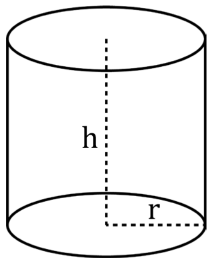
1. The volume, V, of the right circular cylinder below is given by the formula $V=\pi r^2 h$, where r is the radius of the base and h is the height of the cylinder shown below. If r is tripled and h is halved, the cylinder's new volume would be:



A. $\frac{3}{4}V$

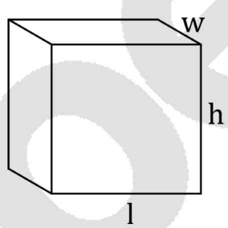
B. $\frac{9}{2}V$

C. $\frac{3}{2}V$

D. $\frac{9}{4}V$

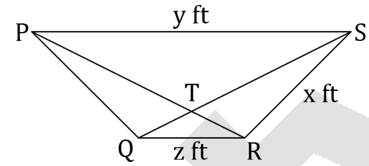
E. $\frac{9}{2}V$

2. The formula for the surface area (S) of a rectangular solid (shown below) is $S=2lw+2lh+2wh$, where l represents the length, w the width, and h the height of the solid. Tripling each of the dimensions (l, w, and h) will increase the surface area to how many times its original size?



A. 3
B. 6
C. 9
D. 12
E. Impossible to determine without knowing the original measurements.

3. Isosceles trapezoid $PQRS$ below has side lengths as marked. Its diagonals intersect at T. What is the ratio of the length of $\overline{PR}$ to $\overline{TQ}$?



1. $\frac{z}{y}$

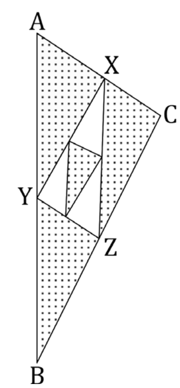
2. $\frac{y}{y+z}$

3. $\frac{y+1}{z}$

4. $\frac{y}{z}$

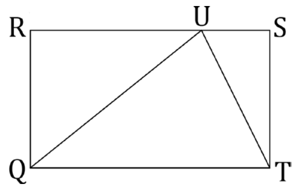
5. $\frac{y+z}{z}$

4. In the figure below, $X, Y,$ and Z are the midpoints of the sides of ΔABC, and $D, E,$ and F are the midpoints of the sides of ΔXYZ. The interiors of ΔAXY, ΔCXZ, ΔBYZ, and ΔDEF are dotted. What percent of the interior of ΔABC is *not* dotted?



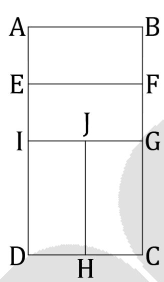
A. 18.75%
B. 22%
C. 37.5%
D. 56.25%
E. Impossible to determine from the given information.

5. In the figure below, U lies $\frac{2}{3}$ of the way from R to S on the rectangle $QRST$. The area of ΔQUT is what fraction of the area of rectangle $QRST$?



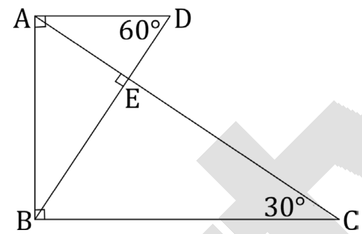
A. $\frac{1}{3}$
B. $\frac{1}{2}$
C. $\frac{2}{3}$
D. $\frac{3}{4}$
E. $\frac{4}{5}$

6. Rectangle $ABCD$ consists of 4 congruent rectangles as shown in the figure below. Which of the following is the ratio of the length of $\overline{EF}$ to the length of $\overline{AD}$?



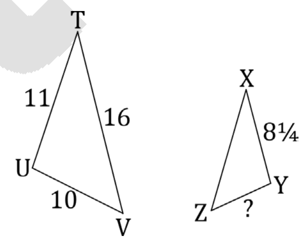
A. $1:4$
B. $1:3$
C. $1:2$
D. $2:3$
E. $3:4$

7. For the triangles in the figure below, which of the following ratios of side lengths is equivalent to the ratio of the perimeter of ΔABD to ΔABC?



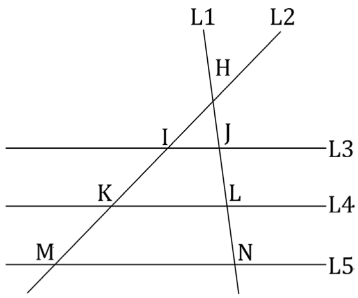
A. $AB:BC$
B. $AB:AC$
C. $AD:BC$
D. $AD:AC$
E. $DB:CB$

8. Triangles ΔTUV and ΔXYZ, shown below, are similar with $\angle T \cong \angle X$ and $\angle U \cong \angle Y$. The given lengths are in meters. What is the length, in meters, of $\overline{YZ}$?



