MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
23	35 minutes	2

Name: ..... Class: .....

Date: .....

MARK ____ / 23

INSTRUCTIONS AND INFORMATION

1. Answer **ALL** the questions in this question paper.
2. Answer QUESTION 1 by **circling** the letter (A–D) in the answer grid at the end of that section.
3. Show **ALL** calculations clearly.
4. Show all units where applicable.
5. Number the answers correctly according to the numbering system used in this question paper.
6. A non-programmable calculator may be used, unless stated otherwise.
7. Write neatly and legibly.

QUESTION 1 [10 MARKS]

Four options are given as possible answers to the following questions. Choose the correct answer and circle the letter (A–D) in the grid at the end of this section. If you want to change your choice, put a cross through the wrong letter and circle your new choice.

1.1 In a three-dimensional problem, the usual first step is to ... (1)

A) work only in the vertical triangle
B) assume every triangle is right-angled
C) use the area rule immediately
D) **find a triangle lying in a single plane and solve that one first** ✓

> **Answer: D** — A 3D figure is solved by chaining 2D triangles together, starting with the one carrying the most information.
> - **A** — the horizontal triangle usually carries the given angles
> - **B** — most of the triangles in a 3D problem are NOT right-angled
> - **C** — the area rule is used only when an area is asked for

1.2 A vertical pole PQ stands at Q on level ground. From R on the ground the angle of elevation of P is 32°, and QR = 40 m. The pole is ... tall. (1)

A) 47,17 m
B) 64,01 m
C) **24,99 m** ✓
D) 21,20 m

> **Answer: C** — PQ = QR tan 32° = 40 tan 32° = 24,99 m.
> - **A** — used 40 ÷ cos 32°, which gives the line of sight RP
> - **B** — DIVIDED 40 by tan 32° instead of multiplying
> - **D** — used 40 sin 32°, but 40 m is the horizontal distance, not the slope length

1.3 A vertical pole PQ stands at Q on level ground, with R another point on the ground. The angle of ELEVATION of P from R is ... (1)

A) **$P\hat{R}Q$** ✓
B) the angle between PQ and the vertical
C) $P\hat{Q}R$
D) $Q\hat{P}R$

> **Answer: A** — The angle of elevation is measured at the OBSERVER, R, between the horizontal RQ and the line of sight RP.
>
> - **B** — PQ is itself vertical, so that angle is $0°$
> - **C** — $P\hat{Q}R$ is the right angle at the foot of the pole
> - **D** — $Q\hat{P}R$ is at the TOP of the pole, not at the observer

1.4 In $\triangle ABC$, $AB = 12$, $\hat{A} = 50°$ and $\hat{B} = 70°$. Then BC = ... (1)

A) 13,02
B) **10,61** ✓
C) 9,19
D) 13,57

> **Answer: B** — $\hat{C} = 60°$, and $BC \div \sin A = AB \div \sin C$ gives $BC = 12 \sin 50° \div \sin 60°$.
>
> - **A** — used $\sin 70°$ — but BC lies opposite $\hat{A}$, which is $50°$
> - **C** — used $12 \sin 50°$ without dividing by $\sin 60°$
> - **D** — inverted the ratio

1.5 To find the DISTANCE between the feet of two vertical poles, you solve ... (1)

A) Pythagoras in a vertical plane
B) **the horizontal triangle joining the two bases** ✓
C) either vertical triangle on its own
D) the area rule

> **Answer: B** — The two bases and the observer all lie in the horizontal plane, so that is the triangle to solve.
>
> - **A** — Pythagoras in a vertical plane gives a slope length
> - **C** — a vertical triangle gives a height, not the distance between the bases
> - **D** — the area rule finds an area, not a distance

1.6 The COSINE rule is needed in a 3D problem when ... (1)

A) two angles and a side are known
B) the triangle is right-angled
C) **two sides and the angle between them are known** ✓
D) only the angles are known

> **Answer: C** — That is the cosine rule's standard case, in three dimensions just as in two.
>
> - **A** — that is the sine rule's case
> - **B** — a right angle needs only Pythagoras and the basic ratios
> - **D** — angles alone never fix a length

1.7 Two vertical poles of EQUAL height stand at A and B. From a point P on the ground the angles of elevation of both tops are equal. This means ... (1)

A) **PA = PB** ✓
B) AB equals the poles' height
C) PA equals the poles' height
D) the poles lean towards each other

> **Answer: A** — With equal heights, equal angles of elevation force equal horizontal distances.
>
> - **B** — the distance AB is not fixed by the equal angles
> - **C** — PA equals the height only if the angle happens to be $45°$
> - **D** — the poles are vertical by definition

1.8 From a point A on level ground, 30 m from the base of a tower, the angle of elevation of the top is 55°. The tower is ... tall. (1)

A) 24,57 m
B) 52,30 m
C) 21,01 m
D) 42,84 m ✓

> **Answer: D** — Height = 30 tan 55° = 42,84 m.
> - **A** — used 30 sin 55°, but 30 m is the horizontal distance
> - **B** — used 30 ÷ cos 55°, which gives the line of sight
> - **C** — DIVIDED 30 by tan 55° instead of multiplying

