Date of Lab 10/18/2017 Date of Submission 10/25/2017

Laboratory Report

Title
表題 Forces in Equilibrium

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Summary

We investigated the forces in Equilibrium by using a Force table in different angles & weights.
After that we put the results into the graph and by using this results we drew a diagram using the parallelogram method & the head-to-tail method. There were some errors in the results but we learned that if the forces are balanced then resultant force will be almost zero.

good summary

・Meet a deadline ・Write logically ・Write clearly ・Write with your own words
・締切り守って ・論理的に ・わかりやすく ・自分のことばで

Teacher Comments

Good tables and figures. It was good to compare net forces, but it would be better to compare angles, too.

1	2	3	4	5	6	7	8	9
Due 提出期限	Summary 要旨	Intro. 序	Method. 方法	Results 結果	Table/Fig. 表/図	Discussion 考察	Clearness わかりやすさ	General 全般
+	+				++	+	++	++

* Write your report in Japanese or in English * Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

Objective: To confirm that the net force made from several forces in equilibrium is zero by using a force table.

Hypothesis: the net force of all the tensional forces acting on three (or four) wises is zero.

Apparatus: Force table, cords, pulleys, hangers, ring, graph paper, ruler, protractor

Experimental Procedure:

1. Assemble a force table, as shown in the figure.
2. Put different amount of weights in three hangers.
3. One cord is set on 0° on the force table.
4. Relocate the other two cords/pulleys so that the ring is centered and the three forces are balanced by trial and error.
5. When the system is balanced, record the angles and the mass of weights in the table.
6. Calculate the magnitude of force. Obtain the length of an arrow expressing the magnitude of each force vector.
7. On graph paper, net force is obtained using the parallelogram method and using head to tail method.
8. Repeat the above using four hangers.
9. Repeat the above but the four forces are slightly off the balance. Obtain the net force.
10. Perform the component method and compare the results with the graph method.

Experimental Results

-3 hangers in equilibrium-

Exp.1	Weight(kg)	Force(N)	Arrow(cm)	Angle(°)
A	0.290	2.842	11.368	0
B	0.200	1.960	7.840	226
C	0.200	1.960	7.840	130

※length of an arrow 1N=4cm

Exp.1	F(N)	θ (°)	Fx=Fcos θ	Fy=Fsin θ
A	2.842	0	2.842	0
B	1.960	226	-1.362	-1.409
C	1.960	130	-1.259	1.501
		ΣFx, ΣFy	0.221	0.092

F= 0.239N θ = 22.60°

-4 hangers in equilibrium-

Exp.2	Weight(kg)	Force(N)	Arrow(cm)	Angle(°)
A	0.220	2.156	8.624	0
B	0.150	1.470	5.88	84
C	0.100	0.980	3.92	180
D	0.200	1.960	7.84	230

※length of an arrow 1N=4cm

Exp.2	F(N)	θ (°)	Fx=Fcos θ	Fy=Fsin θ
A	2.156	0	2.156	0
B	1.470	84	0.154	1.462
C	0.980	180	-0.980	0
D	1.960	230	-1.259	-1.501
		ΣFx, ΣFy	0.071	-0.039

F= 0.081N θ = -28.78°

-4 hungers in slightly off balance-

Exp.3	Weight(kg)	Force(N)	Arrow(cm)	Angle(°)
A	0.220	2.156	8.624	0
B	0.200	1.960	7.84	84
C	0.100	0.980	3.92	180
D	0.200	1.960	7.84	230

※length of an arrow 1N=4cm

Exp.3	F(N)	θ (°)	Fx=Fcos θ	Fy=Fsin θ
A	2.156	0	2.156	0
B	1.960	84	0.205	1.949
C	0.980	180	-0.980	0
D	1.960	230	-1.259	-1.501
		Σ Fx, Σ Fy	0.122	0.448

F= 0.464N θ = 74.77°

Discussion:

I compared the net force between the ones I solved by calculation and by solving from the graph.

Exp.2

Calculation→ **0.081N**

graph→ **0.125N**

|0.125-0.081|/0.081×100%=54.3%

Exp.3

Calculation→ 0.464N

graph→ 0.475N

|0.475-0.464|/0.464×100%=2.37%

By these two results, you know that in Exp.2 I made an error, but in Exp.3 I almost didn't make any error. I was so close!!!
If the net force is zero then the force is equilibrium. But in this experiment we didn't get any zero.
That's because...
-we thought the ring was center, but actually it wasn't. →this means the force are nor equal.
-when we calculate, we round off. That cause our error.
-when didn't read the angle of the force table properly.

