Date of Lab 10/17/2018 Date of Submission 10/17/2018

Laboratory Report

Title The Net force of three or more force

Homeroom	Section	Name	
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Summary

We recorded and analyzed the net force of three or more forces by using hangers and protractor. We draw the diagrams of data by using Parallelogram and Head to tail method. I learned that, as the length of net force, I can get more accurate value by using Parallelogram than using Head-to-tail method. However, for the angle, I could get more accurate numbers by using Head to tail than Parallelogram method. So I can get close value to math method by using both of them.

• Meet a deadline • Write logically • Write clearly • Write with your own words

Teacher's Comments

Drawings are beatiful and clear. Some wrong expressions about the angles in the math method.

1	2	3	4	5	6	7	8	9
Due	Summary	Intro.	Method	Results	Table/Fig.	Discussion	Clearness	General

* Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

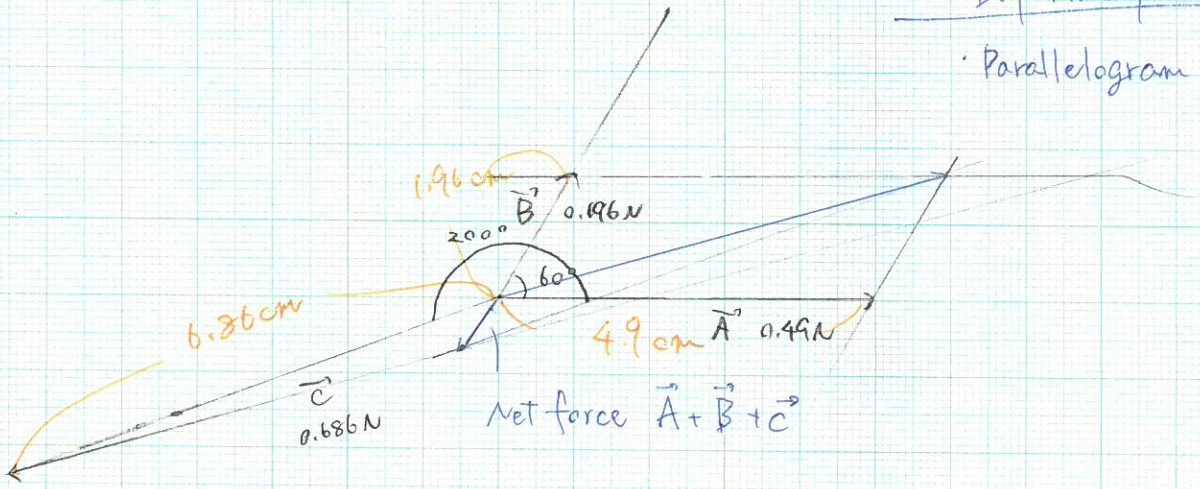
Data 1

Exp. 1	Mass of Weight (kg)	Force (N)	Angle (°)
A	0.05	4.9	0°
B	0.02	1.96	60°
C	0.686	6.86	200°