1.9 The angle between a line and a horizontal PLANE is the angle between that line and ... (1)

A) any line lying in the plane
B) the vertical
C) the normal to the plane
D) its projection onto the plane ✓

> **Answer: D** — The angle is measured to the shadow the line casts on the plane.
> - **A** — different lines in the plane give different angles; only the projection is correct
> - **B** — that gives the COMPLEMENT of the angle wanted
> - **C** — the normal is perpendicular to the plane, so it gives the complement

1.10 Why is the SINE rule used more often than SOH-CAH-TOA in 3D problems? (1)

A) the triangles involved are usually not right-angled ✓
B) the sine rule needs no angles at all
C) the sine rule is quicker to write out
D) SOH-CAH-TOA does not work in three dimensions

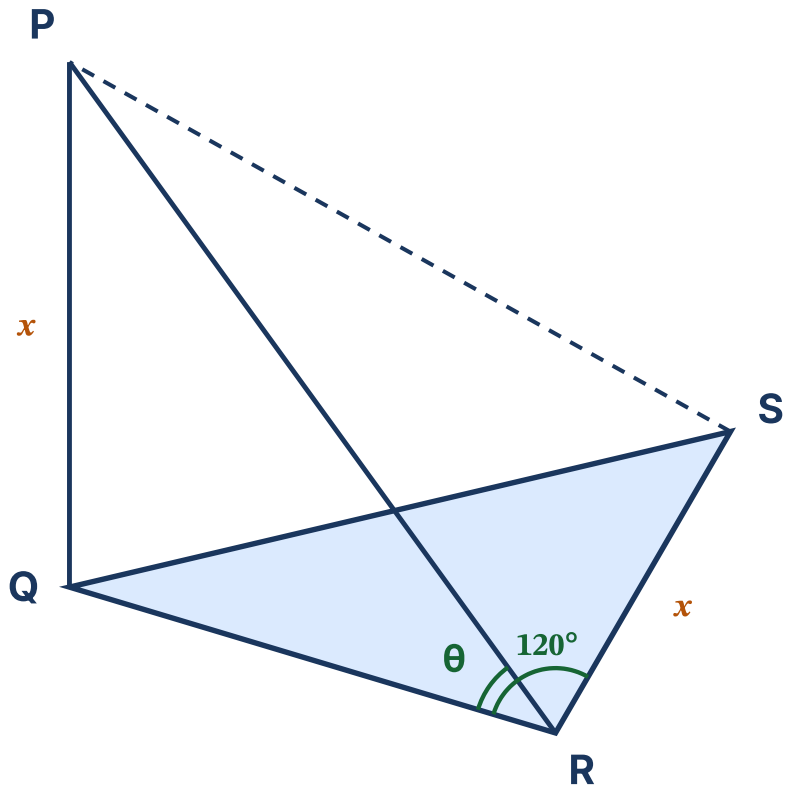
> **Answer: A** — Only the vertical triangle at the foot of a pole is right-angled; the rest are general triangles.
> - **B** — the sine rule needs at least one complete side-and-angle pair
> - **C** — convenience of writing is not a mathematical reason
> - **D** — SOH-CAH-TOA works in any right-angled triangle, in 3D just as in 2D

ANSWER GRID — MARKING GUIDELINE

1.1	A	B	C	(D)
1.2	A	B	(C)	D
1.3	(A)	B	C	D
1.4	A	(B)	C	D
1.5	A	(B)	C	D
1.6	A	B	(C)	D
1.7	(A)	B	C	D
1.8	A	B	C	(D)
1.9	A	B	C	(D)
1.10	(A)	B	C	D

QUESTION 2 **[13 MARKS]**

In the diagram, PQ is a vertical tower. Q, R and S are points in the same horizontal plane. The angle of elevation from R to P is θ, $Q\hat{R}S = 120°$ and PQ = RS = x.



ot drawn to scale — PQ is vertical and Q, R and S lie in one horizontal plan

2.1 Determine QR in terms of θ and x. **(3)**

In $\triangle PQR$, $\tan\theta = \frac{PQ}{QR}$ *(2)*

QR = $\frac{x}{\tan\theta}$ *(1)*

2.2 Explain which rule must be used to find QS, and why. **(2)**

The **cosine rule** *(1)* — two sides and the INCLUDED angle (120°) are known *(1)*

2.3 If $x = 15$ cm and $\theta = 22°$, calculate the length of QS, correct to TWO decimal places. **(5)**

$QR = \frac{15}{\tan 22°} = 37{,}13$ cm *(2)*

$QS^2 = QR^2 + RS^2 - 2(QR)(RS)\cos 120°$ *(2)*

QS = **46,48 cm** *(1)*

2.4 Hence calculate the size of $Q\hat{P}S$, correct to TWO decimal places. **(3)**

PQ ⊥ the horizontal plane, so $\triangle PQS$ is right-angled at Q *(1)*

$\tan Q\hat{P}S = \frac{46{,}48}{15}$ *(1)* = **72,11°** *(1)*

TOTAL: 23 marks

This question paper consists of 2 questions.

© Danemathics — free to print and share for classroom use.