

Peter Chew Triangle Diagram and Application

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Abstract: The objective of Peter Chew Triangle Diagram is to give complete image of topic solution of triangle. Peter Chew Triangle Diagram will suggest a single rule that allows us to solve any problem of triangle simple, directly and more directly. There are two important rules for the topic solution of triangle, vice like the sine rule and the cosine rule. The sine rule generally is used to find a non-included angle when we're given two sides and a non-included angle or the opposite side angle given when are given two angles and one side. The cosine rule generally is used to find the angle when we're given three sides or to find the third side when are given two sides and the included angle. Peter Chew Method can let us to find the third side simple when given two sides and a non-included angle. Peter Chew Rule allow us to find a non included angle simple, directly when given 2 sides and an included angle. Apply Peter Chew Triangle Diagram to Education 4.0 Calculator allows the Calculator to solve any problems in topic solution of triangle simple, directly and more accurate. This can be effective in let student interest in using technology while learning mathematics especially when analogous COVID-19 issues arise in the future. In addition to applying Peter Chew Triangle Diagram in the Education 4.0 calculator, Peter Chew Triangle Diagram are also applicable to many different Engineering fields, Pool Game and Criminology.

Keywords: Peter Chew triangle diagram, solution of triangle, Education 4.0 calculator, Peter Chew

1. Introduction

There are two important rules for the topic solution of triangle [1, 2], vice like the sine rule and the cosine rule.

1.1. The Sine Rule

The sine rule $\frac{a}{\sin \angle A} = \frac{b}{\sin \angle B} = \frac{c}{\sin \angle C}$ is used to find:

a) a non-included angle when are given two sides and a non-included angle (Fig. 1):

Because the aim of the Peter Chew Triangle Diagram aims to facilitate the teaching and learning of the Topic "Solution of Triangle" easily especially during a pandemic such as Covid-19, the Peter Chew Triangle Diagram (preprint) has been published at the Europe PMC: <https://europepmc.org/article/PPR/PPR620074>.

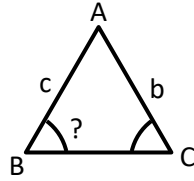


Fig. 1. Find a non-included angle when are given two sides and a non-included angle.

Example:

Given $\angle C = 50^\circ$, $AB = 5$ cm and $AC = 3$ cm. Find $\angle B$ (Fig. 2):

$$\frac{b}{\sin \angle B} = \frac{c}{\sin \angle C}$$

$$\frac{3}{\sin \angle B} = \frac{5}{\sin 50^\circ}$$

$$\sin \angle B = 0.4596$$

$$\angle B = 27.36^\circ, 152.64^\circ \text{ (Rejected)}$$

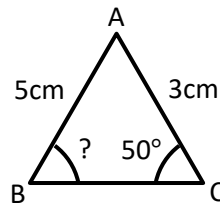


Fig. 2. Example find a non-included angle when are given two sides and a non-included angle.

Or

b) The opposite side angle given when are given two angles and one side (Fig. 3):

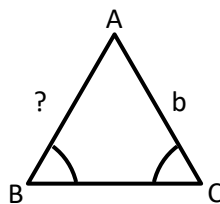


Fig. 3. Find the opposite side angle given when are given two angles and one side.

Example:

Given $\angle B = 30^\circ$, $\angle C = 50^\circ$ and $AC = 3$ cm. Find the side AB (Fig. 4):

$$\frac{b}{\sin \angle B} = \frac{c}{\sin \angle C}$$

$$\frac{3}{\sin 30^\circ} = \frac{c}{\sin 50^\circ}$$

$$c = 4.596 \text{ cm}$$

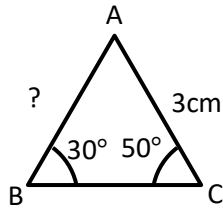


Fig. 4. Example Find the opposite side angle given when are given two angles and one side.

1.2. The Cosine Rule

The cosine rule $a^2 = b^2 + c^2 - 2bc \cos \angle A$ is used to find

a) the included angle when are given three sides (Fig. 5):

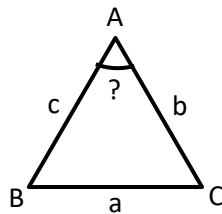


Fig. 5. Find the included angle when are given three sides.

