

Pythagoras

Foundation and Higher tiers

Total marks: 65

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	Find the hypotenuse	G20	Common	3	No	2
2	Is a triangle right-angled?	G20	Common	4	No	2
3	Distance between two points	G20	Common	5	No	3
4	Pythagoras in a rhombus	G20	Common	5	No	3
5	Exact lengths with surds	G20 N8	Higher	6	No	3
6	Pythagoras in reverse on coordinates	G20	Common	6	No	3
7	Pythagoras with algebra	G20 A18 A4	Common	7	No	5
8	Pythagoras with algebra: show that	G20 G9	Common	8	No	4
9	Pyramid from its volume and an exact angle	G20 G21 G17 N8	Higher	9	No	5
10	Find a shorter side	G20	Common	4	Yes	3
11	Pythagoras in context: an isosceles triangle	G20	Common	5	Yes	3
12	Pythagoras in context: a decision	G20	Common	5	Yes	3
13	Two right-angled triangles	G20	Common	5	Yes	3
14	Pythagoras with a ratio and a unit change	G20 N13	Common	6	Yes	4
15	Pythagoras in 3D: height of a pyramid	G20	Higher	7	Yes	4
16	Pythagoras in 3D: a wedge	G20	Higher	7	Yes	4

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Pythagoras in 3D, in reverse	G20	Higher	7	Yes	3
18	Shortest route over a cuboid	G20	Higher	8	Yes	3
19	Pythagoras in a circle: a decision	G20 G9	Higher	9	Yes	5
	Total					65

Question 1 G20 · Common · Grade 3 · 2 marks

Q	Answer	Mark	Comments
1	$15^2 + 8^2$ or $225 + 64$ or 289	M1	
	17	A1	

Question 2 G20 · Common · Grade 4 · 2 marks

Q	Answer	Mark	Comments
2	$9^2 + 12^2 = 225$ and $16^2 = 256$	M1	or $\sqrt{225} = 15$
	No with 225 and 256 or 15 and 16	A1	

Question 3 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
3	$5 - -3$ or 8 or $8 - 2$ or 6	M1	the horizontal or vertical distance
	$8^2 + 6^2$ or 100	M1	oe
	10	A1	

Question 4 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
4	half diagonals 9 and 12	M1	may be on the diagram
	$9^2 + 12^2$ or 225 or side = 15	M1	oe
	60	A1	

Question 5 G20 N8 · Higher · Grade 6 · 3 marks

Q	Answer	Mark	Comments
5	$6^2 + 3^2$ or 45	M1	oe
	$\sqrt{45}$	M1	oe, or $\sqrt{9} \times \sqrt{5}$
	$3\sqrt{5}$	A1	

Question 6 G20 · Common · Grade 6 · 3 marks

Q	Answer	Mark	Comments
6	$20^2 + (k - 1)^2 = 29^2$	M1	oe, the horizontal distance 20 used with 29
	$(k - 1)^2 = 441$ or $k - 1 = 21$	M1	oe, a vertical distance of 21
	-20 and 22	A1	

Question 7 G20 A18 A4 · Common · Grade 7 · 5 marks

Q	Answer	Mark	Comments
7(a)	$x^2 + (x + 17)^2 = (x + 18)^2$	M1	oe
	$x^2 + 34x + 289$ or $x^2 + 36x + 324$	M1	one bracket expanded correctly
	$2x^2 + 34x + 289 = x^2 + 36x + 324$ leading to $x^2 - 2x - 35 = 0$	A1	with no errors
7(b)	$(x - 7)(x + 5)$ or $x = 7$	M1	oe
	56	A1	

Question 8 G20 G9 · Common · Grade 8 · 4 marks

Q	Answer	Mark	Comments
8	OQ = $\frac{1}{2}x$ where x is the side of the square	M1	oe, O is the midpoint of PQ by symmetry
	$(\frac{1}{2}x)^2 + x^2 = 10^2$	M1	oe, Pythagoras in triangle OQR
	$\frac{5}{4}x^2 = 100$	M1	oe, collects the terms in x^2
	$x^2 = 80$ so the area is 80 cm^2	A1	a complete method with no errors

