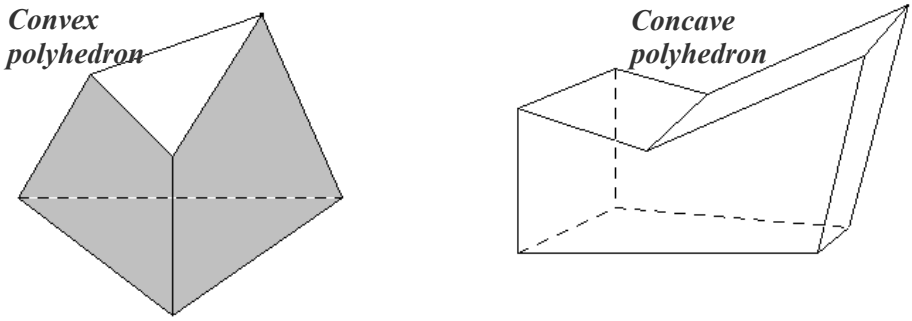
CHAPTER 20 - GEOMETRIC SHAPES

POLYHEDRONS

A polyhedron is a geometric shape of three dimensions bounded by four or more plane polygons or faces. The sides of the faces are called edges and the vertices of the faces are called vertices.

A polyhedron is called convex if the plane made by each of its faces doesn't cut the polyhedron. If it does, it is concave.

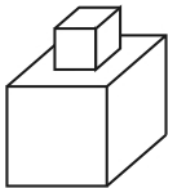


All of the convex polyhedrons verify the Euler Formula. "The number of faces plus the number of vertices is equal to the number of edges plus two." **F + V = E + 2**

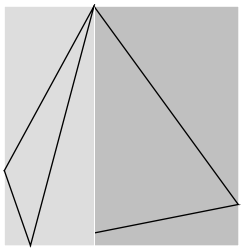
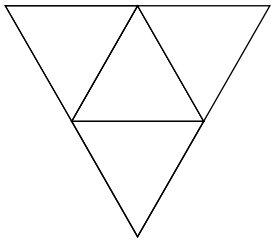
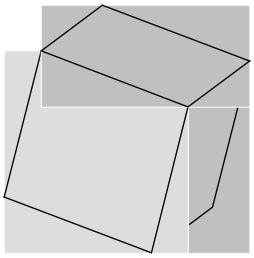
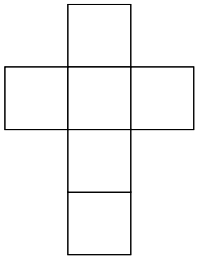
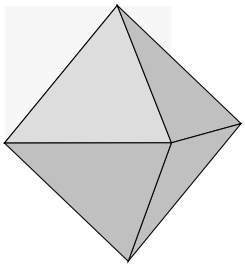
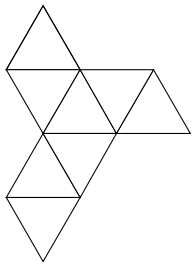
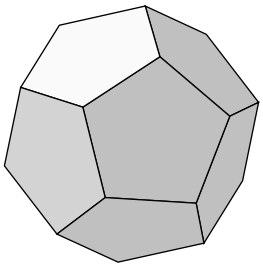
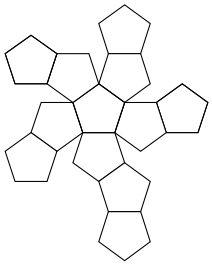
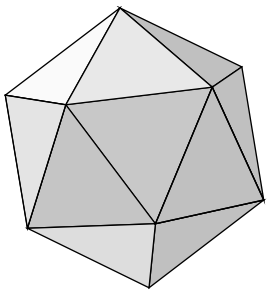
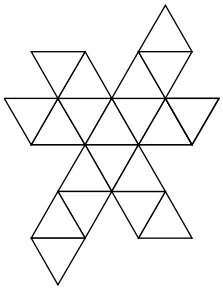
The faces of a regular polyhedron are regular polygons with the same shape and size and all of its vertices intersect by the same number of faces. There are only five distinct regular polyhedrons.

1) Check the Euler formula in the convex polyhedron in the figure above.

2) Check if the Euler formula is correct in the concave polyhedron above. Repeat the process with the concave polyhedron below.



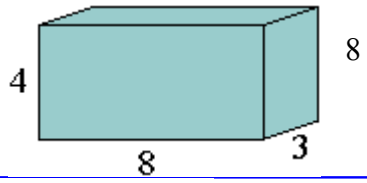
REGULAR POLYHEDRONS AND THEIR CONSTRUCTION

TETRAHEDRON *Faces: equilateral triangles* Number of faces = Number of vertices = Number of edges =		
CUBE *Faces: squares* Number of faces = Number of vertices = Number of edges =		
OCTAHEDRON *Faces: equilateral triangles* Number of faces = Number of vertices = Number of edges =		
DODECAHEDRON *Faces: regular pentagons* Number of faces = Number of vertices = Number of edges =		
ICOSAHEDRON *Faces: equilateral triangles* Number of faces = Number of vertices = Number of edges =		

SURFACE AREA OF A SPACE FIGURE

The surface area of a space figure is the total area of all the faces of the figure.