1N = 10 cm

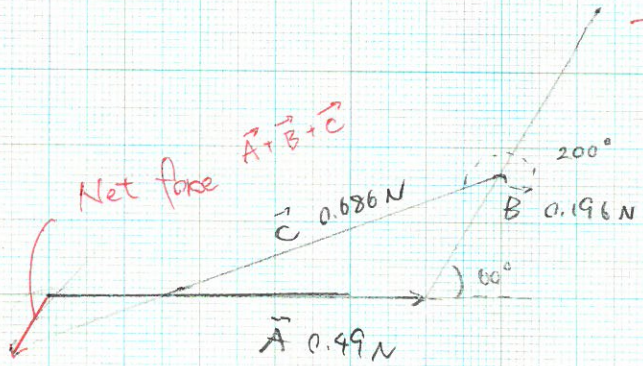
Experiment - 1

· Parallelogram method



Experiment - 1

· Head to tail Method



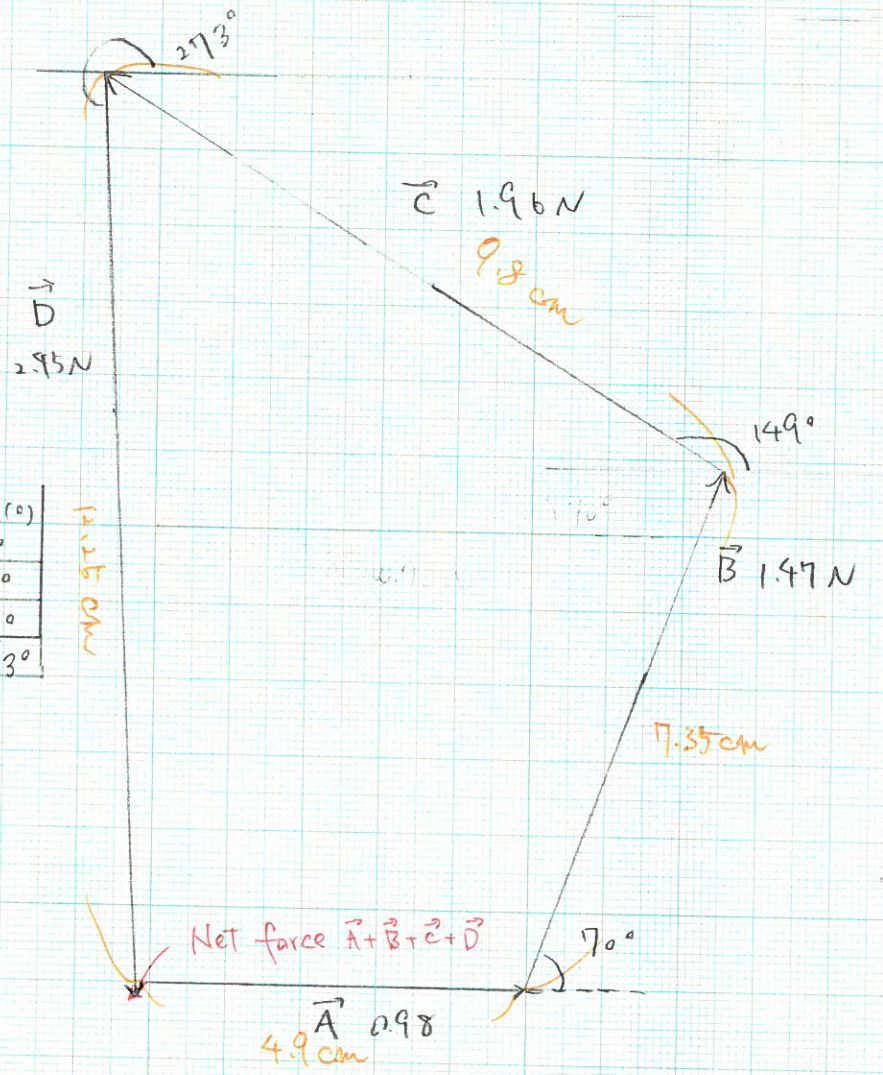
Data 2

1 N = 5cm

Experiment ~ 2

- Head to tail Method

Exp 2	Mass of weight (kg)	Force(N)	Angle(°)
A	0.1	0.98	0°
B	0.15	1.47	70°
C	0.2	1.96	149°
D	0.25	2.45	273°

