SHSAT Lesson 4: Measurements and Scales

In this lesson:

Measurements: units, square units, unit conversion.

Definition of scale and scale factor: scale drawings.

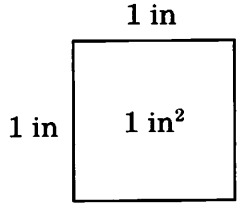
What you must know

Definitions

A scale drawing or model is a resized copy of an object, when the actual object is too large to be drawn or modeled at actual size.

Consequently, **a scale factor** is the ratio of the dimensions of the object in the drawing to the dimensions of the actual object. The scale factor is written as a ratio between the two dimensions. For example, if a drawing of an object has a scale of 1:20, that means that any line segment in the drawing with some length, would have 20 times the length on the actual object. Thus, a line segment 3 inches long in the drawing would be 60 inches in the actual object.

A square unit is the area of the square with a side of one linear unit. For example, if a square has a side length of 1 inch, its area is equal to 1 square inch, or 1 in^2.



Measurements

Review major and well-known units and basic relationships between them. For example, 1 yard = 3 feet, 1 foot = 12 inches, 1 kilometer = 1000 meters, 1 meter = 100 centimeters, 1 centimeter = 10 millimeters.

Recall relationships between linear (use to measure length), square (used to measure area), and cubic (used to measure volume) units.

Sample Problems

1. A model of a tower is made using a scale of 1 in : 5 ft. If the height of the model tower is 5 inches, what is the actual height of the tower?

Solution

If there are 5 feet in the actual tower for every 1 inch in the model tower, then 5 inches in the model can be written as: 5 in · (5 ft / 1 in) = 25 ft. Therefore, the actual height of the tower is **25 ft.**

2. What is the actual area of the living room in square yards, if in a scale drawing, its dimensions are 9 inches by 6 inches, and its actual length is 13.5 yards?

Solution

First, find the scale factor for the drawing, which is 9 to 13.5, or 2 : 3 (divide both side by 4.5). Keep in mind that the units here are different; the lengths in the drawing are in inches, and the actual lengths are in yards, so the scale factor only applies when you scale between inches and yards.

Use the obtained scale factor to get the actual width of the room:

$$6 \text{ inches} \cdot (3 \text{ yards} / 2 \text{ inches}) = 9 \text{ yards}.$$

Therefore, the actual area of the room is 9 yards · 13.5 yards = **121.5 yd^2**.

Practice Problems

1. On the map, 0.1 inches represents 25 miles. If the real distance between two cities is 112.5 miles, what is the distance between their locations on the map?

   A. 0.45 in
   B. 2 in
   C. 0.2 in
   D. 1 in

2. Two cubes have the volumes of 125 in^3 and 64 in^3 respectively. What is the ratio of the surface area of the smaller cube to the surface area of the larger cube?

   E. 16 : 25
   F. 4 : 5
   G. 5 : 8
   H. None of the above

3. If on the scale ○○○○○○ is in balance with △△△, than △○○ = ?

   A. ○
   B. △
   C. △△
   D. ○△

4. If the ratio of the areas of two similar triangles is 49 to 81, and the longest side of the larger triangle is 18, what is the longest side of the small triangle?

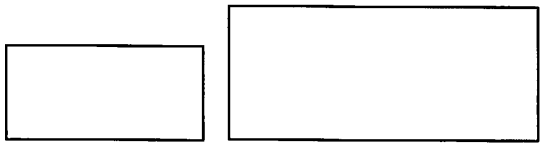
   E. 16
   F. 14
   G. 12
   H. 7

5. In a scale drawing, 1 cm represents 10 m. On the same diagram, how many square centimeters would represent 1 square meter?

   A. 10
   B. 1
   C. 0.1
   D. 0.01

6. If Tim can do A pull-ups in B seconds, how many pull-ups can he do in C minutes?

   E. 60AC / B
   F. B / (60AC)
   G. AC / B
   H. ABC



12 cm 18 cm

7. Two rectangles in the diagram above are similar. If the area of the first rectangle is 36 cm^2, what is the area of the second rectangle?

   A. 54 cm^2
   B. 16 cm^2
   C. 81 cm^2
   D. 540 cm^2

8. The area of a circle is 625 yd^2. A second circle has a radius equal to one-fifth of the first circle's radius. What is the area of the second circle?

