nexamind EDUCATION

Name _____ Date _____

14.6 Enlargement — worked answers

Enlarge shapes by a positive integer scale factor about a centre, identify an enlargement, and understand that the image is mathematically similar to the object. · 58 questions

A · Fluency — Multiply by the scale factor, and see what it does.

1 Enlarge the point (2, 3) by scale factor 2, centre the origin.

Answer: (4, 6)

Multiply both coordinates by 2: 2 × 2 = 4 and 3 × 2 = 6, giving (4, 6).

2 Enlarge the point (1, 4) by scale factor 3, centre the origin.

Answer: (3, 12)

Multiply both coordinates by 3: 1 × 3 = 3 and 4 × 3 = 12, giving (3, 12).

3 Enlarge the point (3, 1) by scale factor 2, centre the origin.

Answer: (6, 2)

Multiply both coordinates by 2: 3 × 2 = 6 and 1 × 2 = 2, giving (6, 2).

4 Enlarge the point (−2, 1) by scale factor 3, centre the origin.

Answer: (−6, 3)

Multiply both coordinates by 3: −2 × 3 = −6 and 1 × 3 = 3, giving (−6, 3).

5 Enlarge the point (2, −3) by scale factor 2, centre the origin.

Answer: (4, −6)

Multiply both coordinates by 2: 2 × 2 = 4 and −3 × 2 = −6, giving (4, −6).

6 Enlarge the point (−1, −2) by scale factor 4, centre the origin.

Answer: (−4, −8)

Multiply both coordinates by 4: −1 × 4 = −4 and −2 × 4 = −8, giving (−4, −8).

7 Enlarge the point (4, 2) by scale factor 2, centre the origin.

Answer: (8, 4)

Multiply both coordinates by 2: 4 × 2 = 8 and 2 × 2 = 4, giving (8, 4).

8 Enlarge the point (1, 1) by scale factor 5, centre the origin.

Answer: (5, 5)

Multiply both coordinates by 5: 1 × 5 = 5 and 1 × 5 = 5, giving (5, 5).

9 Enlarge the point (−3, 2) by scale factor 2, centre the origin.

Answer: (−6, 4)

Multiply both coordinates by 2: −3 × 2 = −6 and 2 × 2 = 4, giving (−6, 4).

10 Enlarge the point (2, 2) by scale factor 3, centre the origin.

Answer: (6, 6)

Multiply both coordinates by 3: 2 × 3 = 6 and 2 × 3 = 6, giving (6, 6).

11 A square has sides of 3 cm. It is enlarged by scale factor 2. How long is each side of the image, in centimetres?

Answer: 6

Every length is multiplied by the scale factor: 3 × 2 = 6 cm.

12 A square has sides of 5 cm. It is enlarged by scale factor 2. How long is each side of the image, in centimetres?

Answer: 10

Every length is multiplied by the scale factor: 5 × 2 = 10 cm.

13 A square has sides of 4 cm. It is enlarged by scale factor 3. How long is each side of the image, in centimetres?

Answer: 12

Every length is multiplied by the scale factor: 4 × 3 = 12 cm.

14 A square has sides of 2 cm. It is enlarged by scale factor 4. How long is each side of the image, in centimetres?

Answer: 8

Every length is multiplied by the scale factor: 2 × 4 = 8 cm.

15 A square has sides of 6 cm. It is enlarged by scale factor 2. How long is each side of the image, in centimetres?

Answer: 12

Every length is multiplied by the scale factor: 6 × 2 = 12 cm.

16 A square has sides of 3 cm. It is enlarged by scale factor 3. How long is each side of the image, in centimetres?

Answer: 9

Every length is multiplied by the scale factor: 3 × 3 = 9 cm.

17 A square has sides of 10 cm. It is enlarged by scale factor 2. How long is each side of the image, in centimetres?

Answer: 20

Every length is multiplied by the scale factor: 10 × 2 = 20 cm.

18 A square has sides of 7 cm. It is enlarged by scale factor 2. How long is each side of the image, in centimetres?

Answer: 14

Every length is multiplied by the scale factor: 7 × 2 = 14 cm.