Conclusion:

If the net force made from 3 or 4 forces is zero then it means equilibrium.
$\vec{A}+\vec{B}+\vec{C}=0$
$\vec{A}+\vec{B}+\vec{C}+\vec{D}=0$ is at equilibrium!

What I thought about this experiment...

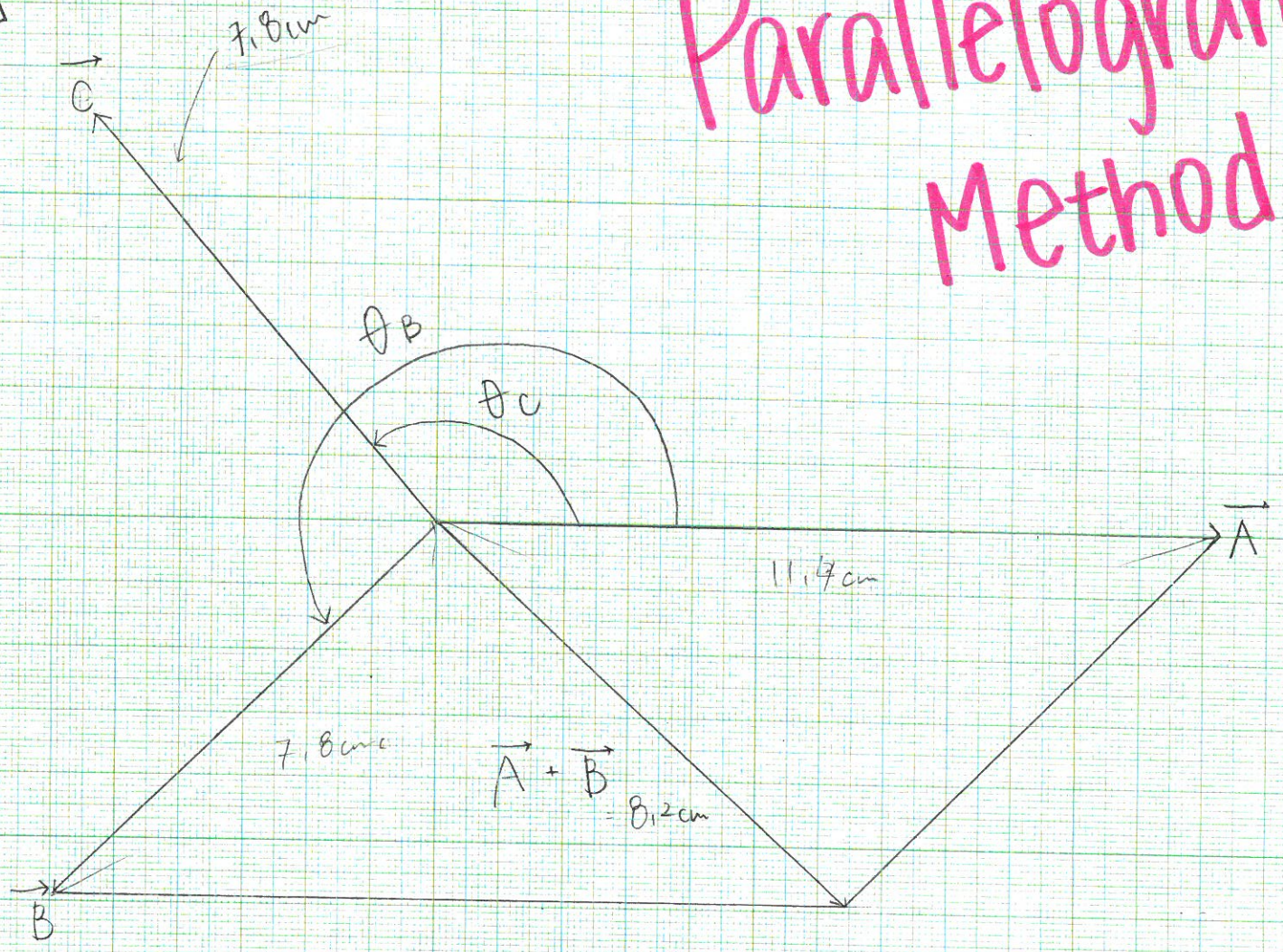
In this experiment, I really used my brain because I had to concentrate on reading the angles from the force table, measure the length and find out the angle using protractor. So, after the experiment I was super tired. (tiredness that I have never experienced in my life). This experiment helped me understand the relationship between the force and equilibrium. I used my brain a lot but I really enjoyed this experiment as always.

