YEAR **10**

NSW SYLLABUS

Mathematics

STUDENT COMPANION **NSW**

Pearson | Secondary Teaching Hub

Pearson Secondary Teaching Hub Maths 10 NSW

Student Companion

Lead authors
Nicola Silva

Contributing authors
Greg Carroll, David Coffey, Andrew Duncan, Grace Jefferson, Garthe Jones, Diane Oliver, Shaun Oliver, Sarah Plummer and Nadin Sidawi

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We respect the living cultures of Aboriginal and Torres Strait Islander peoples and their ongoing connection to Country across lands, sky, seas, waterways and communities. We celebrate the richness of Indigenous Knowledge systems, shared with us and with schools Australia-wide.

We pay our respects to Elders, past and present.

Pearson Australia
(a division of Pearson Australia Group Pty Ltd)
459–471 Church Street
Level 1, Building B
Richmond, Victoria 3121
www.pearson.com.au

First published 2024 by Pearson Australia
2027 2026 2025 2024

10 9 8 7 6 5 4 3 2 1

Project Leads: Julian Lumb and Lindy Sharkey
Development Editor: Anna Pang
Schools Programme Manager: Michelle Thomas
Production Editors: Elizabeth Gosman, Ellen Trevan and Martina Vascotto
Rights & Permissions Editor: Amirah Fatin Binte Mohamed Sapi’ee
Illustrators: QBS Learning
Proofreader: Robert Borg and Lucy Bates
Desktop Operator: JitPin Chong

Printed in Australia

ISBN 978 0 6557 1593 1

Pearson Australia Group Pty Ltd ABN 40 004 245 943

Attributions
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Contents

Contents

How to use this Student Companion

The Student Companion is a complementary resource that offers a print medium for corresponding lessons in Pearson Secondary Teaching Hub. It is designed to support teaching and learning by providing learners with a place to create a portfolio of learning to suit their individual needs, whether you are:

- supporting a blended classroom using the strengths of print and digital
- preparing for exams by creating a study guide or bound reference
- needing a tool to differentiate learning or
- looking for meaningful homework tasks.

Learners can develop their portfolio of learning as part of classroom learning or at home as an additional opportunity to engage and re-engage with the knowledge and skills from the lesson.

This could be done as prior learning in a flipped classroom environment or as an additional revision or homework task.

Learning intention and success criteria

Solve 2D problems using Pythagoras' theorem and trigonometry

Learning intention: To be able to solve 2D problems using Pythagoras' theorem and trigonometry

Success criteria:

- [ ] **SC 1:** I can use Pythagoras' theorem to determine the length of the hypotenuse and a shorter side.
- [ ] **SC 2:** I can use trigonometric ratios to determine the length of unknown sides.
- [ ] **SC 3:** I can use trigonometric ratios to determine the size of angles.

Learning intentions are provided for every lesson. The learning intentions are goals or objectives that align to the corresponding digital lesson. They describe what learners should know, understand or be able to do by the end of the lesson.

Success criteria clarify expectations and describe what success looks like. The success criteria are specific, concrete and measurable so learners can actively engage with and reflect on their evidence of learning within each lesson.

Worked examples

Worked examples provide learners with a step-by-step solution to a problem. The worked examples in the Student Companion correspond to those in the digital lesson and are provided for each skill to:

- scaffold learning
- support skill acquisition
- reduce the cognitive load.

The **worked examples** are an effective tool to demonstrate what success looks like. The 'try yourself' format of the worked examples in the Student Companion support the gradual release of responsibility. Learners can view a completed worked example and a video walkthrough of the worked example in the corresponding digital lesson and then apply the scaffolded steps themselves to solve a unique problem.

Practice questions are provided in the student companion so that learners can apply the knowledge and skills obtained in the worked example given. These questions are designed to ensure learners build confidence and demonstrate efficiency. They follow on from the Check your understanding questions beside the corresponding worked example in the digital lesson.

Each lesson in the Student Companion contains a space for students to reflect on their understanding. The simple and intuitive design of the **lesson reflection tool** allows students to scale their confidence, reflect on their learning and identify areas in which they need support.

