What is scientific notation?

- a way of... _____

The number 154,000,000,000 is written in scientific notation as

The first number (1.54) is called the _____. It must be greater than or equal to 1 and less than 10.

The second number (10) is called the _____ It will **always** be _____.

The third number (11) is called the _____. It is also referred to as the power of ten.

Write this number in scientific notation by following the steps below. 785 000

Step 1: Write the _____ by putting the decimal after the first non-zero digit.

Step 2: Write the _____ (x 10).

Step 3: Find the _____ by counting the number of places the decimal must move.

Ex. Write the following numbers in scientific notation:

195 000 000 000 =
56 000 000 =
675 000 000 =
72 000 =

What about really small numbers?
Numbers that are less than 1 have a _____ exponent.
A millionth of a second would look like this: 0.000001 = _____.

Ex. Write the following numbers in scientific notation**.** Remember that the coefficient only has one number before the decimal place.

0.00000007 =
0.00056 =
0.0000743 =
0.092 =

When do you write a negative exponent when converting to scientific notation? When do you write a positive exponent when converting to scientific notation?	

Using Calculators in scientific notation
Multiply these two numbers together by following using the **Exp** or **EE** button on your calculator

$$(2.1 \times 10^{8}) \times (3.2 \times 10^{4}) = 6.72 \times 10^{12}$$

Type EXACTLY into your calculator:

2.1 EXP 8 x 3.2 EXP 4 =

$(6.3 \times 10^{12}) \times (5 \times 10^{4}) =$

$(3 \times 10^{6}) \div (4.2 \times 10^{-3}) =$

Homework: **Scientific Notation/Conversions Practice**

1. Express each of the following in scientific notation:

a) 978 000 000 000 = _____

b) 0.000 000 3001 = _____

c) 457.1 = _____

d) 8 920 000 = _____

e) 1000 = _____

f) 0.035 000 = _____

g) 36 400 = _____

h) 0.000 000 0198 = _____

2. Complete the following calculations - use your calculator and answer in scientific notation rounded to 2 decimal places:

a) $4.15 \times 10^{5} \times 2.14 \times 10^{6} =$ _____

b) $3.78 \times 10^{9} \div 9.55 \times 10^{2} =$ _____

c) $7.84 \times 10^{-6} \times 8.08 \times 10^{7} =$ _____

d) $6.95 \times 10^{4} \div 1.07 \times 10^{-9} =$ _____

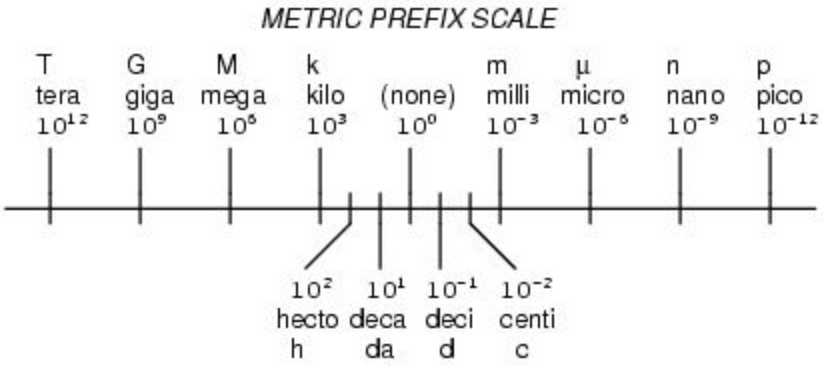
e) $3.00 \times 10^{8} \div 4.18 \times 10^{14} =$ _____

f) $5.50 \times 10^{15} \times 9.81 \times 10^{-3} =$ _____

g) $8.15 \times 10^{-2} \div 9.17 \times 10^{-8} =$ _____

h) $2.11 \times 10^{6} + 4.33 \times 10^{5} =$ _____

Metric Conversions



Use the metric prefix scale to convert between units.

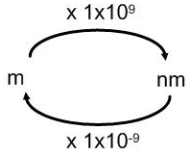
900 mm = ___ m 3 GL = ____ kL 500 cm = ____ nm 265 mm = ____ cm

Converting with nanometres!

One nanometre is _____ metres.

Convert the following values.

1. 600nm = _____ m
2. 20 nm = _____ m
3. 4550 nm = _____ m
4. 175 nm = _____ m



5. 6 m = _____ nm
6. 2.99×10^{-10} m = _____ nm
7. 7.5×10^{-9} m = _____ nm

8. 9.87×10^{-7} m = _____ nm

Homework: **Convert between the following metric units.**

a) 75m = _____ km

b) 538 nm = _____ m

c) 0.0036m = _____mm

d) 0.000 000 179 m = _____ nm

e) 50.6 L = _____ mL

f) 90.25 kV = _____mV

g) 3.75×10^{-7} m = _____ nm

h) 2 GV = _____ V

i) 3.78 nm = _____ m

j) 2.5 hours = _____ seconds

k) 3 days = _____ hours

l) 1 000 000 seconds = _____ days

What is Light?

