

Gifted Education School Network 2021/22

KLA: Mathematics Education

Lesson Design

Acknowledgement: This lesson example was adapted/adopted from the tryout by Dr. LO Wai-lok of HKMA David Li Kwok Po College

Key Learning Area:	Mathematics Education
Level:	Secondary 5
Topic	Applications of Trigonometry
Learning Objectives:	<ul style="list-style-type: none">● For all students: Students can apply different laws of trigonometry to situations of 3D problems.● For gifted/more able students: Students can derive the “Three Perpendiculars Theorem” and solve 3D problems of general polyhedron.
Learning outcomes:	Students will be able to solve various problems involving angles between line and plane and angles between planes.
Prior Knowledge of students:	<ul style="list-style-type: none">● Students learned different laws of trigonometry.● Students learned the definitions of angle between line and plane and angle between planes.
Highlights of this example:	<ul style="list-style-type: none">● This example demonstrates the merits of exploratory task as a learning tool.● This example gives the students an opportunity to apply the mathematical knowledge.● The less able students start analysing the problem with simple situation while;● the gifted/more able students can learn deeper through the related anchor activities.
Strategies employed:	In order to cater for the specific learning needs of students in a mixed ability class, differentiation strategies could be employed to maximise the learning outcomes of students. Tiered questioning helps less able students to get ready for the lesson and gives challenges to the gifted/more able students.

Flow of Learning Activities	Rationale and Tips for Implementation
<p>1) Exploration</p> <ul style="list-style-type: none"> ● Give warm-up exercise. Quick test on previous knowledge about angles between line and plane and angles between planes will be done on Kahoot app on students' tablets. ● For average students: Simple problems of finding angles or lengths involving one triangle in special polyhedron. Ref.: Questions 1 and 2 in the worksheet ● For gifted/ more able students: Problems of finding angles or lengths involving more than one triangles in special polyhedron. Ref.: Questions 3 and 4 in the worksheet <p>2) Development</p> <ul style="list-style-type: none"> ● Differentiated Instruction For average students: Derive the Three Perpendiculars Theorem 	<p>In order to engage students into the classroom activities, a Kahoot game is designed where the questions are set according to the pre-requisite knowledge (Sine Formula, Cosine Formula, Heron's Formula, Identification of Angle between Line and Plane and Angle between Planes) for this topic.</p> <p>For less able students, teachers may choose problems where the key triangle is a right-angled triangle such that students apply junior forms trigonometry only.</p> <p><u>Reminder</u></p> <p>For average and more able students, teachers are suggested to teach the students to use the memory registers in the calculators to store the approximated values got in the intermediate steps to avoid accumulation of errors throughout the calculations.</p> <p>For average students: Students will be guided to list out the Pythagoras Theorem for different triangles and rearrange the terms to get the required result.</p> <p>For gifted/ more able students: Students will be asked what should be proved in order to achieve the required result. Then they will be asked to prove the results without mentioning the method of Pythagoras Theorem.</p>

For gifted/ more able students:

Derive the condition for a line being perpendicular to a plane.

For gifted/ more able students:

Students will be asked to interpret the proposition, i.e. what is the given condition and what should be proved in order to get the required result.

Students could be guided by setting up the diagram and hinting which triangles should be considered.

Reminder

Students may not be familiar with doing deductive geometry in space, teachers are advised to bring along with solid models to demonstrate the triangles or planes in consideration for students weak in 3-dimensional sense.

Reminder

Situations like Question 21(b) where the intersection between planes is a point instead of a line should be emphasized. Students should be reminded that when the planes in consideration are extended, the relative position (and hence the angle) between the planes are unchanged, but this could make the planes intersect at a line instead of just a point.

For gifted students, teachers may consider to challenge them by giving irregular polyhedron where the lines of representation on each plane may not intersect at a point on the line of intersection.

3) Consolidation

● **Differentiated Assignment**

For average students:

Exercise on applying the theorems to problems involving special polyhedron.

For gifted/ more able students:

Exercise on applying the theorems to problems involving general polyhedron. (Question 21(b), 26 and 27)