Pythagoras, trigonometry, angles and bearings

Solve 3D problems using Pythagoras' theorem

Learning intention: To be able to solve 3D problems using Pythagoras' theorem

Success criteria:

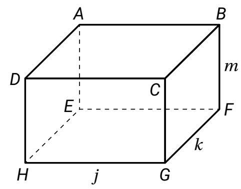
- ☐ SC 1: I can identify triangles in 3D shapes.
- ☐ SC 2: I can use Pythagoras' theorem to determine unknown side lengths in 3D shapes.

SC 1: I can identify triangles in 3D shapes

Worked example: Identifying right angled triangles on a rectangular prism

The rectangular prism $ABCDEFGH$ has known dimensions j, k and m.

Draw each of the named right-angled triangles in 2D, writing the known side lengths where possible, and assigning letters where sides are different lengths from those given.



(a) ΔABF

Thinking	Working
Identify the right angle. Identify the known lengths. Orient the triangle as closely as possible to the 3D diagram. Mark the unknown side as x.	

(b) ΔAFG

Thinking	Working
Identify the right angle. Identify the known lengths. Orient the triangle as closely as possible to the 3D diagram, but now facing the page. Mark the unknown side as y.	

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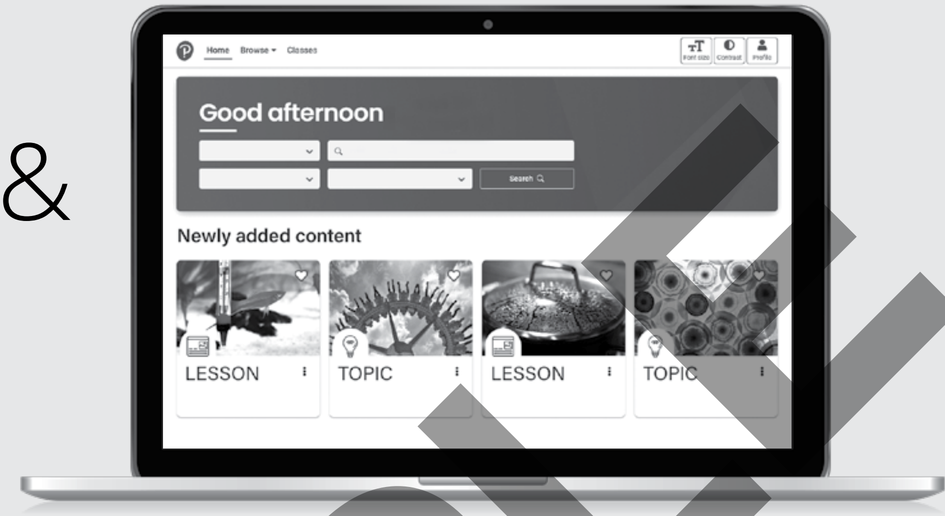

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This solution provides continuity for students from one class to the next and a rare whole-school view for school leadership while still delivering the rigour and support teachers need to help students meet the specific outcomes of their curriculum area.

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Pythagoras, trigonometry, angles and bearings

Solve 2D problems using Pythagoras' theorem and trigonometry

Learning intention: To be able to solve 2D problems using Pythagoras' theorem and trigonometry

Success criteria:

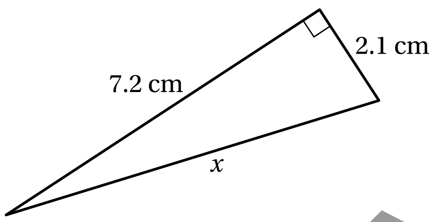
- [ ] **SC 1:** I can use Pythagoras' theorem to determine the length of the hypotenuse and a shorter side.
- [ ] **SC 2:** I can use trigonometric ratios to determine the length of unknown sides.
- [ ] **SC 3:** I can use trigonometric ratios to determine the size of angles.

SC 1: I can use Pythagoras' theorem to determine the length of the hypotenuse and a shorter side

Worked example: Calculating sides in a right-angled triangle

Calculate the length of the unknown side in each triangle.

(a)



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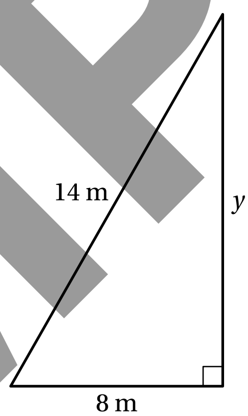

Write the answer exactly, then correct to the nearest centimetre.