19 A square has sides of 3 cm. It is enlarged by scale factor 2. What is the area of the image, in square centimetres?

Answer: 36

The new side is 3 × 2 = 6 cm, so the area is 6 × 6 = 36 cm². Notice that is the old area 9 multiplied by 4, not by 2.

20 A square has sides of 5 cm. It is enlarged by scale factor 2. What is the area of the image, in square centimetres?

Answer: 100

The new side is 5 × 2 = 10 cm, so the area is 10 × 10 = 100 cm². Notice that is the old area 25 multiplied by 4, not by 2.

21 A square has sides of 4 cm. It is enlarged by scale factor 3. What is the area of the image, in square centimetres?

Answer: 144

The new side is 4 × 3 = 12 cm, so the area is 12 × 12 = 144 cm². Notice that is the old area 16 multiplied by 9, not by 3.

22 A square has sides of 2 cm. It is enlarged by scale factor 4. What is the area of the image, in square centimetres?

Answer: 64

The new side is 2 × 4 = 8 cm, so the area is 8 × 8 = 64 cm². Notice that is the old area 4 multiplied by 16, not by 4.

23 A square has sides of 6 cm. It is enlarged by scale factor 2. What is the area of the image, in square centimetres?

Answer: 144

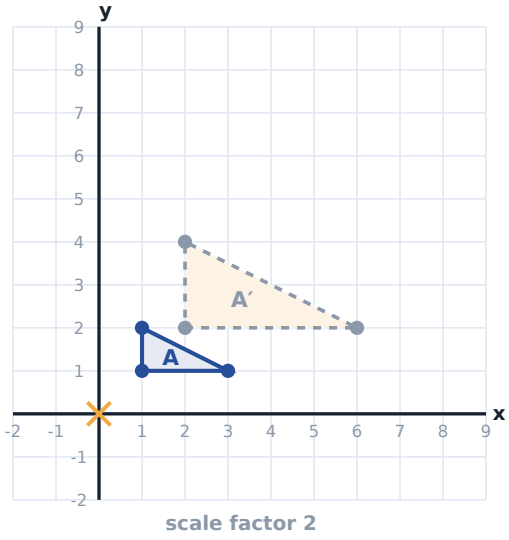
The new side is 6 × 2 = 12 cm, so the area is 12 × 12 = 144 cm². Notice that is the old area 36 multiplied by 4, not by 2.

24 A square has sides of 3 cm. It is enlarged by scale factor 3. What is the area of the image, in square centimetres?

Answer: 81

The new side is 3 × 3 = 9 cm, so the area is 9 × 9 = 81 cm². Notice that is the old area 9 multiplied by 9, not by 3.

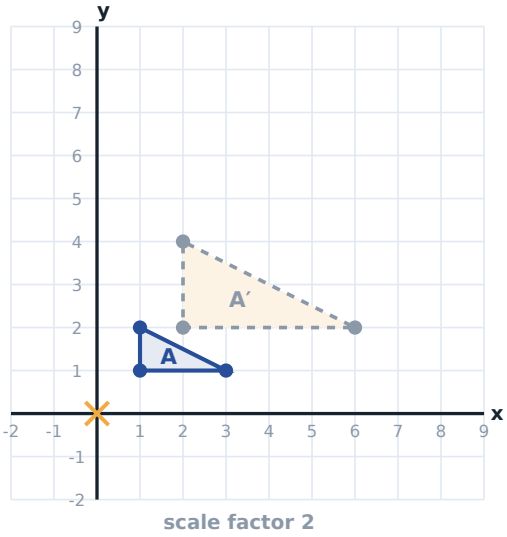
25 Triangle A has vertices (1, 1), (3, 1) and (1, 2). It is enlarged by scale factor 2, centre the origin. Where does (1, 1) go?



Answer: (2, 2)

Multiply both coordinates by 2: (1, 1) → (2, 2). The image is mathematically similar to the object — the same shape, 2 times as large.

