Y8	UNIT 3 ***Pythagoras' Theorem*** Lesson Plan 1	*Introduction to Pythagoras' Theorem*
Activity		***Notes***
		Ps will need scissors for this lesson (Activity 2)
1A	**Introduction** T: We looked at angles between $0°$ and $360°$ two weeks ago. Can you list the different types of angles? *(Acute, right, reflex, obtuse angles; angles on straight lines, angles round a point)* T: Which of these can be inside a triangle? *(Acute, right and obtuse angles)* T: Why? *(Because the sum of the interior angles of a triangle is exactly $180°$)* T: How many acute angles can there be in one triangle? *(Two or three)* T: How many right angles? *(At most one)* T: And how many obtuse angles? *(At most one)* T: In this unit we're going to deal with right-angled triangles. Who'd like to draw one on BB? Please mark the right angle.	Whole class activity: a short review of triangles before Pythagoras' Theorem. T asks, Ps volunteer, Ps answer, T praises/waits for correction. A volunteer P draws a right-angled triangle on BB, and T introduces the words 'hypotenuse' for the side opposite the right angle, and 'perpendicular sides' for the other two sides.
1B	**Practice identifying the hypotenuse** **PB 3.1, Q1** *(a) PQ (b) YZ (c) JK (d) ST*	Whole class activity. Task appears on OHP and volunteer Ps come out to show and explain their answers.
	7 mins	
2	**Practical work with Pythagoras' Theorem** **Activity 3.1** (changed) T should write letters *a* and *b* instead of '4 cm' and '3 cm' on the two figures, and the letter *c* on the hypotenuse of the triangles. Q4 must be deleted before the page is copied for Ps. T: Compare the sizes of the original and the new figures. What do you notice? *(They are both squares with $a+b$ side lengths)*	Whole class activity. Each P has a copy of Activity 3.1.1 (amended) and a pair of scissors. (T has spare pairs of scissors, in case they are needed.) T directs Ps to carry out instructions 2 and 3. When Ps have cut out and rearranged the triangles, discussion follows.
	T: What is the area of square A? (a^2)	
	T: What is the area of square B? (b^2)	
	T: What is their total area? (a^2+b^2)	T writes on BB.
	T: What is the area of square C inside the second figure? (c^2)	T writes on BB.
	T: What can you say about the three areas? ...Why? *(Area of square A + area of square B = area of square C, because C and the 4 triangles cover the same area as A, B and the 4 triangles)*	
(continued)	T: Say this using the letters *a*, *b* and *c*. $(a^2+b^2=c^2)$	

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 1	*Introduction to Pythagoras' Theorem*
Activity		***Notes***
2 *(continued)*	T: What is this? *(This is a connection between the three sides)* T: Was this an unusual right-angled triangle? *(No)* T: So we have just found a formula for all right-angled triangles. Can you give it in words? *(The square on the hypotenuse is equal to the sum of the squares on the two perpendicular sides)* *17 mins*	T helps, ensuring that correct and precise wording is used. Ps write in Ex.Bs. Praising.
3	**Pythagoras** T: What have you found out about Pythagoras? *20 mins*	At the end of the last lesson, Ps were asked to find some facts about Pythagoras (who he was, when he lived, etc.). Now they can write information on BB. Discussion. Praising.
4A **4B**	**Measuring triangles to check the formula** T: Let's check the formula. You've just cut out some right-angled triangles. Measure their sides in cm. T (writes, Ps dictate): $a \approx 3.8$ cm $\rightarrow$ $a^2 = 14.44$ cm^2 $b \approx 2.8$ cm $\rightarrow$ $b^2 = 7.84$ cm^2 $b \approx 4.7$ cm $\rightarrow$ $c^2 = 22.09$ cm^2 $a^2 + b^2 \approx c^2$ T: Why is $a^2 + b^2$ not exactly c^2 ? *(Our cutting out or measurement could not have been accurate enough)* **Checking the formula inversely** T: Let's check the formula inversely. Look at a triangle with sides of 5 cm, 12 cm and 13 cm. Do these numbers fit the formula? *(* $a = 5$ cm $\rightarrow$ $a^2 = 25$ cm^2 $b = 12$ cm $\rightarrow$ $b^2 = 144$ cm^2 $c = 13$ cm $\rightarrow$ $c^2 = 169$ cm^2 $25 + 144 = 169$*)* T: So what kind of triangle must it be? *(Right-angled triangle)* T: Construct the triangle and see if it is right-angled. *40 mins*	Whole class activity. All Ps use rulers to measure triangles, then T asks length of sides and writes them on BB. Ps square the numbers, dictating to T and writing them in Ex.Bs. Ps and T together check the formula. Individual work, monitored, helped. Before they start work, T should make Ps recall how to construct a triangle when the length of its sides are known. (Ps will need equipment.) After constructing, Ps have to measure the angle opposite the longest side and decide whether or not it is $90°$. Agreement. Praising.

