Maths Points

Junior and Leaving Cert

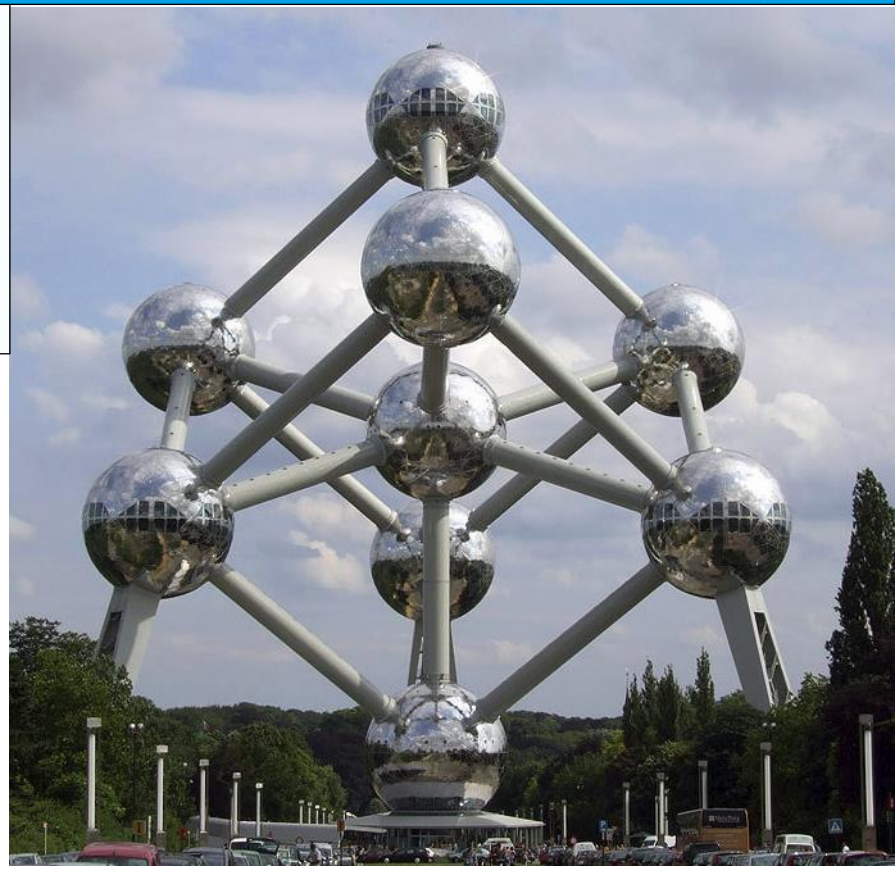
2016 PAPER 2 – Q7

Leaving Cert Ordinary Level

2016 LCOL Paper 2 – Table of Contents

The Atomium in Brussels is one of Belgium's most famous landmarks.
It consists of 9 identical spheres joined by two types of cylindrical pipes.

The Atomium is modelled on an iron atom that has been magnified 165 billion times.
Given that a billion is a thousand million, write 165 billion in the form $a \times 10^n$, where $n \in \mathbb{Z}$, and $1 \leq a < 10$.



First write 165 billion in digits.

165 billion

$= 165{,}000{,}000{,}000$

11

The size of the power is found by counting the number of digits after the 1st digit.