(a)

Thinking	Working
Write Pythagoras' theorem in terms of the given lengths and variable.	
Solve for x. Then write the answer, including units.	
Alternatively, use Pythagorean triples.	

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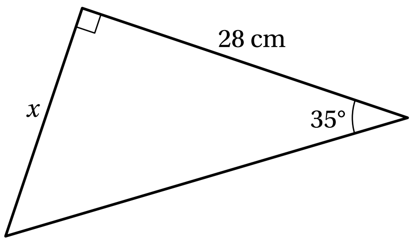
SC 2: I can use trigonometric ratios to determine the length of unknown sides

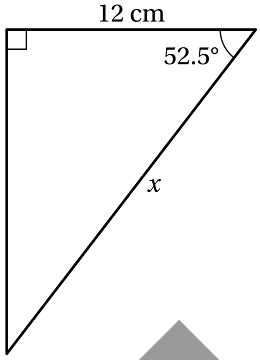
Worked example: Calculating side lengths from trigonometric ratios

Calculate the length of the unknown side in each triangle, correct to the nearest millimetre.

(a)



(b)



(a)

Thinking	Working
Identify each of the labelled sides as either the hypotenuse, or opposite or adjacent to the given acute angle.	
Use SOHCAHTOA to write the relevant trigonometric equation.	
Solve for x Then write the answer, including units.	

(b)

Thinking	Working
Identify each of the labelled sides as either the hypotenuse, or opposite or adjacent to the given acute angle.	
Use SOHCAHTOA to write the relevant trigonometric equation.	
Solve for x. Then write the answer, including units.	

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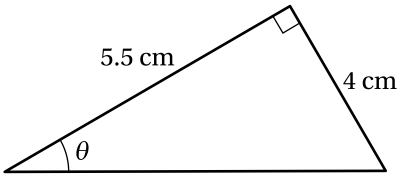
SC 3: I can use trigonometric ratios to determine the sizes of angles

Worked example: Using trigonometry to calculate the size of acute angles in right-angled triangles

Calculate the value of θ to the nearest degree.



Thinking	Working
Describe the given sides as the hypotenuse or in terms of the angle to be calculated.	
Use SOHCAHTOA to determine the trigonometric ratio to use.	
Substitute the values into the formula.	
Use the inverse of the trigonometric function to determine the required angle.	

1 Calculate the value of θ, correct to the nearest degree, given each of the following trigonometric ratios.

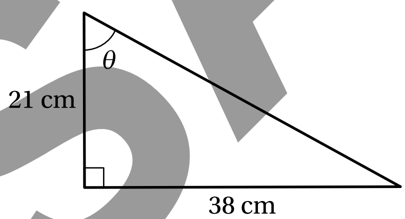
(a) $\sin(\theta) = 0.8$ **(b)** $\cos(\theta) = 0.3$ **(c)** $\tan(\theta) = 1.8$

2 Calculate the value of θ, correct to the nearest degree, given each of the following trigonometric ratios.

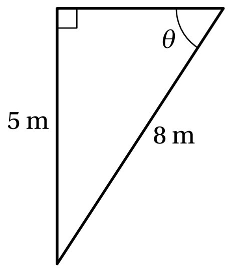
(a) $\tan(\theta) = \frac{7}{13}$ **(b)** $\sin(\theta) = \frac{7}{13}$ **(c)** $\cos(\theta) = \frac{7}{13}$

3 Calculate the value of θ, correct to the nearest degree, in each of the following right-angled triangles.

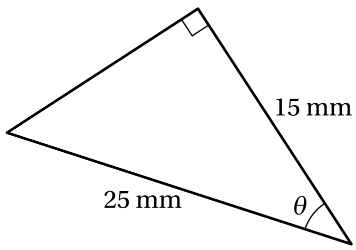
(a)



(b)



(c)



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Draw and solve problems involving angles of elevation and depression

Learning intention: To be able to draw and solve problems involving angles of elevation and depression

Success criteria:

- [ ] **SC 1:** I can draw and describe scenarios involving angles of elevation and depression.
- [ ] **SC 2:** I can model and solve problems involving unknown side lengths using angles of elevation and depression.
- [ ] **SC 3:** I can solve problems involving multiple angles of elevation or depression.