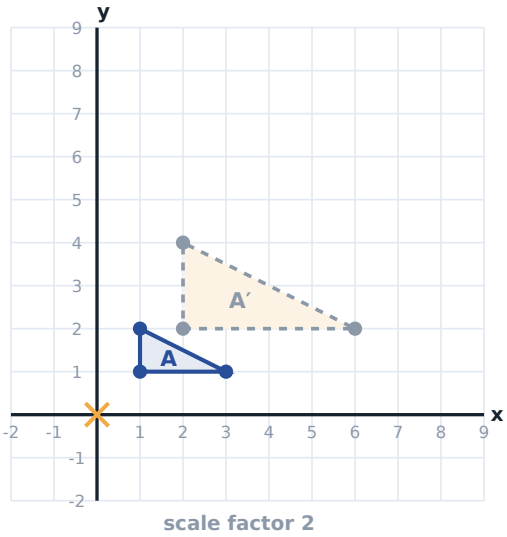
26 Triangle A has vertices (1, 1), (3, 1) and (1, 2). It is enlarged by scale factor 2, centre the origin. Where does (3, 1) go?



Answer: (6, 2)

Multiply both coordinates by 2: (3, 1) → (6, 2). The image is mathematically similar to the object — the same shape, 2 times as large.

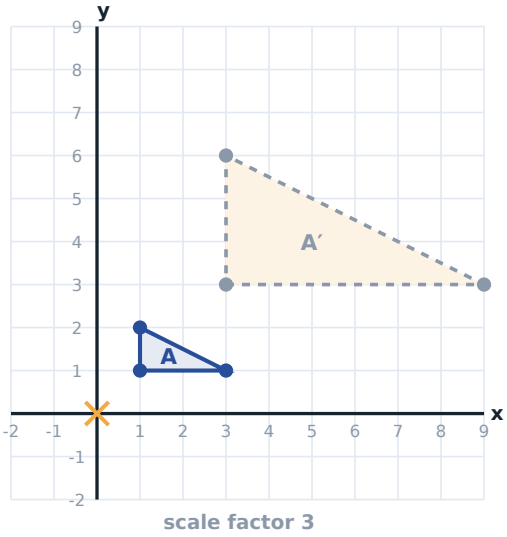
27 Triangle A has vertices (1, 1), (3, 1) and (1, 2). It is enlarged by scale factor 2, centre the origin. Where does (1, 2) go?



Answer: (2, 4)

Multiply both coordinates by 2: (1, 2) → (2, 4). The image is mathematically similar to the object — the same shape, 2 times as large.

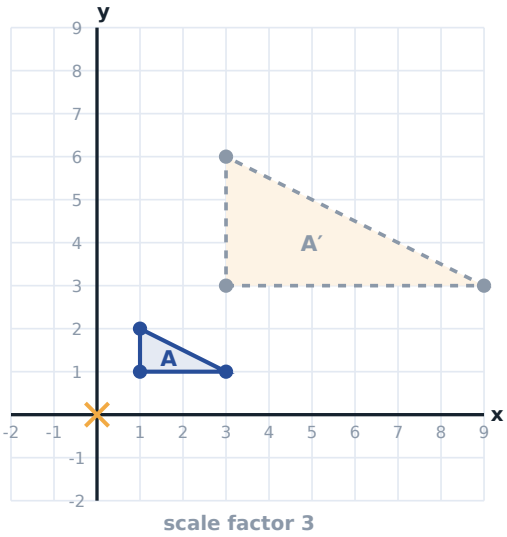
28 Triangle A has vertices (1, 1), (3, 1) and (1, 2). It is enlarged by scale factor 3, centre the origin. Where does (1, 1) go?



Answer: (3, 3)

Multiply both coordinates by 3: (1, 1) → (3, 3). The image is mathematically similar to the object — the same shape, 3 times as large.