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 1	*Introduction to Pythagoras' Theorem*
Activity		***Notes***
5A	**Verifying Pythagoras' Theorem** **PB 3.1, Q3 (a)** T: Let's look again at how we check Pythagoras' Theorem for a particular right-angled triangle. T/Ps: Calculating the area of the square, we can draw on the 10 m side. Slower P: $a^2 = 10^2 = 100 \text{ m}^2$ T/Ps: Calculating the area of the square, we can draw on the 24 m side. Slower P: $b^2 = 24^2 = 576 \text{ m}^2$ T/Ps: Calculate the sum of these areas. Slower P: $100 \text{ m}^2 + 576 \text{ m}^2 = 676 \text{ m}^2$ T/Ps: Calculate the area of the square on the longest side of the triangle, and verify Pythagoras' Theorem. Slower P: $c^2 = 26^2 = 676 \text{ m}^2 = a^2 + b^2$	T sketches the triangle in Q3 (a) on BB and encourages a slower P to check the theorem with help of T and other Ps. Other Ps can prompt by asking questions to help P at BB. Praising
5B	**Further practice** **PB 3.1, Q3 (b), (c)** *(b)* $9^2 + 12^2 = 81 + 144 = 225$ *and* $15^2 = 225$ *i.e. equal* *(c)* $13^2 + 84^2 = 169 + 7056 = 7225$ *and* $85^2 = 7225$ *i.e. equal* *38 mins*	Individual work, monitored, helped. Verbal checking. Agreement, feedback, self-correction. Praising.
6A	**Pythagorean triples** T: Since ancient times the construction of right angles has been very important for uses such as marking out territory. A possible way of finding a right angle is to use three numbers, e.g. 9, 12 15, which we know, from the previous Activity, fit Pythagoras' rule. Since $9^2 + 12^2 = 15^2$, these numbers will always give a triangle with a right angle opposite the longest side, whatever unit of measurement is used. It is not surprising that more than 100 years before Pythagoras', lots of triples were already known to give right angles - we call these sets of numbers Pythagorean triples. Let's look at the set of numbers 7, 24, 25 and see if it is a Pythagorean triple. Ps: $7^2 = 49$ $24^2 = 576$ $25^2 = 625$ $49 + 576 = 625 \rightarrow$ the triple is Pythagorean.	T gives background to Pythagorean triples. Ps calculate, dictate, T writes on BB. Praising.
6B	**Practice with Pythagorean triples** **PB 3.1, Q4 (a)** ***(Yes)*****,** **(d)** ***(No)*** *45 mins*	Individual work, monitored, helped. Verbal checking, Agreement, feedback, self-correction. Praising.
	Set homework **PB 3.1, Q2** **PB 3.1, Q4 (b), (c)**	

Y8 UNIT 3 *Pythagoras' Theorem* Lesson Plan 2

Finding the Length of the Hypotenuse

Activity		*Notes*
1	**Checking homework**	
	PB 3.1, Q2	Verbal checking with explanations, at the same time reviewing Pythagoras' Theorem. Feedback, self-correction. Praising.

	(a)	(b)	(c)
(i)	25	64	121
(ii)	144	225	3600
(iii)	169	289	3721
(iv)	169	289	3721
(v)	$25 + 144 = 169$	$64 + 225 = 289$	$121 + 3600 = 3721$

PB 3.1, Q4 (b) Yes (c) No

5 mins

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2 **Deciding whether or not triangles are right-angled**

OS 3.2

T: How can we decide whether or not a triangle contains a right angle?