Reference:

Lab report by Rieko Shiozaki (2015) & Megumi Kingyo(2014)

Exp. 7

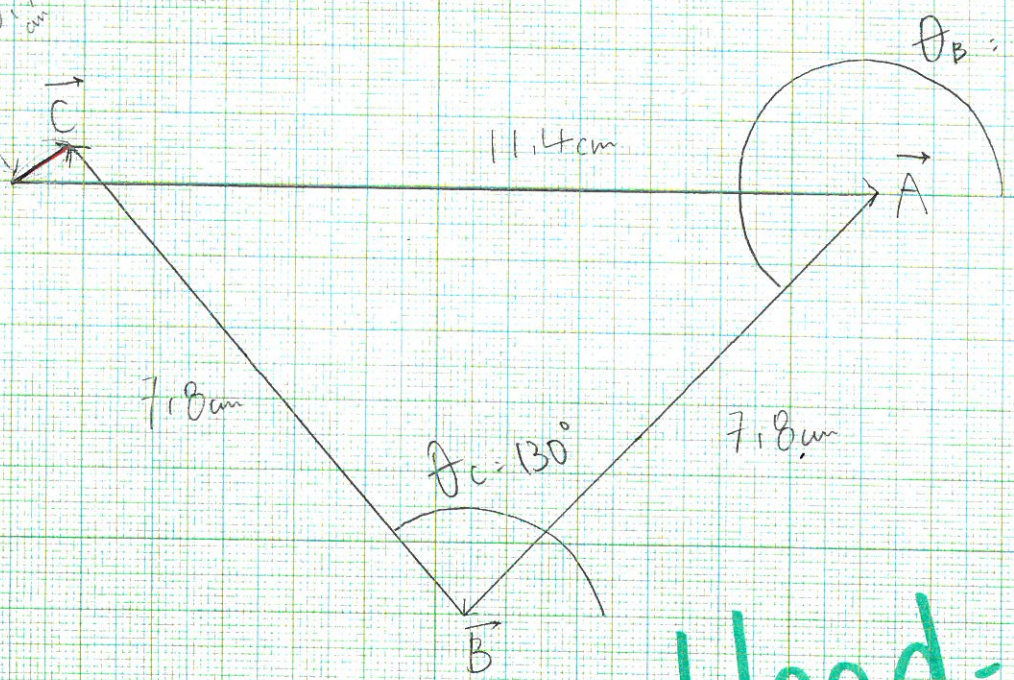
Parallelogram Method



Exp. 1

$\vec{E} = \vec{A} + \vec{B} + \vec{C}$

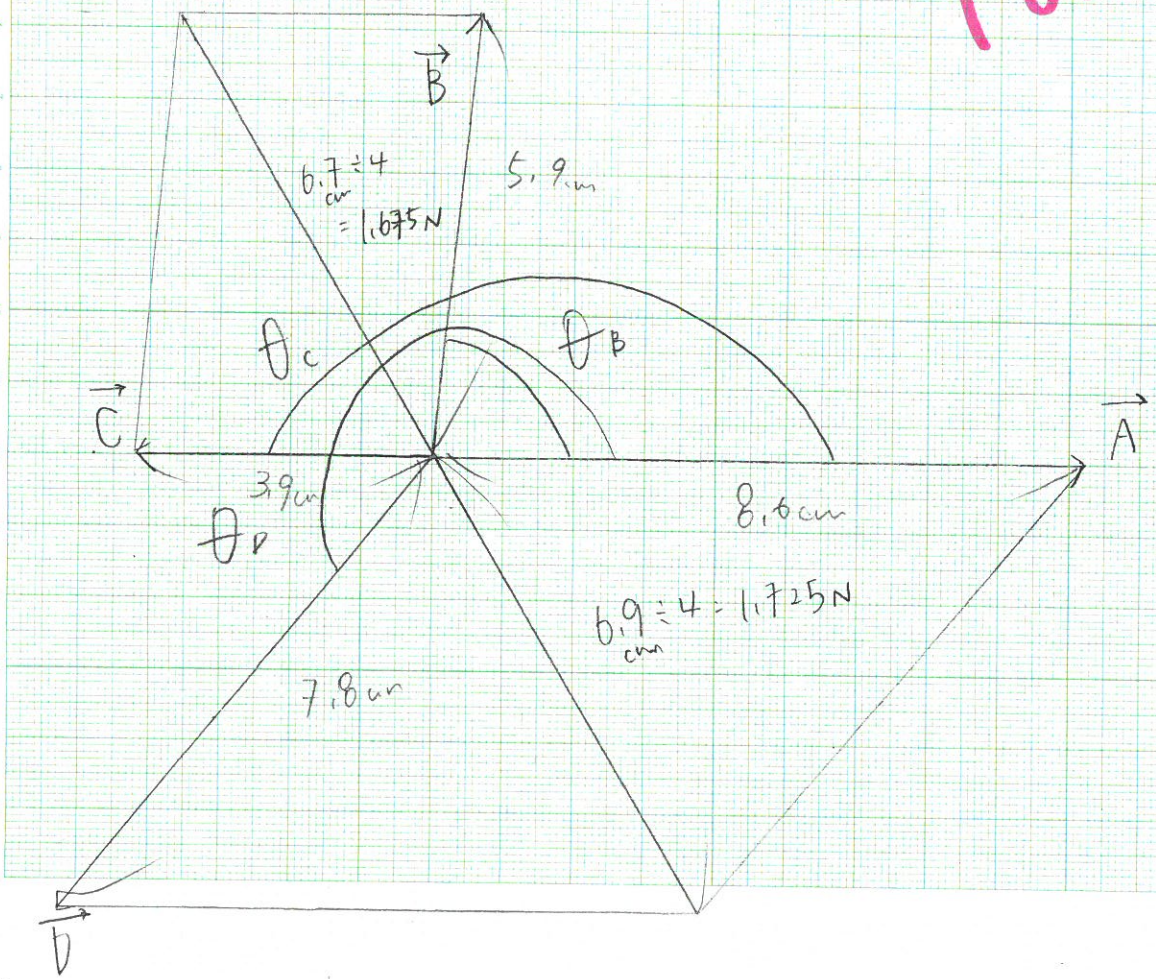
$0{,}9\,\text{cm} = 4 \therefore 0{,}225\,\text{N}$