Example:

Given $AB = 3 \text{ cm}$, $BC = 5 \text{ cm}$ and $AC = 6 \text{ cm}$, Find $\angle A$ (Fig. 6):

$$a^2 = b^2 + c^2 - 2bc \cos \angle A$$

$$5^2 = 6^2 + 3^2 - 2(6)(3) \cos \angle A$$

$$36 \cos \angle A = 20$$

$$\cos \angle A = 0.5556$$

$$\angle A = 56.25^\circ$$

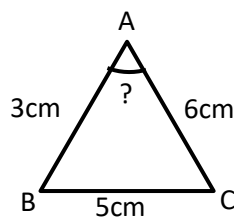


Fig. 6. Example Find the included angle when are given three sides.

Or

b) The third side when are given two sides and the included angle (Fig. 7):

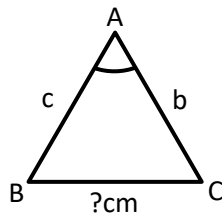


Fig. 7. Find the third side when are given two sides and the included angle.

Example:

Given $\angle A = 50^\circ$, $AB = 4$ cm and $AC = 7$ cm. Find the side BC. (Fig. 8):

$$a^2 = b^2 + c^2 - 2bc \cos \angle A$$

$$BC^2 = 7^2 + 4^2 - 2(7)(4)\cos 50^\circ$$

$$BC^2 = 29$$

$$BC = 5.385 \text{ cm}$$

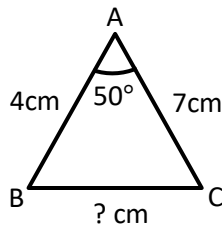


Fig. 8. Example find the third side when are given two sides and the included angle.

Peter Chew Method [3] can let us to find the third side simple when given two sides and a non-included angle. Peter Chew Rule [4] allow us to find a non included angle simple and directly when given 2 sides and an included angle.

1.3. Peter Chew Rule

Example:

Given $\angle B = 50^\circ$, $AB = 3$ cm and $BC = 5$ cm. Find $\angle C$. (Fig. 9):

$$\tan \angle C = \frac{c \sin \angle B}{a - c \cos \angle B}$$

$$\tan \angle C = \frac{3 \sin 50^\circ}{5 - 3 \cos 50^\circ}$$

$$= 0.7482$$

$$\angle C = 36.8038^\circ$$

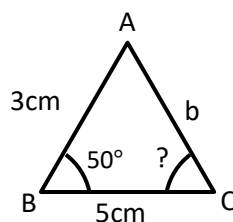


Fig. 9. Example find a non included angle when given 2 sides and an included angle.

2. Peter Chew Triangle Diagram

The Peter Chew triangle diagram is shown in Fig. 10. This diagram allows learners to easily and simply understand which single rule to use to solve the triangle problem they face.