P: We should find out if the sides are Pythagorean triples.

T: Be careful! In a Pythagorean triple, all numbers must be integers, but there are right-angled triangles with sides lengths that are not integers.

T: Who would like to do the first one?

P_1: The shorter sides are those of lengths 5 m and 12 m. The sum of their squares is $25 + 144 = 169$. This is equal to the square of the longest side, so the triangle does contain a right angle.

P_2 and P_3 continue with the triangles in (b) and (c).

T: Comparing $a^2 + b^2$ with c^2, what do we see for the third triangle?

(In the first triangle c^2 was equal, in the second c^2 was less, and in the third triangle c^2 was more than $a^2 + b^2$)

T: What type of triangle is each one of these?

(The first triangle is right-angled, the others are not. The third triangle might contain an obtuse angle.)

T: Right. We'll come back to this later.

Notes: Mental work. Task appears on OHP. Volunteer Ps will see whether the triangle is or is not right-angled, but slower Ps must be given time to work it out in their Ex.Bs. Agreement, praising, and then short discussion.

11 mins

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3 **Pythagorean triples**

Activity 3.4

Notes: Working in pairs. Each pair has a copy of Activity 3.4. T monitors the work and helps if necessary. T stops the work when several pairs of Ps have found one or two of the triples asked for in Q3. Verbal checking. Agreement, feedback, self-correction. Praising.

20 mins

4A **Finding Pythagorean triples**

T: In the last question, you had to find two unknown numbers which, together with a known number, gave a Pythagorean triple. Would it be easier if I gave you two of the numbers?

Notes: Whole class activity. Discussion on how to find the largest member of a Pythagorean triple, given the other two numbers.

(continued)

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 2	*Finding the Length of the Hypotenuse*
Activity		***Notes***
4A *(continued)*	T: Find the largest member of a Pythagorean triple if the smaller numbers are 12 and 16. *(The square of the unknown number has to be equal to* $12^2 + 16^2$. *Since* $144 + 156 = 400$*, we have to find a number which, when squared, gives 400. The number is 20.)* T: Find the hypotenuse of a right-angled triangle if the lengths of the other sides are 6 cm and 8 cm. *(* $6^2 + 8^2 = 100$. *Since* $10^2 = 100$*, the length of the hypotenuse must be 10 cm, by Pythagoras' Theorem.)*	Ps can calculate in their Ex.Bs, and T can write on BB what Ps say.
4B	**Finding the hypotenuse** **OS 3.3** P (at OHP): $h^2 = 8^2 + 7^2$ $h^2 = 64 + 49$ $h^2 = 113$ $h = \sqrt{113}$ $h \approx 10.63$ m, correct to 2 d.p. *29 mins*	Individual work. T gives no explanation or guidance, but puts OS on OHP and says, "Find the hypotenuse." T monitors Ps' work, noting which Ps use calculators and which use what they learned about square roots in Unit 2. Checking: a volunteer P come to front and writes and explains solution. When P reaches the point '$h = \sqrt{113}$', T can get Ps to repeat the definition of a square root. Agreement, feedback, self-correction. Praising.
5	**Further work with Pythagoras' Theorem** **PB 3.2, Q1 (b)** **PB 3.2, Q2 (b)** P_1: $c^2 = a^2 + b^2$ $c^2 = 15^2 + 36^2$ $c^2 = 225 + 1296$ $c^2 = 1521$ $c = \sqrt{1521}$ $c = 39$ (cm), the length of the hypotenuse P_2: $h^2 = 5^2 + 8^2$ $h^2 = 25 + 64$ $h^2 = 89$ $h = \sqrt{89}$ $h \approx 9.4$ (cm), correct to 1 d.p. *37 mins*	Individual work, monitored, helped. Checking at BB: a volunteer P works through the first question at BB and another (encouraged) P works through the second one. Feedback, self-correction. Praising.

