MARKING GUIDE S6 THEORY

1. C (They require material medium to propagate) **(1 mark)**

2.

a) $v = \sqrt{\frac{T}{\mu}}, 2v = 2\sqrt{\frac{T}{\mu}}, 2v = \sqrt{\frac{4T}{\mu}}$, the tension must be multiplied by 4 **(2marks)**

b) $f = \frac{v}{2L}, v = 2Lf = 2 \times 64.5 \times 10^{-2} \times 110 = 141.9\text{m/s}$ **(2 marks)**

3. a) Climate change refers to any significant change in the measures of climate lasting for an extended period of time. **(2 marks)**

b) Greenhouse effect is the process by which thermal radiation from the sun is prevented from leaving the atmosphere and then re-radiated in different directions. **(2 marks)**

4. **(4 marks)**

Term	**An example of economic activities taking place in the corresponding layer if available.**
Troposphere	Agricultural activities
Stratosphere	***Strategic positioning of space crafts*** (***civil airplane move there***)
Mesosphere	Most meteors burn up in there
Thermosphere	***Many satellites actually orbit Earth within the thermosphere.***

5. **(a)Mechanical weathering** is the physical breaking up of rocks into smaller pieces. **(2 marks)**

(b) Temperature is an essential part of rock creation, modification and destruction. Heating a rock causes it to expand, and cooling causes it to contract. Repeated swelling and shrinking of minerals that have different expansion and contraction rates should exert some stress on the rock's outer shell. **(2marks)**

6. A) An earthquake is the shaking or trembling of the ground caused by the sudden release of energy. **(2 marks)**

b) A landslide is the movement by which soil, sand, and rock move down the slope under the force of gravity. **(2 marks)**

Erosion is incorporation and transportation of material by a mobile agent, usually water, wind, or ice. **(2 marks)**

c) i) loss of lives, loss of soil, destruction of houses, …… **(2 marks)**

ii) you can plant trees, …… **(2 marks)**

7. a) $^{45}_{20}Ca \rightarrow {}^{45}_{21}Sc + e^- + \overline{\nu}_e$ **(1mark)**

b) $^{58}_{29}Cu \rightarrow {}^{58}_{29}Cu + \gamma$ **(1mark)**

c) $^{46}_{24}Cr \rightarrow {}^{46}_{23}V + e^+ + \upsilon_e$ **(1mark)**

d) $^{234}_{94}Pu \rightarrow {}^{230}_{94}U + \alpha$ **(1mark)**

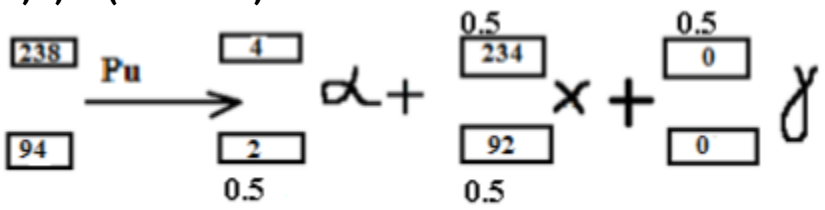
e) $^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + e^- + \overline{\nu}_e$ **(1mark)**

8. a) - A: gamma radiation **(1 mark)**

-B: alpha radiation **(1 mark)**

- C: beta radiation **(1 mark)**

b) i) (2 marks)



ii) The element X is Uranium (U) (1 mark)

c) i) The mass defect $\Delta m = (mp + mn) - mC$

$m_p + m_n = 6 \times 1.007825 + (14 - 6) \times 1.008665 = 14.11627amu$ **/1**

$\Delta m = 14.11627amu - 14.003242$ a. m. u $= 0.113028$ amu **/1**

ii) The binding energy $\Delta E = 0.113028$ amu $\times$ 931.5 MeV $= 105.285582$MeV **/1**

iii) The binding energy per nucleon

$$E' = \frac{\Delta E}{14} = \frac{105.285582\text{MeV}}{14} = 7.520398714MeV \text{ /1}$$

9. A is outer coating **(1mark)**

B is cladding **(1mark)**

C is core **(1mark)**

b) The outer coating A is protection against mechanical hazards like scrapes and scratches. **(2marks)**

The central core C is highly transparent and carries the signal **(2marks)** while the B layer is a cladding of lower refractive index than the core so that total internal reflection occurs at the boundary. **(2marks)**

10. State two advantages of FM over AM.

(i) Efficiency of FM transmission is quite high. **1mark**

(ii) FM transmission gives high fidelity reception due to the presence of a large number of sidebands. **1mark**

(iii) Noise level is very low in FM transmission.