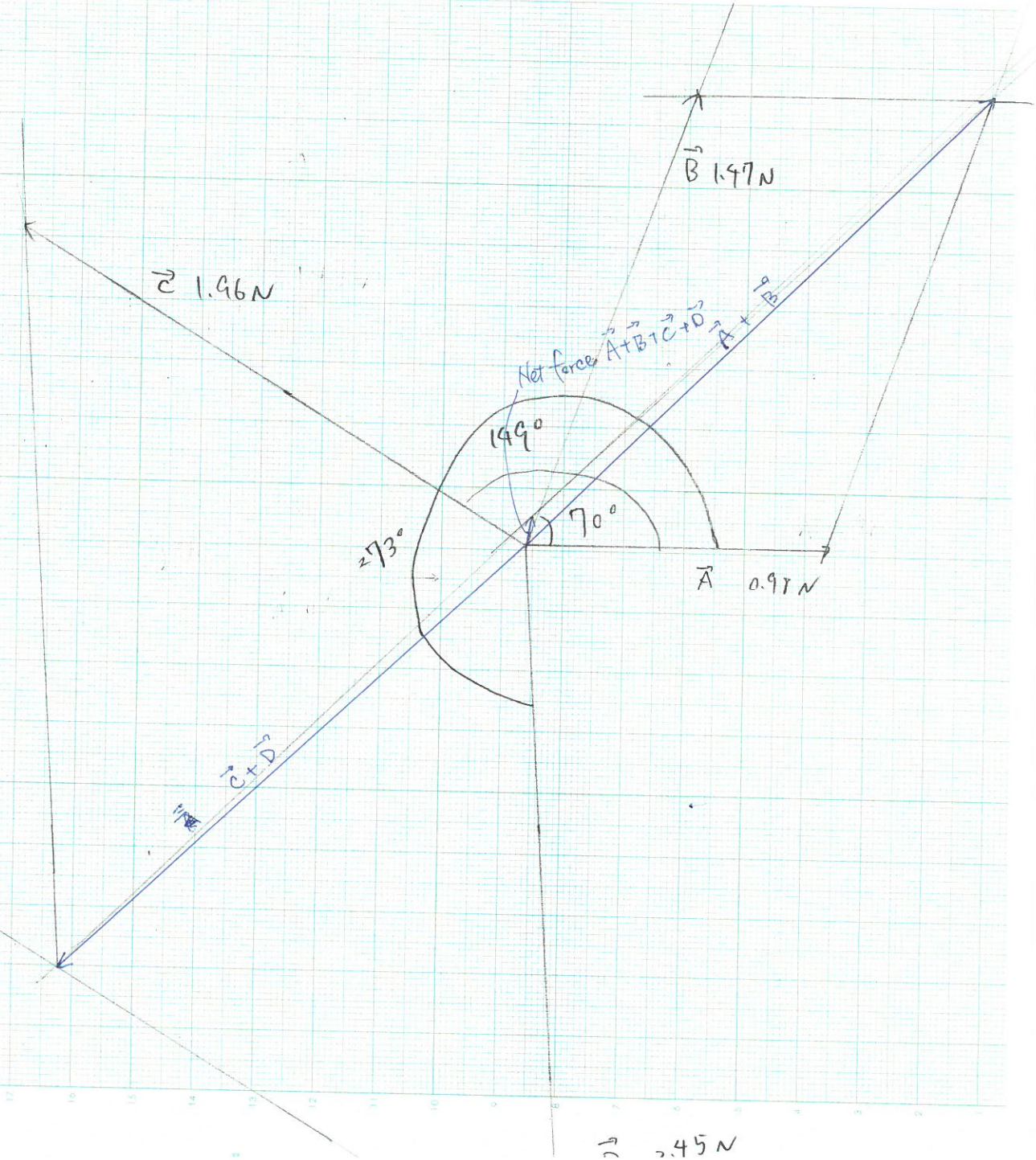


Data 3

1N = 5cm

Experiment – 2.