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 2	*Finding the Length of the Hypotenuse*
Activity		***Notes***
6	**Diagonal of a rectangle** T: You'll see that many problems in geometry can be solved by dividing the particular figure into triangles. That's why Pythagoras' Theorem is so important. **OS 3.4** T (writes, Ps dictate): $d^2 = 16^2 + 8^2$ $d^2 = 256 + 64$ $d^2 = 320$ $d = \sqrt{320}$ $d \approx 17.9$ (cm), correct to 1 d.p. *41 mins*	Whole class activity. Task appears on OHP. First, T covers the second figure, writes the lengths close to the sides of the top rectangle, and makes Ps find the suitable right-angled triangle. Then T uncovers the second figure and asks Ps to determine the diagonal. Ps dictate, T agrees, writes on OS, praises.
7	**Finding the diagonal, individual work** **PB 3.2, Q3** P (at BB): $d^2 = a^2 + b^2$ $d^2 = 5^2 + 10^2$ $d^2 = 25 + 100$ $d^2 = 125$ $d = \sqrt{125}$ $d \approx 11.2$ cm is the diagonal (correct to 1 d.p.) *45 mins*	Individual work, monitored, helped. Checking at BB: T sketches the rectangle on BB, writes data on it and points to a volunteer P to come to BB and show and explain solution. Agreement, feedback, self-correction. Praising.
	Set homework **PB 3.2, Q1 (c), (d)** **PB 3.2, Q2 (a), (d)** **PB 3.2, Q9**	

<table>
<tr><td>Y8</td><td>UNIT 3 Pythagoras' Theorem Lesson Plan 3</td><td>Calculating the Lengths of Other Sides</td></tr>
<tr><td>Activity</td><td></td><td>Notes</td></tr>
<tr><td>1A</td><td>Checking homework
PB 3.2, Q1 (c) 41 mm (d) 34 mm
PB 3.2, Q2 (a) 12.8 cm</td><td>Verbal checking of the first three problems. Agreement, feedback, self-correction. Praising.</td></tr>
<tr><td>1B</td><td>PB 3.2, Q2 (d)
P (at BB): $h^2 = 4^2 + 3.5^2$
$h^2 = 16 + 12.25$
$h^2 = 28.25$
$h \approx 5.3$ (m), correct to 1 d.p.</td><td>In Q2 (d) Ps experienced the length of a side being a decimal. T asks a P to show solution at BB, and, at the same review how to deduce the length of the hypotenuse.
Feedback, self-correction. Praising.</td></tr>
<tr><td>1C</td><td>PB 3.2, Q9
P (at BB): for rect. A: $d^2 = 3^2 + 5^2$
$d^2 = 9 + 25$
$d = \sqrt{34}$ cm
for rect. B: $d^2 = 3.5^2 + 4.5^2$
$d^2 = 12.25 + 20.25$
$d = \sqrt{32.5}$ cm
So rectangle A has the longer diagonal.
6 mins</td><td>Then another P is asked to explain the solution to this final part of the homework.
Note that there is no need to find the actual values as $\sqrt{34} > \sqrt{32.5}$.
Feedback, self-correction. Praising.</td></tr>
<tr><td>2

(continued)</td><td>Practice with Pythagorean triples
T: Can you remember the work we did on Pythagorean triples? I'll say the two largest numbers of a triple, and you have to find the third number.
T: 10 and 8 ...
P_1: 6
T: How did you find it?
P_1: In a Pythagorean triple, $c^2 = a^2 + b^2$, so $b^2 = c^2 - a^2$.
Here $b^2 = 10^2 - 8^2 = 36 \Rightarrow$ the unknown number as 6.
T: The next pair of numbers are 5 and 4. What is the third number?
P_2: We are looking for x, and we know that $x^2 + 4^2 = 5^2$.
Since $x^2 = 25 - 16 = 9$, the unknown number is 3.
T: The hypotenuse of a right-angled triangle is 13 m long. One of the perpendicular sides is 12 m long. Find the length of the other side.
P_3: $a^2 + b^2 = c^2$
$a^2 + 12^2 = 13^2$
$a^2 = 169 - 144$
$a^2 = 25$
$a = 5$ (m)
T: We know the that the length of the hypotenuse of a right-angled triangle is 7 cm and that the length of another side is 3 cm. Find the length of the unknown side.</td><td>Whole class activity.
T asks a (stronger?) volunteer to answer and explain the first question.
Praising.
The second question is easier, so a slower P should be encouraged to answer and explain in the same way as in the first question, writing in Ex.B. if necessary. Praising.
For the third question, T calls a volunteer to BB to deduce solution. Other Ps write in Ex.Bs.
Praising.
Finally, T encourages a slower P to come to BB to show how to deduce the unknown perpendicular side (P brings calculator to BB).</td></tr>
</table>