$= 1.65 \times 10^{11}$

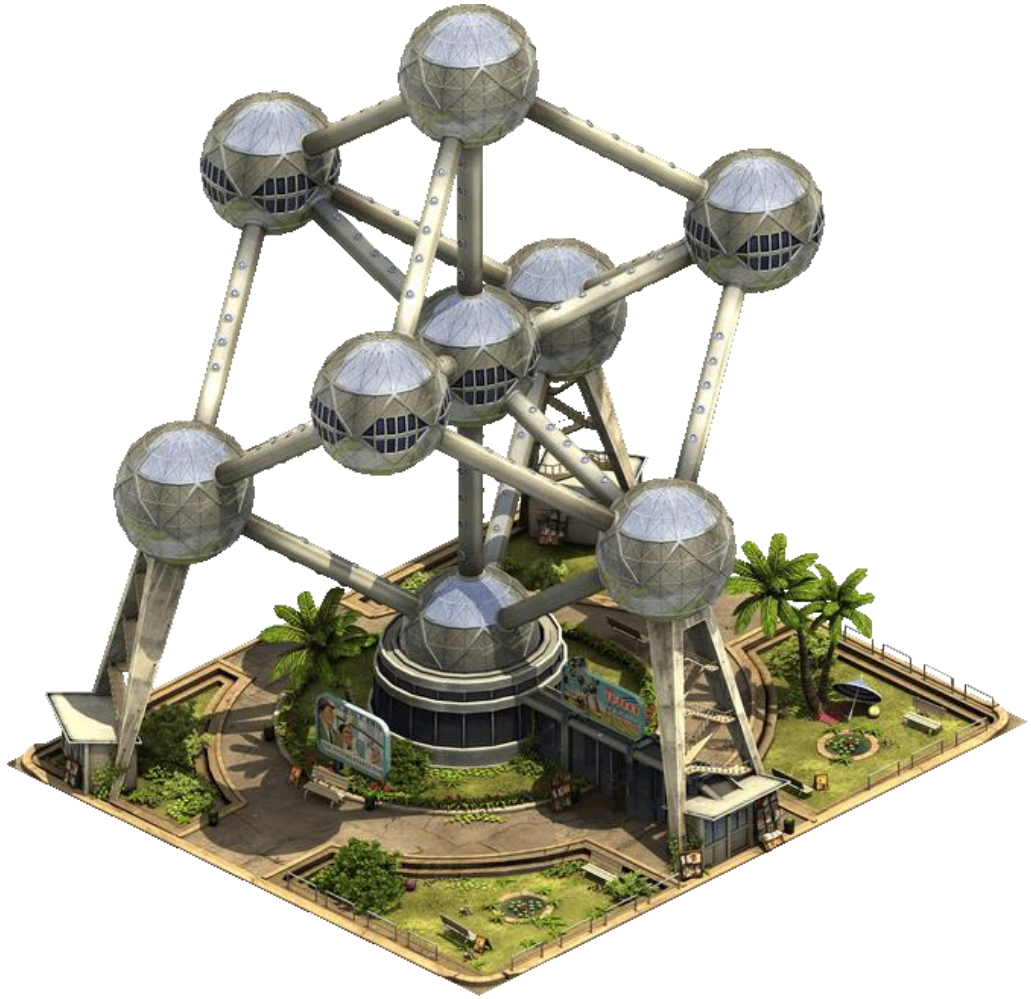
The **Atomium** was originally built for the 1958 World Expo, which was held in Brussels, and has since become a symbol of the city.
It stands at 102 meters tall, with nine interconnected spheres. The spheres are made of stainless steel and contain exhibit spaces, a restaurant, and an observation deck.

The diameter of each sphere in the Atomium is 18 metres.

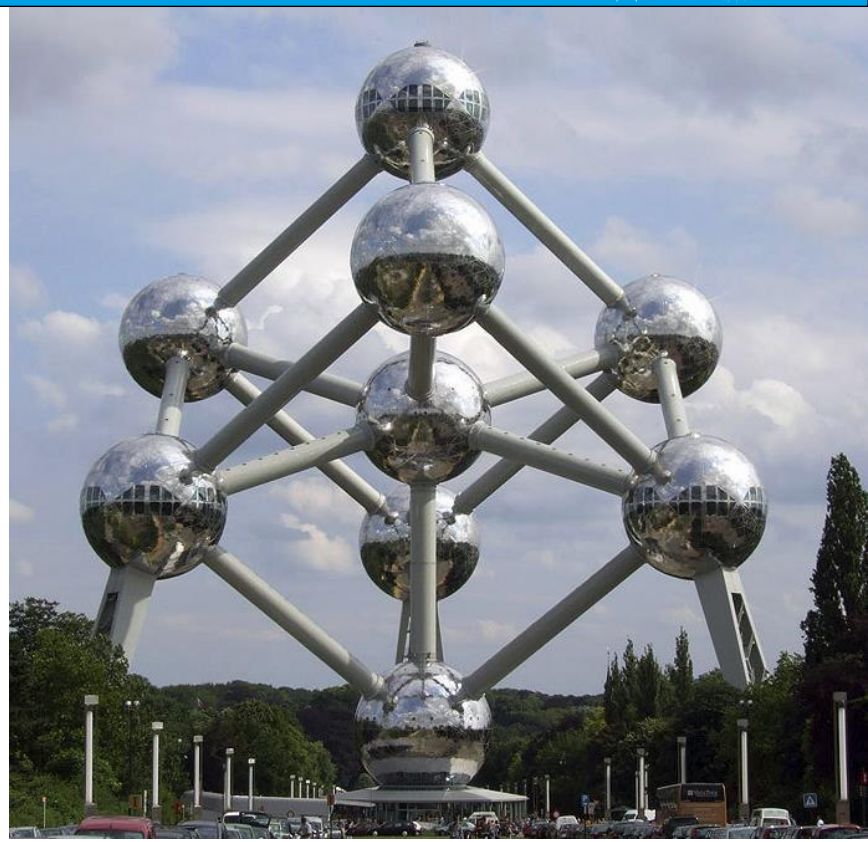
Find the radius of each sphere.