Question 9 G20 G21 G17 N8 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
9	AM = $\frac{x\sqrt{2}}{2}$ or $\frac{x}{\sqrt{2}}$	M1	oe, x the length of a side of the base, or AC = $x\sqrt{2}$
	VM = their AM $\times \tan 60$ or $\frac{x\sqrt{2}}{2} \times \sqrt{3}$	M1	oe, VM = $\frac{x\sqrt{6}}{2}$
	$\frac{1}{3} \times x^2 \times \text{their } \frac{x\sqrt{6}}{2} = 36\sqrt{6}$	M1	oe, leading to $x^3 = 216$
	$x = 6$	A1	
	$6\sqrt{2}$	A1	accept $\sqrt{72}$. From VA = $2 \times \text{AM}$ ($\cos 60 = \frac{1}{2}$) or $VA^2 = AM^2 + VM^2 = 18 + 54$

Question 10 G20 · Common · Grade 4 · 3 marks

Q	Answer	Mark	Comments
10	$27.9^2 - 15.2^2$	M1	oe, 547.37
	$\sqrt{(27.9^2 - 15.2^2)}$	M1	oe
	23.4	A1	accept 23.4 or [23.39, 23.40]

Question 11 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
11	$9.6 \div 2$ or 4.8	M1	
	$6.2^2 - 4.8^2$ or 15.4	M1	oe
	3.9	A1	accept 3.9 or [3.92, 3.93]

Question 12 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
12	$1.9^2 + 1.2^2$ or 5.05	M1	oe
	$\sqrt{5.05}$ or 2.247...	M1	the diagonal of the doorway
	Yes and 2.247...	A1	

Question 13 G20 · Common · Grade 5 · 3 marks

Q	Answer	Mark	Comments
13	$9^2 + 12^2$ or PR = 15	M1	oe
	their $15^2 + 8.4^2$ or 295.56	M1	oe
	17.2	A1	accept 17.2 or [17.19, 17.20]

Question 14 G20 N13 · Common · Grade 6 · 4 marks

Q	Answer	Mark	Comments
14	$16^2 + 9^2$ or 337 or $\sqrt{337}$	M1	oe, the diagonal of a 16 by 9 rectangle
	$55 \div \sqrt{337}$ or 2.996...	M1	oe, the length of one part in inches, or $55 \times \frac{16}{\sqrt{337}} = 47.94...$
	$\times 2.54$	M1	at any stage
	121.8	A1	accept 121.8 or [121.75, 121.76]

Question 15 G20 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
15	$AC^2 = 8^2 + 8^2$ or $AC = \sqrt{128}$	M1	oe, AC = 11.31...
	$AM = \frac{1}{2} \times \text{their } AC$	M1	oe, 5.66...
	$10^2 - \text{their } AM^2$	M1	oe, 68
	8.2	A1	accept 8.2 or [8.24, 8.25]

Question 16 G20 · Higher · Grade 7 · 4 marks

Q	Answer	Mark	Comments
16	$9^2 + 3.5^2$ or $BE = \sqrt{93.25}$	M1	oe, or $9^2 + 3^2$ for the distance from B to the point below M
	$EM = 3$	M1	
	their $BE^2 + 3^2$ or 102.25	M1	oe, or $9^2 + 3^2 + 3.5^2$
	10.1	A1	accept 10.1 or [10.11, 10.12]

Question 17 G20 · Higher · Grade 7 · 3 marks

Q	Answer	Mark	Comments
17	$45^2 + 30^2$ or 2925	M1	oe, the diagonal of the base squared
	$62^2 - 2925$ or 919	M1	oe, or $62^2 - 45^2 - 30^2$
	30.3	A1	accept 30.3 or [30.31, 30.32]

Question 18 G20 · Higher · Grade 8 · 3 marks

Q	Answer	Mark	Comments
18	the two faces opened out flat into one rectangle 6 by 7	M1	oe, a net or sketch with 3 + 4
	$6^2 + (3 + 4)^2$ or $\sqrt{85}$	M1	oe
	9.2	A1	accept 9.2 or [9.21, 9.22]

Question 19 G20 G9 · Higher · Grade 9 · 5 marks

Q	Answer	Mark	Comments
19	$(5.1 - r)^2 + 3.6^2 = r^2$	M1	oe, Pythagoras with the radius and the centre below the top
	$r = 3.821...$	A1	
	$\sqrt{(r^2 - 1.7^2)}$ or 3.422...	M1	oe, ft their r , the height above the centre 1.7 m from the middle
	their 3.42... + (5.1 - their r)	M1	oe, the height of the tunnel above the edge of the lorry
	No and 4.701...	A1	compared with 4.75