

Exercise walk-through

3.2

Right triangles and non-right triangles

International Baccalaureate · IB Diploma · Mathematics: Applications and Interpretation

3.2 Right triangles and non-right triangles

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

KEY WORDS hypotenuse

Objective

Right triangles and non-right triangles. Original classroom practice for IB HL; not an official IB paper.

1 Key knowledge and worked examples

■ Which side does the ladder need?

- A ladder reaches a height of 4 m while its foot is 3 m from a wall. Which sides are known, and which angle do we need?
- This lesson studies **hypotenuse** : The side opposite the right angle in a right-

angled triangle.

■ The method

- In a right triangle $a^2 + b^2 = c^2$; $\sin\theta = \text{opposite}/\text{hypotenuse}$, $\cos\theta = \text{adjacent}/\text{hypotenuse}$ and $\tan\theta = \text{opposite}/\text{adjacent}$.
 - For other triangles, use the sine or cosine rule, or $\text{area} = ab \sin C/2$.
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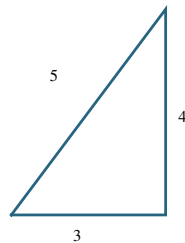
■ A worked case

$$a^2 + b^2 = c^2, \quad \tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

Example:

The ladder length is $c=\sqrt{3^2+4^2}=5$ m. Its angle to the ground satisfies $\tan\theta=4/3$, so $\theta\approx 53.1^\circ$. With two sides 6 and 8 enclosing 60° , $c^2=6^2+8^2-2\times 6\times 8\cos 60^\circ=52$.

Label the known sides before choosing a rule



■ **Where it goes wrong**

- Label sides relative to the chosen angle.
- Pythagoras needs a right angle.
- A calculator angle mode error can produce a plausible but wrong result.
- Keep unrounded values for later steps.

Not true: Pythagoras applies to every triangle, including triangles without a right angle. Pythagoras needs a right angle; for other triangles use the cosine rule.

■ **Applying it**

- Use a plan or elevation for a three-dimensional problem before applying a triangle rule.
- Explain why the chosen triangle contains the required length or angle.

■ **In your course**

- Applications and Interpretation HL, the course first assessed in 2021.
- Every paper allows a calculator, but method marks still need the expression or equation written before its value.

Key:

- **Hypotenuse:** The side opposite the right angle in a right-angled triangle.
 - In a right triangle $a^2 + b^2 = c^2$; $\sin\theta = \text{opposite/hypotenuse}$, $\cos\theta = \text{adjacent/hypotenuse}$ and $\tan\theta = \text{opposite/adjacent}$.
 - Watch for: label sides relative to the chosen angle.
-

■ **Write from a hypotenuse of 29**

- A right triangle has legs 20 and 21.
- Find the hypotenuse and the area. Pythagoras is only for right triangles.

Exercises 2.1-2.3

2.1 Find the hypotenuse when the legs are 3 and 4. Show the relation, substitution and units. [2]

2.2 Find $\sin\theta$ when opposite=3 and hypotenuse=5. Show the relation, substitution and units. [2]

2.3 Two sides 6 and 8 enclose 90° . Find their area. Show the relation, substitution and units. [2]

Exercises 2.1-2.3

2.1 Find the hypotenuse when the legs are 3 and 4. Show the relation, substitution and units. [2]

2.1 Pythagoras gives $\sqrt{3^2+4^2}=5$.

2.2 Find $\sin\theta$ when opposite=3 and hypotenuse=5. Show the relation, substitution and units. [2]

2.2 Sine=opposite/hypotenuse= $3/5=0.6$.

2.3 Two sides 6 and 8 enclose 90° . Find their area. Show the relation, substitution and units. [2]

2.3 The sides are perpendicular, so area= $6 \times 8 / 2 = 24$.

Exercises 2.4·3.1

2.4 Decide whether this claim is true and justify: Pythagoras applies to every triangle, including triangles without a right angle. [2]

2.5 Which condition must hold before Pythagoras $a^2+b^2=c^2$ can be used? Choose one answer.

- **A** The triangle must contain a right angle
- **B** The triangle must be isosceles
- **C** All three sides must be known

[1]

3.1 A triangle has sides $a=7$, $b=10$ and angle $A=30^\circ$. Determine how many triangles are possible and give the possible B angles. [4]

Exercises 2.4·3.1

2.4 Decide whether this claim is true and justify: Pythagoras applies to every triangle, including triangles without a right angle. [2]

2.4 False. Pythagoras needs a right angle; for other triangles use the cosine rule.

2.5 Which condition must hold before Pythagoras $a^2+b^2=c^2$ can be used? Choose one answer.

- **A** The triangle must contain a right angle
- **B** The triangle must be isosceles
- **C** All three sides must be known [1]

2.5 A Pythagoras is a property of right-angled triangles only, with c the hypotenuse. For other triangles the sine or cosine rule is needed.

3.1 A triangle has sides $a=7$, $b=10$ and angle $A=30^\circ$. Determine how many triangles are possible and give the possible B angles. [4]

3.1 Sine rule gives $\sin B = 10 \sin 30^\circ / 7 = 5/7$. $B \approx 45.585^\circ$ or 134.415° ; both leave a positive third angle. The ambiguous SSA case has two solutions, unlike a right-triangle shortcut.