SC 1: I can draw and describe scenarios involving angles of elevation and depression

Worked example: Drawing a diagram to depict an angle of elevation scenario

The angle of elevation from a student's eye to the top of a flagpole is 32°. The distance to the flagpole along the ground can be measured, as can the height of the student's eye above the ground.

Draw a diagram involving a right-angled triangle to represent the situation so that the height of the flagpole can be determined, marking this distance with x.

Thinking	Working
Draw the ground and horizontal from the eye as horizontal lines. Draw the heights of the student and the flagpole as vertical lines. Mark in the right angles. Draw an oblique line from the eye to the top of the flagpole to make the given angle of elevation with the top of the flagpole.	
Mark the height of the flagpole with x, and the distances to be measured with other defined variables.	

1 Draw a diagram containing a right-angled triangle to match each description.
Mark the distance or length to be determined as x each time.

(a) The angle of elevation to the top of a building from D m away is 57°.
The height of the building, in metres, is to be determined.

(b) The angle of depression to the boat from the top of a cliff H m high is 21°.
The distance of the boat from the cliff, in metres, is to be determined.

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SC 2: I can model and solve problems involving unknown side lengths using angles of elevation and depression

Worked example: Solving side lengths in angles of elevation or depression problems

The angle of elevation from a student's eye to the top of a flagpole is 29°. The distance to the flagpole along the ground is 16.4 m, and the height of the student's eye above the ground is 1.5 m.

Determine the height of the flagpole in metres, correct to 1 decimal place.

Thinking	Working
Draw a diagram, making sure it contains a right-angled triangle. Mark the height of the flagpole with x, and show all other values. Write algebraic expressions for the sides of the triangle, where necessary.	
Use the diagram to write a trigonometric equation.	
Solve the equation to determine the value of x. Then write the answer.	

1 In each of the following, use a diagram containing a right-angled triangle to justify your working. Give answers in metres, correct to 1 decimal place.

(a) The angle of elevation to the top of a tree from 25 m away is 33°. Determine the height of the tree.

(b) The angle of depression of a whale seen from the top of a cliff 47 m high is 9.2°. Determine the distance of the whale from the cliff.

2 The angle of elevation of a tower is measured from 23 m away using a clinometer 1.8 m above the ground. The angle is 53°. Determine the height of the tower. Draw a diagram containing a right-angled triangle to justify the calculation. Give your answer in metres, correct to 1 decimal place.

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SC 3: I can solve problems involving multiple angles of elevation or depression

Worked example: Solving problems using multiple angles of elevation

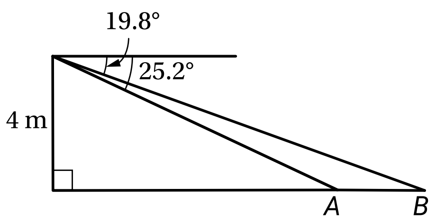
Calculate the height of the third floor of a building if the angles of elevation from 40 m away are 14.5° to the bottom of the third floor and 19.1° to the top of the third floor, respectively.
Write your answer correct to 1 decimal place.

Thinking	Working
Draw a diagram of the situation, marking the required length with x.	
Separate the triangles, marking lengths to be determined with suitable variables.	
Determine the marked lengths in the separated triangles.	
Write an expression for x and hence determine the required length.	

1 Calculate the height of the eighth floor of a building if the angles of elevation from 50 m away are 33° to the top of the eighth floor and 29.7° to the top of the seventh floor, respectively.
Justify the calculation with a diagram containing two right-angled triangles.
Write your answer correct to 1 decimal place.

2 The positions of two swimmers, A and B, directly line up with the top of a surf life-saving tower, with angles of depression as shown on the diagram.

Determine how far apart the swimmers are, correct to 1 decimal place.



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Illustrate bearings

Learning intention: To be able to illustrate bearings

Success criteria:

- [ ] **SC 1:** I can draw and describe bearings.
- [ ] **SC 2:** I can convert between true bearings and magnetic bearings.

SC 1: I can draw and describe bearings

Worked example: Drawing and describing true bearings and compass bearings

(a) Illustrate each of the following on a diagram, then convert the true bearings to compass bearings.

(i) 034° **(ii)** 240°

Thinking	Working
(i) On a four compass points diagram, mark the number of degrees of the true bearing clockwise from north.	
Write the compass bearing with N or S first, then the number of degrees of turning towards E or W.	
(ii) On a four compass points diagram, mark the number of degrees clockwise from north.	
Write the compass bearing.	

