SOLUTION of PROBLEM – A :

1) Hydrogen (70%)
2) Helium (28%)
3) Astronomical Unit (AU)
4) Carbon-dioxide (95.32%)
5) Asteroids
6) 79
7) IO (Jupiter I)
8) 164.79 Earth years

SOLUTION of PROBLEM –B

(a) Given,

Diameter of Earth = 12,700 km = 1.27×10^4 km

Diameter of Sun = 1.4×10^6 km

Here,

Sun ÷ Earth = $1.4 \times 10^6 \div 1.27 \text{ X } 10^4$

=110.24

So, Sun = (110.24 × 1 cm) × Earth

=110.24 cm × Earth.

(b) The nearest star is 'Proxima Centauri'.

We know, a light year is the distance light travels in one year.

So, the distance from Earth to the nearest star is = $(9.461 \times 10^{12} \times 4.24)$ km

= 4.011×10^{13} km

So, the distance in cosmic scale is = $(4.011 \times 10^{13}) \times 10^5$ cm

= 4.011×10^{18} cm.

SOLUTION of PROBLEM – C

A proportional relation can be set:

Distance of Moon ÷ Diameter = Distance of ruler ÷ Size of image

Or, Distance of Moon ÷ 3500 km = 60 cm ÷ .55 cm

Or, Distance of Moon = 3500 km × (60 ÷ .55)

So, Distance of Moon = 381,818 km.

The precision of the result of the experiment is limited by the precision of the measurements done. The least precision of my measurement is that of the distance of 60 cm, which has one significant figure. If the answer must have one significant figure, so the distance will be 400,000Km. If the distance of 60 cm would have been reported with two significant figures, i.e. 60 cm, then the answer would be 380,000Km.

SOLUTION of PROBLEM – D:

(a) Given,

Gravitational force, $F_G = (G \times m_S \times m_E) \div (R_E+h)^2$ ………(i)

Centripetal force, $F_C = (m_S \times v^2) \div (R_E+h)$ …………..(ii)

From eq^n (i),

$$m_S = (F_G \times (R_E+h)^2) \div (G \times m_E) \text{ ………..(iii)}$$

From eq^n (ii),

$$v^2 = (F_C \times (R_E+h)) \div ((F_G \times (R_E+h)^2) \div (G \times m_E)) \text{ … [from } eq^n \text{ (i)]}$$

So, $v^2 = (F_C \times G \times m_E) / (F_G \times (R_E+h))$ …….. (iv)

Therefore, Kinetic energy, $E_{kin}(h) = (1 \div 2) \times m_s \times v^2$

$= (1 \div 2) \times F_C \times (R_E + h)$ …. [putting the value of m_S from (iii) & v^2 from (iv)].

(b) Given,

Energy density, $E_d = 10^6$ J/Litre.

Mass of satellite, $m_s = 1$ kg

Need of Hydrogen, m_p = ?

We know,

Gravitational constant , $G = 6.674 \times 10^{-11}\ m^3 \cdot kg^{-1} \cdot s^{-2}$

Mass of Earth, $m_E = 5.972 \times 10^{24}$ kg

Radius of earth, $R_E = 6371$ km = 6371000 m

Here, $v^2 = (G \times m_E) \div R$

$= (6.674 \times 10^{-11} \times 5.972 \times 10^{24}) \div (6371000)\ m^2s^{-2}$

$= 6.256 \times 10^7\ m^2s^{-2}$

From (a), Kinetic energy is $(1 \div 2) \times m_s \times v^2$.

We know, the total chemical potential energy stored in satellite is $E_d \times m_p$

If we equate this to the kinetic energy, we get ,

$$(1 \div 2) \times m_s \times v^2 = E_d \times m_p$$

$$\text{or, } (1 \div 2) \times 1 \times (6.256 \times 10^7) = 10^6 \times m_p$$

$$\text{So, } m_p = 31.28 \text{ kg.}$$

Again we know, Density = Mass ÷ volume

Hence, Volume = Mass(m_p) ÷ Density(E_d)

$= (31.28) \div 10^6$

$= 3.128 \times 10^{-5}\ L^3$

So, $3.128 \times 10^{-5}\ L^3$ Hydrogen is needed.

SOLUTION of PROBLEM – E

The simple answer is that the Sun,

like all stars, is able to create energy because it is essentially a massive fusion reaction.

Scientists believe that this began when a huge cloud of gas and particles

(i.e. a nebula) collapsed under the force of its own gravity – which is known as Nebula Theory.

This not only created the big ball of light at the center of our Solar System,

it also triggered a process whereby hydrogen, collected in the center, began fusing to create solar energy.

Technically known as nuclear fusion,

this process releases an incredible amount of energy in the form of light and heat.

But getting that energy from

the center of our Sun all the way out to planet Earth and beyond involves a couple of crucial steps. In the end, it all comes down to the Sun's layers,

and the role each of them plays in making sure that solar energy gets to where it can help create and sustain life

The core of the Sun is the region that extends from the center to about 20–25% of the solar radius.

It is here, in the core, where energy is produced by hydrogen atoms (H) being converted into molecules of helium (He).

This is possible thanks to the extreme pressure and temperature that exists within the core, which are estimated to be the equivalent of 250 billion atmospheres (25.33 trillion KPa) and 15.7 million kelvin, respectively.

The net result is the fusion of four protons (hydrogen molecules) into one alpha particle – two protons and two neutrons bound together into a particle that is identical to a helium nucleus. Two positrons are released from this process, as well as two neutrinos (which changes two of the protons into neutrons), and energy.

The core is the only part of the Sun that produces an appreciable amount of heat through fusion.

In fact, 99% of the energy produced by the Sun takes place within 24% of the Sun's radius.

By 30% of the radius, fusion has stopped almost entirely. The rest of the Sun is heated by the energy that is transferred from the core through the successive layers, eventually reaching the solar photosphere and escaping into space as sunlight or the kinetic energy of particles.

The Sun releases energy at a mass–energy conversion rate of 4.26 million metric tons per second, which produces the equivalent of 38,460 septillion watts (3.846×1026 W) per second. To put that in perspective, this is the equivalent of about 9.192×1010 megatons of TNT per second, or 1,820,000,000 Tsar Bombas – the most powerful thermonuclear bomb ever built!