Unit 11 · Construction

HARDER WORKSHEET · ANSWER KEY

Full marks 20

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Five sides into three

ANSWER HA · 4

Construct the rectangle (right angles at A and B) and D from arcs of 4 cm from C and E.
Remove C: draw the diagonal BD, and through C a line parallel to it, meeting AB produced at F. $AFDE$ has the area of $ABCDE$ ($\triangle BCD = \triangle BFD$).
Remove E: draw AD, and through E a line parallel to it, meeting BA produced at G. $\triangle GFD$ has the same area ($\triangle AED = \triangle AGD$).
Its area: the rectangle 17.5 cm^2 and the roof $\tfrac{1}{2} \times 5 \times \sqrt{4^2 - 2.5^2} \approx 7.81$ cm^2, so **about 25.3 cm^2**; $\tfrac{1}{2} \times GF \times$ height measured should come close.

MARKING SCHEME

- ✓ The figure $ABCDE$ correctly constructed.
- ✓ One corner removed with a line parallel to a diagonal.
- ✓ The second corner removed, giving the triangle.
- ✓ Its area measured and found, about 25.3 cm^2.

2 Spot the error

MARKING SCHEME U · 3

- ✓ On the whole base the parallelogram is twice the triangle.
- ✓ Bisect BC at its midpoint M.
- ✓ Build the parallelogram on BM.

3 Work backwards

ANSWER A · 3

The triangle stands on twice the parallelogram's base, so $BC = 10 \div 2 =$ **5 cm**.
$BC \times h = 24$, so $h =$ **4.8 cm**. Check: $\tfrac{1}{2} \times 10 \times 4.8 = 24$. ✓

MARKING SCHEME

- ✓ $BE = 2BC$, so $BC = 5$ cm.
- ✓ $h = 24 \div 5$.
- ✓ 4.8 cm.

4 In a real setting

ANSWER A · 4

Construct $\triangle ABC$ from its three sides, then D from arcs of 4.5 cm from A and 4 cm from C. Through D draw a line parallel to AC, meeting BA produced at E: $\triangle EBC$ has the area of $ABCD$.
Measure the base EB and the height from C to it; $\tfrac{1}{2} \times$ base $\times$ height is **about 23.1 cm^2** on the paper.
Each square centimeter stands for 10 m $\times$ 10 m = 100 m^2, so the plot is **about 2,310 m^2**. (Exactly, by Heron's formula on the two triangles, 14.70 + 8.42 = 23.11 cm^2.)

MARKING SCHEME

- ✓ $ABCD$ correctly constructed.
- ✓ The triangle of the same area.
- ✓ Its area on paper, about 23 cm^2.
- ✓ $\times$ 100: about 2,300 m^2.

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5 Is the claim true?

ANSWER HA · 2

No. D must lie on the line through A parallel to BC, and no point of that line is closer to B than the height of $\triangle ABC$. An arc from B shorter than the height doesn't reach the line.

MARKING SCHEME

- ✓ D must lie on the parallel line.
- ✓ So DB can't be less than the height.

6 Make your own

ANSWER HA · 2

Draw the rectangle $ABCD$ and produce AB to E with $BE = AB$, so $AE = 12$ cm; produce DC. Draw the perpendicular bisector of AE: where it meets DC produced is the top F. $FA = FE$, and $\triangle AEF$ has twice the base between the same parallels: 24 cm^2.

MARKING SCHEME

- ✓ The base doubled, $AE = 12$ cm, the top on the line DC.
- ✓ The top on the perpendicular bisector of AE, so the triangle is isosceles.

7 Think

ANSWER HA · 2

No. In 1882 Lindemann proved that π is a transcendental number, which means no ruler-and-compass construction can give a square with exactly a circle's area ("squaring the circle" is impossible).

MARKING SCHEME

- ✓ No, it can't be done.
- ✓ Lindemann, 1882: π is transcendental.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	0	3	7	10	**20**

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