The radius is half of the diameter, 18 m.

Radius $= 9$



Find the volume of each sphere, correct to 2 decimal places.



Volume of a Sphere

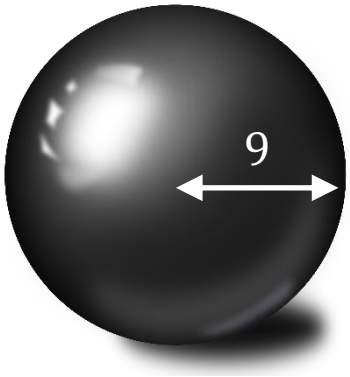
$$V = \frac{4}{3}\pi r^3$$

$r = 9$

$$V = \frac{4}{3}\pi r^3$$

$$V = \frac{4}{3}\pi(9)^3 \quad \leftarrow r = 9$$

$$V = 3053.63 \text{ m}^3$$



The formula for the **Volume of a Sphere** can be found on **page 10** of the Maths Formulae Book.

Find the combined surface area of all 9 spheres in the Atomium, correct to the nearest m^2.

Surface Area of a Sphere

$SA = 4\pi r^2$

$r = 9$

$A = 4\pi r^2$

$A = 4\pi(9)^2$ ← $r = 9$

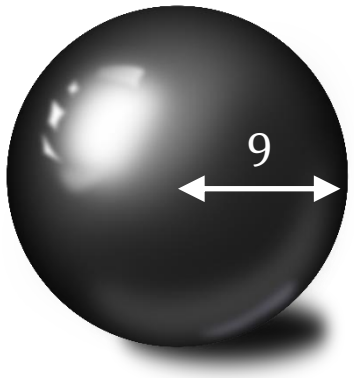