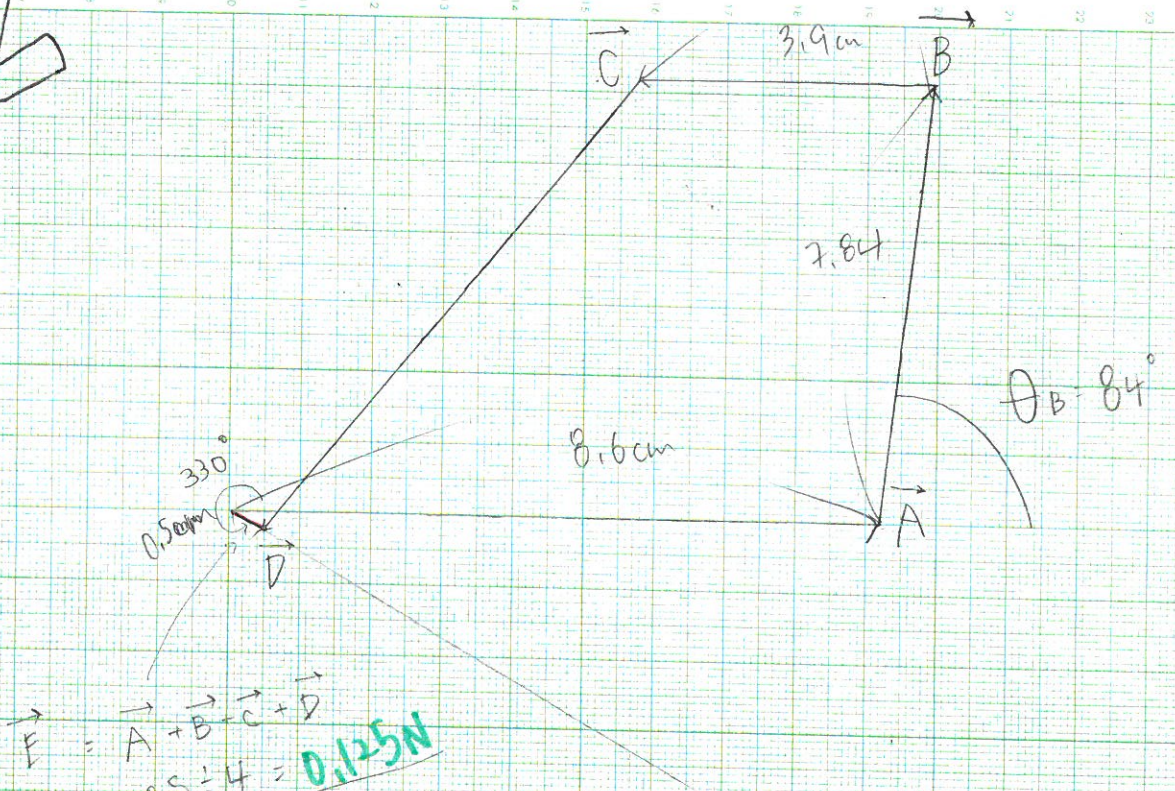
Head-to-tail Method

Exp. 2

Parallelogram Method