(b) Illustrate each of the following on a diagram, then convert the compass bearings to true bearings.

(i) S57° E **(ii)** N25° W

Thinking	Working
(i) On a four compass points diagram, mark the number of degrees from N or S towards E or W.	
Calculate the true bearing as the number of degrees clockwise from north.	
(ii) On a four compass points diagram, mark the number of degrees from N or S towards E or W.	
Calculate the true bearing.	

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SC 2: I can convert between true bearings and magnetic bearings

Worked example: Calculating true bearings from magnetic bearings

Calculate the true bearing in each of the following.

(a) The magnetic bearing to a boat in Sydney Harbour, where the 2023 magnetic declination is 13°48′ E or +13°48′, is 138.5°.

Thinking	Working
Show true north, magnetic north and the measured bearing to the boat on a diagram of a compass rose.	
Calculate the angle clockwise from true north. The 'degrees-minutes-seconds' button on a calculator can be used. (Key in 13°48′ by pressing the button after both 13 and 48.) Note: The "degrees-minutes-seconds" button allows you to toggle between answers as decimals and the answer in degrees, minutes and seconds.	
Write the true bearing of the boat, including T to be clear.	

(b) The magnetic bearing to the White House in Washington DC, where the 2023 magnetic declination is 10°44′ W or −10°44′, is 320.8°.

Thinking	Working
Show true north, magnetic north and the measured bearing to the White House on a diagram of a compass rose.	
Calculate the angle clockwise from true north. The 'degrees-minutes-seconds' button on a calculator can be used, or remember that there are 60 minutes in a degree.	

1 Convert the following magnetic bearings to true bearings, given the 2023 magnetic declination for each locality. Give your answers in degrees and minutes.

(a) Magnetic bearing 087.3°; Cairns, +6°31′ or 6°31′ E

(b) Magnetic bearing 208.5°; Canberra, +12°38′

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Solve 2D problems involving navigation

Learning intention: To be able to solve 2D problems involving navigation

Success criteria:

- [ ] **SC 1:** I can solve problems involving an unknown distance.
- [ ] **SC 2:** I can solve problems involving an unknown direction.
- [ ] **SC 3:** I can solve problems involving an unknown distance and direction.

SC 1: I can solve problems involving an unknown distance

Worked example: Determining distances in navigation

Calculate the distance in each of the following situations, correct to 2 decimal places.

(a) A cat walks 300 m north then turns west and walks a further 250 m.

Determine the distance of the cat from the start.

Thinking	Working
Draw a diagram of the situation, marking the required distance as x. Clearly mark right angles where right-angled triangles will be used in the calculations.	
Use Pythagoras' theorem to calculate the required distance.	

(b) A motorist drives 4.5 km in the direction S25° W.

Determine how far west the motorist is from the start.

Thinking	Working
Draw a diagram of the situation, marking the required distance as x. Clearly mark right angles where right-angled triangles will be used in the calculations.	
Use trigonometry to calculate the required distance.	

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SC 2: I can solve problems involving an unknown direction

Worked example: Determining unknown directions and bearings

An orienteer runs 3 km due west and then 5 km on a bearing of 330°T. Determine the true bearing the orienteer must take to return to the start by the shortest possible route.

Thinking	Working
Write the true bearing as a compass bearing.	
Draw both parts of the journey on a pair of compass roses. Place another compass rose at the end of the journey and draw the direct return direction, marking it with an arrow.	
Break the 330°T path into its component parts in the main compass point directions.	
Calculate the final position in terms of the start as its N and W components.	
Calculate the acute angle between S and the return journey from the return journey's compass rose.	
Calculate the true bearing for the return journey.	

1 A helicopter flies 5 km due south and then 3.5 km on a bearing of 120°T. Determine the true bearing to return to the start by the shortest possible route. Write the answer correct to the nearest degree.

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SC 3: I can solve problems involving an unknown distance and direction

Worked example: Solving navigation problems involving distance and direction

Determine the distance and true bearing of the shortest return path for each of the following journeys. Write the distances correct to 1 decimal place and the bearings correct to the nearest degree.