- Parallelogram - Method

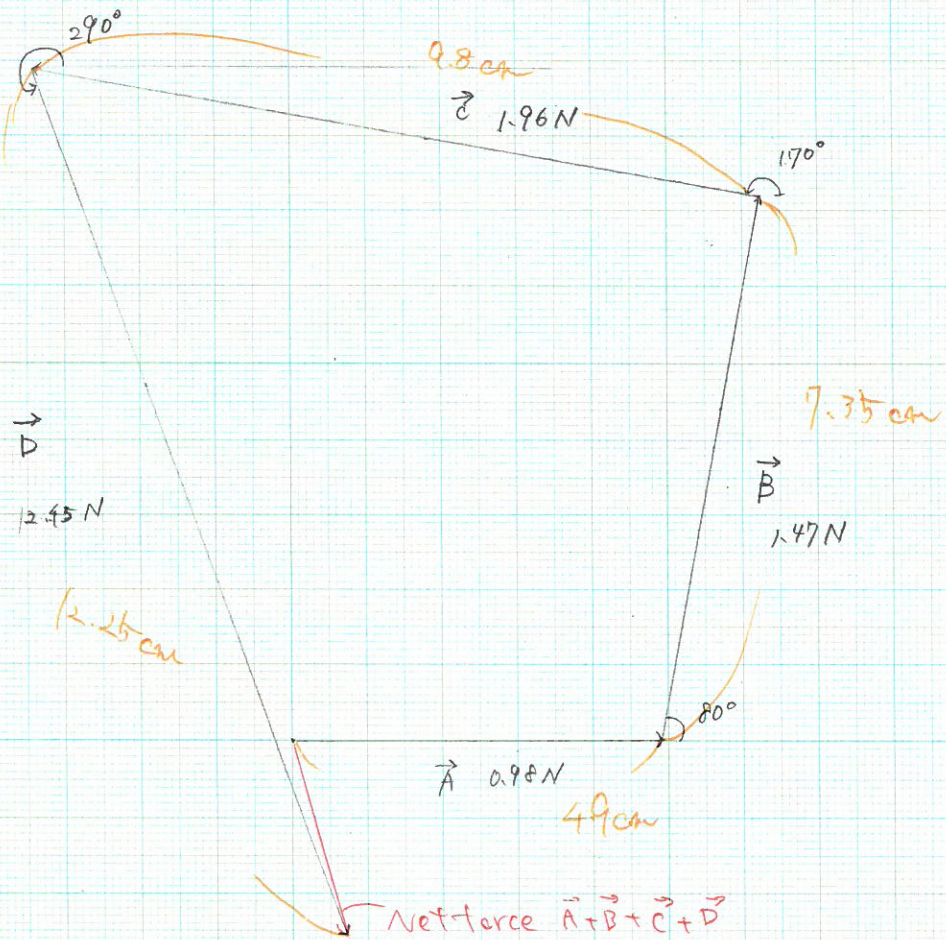


1 N = 5 cm

Data 4

Experiment - 3

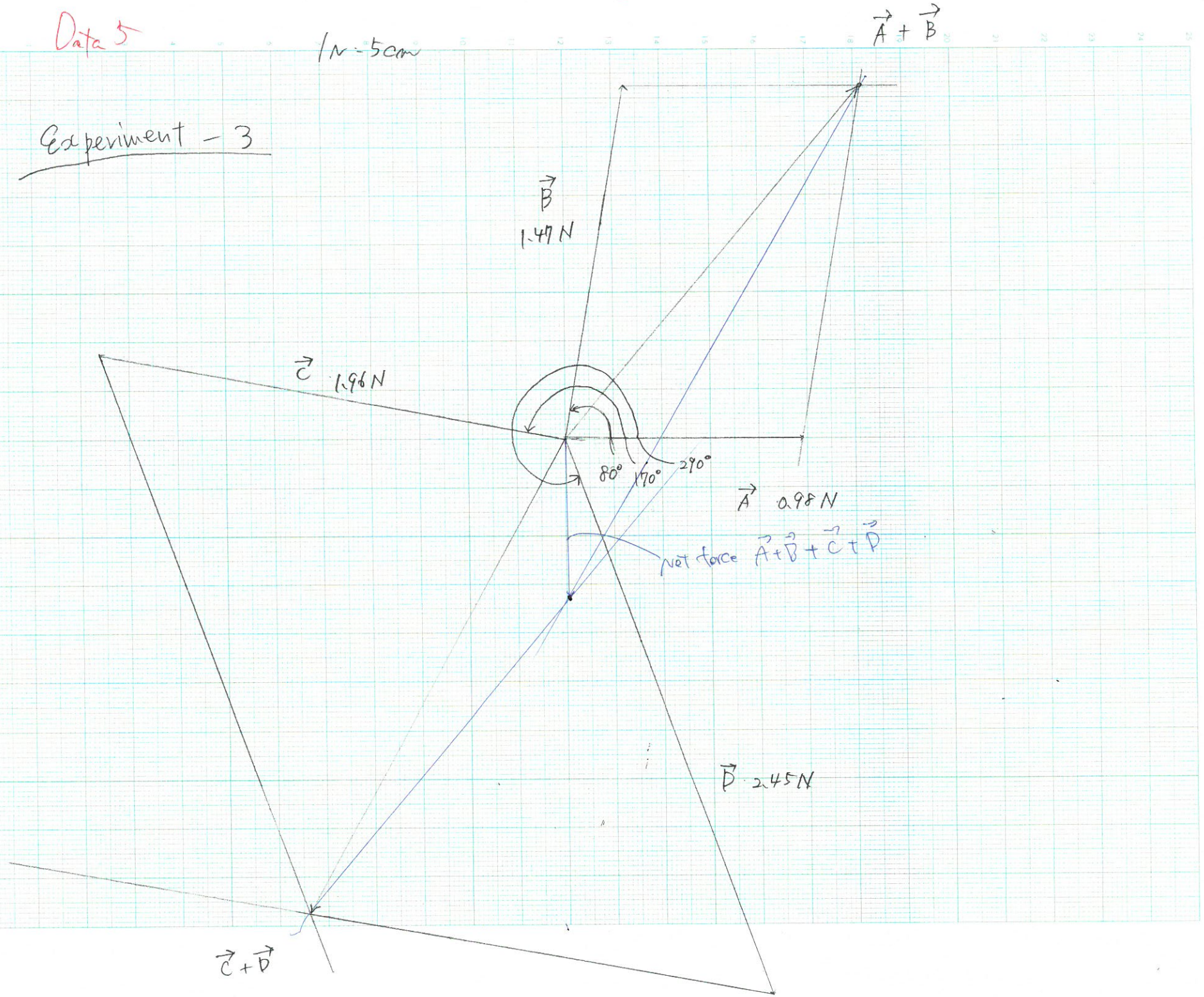
Exp. 3	Mass of Weight (kg)	Force (N)	Angle (°)
A	0.1	0.98	0°
B	0.15	1.47	80°
C	0.2	1.96	170°
D	0.25	2.45	290°



Data 5

1N - 5cm

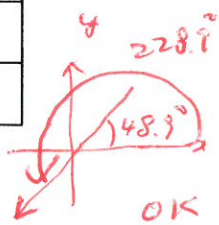
Experiment - 3



Force table (Math method)

	F	θ	Fx=Fcosθ	Fy=Fsinθ
Exp.1	(N)	(°)	(N)	(N)
A	0.49	0	0.49	0
B	0.196	60	0.098	0.16974
C	0.686	200	-0.6446	-0.234625
		Fx, Fy	-0.0566	-0.064885

$F=\sqrt{(Fx)^2+(Fy)^2}$ =0.086 $\theta=\tan^{-1}\left(\frac{Fy}{Fx}\right)$ =48.9 $180^\circ+48.9^\circ=228.9^\circ$



	F	θ	Fx=Fcosθ	Fy=Fsinθ
Exp.2	(N)	(°)	(N)	(N)
A	0.98	0	0.98	0
B	1.47	70	0.503	1.381
C	1.96	149	-1.68	1.00947
D	2.45	273	0.128	-2.4466
		Fx, Fy	-0.069	-0.05613