EXP. 2



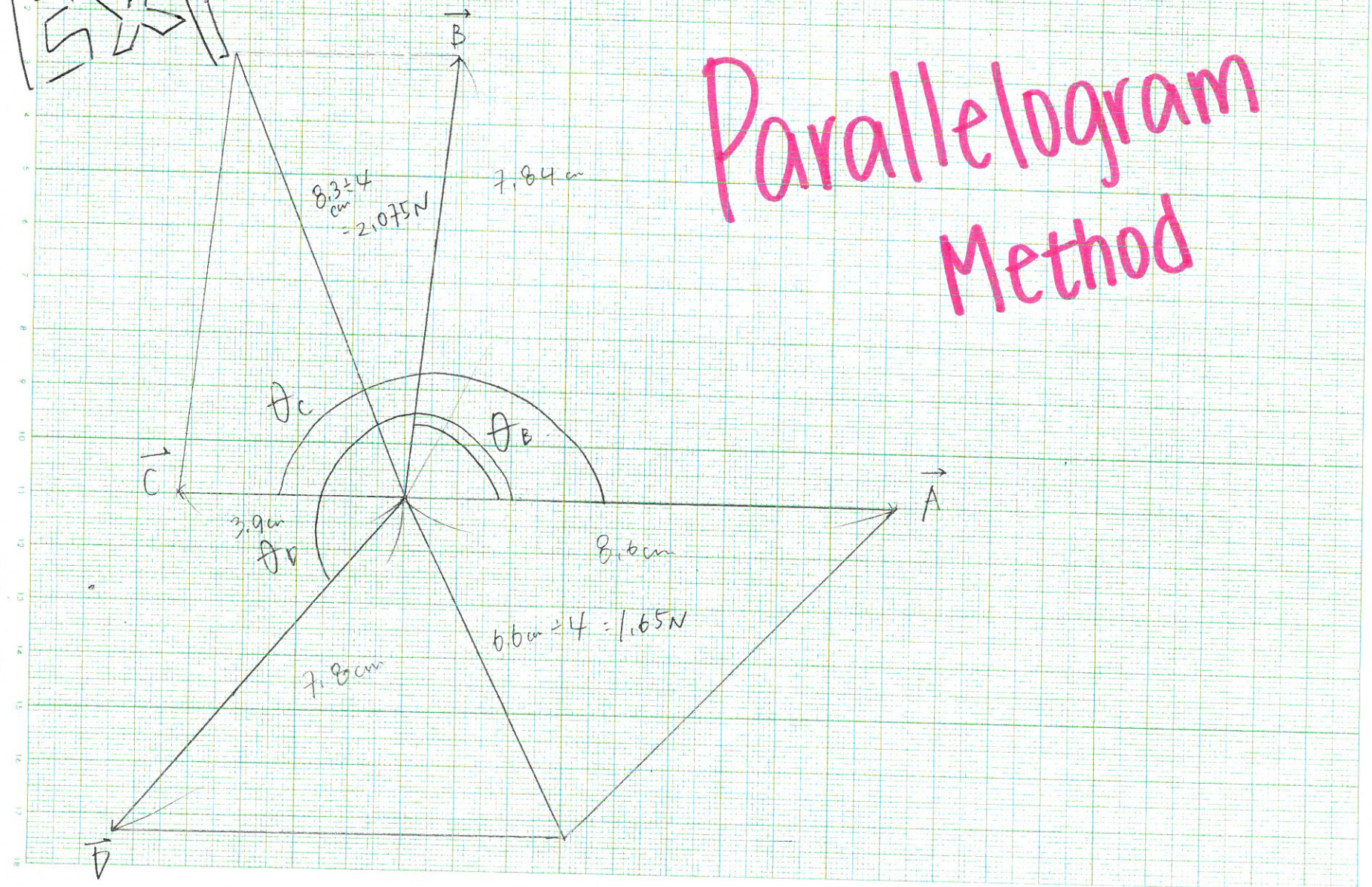
$$\vec{F} = \vec{A} + \vec{B} - \vec{C} + \vec{D}$$