(a) 8 km E followed by 6 km SE

Thinking	Working
Draw both parts of the journey on a pair of compass roses. Place another compass rose at the end of the journey and draw the direct return path d, marking it with an arrow. Mark an angle θ between the return path and a vertical line.	
Break the SE path into its component parts in the main compass point directions.	
Use Pythagoras' theorem to calculate the shortest-path return distance. Round as directed, including units of distance.	
Use trigonometry to calculate the value of θ, to the nearest degree.	
Calculate the true bearing of the return path.	

(b) 5 km on a bearing of 300°T followed by 10 km on a bearing of 190°T.

Thinking	Working
Convert both true bearings to compass bearings.	

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Draw both parts of the journey on a pair of compass roses. Place another compass rose at the end of the journey and draw the direct return path d, marking it with an arrow. Mark an angle θ between the return path and a vertical line.	
Break the 300°T path into its component parts in the main compass point directions.	
Break the 190°T path into its component parts in the main compass point directions.	
Use Pythagoras' theorem to calculate the shortest-path return distance. Round as directed, including units of distance.	
Use trigonometry to calculate the value of θ, to the nearest degree.	
Calculate the true bearing of the return path.	

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Solve 3D problems using Pythagoras' theorem

Learning intention: To be able to solve 3D problems using Pythagoras' theorem

Success criteria:

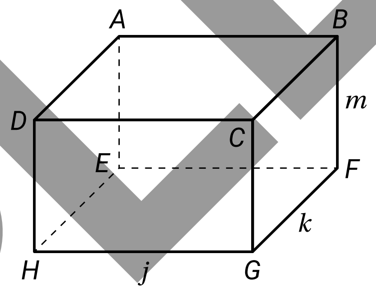
- [ ] **SC 1:** I can identify triangles in 3D shapes.
- [ ] **SC 2:** I can use Pythagoras' theorem to determine unknown side lengths in 3D shapes.

SC 1: I can identify triangles in 3D shapes

Worked example: Identifying right angled triangles on a rectangular prism

The rectangular prism $ABCDEFGH$ has known dimensions j, k and m.

Draw each of the named right-angled triangles in 2D, writing the known side lengths where possible, and assigning letters where sides are different lengths from those given.



(a) ΔABF

Thinking	Working
Identify the right angle. Identify the known lengths. Orient the triangle as closely as possible to the 3D diagram. Mark the unknown side as x.	

(b) ΔAFG

Thinking	Working
Identify the right angle. Identify the known lengths. Orient the triangle as closely as possible to the 3D diagram, but now facing the page. Mark the unknown side as y.	

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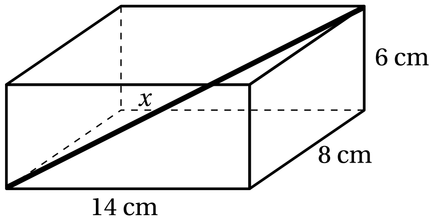
SC 2: I can use Pythagoras' theorem to determine unknown side lengths in 3D shapes

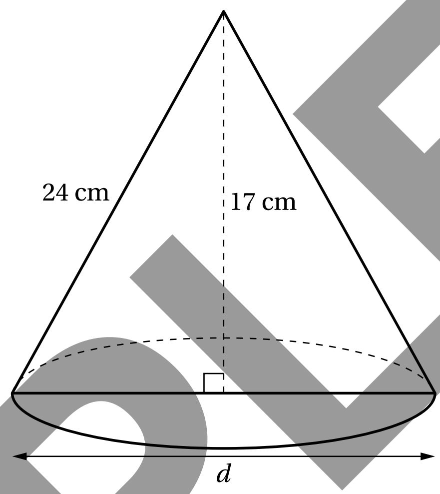
Worked example: Using Pythagoras' theorem to calculate lengths in 3D shapes

Calculate each unknown length, correct to the nearest millimetre.

(a) Main diagonal of a rectangular prism



(b) Diameter of a right cone



(a)

Thinking	Working
For a main diagonal, use Pythagoras' theorem for 3D.	

(b)

Thinking	Working
Use Pythagoras' theorem for a shorter side to calculate the radius.	
Calculate the diameter by doubling the radius.	