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 3	*Calculating the Lengths of Other Sides*
Activity		***Notes***
2 *(continued)*	P_4: $a^2 + b^2 = c^2$ $a^2 + 3^2 = 7^2$ $a^2 + 9 = 49$ $a^2 = 40$ $a = \sqrt{40}$ $a \approx 6.3$ cm, correct to 1 d.p. *16 mins*	Praising.
3	**Practice using Pythagoras' Theorem to calculate lengths of sides** **PB 3.3, Q1 (a)** *16 cm* **PB 3.3, Q2 (c)** *3.3 cm* *23 mins*	Individual work, monitored, helped. Verbal checking or detailed checking at BB, if needed. Agreement, feedback, self-correction. Praising.
4	**Finding the perpendicular height of an isosceles triangle** T: We have seen that Pythagoras' Theorem is very important, not only in right-angled triangles, but also when we can find a right-angled triangle in a figure, for example, by dividing it into parts. So let's look at the next problem, which is shown on this slide. **OS 3.6** T (writes, Ps dictate): $h^2 + 2^2 = 6^2$ $h^2 + 4 = 36$ $h^2 = 32$ $h = \sqrt{32}$ $h \approx 5.7$ (cm), correct to 1 d.p. *28 mins*	Whole class activity. Task appears on OHP. First, T covers the second figure, asks a volunteer P to draw the perpendicular height, and lets Ps discover the right-angled triangle in the figure. Then T uncovers the second figure and asks Ps to determine *h*. Ps dictate, T agrees, writes on OS (Ps write in Ex.Bs.), T praises.
5	**Finding perpendicular height of equilateral triangle** **PB 3.3, Q3** P (at BB): $h^2 + 2^2 = 4^2$ $h^2 + 4 = 16$ $h^2 = 12$ $h = \sqrt{12}$ $h \approx 3.5$ (cm), correct to 1 d.p. *36 mins*	Individual work, monitored, helped. Checking at BB: T sketches the equilateral triangle (without drawing the perpendicular height) on BB, writes data on it and points to volunteer Ps to come to BB, draw *h* on the triangle, show the right-angled triangle as part of the figure, and deduce solution. Agreement, feedback, self-correction. Praising.

Y8	UNIT 3 ***Pythagoras' Theorem*** Lesson Plan 3	*Calculating the Lengths of Other Sides*
Activity		***Notes***
6	**Finding side lengths in other types of triangle** **PB 3.2, Q5**	
6A	T: As you can see, if the triangle is not isosceles and not equilateral, the perpendicular height will not divide the base into two equal parts. However, we do get two right-angled triangles when we divide a scalene triangle in this way. T: So, use Pythagoras' Theorem to find PQ and QS and hence to calculate the perimeter if this triangle.	T sketches the figure on BB.
	P_1: $QS^2 = 3^2 + 4^2$ $QS = 5$ m, because it's one of the Pythagorean triples P_2: $PQ^2 = 3^2 + 3.5^2$ $PQ^2 = 9 + 12.25$ $PQ^2 = 21.25$ $PQ^2 = \sqrt{21.25}$ $PQ \approx 4.6$ m, correct to 1 d.p.	Whole class activity. Two slower Ps are asked to deduce the lengths of the unknown sides at BB. T encourages P_1 to apply knowledge about Pythagorean triples by using them in the calculations.
	P_3: $P \approx 4.6$ m $+ 7.5$ m $+ 5$ m $= 17.1$ m	Agreement. Praising.
6B	**PB 3.3, Q9** P_1: $XZ^2 + 4^2 = 5^2$ $XZ^2 = 3$ m (Pythagorean triple) P_2: $YZ^2 + XZ^2 = 4^2$ $YZ^2 + 9 = 16$ $YZ^2 = 7$ $YZ = \sqrt{7}$ m ≈ 2.6 m, correct to 1 d.p.	Individual work. Before starting T leads a short discussion on how to get the missing section of the framework. Then T monitors and helps Ps. Checking at BB: T sketches the figure on BB, volunteer Ps come out and show solution as previously agreed. T can also point out the possible misconception of using Pythagorean triples for the XYZ triangle. (The known sides are 3 m and 4 m but the unknown side is not 5 m, as the hypotenuse, the longest side, is 4 m.)
	45 mins	
	Set homework **PB 3.3, Q1 (c)** **PB 3.3, Q2 (b)** **PB 3.3, Q5**	