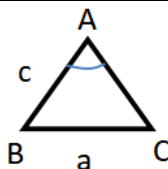
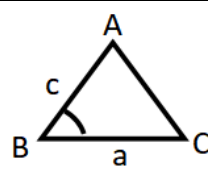
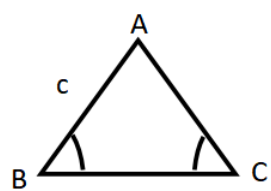
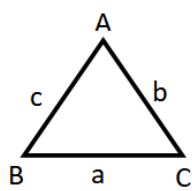
Given 2 sides and an angle	
Given 2 sides and one non included angle	Given 2 sides and an included angle
 <p>Description: Given a triangle with 2 sides and one non included angle, learners may need to find the answer for side b, angle C, or angle B. The best solution for each triangle problem is as follows:</p> <ol style="list-style-type: none"> Find side b, use Peter Chew Method. $a^2 = b^2 + c^2 - 2bc \cos A$ Find angle C, use sine rule, $\frac{a}{\sin A} = \frac{c}{\sin C}$ Find angle B, Use sine rule, find angle C first, then $\angle B = 180^\circ - \angle A - \angle C$. 	 <p>Description: Given a triangle with 2 sides and an included angle, learners may need to find the answer for side b, angle C, or angle A. The best solution for each triangle problem is as follows:</p> <ol style="list-style-type: none"> Find side b, use cosine rule. $b^2 = a^2 + c^2 - 2ac \cos B$ Find angle C, use Peter Chew rule, $\tan C = \frac{c \sin B}{a - c \cos B}$ Find angle A, use Peter Chew rule, $\tan A = \frac{a \sin B}{c - a \cos B}$
Given 2 angles and one sides or three sides	
2 angles and one sides	Three sides
 <p>Description: Given a triangle with 2 angles and one sides, learners may need to find the answer for side b, side a, or angle A. The best solution for each triangle problem is as follows:</p> <ol style="list-style-type: none"> Find side b, use sine rule. $\frac{b}{\sin B} = \frac{c}{\sin C}$ Find side a, use sine rule, $\frac{a}{\sin(180^\circ - \angle B - \angle C)} = \frac{c}{\sin C}$ Find angle A, $\angle A = 180^\circ - \angle B - \angle C$. 	 <p>Description: Given a triangle with Three sides, learners may need to find the answer for angle A, angle B, or angle C. The best solution for each triangle problem is as follows:</p> <ol style="list-style-type: none"> Find angle A, use cosine rule. $a^2 = b^2 + c^2 - 2bc \cos A$ Find angle B, use cosine rule. $b^2 = a^2 + c^2 - 2ac \cos B$ Find angle C, use cosine rule. $c^2 = a^2 + b^2 - 2ab \cos C$

Fig. 10. Peter Chew triangle diagram.

3. Peter Chew Triangle Diagram Example Solution.

The Peter Chew Triangle Diagram example solution is shown in Fig. 11. This diagram allows learners to easily understand how to solve the triangle problem step by step.

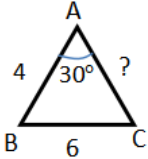
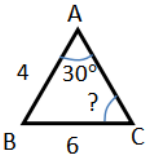
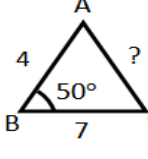
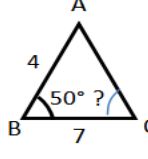
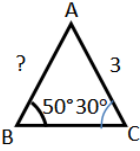
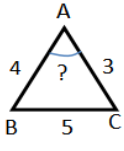
Given 2 sides and an angle			
Given 2 sides and one non included angle		Given 2 sides and an included angle	
Find side	Find angle	Find side	Find angle
 <p>Description: Given a triangle with 2 sides and one non included angle and find third side, the best solution is using Peter Chew Method. Peter Chew Method</p> $a^2 = b^2 + c^2 - 2bc \cos A$ $6^2 = b^2 + 4^2 - 2b(4)\cos 30^\circ$ $b^2 - 6.928b - 20 = 0$ $b = 9.12, -2.19(\text{reject})$	 <p>Description: Given a triangle with 2 sides and one non included angle and find another angle, the best solution is using Sine Rule. Sine rule:</p> $\frac{a}{\sin A} = \frac{c}{\sin C}$ $\frac{6}{\sin 30^\circ} = \frac{4}{\sin C}$ $\sin C = \frac{4 \sin 30^\circ}{6}$ $= 0.3333$ $C = 19.47^\circ, 161^\circ(\text{reject})$	 <p>Description: Given a triangle with 2 sides and an included angle and find third side, the best solution is using Cosine Rule. Cosine rule:</p> $b^2 = a^2 + c^2 - 2ac \cos B$ $= 7^2 + 4^2 - 2(7 \times 4)\cos 50^\circ$ $= 29$ $b = 5.385$	 <p>Description: Given a triangle with 2 sides and an included angle and find another angle, the best solution is using Peter Chew Rule. Peter Chew rule:</p> $\tan C = \frac{c \tan B}{a - c \cos B}$ $= \frac{4 \sin 50^\circ}{7 - 4 \cos 50^\circ}$ $= 0.69187$ $C = 34.68^\circ$
Given 2 angles and one sides or three sides			
2 angles and one sides		Three Sides	
<p>Description: Given a triangle with 2 angles and one sides and find another side, the best solution is using Sine Rule.</p>  <p>Sine rule: $\frac{b}{\sin B} = \frac{c}{\sin C}$</p> $\frac{3}{\sin 50^\circ} = \frac{c}{\sin 30^\circ}$ $c = \frac{3 \sin 30^\circ}{\sin 50^\circ}$ $= 1.958$		<p>Description: Given a triangle with Three Sides and find an angle, the best solution is using Cosine Rule.</p>  <p>Cosine rule:</p> $a^2 = b^2 + c^2 - 2bc \cos A$ $5^2 = 7^2 + 4^2 - 2(7)(4)\cos A$ $\cos A = 0.7143$ $A = 44.41^\circ$	