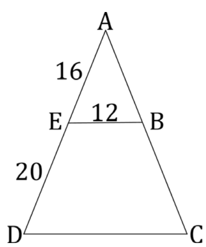
A. $5\frac{5}{32}$
B. $7\frac{1}{4}$
C. $7\frac{1}{2}$
D. $9\frac{3}{40}$
E. $13\frac{1}{5}$

9. Lines $L1$ and $L2$ intersect each other and 3 parallel lines, $L3$, $L4$, and $L5$, as shown below. The ratio of the perimeter of ΔHKL to ΔHMN is $5:8$. The ratio of IJ to MN is $3:10$. What is the ratio of KL to IJ?



A. $3:16$
B. $12:25$
C. $24:50$
D. $25:12$
E. $16:3$

10. In ΔACD below, $\overline{EB} \parallel \overline{DC}$. The lengths are given in feet. What is CD?



A. 6.7
B. 15
C. 9.6
D. 27
E. 60

ANSWER KEY

1. E **2. C** **3. E** **4. B** **5. B** **6. C** **7. A** **8. C** **9. D** **10. D**

ANSWER EXPLANATIONS

1. **E.** Let the original volume be $V=\pi r^2 h$. The new volume is $\pi(3r)^2\left(\frac{h}{2}\right)$. This becomes $\frac{9}{2}\pi r^2 h=\frac{9}{2}V$.

2. **C.** Tripling the measurement of each dimension turns our formula into:
$$2(3l)(3w)+2(3l)(3h)+2(3w)(3h)=9(2lw)+9(2lh)+9(2lw)=9(2lw+2lh+2wh)=9S$$

3. **E.** The ratio of $\overline{PT}$ to $\overline{QT}$ is $\frac{y}{z}$. The ratio of $\overline{TR}$ to $\overline{QT}$ is $\frac{z}{z}$. So, since $\overline{PR}=\overline{PT}+\overline{TR}$, $\frac{PR}{TQ}=\frac{PT+TR}{TQ}=\frac{y}{z}+\frac{z}{z}=\frac{y+z}{z}$.

4. **A.** The triangles formed by connecting the midpoints of the larger triangles are congruent. Thus, the center triangle is $\frac{1}{4}$ of the total area. Similarly, the three undotted triangles within the center triangle are $\frac{3}{4}$ of the center triangle's area. Thus, the undotted triangles are $\frac{3}{4}\times\frac{1}{4}=\frac{3}{16}=18.75\%$ of the total triangle's area.

5. **B.** Draw a line straight down from U to the bottom of the rectangle. It's clear that the two triangle's that ΔQUT has been divided into are half of the respective rectangles that $QRST$ has been divided into. Thus, ΔQUT is half of the area of rectangle $QRST$.

6. **C.** Since the two shorter sides of the bottom rectangles together equal the longer side of the rectangle above them, we can conclude that the shorter side of any of the rectangles are half of the long side. Let s be the length of the short end and l be the length of the long end. $EF=l$. $AD=2s+l=l+l=2l$. Therefore $E:F=l:2l=1:2$.

7. **A.** The ratio of the corresponding sides of similar shapes is equal to the ratio of their perimeters. In this case, the way to find the answer is to ensure that the sides we choose are, in fact, corresponding sides. The only choice of sides that are both across from congruent angles are $\overline{AB}$ and $\overline{BC}$, which are both across from $60°$ angles. Thus, since the ratio between the two is equal to the ratio of the perimeters, the ratio of the perimeters is equal to $AB:BC$.

8. **C.** The triangles are similar, but are mirror images to each other. The ratio of $\overline{TU}$ to $\overline{XY}$ is equal to the ratio of $\overline{UV}$ to $\overline{ZY}$. We set this up as $\frac{11}{10}=\frac{8.25}{ZY}$. We cross multiply to get $11ZY=82.5$, and divide by 11 to get $ZY=7.5$ or $7\frac{1}{2}$.

9. **D.** The ratio of ΔHKL to ΔHMN, $5:8$, is equal to the ratio of $\overline{KL}$ to $\overline{MN}$. We express this as $\frac{KL}{MN}=\frac{5}{8}$. Since we are given that the ratio of $\overline{IJ}$ to $\overline{MN}$ is $3:10$, that is, $\frac{IJ}{MN}=\frac{3}{10}$, we can combine the fractions to get our desired ratio, $\frac{KL}{IJ}$. We first flip the $\overline{IJ}$ to $\overline{MN}$ ratio so that the $\overline{MN}$'s cancel out: $\frac{MN}{IJ}=\frac{10}{3}$. We then multiply $\frac{KL}{MN}\times\frac{MN}{IJ}=\frac{5}{8}\times\frac{10}{3}=\frac{50}{24}=\frac{25}{12}$. Since $\overline{KL}$ and 25 are the numerators, they correspond, and the same goes for $\overline{IJ}$ and 12. Thus, $KL:IJ=25:12$.

10. **D.** The ratio of $\overline{DC}$ to $\overline{AD}$ is equal to the ratio between $\overline{EB}$ and $\overline{AE}$. $\frac{DC}{AD}=\frac{EB}{AE}$. We know that $AD=AE+ED=16+20=36$. With other values given in the diagram, we can express our ratios as $\frac{DC}{36}=\frac{12}{16}$. Cross multiply to $16DC=432$, and divide by 16 to get $DC=27$.