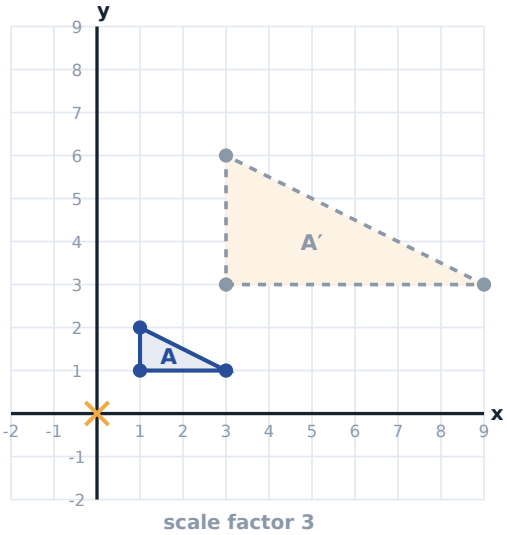
29 Triangle A has vertices (1, 1), (3, 1) and (1, 2). It is enlarged by scale factor 3, centre the origin. Where does (3, 1) go?



Answer: (9, 3)

Multiply both coordinates by 3: (3, 1) → (9, 3). The image is mathematically similar to the object — the same shape, 3 times as large.

30 Triangle A has vertices (1, 1), (3, 1) and (1, 2). It is enlarged by scale factor 3, centre the origin. Where does (1, 2) go?



Answer: (3, 6)
Multiply both coordinates by 3: (1, 2) → (3, 6). The image is mathematically similar to the object — the same shape, 3 times as large.

B · Reasoning — Similar against congruent, and why areas behave differently.

31 After an enlargement with scale factor 3, the image is …

- ☐ congruent to the object
- ☐ mathematically similar to the object
- ☐ a mirror image
- ☐ unchanged

Answer: mathematically similar to the object
Same shape, different size. Congruent would mean the same size too.

32 What happens to the angles in an enlargement?

- ☐ They are multiplied by the scale factor
- ☐ They stay the same
- ☐ They are divided by the scale factor
- ☐ They double

Answer: They stay the same
Only lengths change. If the angles changed, the shape would distort and it would no longer be similar.

33 A shape is enlarged by scale factor 3. Its area is multiplied by …

- ☐ 3
- ☐ 6
- ☐ 9
- ☐ 27

Answer: 9
An area is a length times a length, so it is multiplied by 3 × 3 = 9.

34 A shape is enlarged by scale factor 2. Its perimeter is multiplied by ...

- ☐ 2
- ☐ 4
- ☐ 8
- ☐ It does not change

Answer: 2

A perimeter is a sum of lengths, so it scales like a length, not like an area.

35 Enlarging from the origin by scale factor k does what to the coordinates?

- ☐ adds k
- ☐ multiplies both by k
- ☐ multiplies x only by k
- ☐ subtracts k

Answer: multiplies both by k

(x, y) → (kx, ky). That is the whole rule when the centre is the origin.

36 Does an enlargement with scale factor 1 change the shape?

- ☐ Yes
- ☐ No

Answer: No

Every length is multiplied by 1, so nothing moves. It is the enlargement that does nothing.

37 Which point does not move in an enlargement?

- ☐ The origin always
- ☐ The centre of enlargement
- ☐ Every point moves
- ☐ The first vertex

Answer: The centre of enlargement

Its distance from itself is 0, and 0 × k is still 0.

38 How do you describe an enlargement fully?

- ☐ Give the scale factor only
- ☐ Give the centre only
- ☐ Give the scale factor and the centre
- ☐ Give the direction

Answer: Give the scale factor and the centre

Both are needed, exactly as a rotation needs both an angle and a centre.

39 Is a scale drawing an enlargement?

- ☐ Yes
- ☐ No

Answer: Yes

It is the same idea: every length multiplied by the same number, every angle unchanged. Section 14.2 was doing this already.

40 Two shapes are mathematically similar. That means ...

- ☐ they are identical
- ☐ they have the same shape but possibly different sizes
- ☐ they have the same area
- ☐ they are congruent

Answer: they have the same shape but possibly different sizes

Equal angles, and sides in the same ratio.

C · Challenge — Centres away from the origin, and working backwards.

41 Enlarge the point (3, 2) by scale factor 2, centre (1, 1).

Answer: (5, 3)
The point is 2 across and 1 up from the centre. Multiply that offset by 2: 2 × 2 = 4 across and 1 × 2 = 2 up. Add the centre back on to get (5, 3).