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Solve 3D problems using trigonometry

Learning intention: To be able to solve 3D problems using trigonometry

Success criteria:

- [ ] **SC 1:** I can solve 3D problems using trigonometry.
- [ ] **SC 2:** I can solve 3D problems involving angles of elevation and depression.
- [ ] **SC 3:** I can solve 3D problems involving navigation.

SC 1: I can solve 3D problems using trigonometry

Worked example: Solving 3D problems using trigonometry

Calculate the required value in each of the following right cones.

(a) The height, to the nearest millimetre, given a diameter of 28 cm and a vertex angle of 32°

Thinking	Working
Draw a diagram, identifying a right-angled triangle. Label the triangle with known values where possible, and variables where calculations are required.	
Use trigonometry to calculate the height.	

(b) The vertex angle, to the nearest degree, given a height of 80 mm and slant height of 100 mm

Thinking	Working
Draw a diagram, identifying a right-angled triangle. Label the triangle with known values where possible, and variables where calculations are required.	
Use trigonometry to calculate the unknown angle.	

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SC 2: I can solve 3D problems involving angles of elevation and depression

Worked example: Solving angle of elevation problems in 3D

Romeo stands 15 m back from the building where Juliet stands on the balcony, looking up at an angle of 48°. 25 m further along the street, his friend Noah also stands 15 m from the building, looking up at Ayame on her balcony, at an angle of 57°.

Making assumptions where necessary in your calculations, determine:

(a) the (oblique) distance between Juliet and Ayame, correct to 1 decimal place

Thinking	Working
Draw separate diagrams showing the angles of elevation from Romeo and Noah. Calculate the heights of Juliet and Ayame.	
Write any assumptions made so far.	
Calculate the vertical distance between Juliet and Ayame.	
Use Pythagoras' theorem to calculate the distance between Juliet and Ayame in the vertical plane of the front of the building.	

(b) the angle of elevation, to the nearest degree, at which Juliet must look up to see Ayame.

Thinking	Working
Use the same triangle to calculate the angle of elevation.	

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SC 3: I can solve 3D problems involving navigation

Worked example: Solving 3D problems involving navigation

A surveyor measures the angle of elevation to the top of a tower from 30 m due east of the tower to be 26.6°. The surveyor then walks 25 m on a bearing of 144°T.

(a) Determine the height of the tower, correct to 1 decimal place.

Thinking	Working
Draw the vertical plane containing the tower and the original position of the surveyor, marking an acute angle, a right angle and the known distance. Mark the height with a variable.	
Calculate the required distance using trigonometry.	

(b) Determine the final distance of the surveyor from the tower, correct to 1 decimal place.

Thinking	Working
Draw the horizontal plane, placing a compass rose at the surveyor's original position and marking acute angles and right angles. Mark the solvable distances with variables.	
Calculate the required distance using trigonometry.	

(c) Determine the angle of elevation to the top of the tower from the final position, correct to 1 decimal place.

Thinking	Working
Draw the vertical plane containing the tower and the final position of the surveyor. Mark the angle of elevation with a variable.	
Calculate the required angle using the inverse of a trigonometric ratio.	

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Pythagoras, trigonometry, angles and bearings

1 A surveyor measures the angle of elevation to the top of a tower from 50 m due south of the tower to be 39.2°.

(a) Determine the height of the tower, correct to 1 decimal place.

(b) The surveyor then walks 22 m on a bearing of 280°T.
Determine, correct to 1 decimal place:

(i) the distance of the surveyor from the tower

(ii) the new angle of elevation to the top of the tower.

2 A student, Darcy, measures the angle of elevation to the top of a tree from 15 m SW of the tree to be 56°.

(a) Determine the height of the tree, correct to 1 decimal place.

(b) Another student, Ayla, moves 25 m away from Darcy on a bearing of 230°T.

(i) Calculate the distance between Ayla and the tree, correct to 1 decimal place.

(ii) Calculate the angle showing on the clinometer, to the nearest degree, when Ayla takes an angle of elevation reading to the top of the tree.

3 A surveyor places a marker at the top of a hill.
The surveyor walks to flat ground 115 m due east of the marker and measures the angle of elevation as 32°.
The surveyor then walks on a bearing 310°T until he is due north of the marker, 150 m from his initial position.

(a) Determine the height of the hill above the flat ground, correct to 2 decimal places.

(b) Determine the angle of elevation from the surveyor's final position to the top of the hill, correct to 1 decimal place.

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