnitudes.**
2. A vector quantity is one that both **magnitude and direction.**
3. Classify each of the following physical quantities as vectors or scalars.

   a. Volume - **Scalar**
   b. Force - **Vector**
   c. Density - **Scalar**
   d. Velocity - **Vector**
   e. Acceleration - **Vector**

4. If F_1 stands for a force vector of magnitude 30.0 N and F_2 stands for a force vector of magnitude 40.0 N acting in the directions shown in the Figure 3-6, what are the magnitude and direction of the resultant obtained by the vector addition of these two vectors using the analytical method? Show your work

   $F_x = 30 + 40\cos 60° = 50\ N$

   $F_y = 40\sin 60° = 34.64\ N$

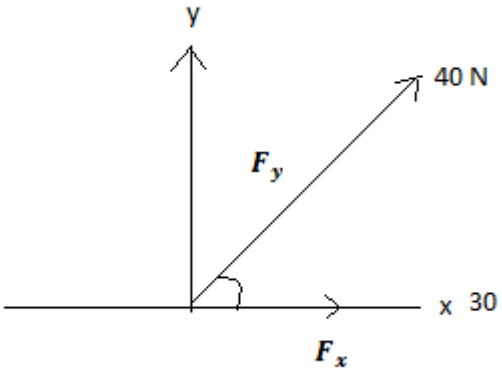
   So, $F = \sqrt{\left(F_x^2 + F_y^2\right)} = 60.83\ N$,

   $\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = 34.7\ degrees$

   Hence, the magnitude is 60.83 N, Direction = 34.7 °.

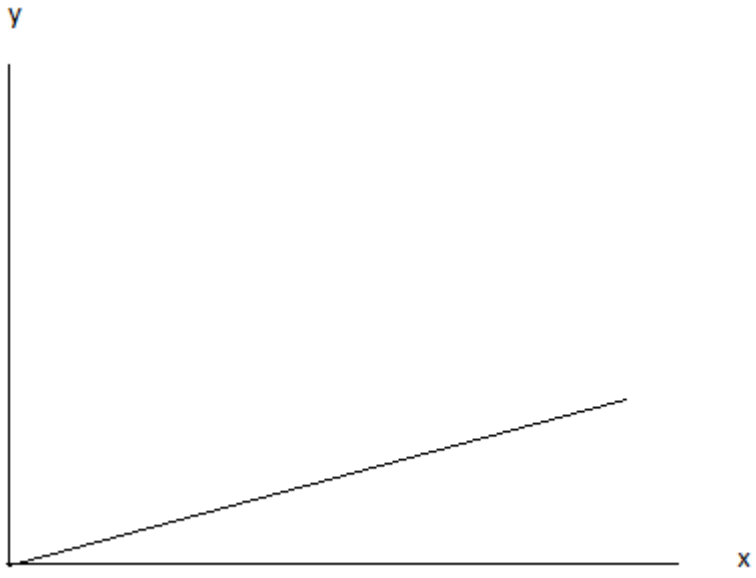
5. What in the equivalence force that would be needed to compensate for the resultant force of the vectors F_x and F_y that you calculated in question 4?

   Magnitude =**60.83 N** and the Direction relative to x axis is (180+34.7) = **214.7°**.



6. Figure 3-6 has been constructed to scale with 1.00 cm = 10.0N. Use the parallelogram graphical method to construct (on figure), the resultant vector F_R for the addition F_1 and F_2. Measure the length of the resultant vector and record it below. Solve the force represented by this length, Measure with a protractor the angle that the resultant makes with the x axis.

   Resultant vector length=**6.083 cm**
   Force represented by this length=**60.83 N**
   Direction of resultant relative to x axis=**34.7° degrees**.



LABORATORY 3: Force Table and Vector Addition of Forces

LABORATORY REPORT

Data Table 1

Force	Mass(kg)	Force(N)	Direction
F_1	0.100	0.98	20.0 °
F_2	0.200	1.96	90.0 °
Equilibriant F_{21}	0.251	2.76	111.9 °
Resultant F_R	0.251	2.76	68.1 °

Data Table 2

Force	Mass(kg)	Force(N)	Direction
F_3	0.150	1.47	30 °
F_4	0.200	1.96	100°
F_5	0.100	0.98	145°
Equilibriant F	0.329586	3.229943	92.1°
Resultant F	0.329586	3.229943	87.9°

Calculation Table 1

Graphical Solution

Force	Mass(kg)	Force(N)	Direction
F_1	0.100	0.98	20 °
F_2	0.200	1.96	90 °

Resultant F_{R1}	0.250	2.73	67.9 °

Analytical Solution

Force	Mass(kg)	Force(N)	Direction	x-component	y-component
F_1	0.100	0.98	20 °	0.92N	0.33N
F_2	0.200	1.96	90 °	0N	1.96N
Resultant F_{R1}	0.158374	1.552063	53.6 °	0.92N	1.2N5

PART 1: ERROR CALCULATIONS

Percent error magnitude experimental compared to analytical = 1.08 %

Percent error magnitude graphical compared to analytical = 43.2 %

Absolute error in angle experimental compared to analytical = 0.029 degrees

Absolute error in angle graphical compared to analytical = 21.06 degrees

Calculations Table 2

Graphical Solution

Force	Mass(kg)	Force(N)	Direction(degrees)
F_3	0.150	1.47	30.0
F_4	0.200	1.96	100
F_5	0.100	0.98	145.0
Resultant F_{R2}	0.35	3.43	86.5

Analytical Solution

Force	Mass(kg)	Force(N)	Direction(degrees)	x-component	y-component
F_3	0.150	1.47	30.0	1.27	0.74
F_4	0.200	1.96	100	-0.34	1.93
F_5	0.100	0.98	145.0	-0.56	0.56
Resultant F_{R2}	0.33	3.234	87.5	0.37	3.23

PART 2

: ERROR CALCULATIONS

Percent error magnitude experimental compared to analytical = 1.06 %

Percent error magnitude graphical compared to analytical = 40.9 %

Absolute error in angle experimental compared to analytical = 0.03 degrees

Absolute error in angle graphical compared to analytical = 20.04 degrees

Questions

Ans 1. It would have no effect in g on the percentage error calculation

Ans 2. The equilibrant will lie in the third quadrant.

Ans 3a) correct option is d because maximum resultant is 5N and minimum resultant is 1 N.

Ans 4) F1=-0.1cos20 °i - 0.1sin20° F2=0 i - 0.2 j Fnet = -0.094 i -0.234 j |F| = 0.25 N

Ans 5) Frictional pulleys are one of the best known lab methods to lift loads.