42 Enlarge the point (4, 5) by scale factor 3, centre (2, 3).

Answer: (8, 9)
The point is 2 across and 2 up from the centre. Multiply that offset by 3: 2 × 3 = 6 across and 2 × 3 = 6 up. Add the centre back on to get (8, 9).

43 Enlarge the point (0, 4) by scale factor 2, centre (0, 2).

Answer: (0, 6)
The point is 0 across and 2 up from the centre. Multiply that offset by 2: 0 × 2 = 0 across and 2 × 2 = 4 up. Add the centre back on to get (0, 6).

44 Enlarge the point (5, 1) by scale factor 2, centre (1, 1).

Answer: (9, 1)
The point is 4 across and 0 up from the centre. Multiply that offset by 2: 4 × 2 = 8 across and 0 × 2 = 0 up. Add the centre back on to get (9, 1).

45 Enlarge the point (−1, 3) by scale factor 3, centre (1, 1).

Answer: (−5, 7)
The point is −2 across and 2 up from the centre. Multiply that offset by 3: −2 × 3 = −6 across and 2 × 3 = 6 up. Add the centre back on to get (−5, 7).

46 A rectangle is 4 cm by 6 cm. It is enlarged by scale factor 3. What is the area of the image, in square centimetres?

Answer: 216
The image is 4 × 3 = 12 cm by 6 × 3 = 18 cm, so its area is 12 × 18 = 216 cm². The original area was 4 × 6 = 24 cm², and 24 × 9 = 216 — the area scales by 3 × 3 = 9.

47 A triangle has area 5 cm². It is enlarged by scale factor 4. What is the area of the image, in square centimetres?

Answer: 80
Areas scale by the square of the scale factor: 4 × 4 = 16, and 5 × 16 = 80 cm².

48 A shape has perimeter 14 cm. After an enlargement its perimeter is 42 cm. What was the scale factor?

Answer: 3
A perimeter scales like a length, so 42 ÷ 14 = 3.

49 A photograph 5 cm wide is enlarged so that it is 20 cm wide. By what scale factor?

Answer: 4
20 ÷ 5 = 4.

50 A square of side 3 cm is enlarged by scale factor 5. How many times bigger is the area?

Answer: 25
5 × 5 = 25. The sides go from 3 cm to 15 cm and the area from 9 cm² to 225 cm², and 225 ÷ 9 = 25.

D · Word problems — Photographs, models, rugs and frames.

51 A photograph is 6 cm by 4 cm. It is enlarged by scale factor 3 for a poster. What is the longer side of the poster, in centimetres?

Answer: 18

6 × 3 = 18 cm. The shorter side becomes 4 × 3 = 12 cm.

52 A model house is built at scale factor 25 from a plan. A wall is 8 cm on the plan. How long is the model wall, in centimetres?

Answer: 200

8 × 25 = 200 cm, which is 2 m.

53 A logo has a corner at (2, 3). It is enlarged by scale factor 4 from the origin. Where is that corner now?

Answer: (8, 12)

2 × 4 = 8 and 3 × 4 = 12, so the corner is at (8, 12).

54 A rug measures 2 m by 3 m. A similar rug has been enlarged by scale factor 2. What is its area, in square metres?

Answer: 24

The new rug is 2 × 2 = 4 m by 3 × 2 = 6 m, so the area is 4 × 6 = 24 m². The old area was 2 × 3 = 6 m², and 6 × 4 = 24.

55 A map is redrawn twice as large. A road was 7 cm; how long is it now, in centimetres?

Answer: 14

7 × 2 = 14 cm.

56 A tile design of area 12 cm² is enlarged by scale factor 3. How much larger is the new area, in square centimetres?

Answer: 96

The new area is 12 × 9 = 108 cm², so the increase is 108 − 12 = 96 cm².

57 A pattern point at (1, 2) is enlarged by scale factor 3 from the centre (1, 1). Where does it go?

Answer: (1, 4)

It is 0 across and 2 − 1 = 1 up from the centre. Tripling the offset gives 0 across and 3 up, so the image is at (1, 4).

58 A picture frame is enlarged by scale factor 2. The original used 60 cm of wood. How many centimetres of wood does the new one need?

Answer: 120

The perimeter scales like a length: 60 × 2 = 120 cm.