We now know that light is a form of _____. This energy travels in _____, which together with visible light are called electromagnetic radiation.

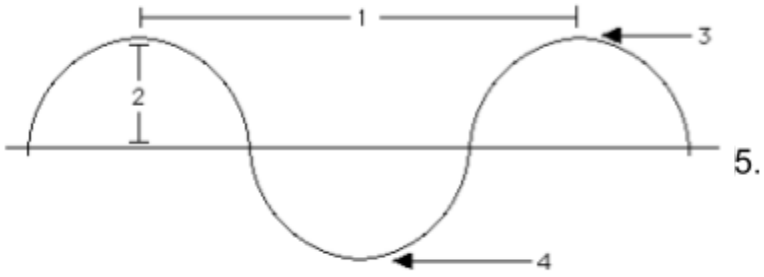
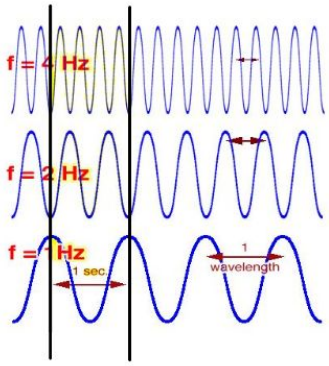


Figure 1: A transverse wave



	It can also be found using the equation: f =

Figure 2: Relationship between frequency & wavelength

Properties of Waves	Definition
Crest	
Trough	
Wavelength	Symbol is λ (lambda)
Amplitude	
Frequency	

The energy transferred by a wave often depends on the _____ of the wave **and** its _____.

The higher the frequency, the _____ energy the wave passes along.

The **wave equation** tells us the relationship between frequency, speed, and wavelength:

$$V = f \times \lambda$$

v = _____
f = _____
λ = _____

Ex 1. Red light has a wavelength of 700 nm. If its frequency is 4.2827×10^{14} Hz, what is the SPEED OF LIGHT?

Ex 2. Knowing that the speed of light is 3.0×10^{8} m/s and that some X-rays have a wavelength of 5.25 nm , what is the frequency of the X-rays?

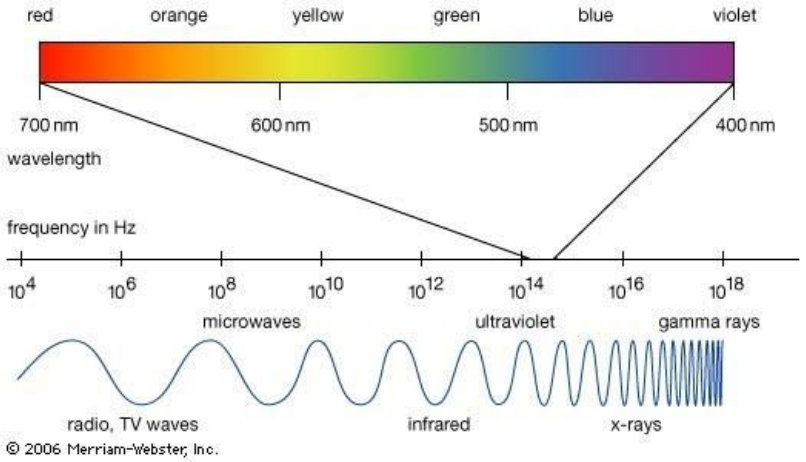
Using the Wave Equation Homework

All final answers should be rounded to 2 decimal places

1. A pendulum goes through 100 cycles in 2.5 minutes. Determine its frequency.
2. While sitting on a dock, a boat passes by you and produces a wave. You estimate the distance from the first crest to the fifth crest is 12 m.
a) Use a diagram to determine the number of cycles and the wavelength of the wave.
b) You measure that it takes 3.4 s for 6 waves to pass your dock. Determine the frequency of the wave.
c) Using your answers from part a) and b) determine the speed of the wave.
3. What is the speed of a wave with a wavelength of 1.75 m and a frequency of 800Hz?
4. A light wave passes through a transparent wall. It has a wavelength of 0.3m and travels at 2000m/s. What is its frequency?
5. A red light has a wavelength of 680 nm. What is its frequency?
6. Radiation from a distant galaxy has a frequency of 3.2×10^{22} Hz. What is the wavelength of the light? What type of ray is it?

7. A light ray from a laser has a frequency of 6.7×10^{14} Hz. What is the wavelength of the light? What colour is the light?

The Electromagnetic Spectrum represents:



We can only see a tiny portion called visible light.

