EQUITY
LEARNING PLACE

Elementary Math Topical (Standard Form)

Question 1:

A floating solar power plant in China generates 4.0×10^7 watts. In United Kingdom, a floating solar power plant generates 6.3×10^6 watts.

a) Giving your answers in standard form, estimate how much more electricity does the China's solar power plant generate compared to the power plant in United Kingdom

b) Express the solar power plant generation of United Kingdom as a percentage of the solar power plant generation of China.

a) $(4 \times 10^7) - (6.3 \times 10^6) = 3.37 \times 10\text{^}7$

b) $\frac{6.3 \times 10^6}{4 \times 10^7} \times 100\% = 15.75\%$

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Question 2:

The table shows the estimated population and Gross Domestic Product of four different countries in 2016.

Gross Domestic Product (GDP) is a monetary measure of the market value of all final goods and services produced

	Singapore	Thailand	United States	China
Population	5,607,300	67,287,600	323,127,513	1,373,541,278
Gross Domestic Product (GDP)	$297 billion	$407 billion	$18,569 billion	$11,218 billion

(1 billion = 1×10^9)

Use as much information from the table as necessary to answer the following.

a) Find the ratio of the population of Singapore to the population of Thailand. Give your answer in the form 1 : *n*.

b) Find the difference between the GDP of United States and China. Give your answer in standard form.

c) Gross Domestic Product(GDP) per capita compares GDP divided by its population.

Is GDP per capita higher in Singapore or United States? You must show your calculations.

a) Singapore : Thailand

$5670300 : 67287600$

$1 : 11.8666$

$1 : 11.9$

b) $18569 \times 10^9 - 11218 \times 10^9$

$= 7351 \times 10^9$

$= 7.351 \times 10^{12}$

c) Singapore GDP per capita $= \frac{297\times10^9}{5607300} = 52966 \approx 53000$

United State GDP per capita $= \frac{18569\times10^9}{323127513} = 57466 \approx 57500$

The United States has a higher GDP per capita than Singapore.

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Question 3:

Light travels 3×10^8 metres per second.

a) 3×10^8 can be written as *k* billions. Find *k*.

b) The Earth is 1.43×10^9 metres from planet Saturn. How long does it take light to travel from Earth to Saturn?

a) $3 \times 10^8 = 300\,000\,000 = 0.3 \text{ billion}$

b) $\text{Time} = \frac{1.43\times10^9}{3\times10^8} = 0.47666 \times 10 = 4.77 \text{ seconds}$

Question 4:

It is estimated that the mass of a single grain of rice is 0.028 grams

a) Write this mass in kilograms in standard form.

b) Estimate the number of grains of rice there are in a 5 kilograms packet, correct to four significant figures and in standard form.

a) $0.028 \text{ g} = 0.000028 \text{ kg} = 2.8 \times 10^{-5} \text{ kg}$

b) $\text{Number of grain} = \frac{5}{2.8\times10^{-5}} = 1.786 \times 10^5$

Question 5:

a) The Pacific Ocean covers approximately 165 250 000 km^2. Write this area in standard form.

b) The ten largest oceans and seas in the world cover a total area of about 3.52 x 10^8 km^2. Calculate the area of the Pacific Ocean as a percentage of the total area of the ten largest oceans and seas.

c) The area of the Earth' surface is given as 5.1 x 10^{10} km^2. Land covers about 30% of the Earth's surface. Calculate the difference between the land area and the total area of the ten largest oceans and seas. Give your answer in standard form.

a) $165\,250\,000 \text{ km}^2 = 1.6525 \times 10^8 \text{ km}^2$

b) $\frac{1.6525\times10^8}{3.52\times10^8} \times 100\% = 46.9\%$

c) $\text{Land area} = \frac{30}{100} \times 5.1 \times 10^{10} = 1.53 \times 10^{10} \text{ km}^2$

$\text{Difference} = 1.53 \times 10^{10} - 3.52 \times 10^8 = 1.4948 \times 10^{10} \text{ km}^2$

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Question 6:

Alpha Canis Majoris is the brightest star in the sky. This star is 8.48 light years away from Earth.

a) Calculate the distance of Alpha Canis Majoris from Earth, in kilometres, giving your answer in standard form, correct to 3 significant figures. (1 light year = 9.46×10^{15} metres)

b) A spaceship travels at 50 000 km/h. Calculate the time taken, in years, correct to the nearest whole number, for the spaceship to travel from Earth to this star.

a) $\text{Distance} = 8.48 \times 9.46 \times 10^{15} = 80.2208 \times 10^{15}\ \text{m} = 80.2208 \times 10^{12}\ \text{km} = 8.03 \times 10^{13}\ \text{km}$

b) $\text{Time} = \frac{8.02208\times10^{13}}{50000} = 1.604416 \times 10^{10}\ \text{h} = 6.6851 \times 10^{8}\ \text{days} = 1831525\ \text{years}$

Question 7:

A radar station transmits a signal which travels at 396 000 km per second. This signal, when reflected from an aircraft, returns to the transmitter at the same speed.

a) Write down the speed at which the signal is transmitted, giving your answer in standard form.

b) Find the difference in time between the signals received by reflection from two aircrafts if one is 495 metres further away from the station than the other.