(iv) Frequency allocation in FM allows for a guard band which reduces adjacent channel interference.

11. A. System in which information is transmitted from one physical location, A, to a second Physical location, B. System which allows this information to be sent beyond the range of usual vocal or visual communications. **(2 marks)**

B. A basic telecommunication system consists of three elements: A transmitter that takes information and converts it to a signal A transmission medium that carries the signal; and, A receiver that receives the signal and converts it back into usable information. **(2 marks)**

12.

The proton has the charge +e, then needs two up and one down quarks

$$\frac{2}{3}e+\frac{2}{3}e-\frac{1}{3}e=+e$$

(2 marks)

13. i. zero charge. no particle created but two similar photons. **(1 mark)**

ii. the charge on the combination is +1e. **(1mark)**

14. A) Annihilation **(1 mark)**

b) When a matter collides with its antimater, the two annihilate each other with their mass being entirely converted into energy by the process called "***Annihilation***" **(2 marks)**

c) Matter is a substance that has mass and takes up a space by having a volume. This include atoms and anything made up of these but no other energy phenomena or wave such as light or sound. Everything around you is made up of matter and is composed of particles including the fundamental fermions (quarks, leptons, antiquarks and antileptons) which generally are matter particles and antimatter particles. **(1.5 marks)**

Antimatter is a material composed of the antiparticle to the corresponding particle or ordinary particles. In theory a particle and its antiparticle have the same mass as one another but opposite electric charge and other differences in quantum numbers. **(1.5 marks)**

15. From the quarks table

i. uuu has a charge $q = +2/3 + 2/3 + 2/3 = +2e$ **(1mark)**

ii. uud has a charge $q = +2/3 + 2/3 - 1/3 = +1e$ **(1 mark)**

iii. udd has a charge $q = 2/3 - 1/3 - 1/3 = 0e$ **(1 mark)**

iv. ddd has a charge $q = -1/3 - 1/3 - 1/3 = -1e$ **(1 mark)**

SECTION B

16. A hazard is a phenomenon or process either natural or human made that can endanger a group of people, their belongings and their environment, if they do not take precautions. Some different types of hazards. There are listed below**.(1mark)**

Some natural hazards are:(each main point+explanation/**2marks)** consider any 4 points only

✓ Earthquakes or earth tremors

✓ Landslides:

✓ Volcanic eruptions:

✓ Tsunamis:

✓ Floods

✓ Hurricanes

✓ Cyclones

Hazards Caused by human beings are industrial or technological hazards such as explosions, fires toxic chemical spillages, war and terrorism are also hazards caused by human beings. Natural phenomena can sometimes strike very hard and cause disasters if preventive measures have been taken or if same human activities have harmed the natural environment or upset the balance of the ecosystem. **(1mark)**

17)- Introduction (good introduction related to the topic) **(1 mark)**

- Body with convinced ideas(at least three impact of flood and two ways of minimizing them) **(8 marks)**
- Conclusion **(1 mark)**

18)a) i) Half life is the time taken for atoms to disintegrate to half of their initial number. **(1 mark)**

ii)Nuclear fission is the disintegration of heavy nucleus into two lighter nuclei with higher binding energy per nucleon **(1mark)**

iii)Nuclear fusion is the combining of two light nuclei to produce a heavier nucleus with higher binding energy per nucleon than the sum of the initial binding energy per nucleon. **(1mark)**

b)

$$\text{From } t_{1/2} = \frac{\ln 2}{\lambda} \Rightarrow \lambda = \frac{\ln 2}{t_{1/2}}, \lambda = \frac{\ln 2}{3.8x24x60x60} = 2.11\times10^{-6}/s$$

(2 marks)

c) Three differences between alpha and beta particles**(3 marks)**

Alpha particle	***Beta particle***
Carry a positive charge	*Carry a negative charge*