$A = 1017.88$

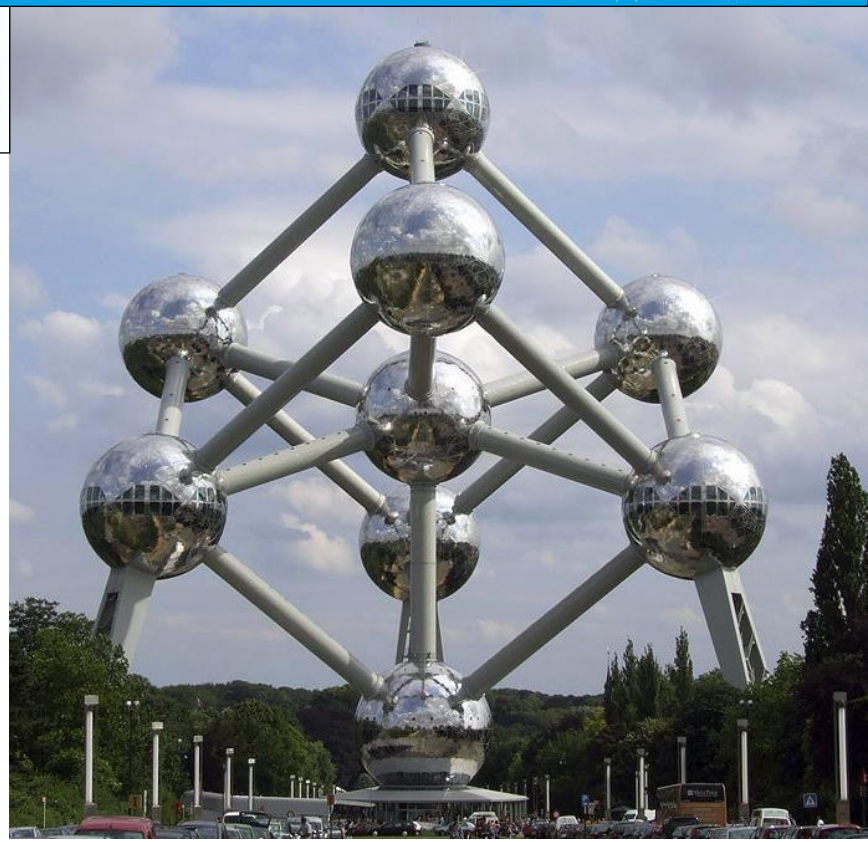
There are 9 spheres

1017.88×9

$= 9160.88\ m^2$

$\approx 9161\ m^2$

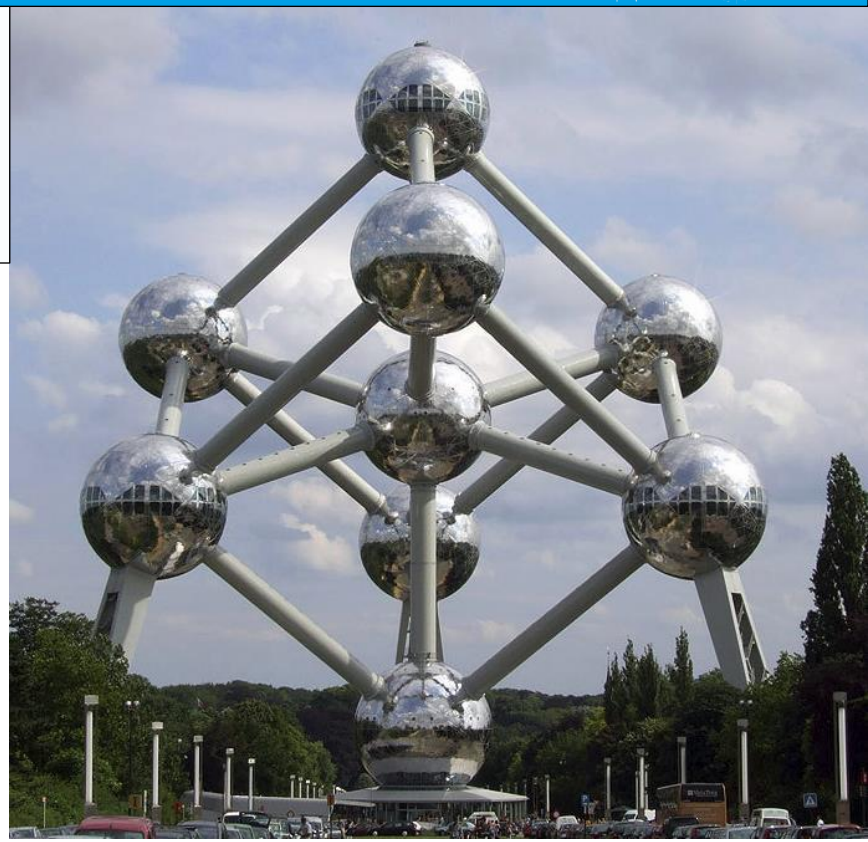




The formula for the **Surface Area of a Sphere** can be found on **page 10** of the Maths Formulae Book.

Each of the 8 cylindrical pipes extending from the centre sphere has a radius of 1·65 m and a length of 23 m.

Find the sum of the curved surface areas of all 8 pipes, correct to the nearest m^2.



Surface Area of a Cylinder

$SA = 2\pi rh$

$A = 2\pi rh$

$A = 2\pi(1.65)(23)$

$A = 238.45 \text{ m}^2$

$r = 1.65$

$h = 23$

There are 8 pipes.