a) $3.96 \times 10^{5}\ \text{km/s}$

b) $\text{Time} = \frac{(0.495)}{3.96\times10^{5}} = 0.125 \times 10^{-5}\ \text{s} = 1.25 \times 10^{-7}\text{s}$

Question 8:

The diameter of a molecular cell is 73 nanometres. [1 nanometre = 1×10^{-9} m.]

a) Express 73 nanometres in metres, giving your answer in standard form.

b) Under a microscope, the molecular cell is enlarged to a diameter of 6.8 millimetres. Find the number of times the diameter is enlarged under the microscope. Express your answer in standard form, correct to 3 significant figures.

a) $7.3 \times 10^{-8}\ \text{m}$

b) $\frac{6.8\times10^{-3}}{7.3\times10^{-8}} = 9.32 \times 10^{4}$

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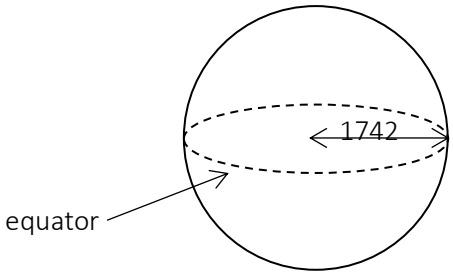
Question 9:

Assume that the moon is a sphere of radius 1742 km.



a) Find the circumference of the moon's equator in metres, expressing your answer in standard form.

b) The speed of light is 3×10^8 m/s. Find the time, in seconds, taken for a light beam to travel a distance equivalent to twice the circumference of the moon's equator.

a) $\text{Circumference} = \pi(2 \times 1742 \times 10^3) = 1.95 \times 10^7 \text{ m}$

b) $\text{Time} = \frac{(1.95\times10^7\times2)}{3\times10^8} = 1.3 \times 10^{-1} \text{ s}$

Question 10:

Express $(2.45 \times 10^{-3}) \div (1.32 \times 10^7)$ in standard form, correct to 3 significant figures.

$= 1.86 \times 10^{-10}$

Question 11:

Four hundred identical drops of oil of density 0.7 g/cm^3 are found to have a total mass 0.000 000 98 g.

a) Write 0.000 000 98 in standard form.

b) Calculate the volume of one drop, in cubic metres.

$a) 9.8 \times 10^{-7}$

b) $\text{volume of 400 drops} = \frac{0.00000098}{0.7} = 0.0000014 \text{ cm}^3 = 1.4 \times 10^{-6} \text{ cm}^3 = 1.4 \times 10^{-12} \text{ m}^3$

Question 12:

The speed of gamma rays in air is approximately 2.983×10^{10} cm/s.

a) Express this speed in metres per second. Give your answer in standard form.

b) Find the time taken for gamma rays to travel one metre. Express this answer in microseconds (μs). (Given 1 second = 1×10^6 microsecond)

a) 2.983×10^8 m/s

b) $\text{Time} = \frac{1}{2.983\times10^8} = 3.35 \times 10^{-9}$ s $= 3.35 \times 10^{-3}$ μs

Question 13:

If the particles have masses *m* and *M*, and are separated by a distance *d*, the magnitude of this gravitational force is given by the formula as shown below

$$F = \frac{GMm}{d^2}$$

where *G* is a constant called the *universal gravitational constant*, and is given by $G = 6.673\times10^{-11}$ Nm^2/kg^2.

a) Two particles with masses *m* = 200 kg, *M* = 500 kg are 0.4 m apart. Calculate the magnitude of the gravitational force exerted between the two particles.

b) Two particles which are 0.6 m apart, exerts a gravitational force of 8.02×10^{-10} N on each other. If one of the particles has a mass of 3.2×10^3 kg, calculate the mass of the other particle.

c) Rearrange the formula to express *d* in terms of *F*, *G*, *M* and *m*.

a) $F = \frac{(6.673\times10^{-11})\times500\times200}{0.4^2} = 4.17 \times 10^{-5}$ N

b) $8.02 \times 10^{-10} = \frac{(6.673\times10^{-11})\times(3.2\times10^3)\times M}{0.6^2}$

$$M = \frac{8.02 \times 10^{-10} \times 0.6^2}{(6.673 \times 10^{-11})(3.2 \times 10^3)}$$

$M = 1.35 \times 10^{-3}$ kg

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Question 14:

The diameter of a virus particle, Avian Influenza, is 80 nanometres and has a spherical shape. Given that **1 nanometre is 1 x 10^{-9} m**, express in standard form,

a) the diameter in centimetres.

b) the volume, in µL, of one such virus. (Note: **1000** µL = **1 cm^3**).

a) $80\ \text{nm} = 80 \times 10^{-9}\ \text{m} = 80 \times 10^{-7}\ \text{cm} = 8 \times 10^{-6}\ \text{cm}$

b) Volume $= \frac{4}{3}\pi(4 \times 10^{-6})^3 = 2.68 \times 10^{-16}\ \text{cm}^3 = 2.68 \times 10^{-13}\ \mu\text{L}$

Question 15:

In the ocean, the largest whale that has ever existed weighs 180 000 kilograms. On land, a male elephant weighs about 7425 kilograms. Calculate the difference in weight, in kilograms, between these two mammals. Give your answer in standard form, correct to 3 decimal places.

Difference $= 180000 - 7425 = 172575 = 1.726 \times 10^5\ \text{kg}$