Fig. 11. Peter Chew triangle diagram Example Solution.

4. The Application of Peter Chew Triangle Diagram

Current online calculators only contain the knowledge formerly explained in the book, such as the sine and cosine rules. For triangle problems that cannot be solve directly by the sine or cosine rules, online calculators such as Wofram alfa and Symbolab cannot help student solve the triangle problem directly. This will affect in student not being interested in using technology similar as online calculators when learning mathematics. In order to break the above mention problems, i produce Peter Chew Method, Peter Chew Rule and Peter Chew Triangle Diagram to provide the necessary knowledge to complete the topic of solution of triangle.

With the help of Peter Chew Method and Peter Chew Rule, Peter Chew Triangle Diagram can guide student to solve all triangle problems with simple solution, only need to use one rule and only once. Apply Peter Chew Triangle Diagram to Education 4.0 Calculator, Peter Chew Triangle Diagram Calculator allows the Calculator to solve any problems in the topic solution of triangle simple, directly and more accurate. This can be effective in increasing students' interest in using technology while learning mathematics and will help in the learning of mathematics, especially when similar COVID-19 issues arise in the future.

The feedback of the Education 4.0 Calculator, Peter Chew Triangle Diagram Calculator Workshop from SMJK Chio Min Student also showed that the Education 4.0 Calculator Workshop was a complete success as all 24 students agreed that after attending the Educational Calculator Workshop 4.0, they knew how to use the Educational Calculator 4.0 to solve triangle problems step by step with one with one Rule and once only. Furthermore, all 24 students agreed that the Educational Calculator 4.0 is easy to use. All 24 students agree that the Educational 4.0 calculator learning method makes teaching and learning Topics solution of triangle (KSSM, Form 4) more effective. All 24 students also agreed to introduce the Malaysian Ministry of Education to add the Education 4.0 calculator learning method to the current learning method to make teaching and learning more effective.

Feedback from Additional Mathematics Teacher SMJK Chio Min, Kulim, Kedah, Teacher Phong Bee Bee. Educational 4.0 Calculator is easy to use, easy to install and easy to access offline. Educational 4.0 Calculator is easy to use to find the final answer to triangle problems because it is user friendly. Educational 4.0 Calculator helps solve triangle problems step by step with a single tip because the steps are clear and systematic. The Education 4.0 calculator learning method is more interesting than the current learning method. Teacher Phong Bee Bee recommend Malaysia to use the Education 4.0 calculator learning method compared to the current learning method because the Education 4.0 calculator learning method is easy to understand, very suitable for students and easy to use.

For more information, please refer to article Education 4.0 Calculator Learning Method [5]. This article provide evidence to support the Peter Chew Triangle Diagram Calculator can increases students' interest in using Education 4.0 Calculator while learning mathematics.

Educational 4.0 Calculator Learning Method combines Simple Knowledge, Problem-based Learning, Experience-based Learning and Technology Integration. The thing of the Education 4.0 Calculator learning Method is to develop the demanded for the Industry 4.0 labor request. In addition, the main goal of Education Calculator Learning Method 4.0 is also in line with the goal of the Ministry of Education Malaysia is enacting a digital education policy.

Main page Education 4.0 Calculator is shown in Fig. 12. This diagram allows learners to easily understand how to solve the triangle problem step by step.

For more information of Education 4.0 Calculator, please refer to article Education 4.0 Calculator Learning Method , Enhancing Tomorrow Education through the Implementation of the Education 4.0 Calculator Learning Method: A Case Study at Phor Tay Secondary School, Malaysia [6] and the YouTube video Education 4.0 Calculator Learning Method [7]. In addition, the Education 4.0 calculator includes future knowledge, Peter Chew correction for sine rule [8] to prevent incorrect answers when solving some triangle problems.