What is the surface area of a box whose length is 8cm, width is 3cm, and height is 4cm?
This box has 6 faces: two rectangular faces are 8 by 4, two rectangular faces are 4 by 3, and two rectangular faces are by 3. Adding the areas of all these faces, we get the surface area of the box:



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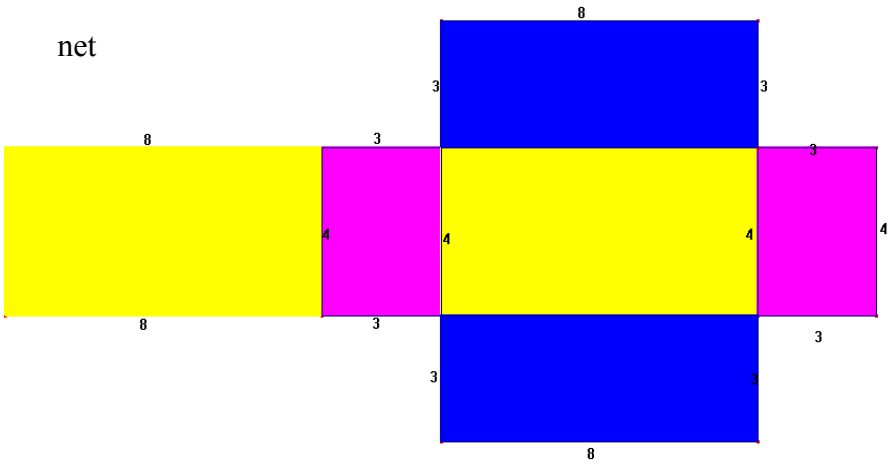
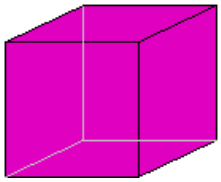


Surface Area = $8 \times 4 + 8 \times 4 + 4 \times 3 + 4 \times 3 + 8 \times 3 + 8 \times 3 =$

$= 32 + 32 + 12 + 12 + 24 + 24 = 136\ cm^2$

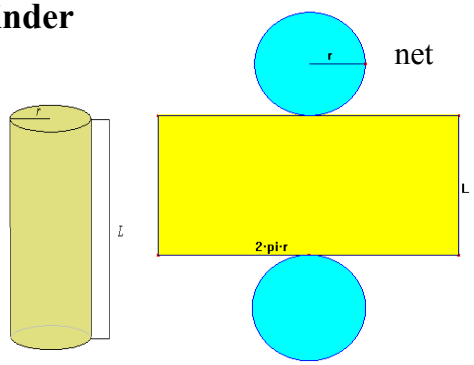
Cube



A cube is a three-dimensional figure having six matching square sides. If L is the length of one of its sides, the surface area of a cube is six times the area of one of these sides.

Surface area = $6 \times L \times L = 6L^2$

Cylinder



A cylinder is a space figure having two congruent circular bases that are parallel. If L is the length of a cylinder, and r is the radius of one of the bases of a cylinder, then:

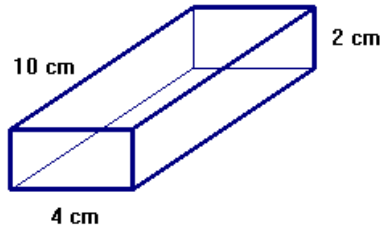
Surface area = $2\pi \times r \times L + 2\pi \times r^2$

EXERCISES

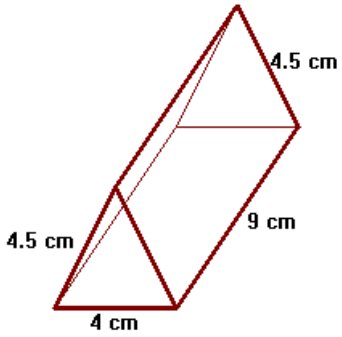
3) What is the surface area of a cylinder having a radius of 3cm and a height of 10 cm?

4) What is the surface area of a cube with a side-length of 2.1 cm?

5) Draw a net for the following rectangular prism and calculate its surface area.

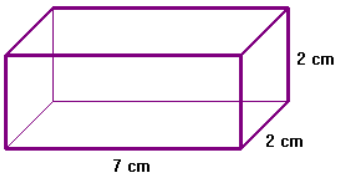


6) Draw a net for the following triangular prism and calculate its surface area.

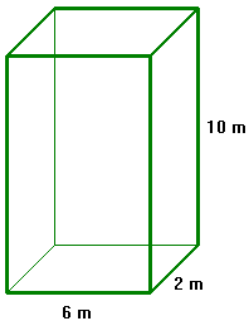


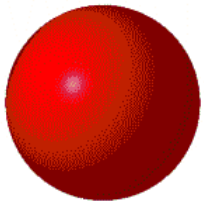
7) Calculate the surface area of each of the following prisms:

a)



b)



A sphere is a space figure having all of its points at the same distance from its centre. The distance from the centre to the surface of the sphere is called its **radius**. Any cross-section of a sphere is a circle. If r is the radius of a sphere, the surface area S of the sphere is given by the formula $S = 4 \cdot \pi \cdot r^2$.	**Sphere** 

Example:
What is the surface area of a sphere having a radius of 10cm?

The surface area S of the sphere is $S = 4 \cdot \pi \cdot 100 = 1256$ cm^2.

EXERCISES

(Give solutions correct to 3 significant figures.)

8) What is the surface area of a sphere having a radius of 15cm?

9) What is the surface area of a sphere having a diameter of 12dm?

10) What is the surface area of a sphere having a radius of 9dm?

11) What is the surface area of a sphere having a diameter of 10cm?

12) A balloon has a surface area of $1000cm^2$, calculate the radius of the balloon.

13) A sphere has a surface area of $2500dm^2$; calculate the diameter of the sphere.

14) A sphere has a surface area of $150dm^2$; calculate the diameter of the sphere. Give the solution in cm.