PART A

1) A square has a side length of 3 cm.
   a) Determine the perimeter and area of the square.
   b) If the square's side length is doubled, what is the resulting perimeter? Area?
   c) How many times greater is the square's perimeter after its side length is doubled?
   d) How many times greater is the square's area after its side length is doubled?

2) A cube has an edge length of 2 mm.
   a) Determine the volume and surface area of the cube.
   b) If the cube's edge length is doubled, what is the resulting volume? Surface area?
   c) How many times greater is the cube's volume after its edge length is doubled?
   d) How many times greater is the cube's surface area after its edge length is doubled?

3) A circular vegetable garden has radius of 2 m.

   a) Determine the circumference and area of the garden.
   b) If the garden's radius is tripled, what is the resulting circumference? Area?
   c) How many times greater is the garden's circumference after its radius is tripled?
   d) How many times greater is the garden's area after its radius is tripled?
   e) Why does tripling the radius have a greater effect on the area than it does on the circumference?

PART B

4) A rectangle has a length of 5 cm and a width of 4 cm.
   a) If both the length and width are doubled, how many times greater is the area of the resulting rectangle.
   b) Does doubling a rectangle's dimensions always have the same effect on its area? Explain.

5) The box of a 400-gram Toblerone chocolate bar is a triangular prism. The triangle on which the prism is constructed has a base length of 6 cm and a height of 5 cm.
   a) Determine the area of the base triangle.
   b) Determine the volume of the box if its length is 30 cm.
   c) Will doubling the area of the base triangle cause the volume of the prism to double? Explain.
   d) How would doubling the height of the base triangle affect the area of the base triangle and the volume of the box?

6) A rectangular prism has a volume of 80 in^3. If the prism's length, width and height are all doubled, what is the resulting volume? What if only the length and width are doubled?

7) A circle has an area of 40 in².
   a) If the circle's radius is doubled, what is the resulting area?
   b) If the circle's diameter is tripled, what is the resulting area?

8) Show that tripling the edge length of a cube always has the same effect on the cube's volume, regardless of the cube's initial edge length.

9) Describe how each of the following would affect the volume of a cylinder.

   a) doubling the height   b) doubling the radius   c) tripling the height
   d) tripling the radius   e) halving the height   f) halving the radius

10) Would tripling the height of a cylinder cause its surface area to triple? Explain.

PART C

11) For a sphere with radius r, the volume is given by $V = \dfrac{4}{3}\pi r^3$ and

   the surface area is given by $A = 4\pi r^2$.

   a) Calculate the volume of a sphere that has a diameter of 2.5 feet.
   b) If the radius of a sphere is tripled, how many times greater will the resulting volume be?
   c) The diameter of a sphere that has a volume of 280 mm³ is doubled. What is the volume of the resulting sphere?
   d) The radius of a sphere that has a volume of 460 cm³ is halved. What is the volume of the resulting sphere?
   e) Determine the surface area of a sphere with a radius of 12.8 in.
   f) A sphere has a surface area of 1529 m². If the radius of the sphere is tripled, determine its volume to the nearest hundredth of a cubic metre.

12) State three ways that the dimensions of the trapezoid shown on the right could be adjusted to increase its area by a factor of four.
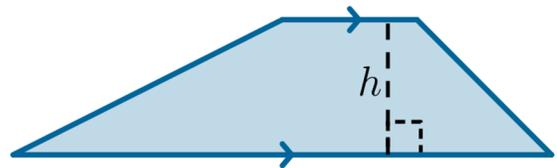
13) A cylinder has a circular base with an area of 40 cm² and a height of 60 cm. Determine the volume of a cone that has five times the radius and six times the height of the cylinder.

14) A rectangle has a length of l inches and a width of w inches. If the width is increased by 5 inches, determine the resulting increase in area.

15) Prove that doubling a square's side length also doubles the length of its diagonal.
   $\left(\text{Hint: } \sqrt{a \times b} = \sqrt{a} \times \sqrt{b}\right)$

ANSWERS

1) a) perimeter = 12 cm, area = 9 cm²   b) perimeter = 24 cm, area = 36 cm²   c) 2   d) 4

2) a) volume = 8 mm³, surface area = 24 mm²   b) volume = 64 mm³, surface area = 96 mm²
   c) 8   d) 4

3) a) circumference ≈ 12.6 m, area ≈ 12.6 m²   b) circumference ≈ 37.7 m, area ≈ 113.1 m²
   c) 3   d) 9   e) Tripling the radius has a greater effect on the area since the radius value is squared when calculating the area, whereas it is not squared when calculating the circumference.

4) a) 4   b) Yes. The area of a rectangle can be found using the formula $A = l \times w$. Doubling the length and width of the rectangle gives $A_{new} = (2l) \times (2w)$, which is equivalent to
$A_{new} = 2 \times 2 \times l \times w$ or $A_{new} = 4 \times (l \times w) = 4A$. So, doubling the length and width always results in the area increasing by a factor of 4.

5) a) 15 cm²   b) 450 cm³   c) Yes. The volume of the prism can be found by multiplying the area of the base triangle by the length of the prism. That is,
$V = \text{area of base trianle} \times \text{length of prism}$. Doubling the area of the base triangle gives
$V_{new} = (2 \times \text{area of base trianle}) \times (\text{length of prism})$, which is equivalent to
$V_{new} = 2 \times (\text{area of base trianle}) \times (\text{length of prism})$ or
$V_{new} = 2 \times (\text{area of base trianle} \times \text{length of prism}) = 2V$.
d) The area of the base triangle would double and the volume of the box would double.

6) 640 in³, 320 in³   **7)** a) 160 in²   b) 360 in²

8) A cube with edge length s has volume $V = s^3$. Tripling the edge length gives
$$V_{new} = (3s)^3$$
$$= (3s)(3s)(3s)$$
$$= 3 \times 3 \times 3 \times s \times s \times s$$
$$= 27s^3$$
$$= 27V$$
Therefore, tripling the edge length of a cube always results in a volume that is 27 times greater.

9) a) volume would be 2 times greater   b) volume would be 4 times greater
   c) volume would be 3 times greater   d) volume would be 9 times greater
   e) volume would be half as great   f) volume would be one quarter as great

10) No. Tripling the height would only triple the area of the lateral surface $(2\pi rh)$. The areas of the circular faces would not be affected.

11) a) 8.2 ft³   b) 27   c) 2240 mm³   d) 57.5 cm³   e) 2058.9 in²   f) 151 791.97 m³

12) Answers will vary. For example, quadruple the height, or quadruple the lengths of the parallel sides, or double both the height and the lengths of the parallel sides.

13) 120 000 cm³   **14)** $5l$ in²

15) Using the side-length relationship for right triangles (Pythagorean Theorem), the length of the diagonal of a square with side length l is $d = \sqrt{l^2 + l^2} = \sqrt{2l^2}$. If the square's side length is doubled, the diagonal length can be found as follows:

$d_{new} = \sqrt{(2l)^2 + (2l)^2}$ $= \sqrt{4 \times 2l^2}$
$= \sqrt{4l^2 + 4l^2}$ $= \sqrt{4} \times \sqrt{2l^2}$
$= \sqrt{8l^2}$ $= 2 \times \sqrt{2l^2}$
     $= 2d$

Therefore, doubling the square's side length also doubles the length of its diagonal.