In addition to applying Peter Chew Triangle Diagram in the Education 4.0 calculator, Peter Chew Triangle Diagram are also applicable to many different Engineering fields, such as Civil Engineering [9], Mechanical Engineering [10], Electrical Engineering [11], Aerospace Engineering [12], Marine Engineering [13], and Astronomical Engineering [14]. Furthermore, Peter Chew Triangle Diagram are also applicable to Pool Game [15] and Criminology [16].

Given 2 sides and an angle

Given 2 sides and one non included angle		Given 2 sides and an included angle	
1. Find side	2. Find angle	3. Find side	4. Find angle
<p>Peter Chew Method Cosine Rule $a^2 = b^2 + c^2 - 2bc \cos A$ $6^2 = 4^2 + 4^2 - 2(4)(4) \cos 30^\circ$ $b^2 - 6.928 b - 20 = 0$ $b = 9.12, -2.19(\text{Reject})$</p>	<p>Sine rule $\frac{c}{\sin C} = \frac{b}{\sin B}$ $\frac{6}{\sin 30^\circ} = \frac{4}{\sin B}$ $\sin B = \frac{4 \sin 30^\circ}{6} = 0.3333$ $B = 19.47^\circ, 161^\circ(\text{Reject})$</p>	<p>Cosine Rule $a^2 = b^2 + c^2 - 2bc \cos A$ $a^2 = 7^2 + 4^2 - 2(7)(4) \cos 50^\circ$ $= 29$ $a = 5.385$</p>	<p>Peter Chew Rule tan C $\frac{c \tan B}{a - c \cos B} = \frac{c \tan A}{a - c \cos A}$ $\tan C = \frac{4 \sin 50^\circ}{7 - 4 \cos 50^\circ} = 0.69187$ $C = 34.68^\circ$</p>
Given 2 angles and one sides or three sides			
5. Given 2 angle and one side, find side		6. Given 3 sides, find angle.	
<p>Sine rule $\frac{c}{\sin C} = \frac{b}{\sin B}$ $\frac{c}{\sin 30^\circ} = \frac{3}{\sin 50^\circ}$ $c = \frac{3 \sin 30^\circ}{\sin 50^\circ} = 1.958$</p>		<p>Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$ $5^2 = 7^2 + 4^2 - 2(7)(4) \cos A$ $\cos A = 0.7143$ $A = 44.41^\circ$</p>	

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Fig. 12. Main page of Education 4.0 Calculator, Peter Chew Triangle Diagram Calculator.

5. Conclusion

Peter Chew's triangle diagram will suggest a better single rule that enables us to solve any problem topic solution of triangle simple, directly, more easily and more accurately. Peter Chew Triangle Diagram is to give complete image of topic solution of triangle. The application of Peter Chew Triangle Diagram to Education 4.0 Calculator allows the Education 4.0 Calculator to solve any problems in topic solution of triangle simple, directly and more accurate. This can be effective in let student interest in using technology while learning mathematics especially when analogous COVID-19 issues arise in the future. In addition to applying Peter Chew Triangle Diagram in the Education 4.0 calculator, Peter Chew Triangle Diagram are also applicable to many different Engineering fields, Pool Game and Criminology.

The main goal of Peter Chew's rules and methods is to simplify the solution for the triangle problems, which is in line with Albert Einstein's quotation: Everything should be made as simple as possible.

In addition, Albert Einstein's also quote:

- i) We cannot solve our problems with the same thinking we used when we created them.
- ii) If you can't explain it simply you don't understand it well enough,
- iii) "Genius is making complex ideas simple, not making simple ideas complex."
- iv). "Any intelligent fool can make things bigger and more complex. It takes a touch of genius—and a lot of courage—to move in the opposite direction."
- v) God always takes the simplest way.
- vi) When the solution is simple, God is answering.

Isaac Newton quote Nature is pleased with simplicity. And nature is no dummy.

From the Albert Einstein's and Isaac Newton quote above, it can be seen that simplifying knowledge is very important.

Conflict of Interest

The author declares no conflict of interest.

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