   E. 16 yd^2
   F. 25 yd^2
   G. 100 yd^2
   H. 125 yd^2

9. If an object travels at 6 feet per second, how many yards does it travel in an hour?

   A. 180
   B. 360
   C. 1800
   D. 7200

10. On a scale drawing, the length of an image of a field is 3 times its width. What is the area of the real field, if its length is 45 m?

    E. 675 m^2
    F. 600 m^2
    G. 360 m^2
    H. 135 m^2

11. An engineer created a drawing of a rectangular region. The dimensions of the drawing are 4 inches by 11 inches. If the area of the real region is 9900 square meters, what is the scale factor of the drawing?

    A. 1 in : 225 m
    B. 1 in : 25 m
    C. 1 in : 15 m
    D. 1 in : 1.5 m

12. The area of a smaller circle is one twenty-fifth of the area of a larger circle. What is the ratio of the radius of the larger circle to the radius of the smaller circle?

    E. 1 : 25
    F. 5 : 1
    G. 1 : 5
    H. None of the above

13. In order to make 7 quarts of green paint, you need 4 quarts of yellow paint and 3 quarts of blue paint. If you have 20 quarts of yellow paint and can buy enough blue paint, what is the largest amount of green paint you can make?

A. 490 qt
B. 350 qt
C. 140 qt
D. 35 qt

14. A map in the book has a scale of 1 cm : 5 km. The map has been further scaled down so that 2 cm on the original map corresponds to 1 cm on the new map. What is the scale factor of the new map?

E. 1 cm : 10 km
F. 0.5 cm : 10 km
G. 1 cm : 2.5 km
H. None of the above

15. David is building a rectangular play space for his cat. The dimensions of the play space are 3 ft by 5 ft. If he increases each side by 10%, what percentage will then the area of the play space increase by?

A. 21%
B. 10%
C. 1%
D. 0.1%

16. If you want to increase the area of a square from 16 in^2 to 25 in^2, then by what percent do you need to increase each side of the square?

E. 25%
F. 20%
G. 12%
H. 3%

17. If 1 m^2 = 100 dm^2, then how many m^2 is 5 dm^2?

A. 0.04 m^2
B. 0.05 m^2
C. 0.1 m^2
D. 5 m^2

18. What scale factor could be used for a map, if the real area of 1 mi^2 needs to be equal to 0.25 in^2 on the map?

E. 1 in : 0.25 mi
F. 1 mi : 0.5 in
G. 1 in : 2 mi
H. None of these

19. If 1 Ukrainian hryvnia (UH) is equal to \$0.43, then how many dollars can you get for 129 UH?

A. \$300
B. \$150
C. \$55.47
D. \$43

20. The lengths of two corresponding sides of two similar triangles are 12 cm and 4 cm. By what percentage is the area of the large triangle bigger than the area of the small triangle?

E. 66%

F. 200%

G. 300%

H. 800%

21. When Katie bought gasoline, she paid $25.20 for 9 gallons. What is the price of 1 gallon of gasoline?

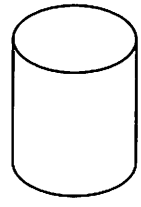
A. $3

B. $2.80

C. $2.78

D. $1.80

22. If the volume of the model of a can is 12 in^3, and the volume of the real can is 96 in^3, what is the scale factor of the model?



E. 1 : 12

F. 2 : 11

G. 1 : 2

H. 1 : 0.2

23. Two villages are 24 miles apart. The scale of the map of the region is 0.2 inch to 3 miles. What is the distance between the locations of the two villages on the map?

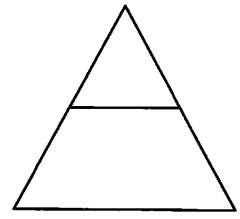
A. 72 in

B. 4.8 in

C. 1.6 in

D. 0.8 in

24. The line segment is parallel to the base of the triangle and connected the midpoints of two other sides. What is the ratio of the area of the original triangle to the area of the small one?



E. 1 : 4

F. 2 : 3

G. 4 : 1

H. 1 : 2

25. In a scale drawing, 0.1 in represents 2 miles. On the same diagram, how many square inchers would represent 1 square mile?

A. 20

B. 2

C. 0.2

D. 0.0025