What we see is a _____**of** colours

The difference between colours of light is:

	Radio	Microwaves	Infrared	Visible	Ultraviolet	X-rays	Gamma
Uses							
Wavelength Range	**> 0.3**	**0.001-0.3**	**7.6×10^{-7} - 0.001**	**3.8×10^{-7} - 7.6×10^{-7}**	**8×10^{-9} - 3.8×10^{-7}**	**6×10^{-12} - 8×10^{-9}**	**< 6×10^{-12}**

Big _____ Big _____

Small _____ Small _____

We can also think about light as a _____.It is made of _____(massless particles that travel in a wave-like pattern at the speed of light). Photons contain a specific amount (bundle) of energy. How much energy the photons contain tells us where the radiation is on the _____

This gives us a *"wave-particle duality"*

The Ray Model of Light

Light can be represented in many different ways; each explanation giving validity to a specific aspect of light. Wave theories help to explain _____, particles explain light at an atomic level, but neither explains _____. This is shown through the _____.

The ray model of light, light is represented by using _____ that show the direction that the light travels. Light rays travel away from the source in _____, and in completely _____. Ray diagrams are drawings that show the _____ as it radiates out. Each ray has an _____ to indicate which direction the light is travelling in.

Light rays diagrams are useful when explaining what happens to light when it hits an object. Once light strikes an object one of three things will occur:

· Light is transmitted freely through the material · e.g. Clear glass or plastic	
· Some light is transmitted through, some is reflected · e.g. Frosted Glass	
· No light is transmitted through the material, all light is reflected · e.g. Wood door	

Light Reflection

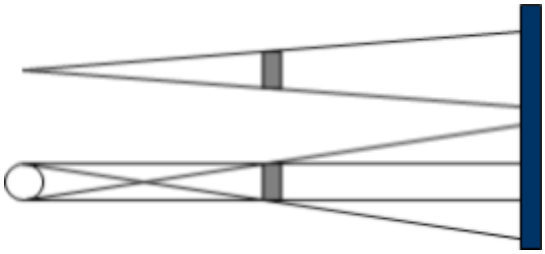
You can see objects around you because _____ and has returned to your eyes. Incoming rays _____ to one another and in regular reflection (_____), outgoing rays _____, travelling parallel as well. In regular reflection, all of the light rays are the same both incoming and outgoing. When this happens you can see a _____ _____ on the smooth surface. However, not all objects are smooth; some are composed of many rough edges. The _____ causes the parallel incoming light rays to be

_____ in many different directions, resulting in _____. Diffuse reflection allows you to see the object rather than a reflected image.

Shadows

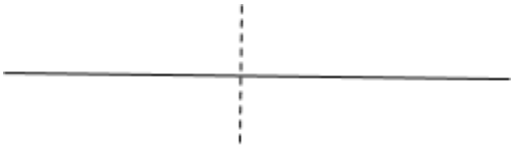
1. How does a shadow form?

2. What is the difference between the umbra and the penumbra of a shadow? Label the diagram.



3. Using a diagram, explain how shadows can change size even though the object remains constant

The Law of Reflection



When light reflects off a surface, the angle of incidence is _____ to the angle of reflection.

The law of reflection can be written using mathematical symbols. Theta, _____, is used as the symbol for an angle. Subscripts identify the angle. The law says that _____.

The angle of incidence and the angle of reflection are always measured from the normal and not from the surface of the object.

Any mirror that has a flat reflective surface is called a _____ mirror. When using a _____ mirror it's not possible to make an image you can capture on paper (placed behind mirror), since no light from the object _____. This means the image in a plane mirror is a _____ image, an image formed by

rays that do not actually pass through the location of the image. (This is an exact reflection of the real object).

How to Draw a Ray Diagram on a Plane Mirror

1. Draw a "mirror image" by measuring the distance to each extreme point
2. Pick an extreme point on the reflected image and draw the ray that will travel to the eye
3. Draw the incoming ray for light traveling from the corresponding extreme on the **object** to the mirror.

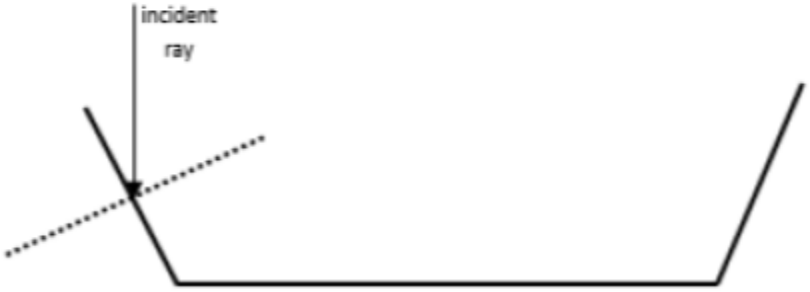
Repeat for each extreme point

Reflection of Plane Mirrors

1. Aim the ray box so that the light passes over top of the first dot. Use two mirrors to reflect the light through the second dot. Use a pencil to trace over the pathway of light.

2. Draw ray diagrams to show the image and the rays that extend to the eye.

3. Trace the incident ray as it reflects from the mirrored surface until it leaves the area (draw in the normals first to show that that law of reflection is being followed... the first normal is drawn for you)



4. Why are letters on an ambulance written in reverse and backward?

5. Come up with a word that does not change appearance in a mirror. (Use the flat mirror to check!)