$$0,5 \div 4 = 0,125N$$

Head-to-tail Method

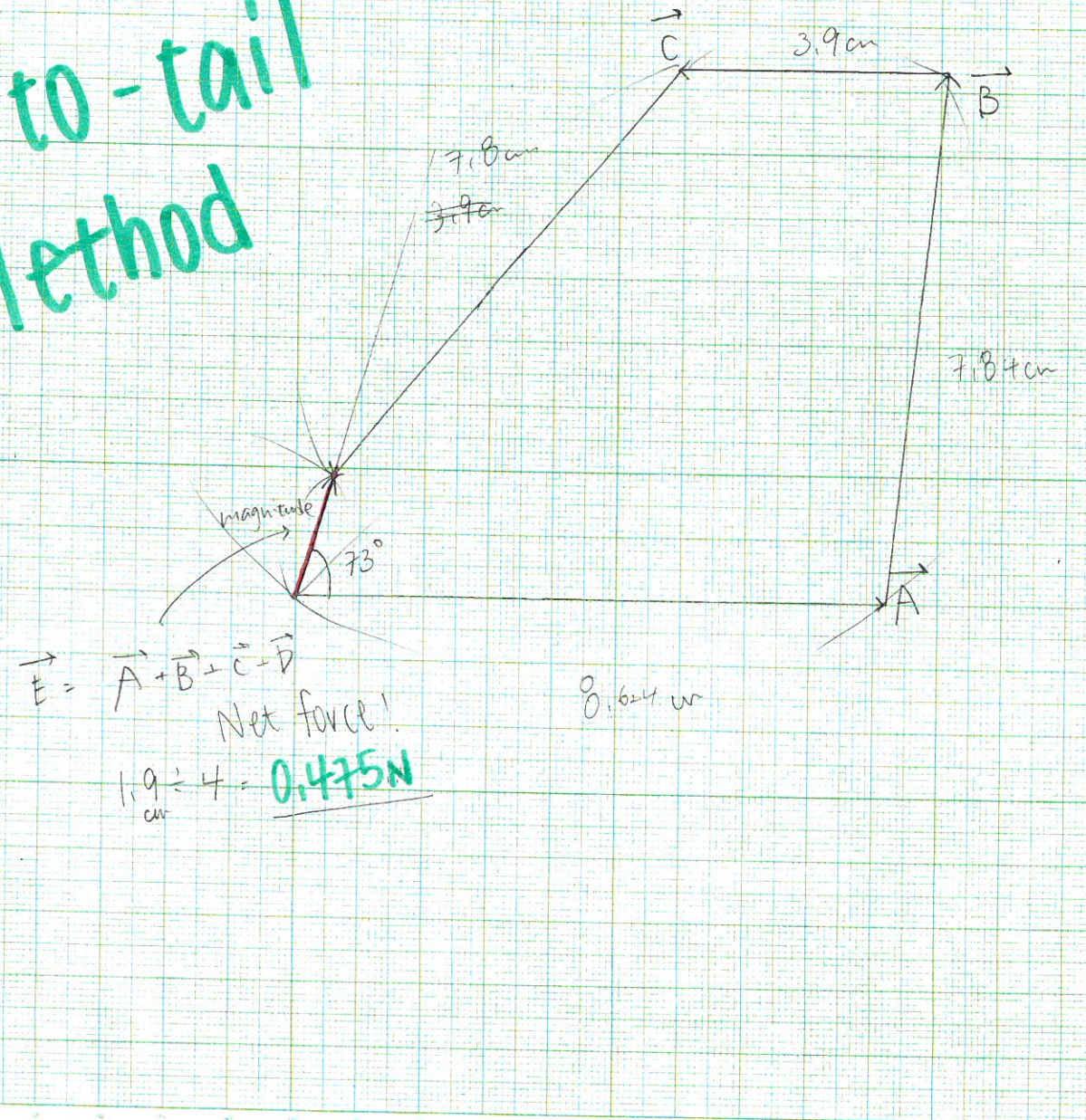
Exp. 3

Parallelogram Method



Exp. 3

Head-to-tail Method



$\vec{E} = \vec{A} + \vec{B} + \vec{C} + \vec{D}$

Net force!

1.9 cm ÷ 4 = **0.475N**