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 4	*Problems in Context*
Activity		***Notes***
1	**Checking homework** **PB 3.3, Q1 (c)** 60 cm **PB 3.3, Q2 (b)** 6.6 cm **PB 3.3, Q5** 7.4 cm, correct to 1 d.p. *4 mins*	Verbal checking with questions: - What equation have you written using Pythagoras' Theorem? - What was the result? Agreement, feedback, self-correction. Praising.
2	**Problems in context** T: So far, we've always looked at a figure and been able to find the right-angled triangle in it using Pythagoras' Theorem. Today we don't have a figure to look at. You will have to imagine and draw the figure from the problem given. Let's start with something familiar ... T: [Calculate the area of the equilateral triangle with sides of length 6 cm.]	T reads out task - it can also appear on OHP.
	T: How do we calculate the area of a triangle? P_1: Area $= \frac{1}{2} \times$ base $\times$ perpendicular height. T: Have we got all the data we need? What's missing? P_2: The perpendicular height.	Whole class activity. T asks, Ps volunteer, answer and/or come to BB to draw or deduce solution.
	T: Who'd like to draw an equilateral triangle with the perpendicular height marked on it?	P_3 draws, writes data onto the figure.
	T: From now on, this is similar to the work you have just done. T: Who'd like to show a right-angled triangle in the figure and write down the equation using Pythagoras' Theorem? P_4 (at BB): $h^2 + 3^2 = 6^2$ T: Deduce the length of the height. P_4: $h^2 + 9 = 36$ $h^2 = 27$ $h = \sqrt{27} = 5.196 \approx 5.2$ cm, correct to 1 d.p.	Praising.
	T: And the area? P_5 (at BB): $A = \frac{1}{2} \times b \times h$ $A = \frac{1}{2} \times 6 \times 5.196$ cm^2 $A = 3 \times 5.196$ cm^2 $A \approx 15.6$ cm^2, correct to 1 d.p. *10 mins*	T encourages P_5 to calculate mentally. Praising.

Y8 UNIT 3 *Pythagoras' Theorem* Lesson Plan 4 *Problems in Context*

Activity		***Notes***
3	**Individual work finding areas of rectangles using triangles** What is the area of the rectangle with width 8 cm and a diagonal of 11 cm? Give your answer correct to 2 decimal places. Ps (dictate, T writes): $A = a \times b$, 'b' is missing. $a^2 + b^2 = d^2$ $8^2 + b^2 = 11^2$ $b^2 = 11^2 - 8^2$ $b^2 = 57$ $b = \sqrt{57} \approx 7.55$ (cm), correct to 2 d.p. $A = 8 \times 7.55$ cm^2 $A = 60.4$ cm^2 *17 mins*	Individual work. Task appears on OHP or BB. T monitors Ps' work, helps struggling Ps to draw the figure, write down equation and recall the formula for the area of a rectangle. Checking at BB: T draws figure on BB, makes Ps dictate solution and writes it on BB. Agreement, feedback, self-correction. Praising.
4	**Drawing and calculating to solve problems** T: You've had to draw the figures for the last two problems, but the method has been familiar to you. Let's look at some new types of problems. **OS 3.7** T: Are these numbers easy to work with? Will you be able to work out h in your head? Let's start. What do we do first? P_1: We have to write down the equation using Pythagoras' Theorem. T: Can you say it, please; we won't write it down. P_2: $h^2 + 2^2 = 6^2$ T: And the next step? P_2: $h^2 = 6^2 - 2^2 = 32$ T: Finally? P_4: We have to find the square root. T (to all Ps): Use your calculators to do this. Ps: 5.7 m, correct to 1 decimal place. *23 mins*	OS 3.7 appears on OHP, but T covers the figure and encourages Ps to draw the problem in their Ex.Bs. Then a volunteer P draws figure on BB and other Ps agree or not. T uncovers figure on OS and Ps can check (correct) their work. Finally Ps calculate h mentally, led by T. Praising.
5	**Individual work** T: Try this on your own. **OS 3.8** T (writes on OS): $d^2 = 300^2 + 100^2$ $d \approx 316.2$ m *30 mins*	Individual work. OS 3.8 appears on OHP with compass rose and wording showing, but with diagram covered. T monitors Ps' work, helping struggling ones to draw the ship's journey. Checking at OHP: T uncovers the figure, writes equation and result on OS. Feedback, self-correction. Praising.