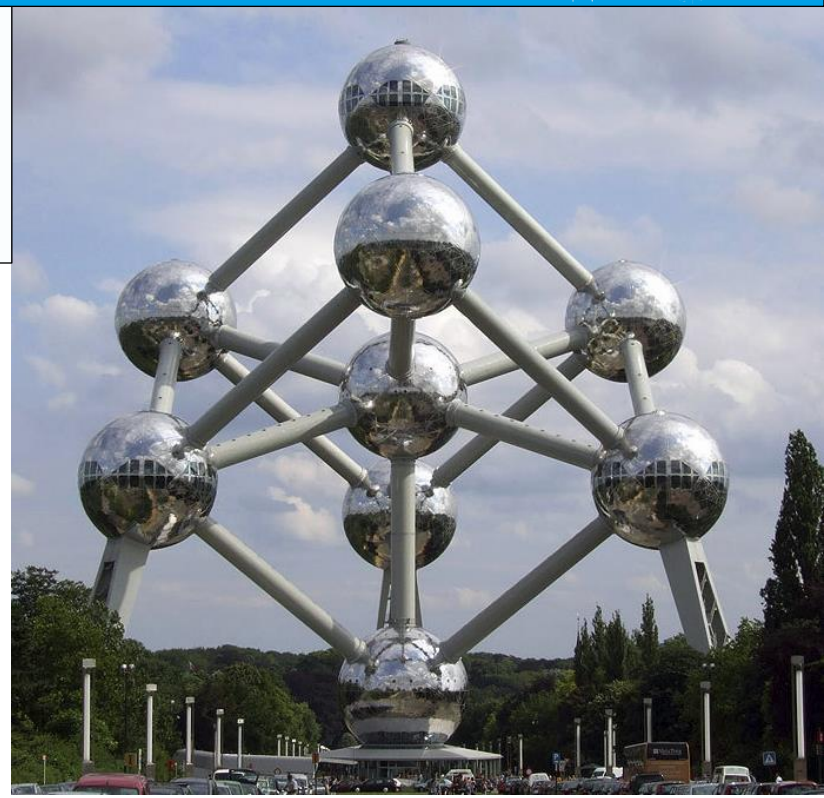
238.45×8

$= 1907.58 \text{ m}^2$

$\approx 1908 \text{ m}^2$

The formula for the **Surface Area of a Cylinder** can be found on **page 10** of the Maths Formulae Book.

The other 12 cylindrical pipes connect the outer spheres to each other. Each pipe has a radius of 1·45 m. All 12 pipes are equal in length. The sum of the curved surface areas of the 12 pipes is 3170 m^2. Find the length of one pipe. Give your answer correct to the nearest metre.



Calculate the surface area of one pipe by dividing the total area by 12.

$$\frac{3170}{12}$$
$$= 264.17$$

Let the formula for surface area equal to the surface area (264.17) of one pipe and solve for the height, h.

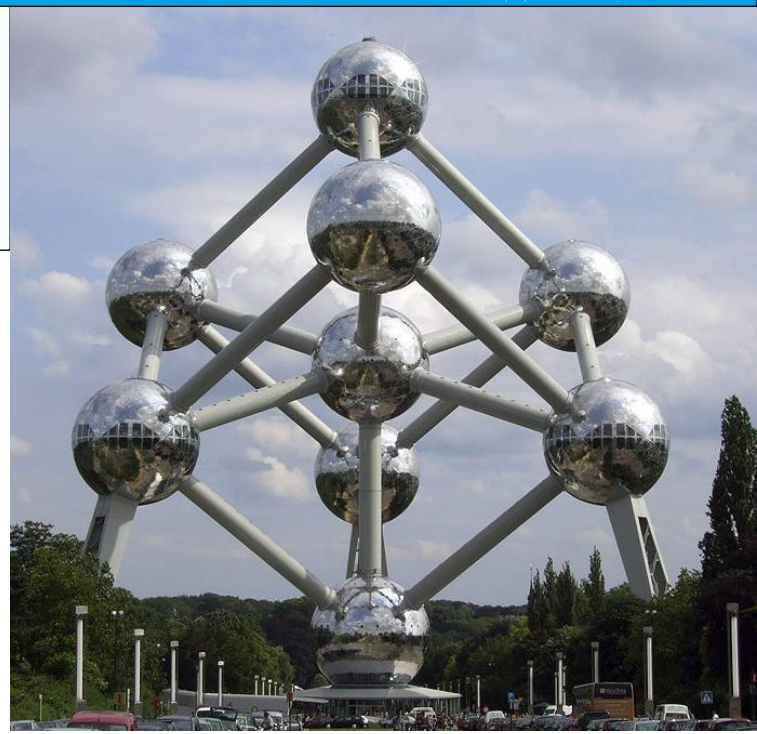
Surface Area of a Cylinder

$SA = 2\pi rh$

$SA = 264.17$
$r = 1.45$

$$2\pi rh = 264.17$$
$$2\pi(1.45)h = 264.17$$
$$9.11h = 264.17$$
$$h = \frac{264.17}{9.11}$$
$$h = 28.998$$
$$h \approx 29 \text{ m}$$

The curved surfaces of the 20 pipes and 9 spheres are covered in stainless steel. Stainless steel costs €70 per square metre. Use the areas you have calculated or have been given above to find the approximate cost of the stainless steel required to resurface the Atomium.



Area of 9 Spheres
$= 9161$

Area of 8 Pipes
$= 1908$

Area of 12 Pipes
$= 3170$

Find the sum of the areas of the 20 pipes and 9 spheres.

$$\begin{array}{r} 1908 + \\ 3170 \\ \underline{9161} \\ 14{,}239 \end{array}$$

Multiply this by the cost per square metre, €70

$$14{,}239 \times 70 = €996{,}730$$

The approximate cost of the stainless steel to resurface the Atomium is €996,730.