$F=\sqrt{(Fx)^2+(Fy)^2}$ =0.089 $\theta=\tan^{-1}\left(\frac{Fy}{Fx}\right)$ =39.1 $180^\circ+39.1^\circ=219.1^\circ$

	F	θ	Fx=Fcosθ	Fy=Fsinθ
Exp.3	(N)	(°)	(N)	(N)
A	0.98	0	0.98	0
B	1.47	80	0.25526	1.447667
C	1.96	170	-1.9302	0.34035
D	2.45	290	0.83795	-2.302247
		Fx, Fy	0.14301	-0.51423

$F=\sqrt{(Fx)^2+(Fy)^2}$ =0.53 $\theta=\tan^{-1}\left(\frac{Fy}{Fx}\right)$ =-74.6

OK

* Percent Error

★Exp. 1 (Parallelogram Method)

$$\frac{|(0.085N - 0.086N)|}{0.086N} \times 100\% = 1.16\% \quad \underline{1.16\%}$$

Head to tail Method)

$$\frac{|(0.09N - 0.086N)|}{0.086N} \times 100\% = 4.65\%. \quad \underline{4.65\%}$$

Exp. 2

Parallelogram Method

$$\frac{|(0.09N - 0.089N)|}{0.089N} \times 100\% = 1.12\% \quad \underline{1.12\%}$$

Head to tail Method

$$\frac{|(0.08N - 0.089N)|}{0.089N} \times 100\% = \underline{10.11\%} \rightarrow \underline{10.1\%}$$

★ Exp. 1 (θ)

Parallelogram Method

$$\frac{|(55° - 48.7°)|}{48.7°} \times 100\% = 12.936 \rightarrow \underline{12.9\%}$$

Head to tail

$$\frac{|(60° - 48.7°)|}{48.7°} \times 100\% = 23.203 \rightarrow \underline{23.2\%}$$

Exp. 2

Parallelogram

$$\frac{|(75° - 39.1°)|}{39.1°} \times 100\% = 91.85 \rightarrow \underline{91.8\%}$$

Head to tail

$$\frac{|(39° - 39.1°)|}{39.1°} \times 100\% = 0.256 \rightarrow \underline{0.256\%}$$

Discussion

As shown in the force table of Exp.1. Net force of the Exp.1 is 0.086N and the angle is 48.7. That means 0.86cm in Data 1 because we recorded that 1N=10cm. In Data 1, the lengths of the net force are 0.85cm in Parallelogram method and 0.9cm in Head to tail method. The angles (θ) are 55° and 60°. From this results, there is some error between math method and other methods. I think this is because our weights were not enough. Dr. Moritani told us that if there is not enough weight on the equipment, I could not get the accurate values because there is some frictions between strings and pulleys. I think this is the reason.

Secondly, in the force table of Exp.2, Net force is 0.089N and angle is 39.1° . We recorded that 1N=5cm in here, so I got 0.445cm of the length of Exp.2. From Data 2, the length and angle of Net force are 0.4cm and 39°, for Data 3, the length is 0.45cm and the angle is 75° to opposite direction. I get some error here too, but biggest error is the angle of Data 3's direction is completely different from math method. This is because I wrote the diagram which was too big for the paper, so I cannot draw the picture of parallelogram. I think that is a cause.

Finally , in the force table of Exp.3, Net force is 0.53N and the angle is -74.6°. In Data 4&5, the length of Net forces are 2.65cm and 3.3cm. We recorded 1N as 5cm, so the length of net force should be 2.65cm. I finally get same value in here. The angle of Net force is-74.6° from math method. In data 4&5, the angles are -75° and-89°.

Opinion

I learned that Parallelogram method is not working accurately than Head to tail method. All of the error that I stated above are occured in Parallelogram method. On the other hand, Head to tail method led close values to math method. I think this is because Head to tail method is simpler to draw than Parallelogram method.