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 4	*Problems in Context*
Activity		***Notes***
6	**Discussing problems** **PB 3.4, Q8-10** *39 mins*	Whole class activity. T points to Ps to read out the questions PB 3.4, Q8-10, asks Ps to say what is required and then, after discussion, asks Ps to draw suitable figures on BB, one problem at a time. At this stage, no solution is required. Praising.
7	**Mental work to 'wind down'** T: You've had to think a lot during this lesson. You can relax now, and finish with some questions you will probably find quite easy. **M 3.2** *45 mins*	T asks, points to a P, P answers, T agrees/waits for correction and then praises, question by question.
	Set homework **PB 3.4, Q3** **PB 3.4, Q8** **PB 3.4, Q10**	T tells Ps that they will each need a ruler, a pair of compasses and a protractor for the next lesson.
	28 mins	

Y8	UNIT 3 ***Pythagoras' Theorem*** Lesson Plan 5	*Constructions and More Problems in Context*
Activity		***Notes***
1	**Checking homework** **PB 3.4, Q3** 25 m **PB 2.4, Q3** 9.17 m, to nearest cm **PB 2.4, Q4** 7.13 m, to nearest cm *4 mins*	T has asked three Ps to draw and write solutions on BB (one task for each P) as soon as Ps arrive. Self-correction, agreement. Praising.
2	**Does the triangle contain a right angle?** T: We've seen that the formula for Pythagoras' Theorem is useful for deciding whether or not a triangle is right-angled. We saw that c^2 can be greater or smaller than $a^2 + b^2$ and we have also looked at its connection with the type of angle opposite *c*.	
2A	T: Let's look at these triangles. **PB 3.5, page 60, Example 2** T (looking at the triangles on OHP): When you look at them quickly they all seem to be right-angled. Let's check if the formula is true.	Whole class activity. The figures from p60 of PB Y8A appear on OHP.
	P_1: $a^2 + b^2 = 25 + 144 = 169$ $c^2 = 169$ $c^2 = a^2 + b^2$, so the triangle is right-angled P_2: $a^2 + b^2 = 36 + 49 = 85$ $c^2 = 64$ $c^2 < a^2 + b^2$, so the triangle is *not* right-angled P_3: $a^2 + b^2 = 36 + 121 = 157$ $c^2 = 196$ $c^2 > a^2 + b^2$, so the triangle is *not* right-angled	Three volunteer Ps come to BB at the same time to work through the calculations and compare c^2 with $a^2 + b^2$. Other Ps listen and correct if necessary. Praising.
2B	T: So, figures (b) and (c) on OS are deceptive. Let's construct all three of the triangles and see what types they are. *15 mins*	Individual work. In Lesson 2, Ps recalled how to construct a triangle, given all its sides. Now T monitors and helps slower ones to use their equipment. Then T and Ps discuss connection raised at beginning of Activity 2 (see top of p59 in PB Y8A).
3	**Types of angles in triangles** **PB 3.5, Q3** P_1: $a^2 + b^2 = 100 + 121 = 221$ $c^2 = 196$ $c^2 < a^2 + b^2 \rightarrow$ the triangle has three acute angles P_2: $a^2 + b^2 = 100 + 144 = 244$ $c^2 = 256$ $c^2 > a^2 + b^2 \rightarrow$ the triangle contains an obtuse angle	Individual work, monitored, helped. Checking at BB: three volunteer Ps work at the same time to show if each triangle is right-angled, contains an obtuse angle, or has three acute angles. Agreement, feedback, self-correction. Praising.
(continued)		

Y8 UNIT 3 *Pythagoras' Theorem* Lesson Plan 5

Constructions and More Problems in Context

Activity		**Notes**
3 *(continued)*	P_3: $a^2 + b^2 = 81 + 144 = 225$ $c^2 = 225$ $c^2 = a^2 + b^2 \rightarrow$ the triangle is right-angled	

23 mins

4

More problems in context

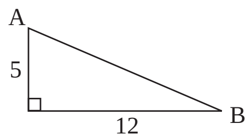
1. What is the distance between point A (–3, 5) and point B (9, 0) in a coordinate system?
2. A rope is 2001 m long. Its two ends are pegged to two points 2000 m apart on level ground. The midpoint of the rope is raised until the rope is pulled tight. How high is its midpoint above the ground? (Make an estimate first; after finding the solution, check it with your estimate.)
3. On a map, the distance between the beginning and the end of a straight road with a constant gradient is 2 cm. What is the height difference (the slope of the road) between the start and the end points, if the map was drawn to a scale of 1 : 100 000, and the length of the road in reality is 2.5 m more than the length you can read from the map?
4. Using 3 pegs stuck in the ground and a loop of rope with 12 knots in it, equal distances apart , the ancient Egyptians could mark out right angles. Show and explain how they might have done this.

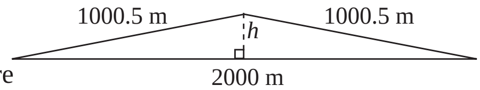
Solutions

1. The distance between the two points in the x direction is 12 units, and in the y direction, 5 units.

   $d^2 = 12^2 + 5^2$

   $d = 13$ units

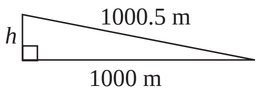


2. 

   From half of the figure

   $h^2 + 1000^2 = 1000.5^2$

   $h \approx 31.6$ m, correct to 1 d.p.



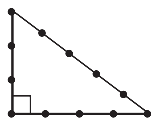
   (The actual result will probably be much more than Ps' estimation.)

3. 2 cm on the map $\rightarrow$ 200 000 cm $=$ 2000 m in reality.
   The length of the road is 2002.5 m.
   If h marks the height difference,

   $h^2 + 2000^2 = 2002.5^2$

   $h \approx 100.03$ m correct to 2 d.p.

4. 12 is the sum of the members of the smallest Pythagorean triple ...



45 mins

Notes

Team work. T divides class into four mixed-ability teams, each containing at least one stronger P to help the others understand the problems.
Each pair of Ps in a team has a copy of the four problems, and they work together in their groups, writing answers in Ex.Bs.
T monitors discussions and calculations.

T prepares a 4×4 scoring grid (for 4 teams and 4 questions) on BB (or OHP) while Ps work on Q1. Each questions is worth two points, awarded if all the team's members have the correct answer in their Ex.Bs.

Teams can be awarded an extra point:

- each question is answered at BB by a P from a different team. That team will be awarded an extra point if the team member explains the solution clearly (i.e. each team member must understand the solutions in case they are asked to give answers at BB).

T interrupts the work when all teams have finished Q1: points to a slower P from a team to draw the figure and explain and write down the formula of Pythagoras' Theorem and give the result. This process is repeated for the other three questions.

Finally, T gives the results of the competition (maximum of 9 points per group), praises and, maybe, gives winning team a prize.

Y8	**UNIT 3** ***Pythagoras' Theorem*** Lesson Plan 5	*Constructions and More Problems in Context*
Activity		***Notes***
	Set homework **PB 3.4, Q1** **PB 3.4, Q2** **PB 3.5, Q6** **PB 3.5, Q7**	