Is heavier	*Has negligible mass*
Has low penetration power	*Has high penetration power*
Is slightly deflected by magnetic field	*Strongly deflected by magnetic field*

d) Isotopes have the same atomic numbers but different mass numbers

$${}^{37}_{17}Cl \rightarrow {}^{4}_{2}He + 2\,{}^{0}_{-1}e + {}^{33}_{17}X$$

(2 marks)

Since the atomic number of X is 17, then it means that it is an isotope of chlorine

19) a) **i) Doppler Effect** refers to the apparent change/ shift in frequency/pitch as the source of a sound and an observer of the sound wave relative to each other. **(2 marks)**

Doppler effect is the apparent change in frequency or wavelength received due to the relative motion between receiver and the source.

ii.Applications of Doppler effects (any 2 applications) (2 marks)

Robotics

Dynamic real-time path planning in robotics to aid the movement of robots in a sophisticated environment with moving obstacles often take help of Doppler effect.

Sirens

A siren on a passing emergency vehicle will start out higher than its stationary pitch, slide down as it passes, and continue lower than its stationary pitch as it recedes from the observer.

Astronomy

The Doppler effect for electromagnetic waves such as light is of great use in astronomy and results in either a so-called redshift or blueshift. It has been used to measure the speed at which stars and galaxies are approaching or receding from us; that is, their radial velocities.

Radar

The Doppler effect is used in some types of radar, to measure the velocity of detected objects. A radar beam is fired at a moving target — e.g. a motor car, as police use radar to detect speeding motorists — as it approaches or recedes from the radar source. Each successive radar wave has to travel farther to reach the car, before being reflected and re-detected near the source

Medical

An echocardiogram can, within certain limits, produce an accurate assessment of the direction of blood flow and the velocity of blood and cardiac tissue at any arbitrary point using the Doppler effect.

Flow measurement

Instruments such as the laser Doppler velocimetry (LDV), and acoustic Doppler velocimeter (ADV) have been developed to measure velocities in a fluid flow. The LDV emits a light beam and the ADV emits an ultrasonic acoustic burst, and measure the Doppler shift in wavelengths of reflections from particles moving with the flow. The actual flow is computed as a function of the water velocity and phase. This technique allows non-intrusive flow measurements, at high precision and high frequency.

iii) observer B hear a lower frequency means that the car is moving away from B and approaching A

$$f_B = \frac{C}{C + v_s} f_s = \frac{340}{340 + 15} f_s$$

$$f_A = \frac{C}{C - v_s} f_s = \frac{340}{340 - 15} f_s$$

$$353 = \frac{340}{340 - 15} f_s$$

$$f_s = 337.4\text{Hz}$$

(3 marks)

Therefore, $f_B = \frac{340}{340+15} 337.4 = 323.7$ Hz

b) l_o is The length of open pipe

The fundamental frequency of open pipe is given by

$f_0 = \frac{v}{2l}$ *where* $\lambda = 2l$ *or* $l_o = \frac{\lambda}{2} = 2\left(\frac{\lambda}{4}\right)$ (1) **(1 mark)**

and l_c is the length of closed pipe, the fundamental frequency of closed pipe is given by

$f_0 = \frac{v}{4l_c}$ *where* $\lambda = 4l_c$ *then* $l_c = \frac{\lambda}{4}$ (2) **(1 mark)**

Compare (1) and (2) we see that $l_c = \frac{1}{2} l_0 = \frac{1}{2}(90)cm = 45cm$ **(1 mark)**

20)a) i) core because internal reflection occurs when a light ray passes from a denser medium to a rare denser medium. **(3 marks)**

ii) nc=1.5 ncl=1.3 $sinc = ncl\ nc$ = 1.3 1.5 = 0.8667

C= 60o **(2marks)**

b) Let a ray be incident at an angle θ, Figure the angle of refraction at P being . Let C be the critical angle at Q, interface of core and cladding (in this case $\theta_c = \theta_{max}$

Refraction from air to core: $n_0 \sin\theta_{max} = n_f \sin\theta_P \leftrightarrow \sin\theta_p = \frac{\sin\theta_{max}}{n_f}$ (1)

Refraction from core to cladding: $n_f \sin C = n_c \sin 90 \leftrightarrow \sin c = \frac{n_c}{n_f}$ (2)

Also $\theta_p = 90 - c$ so $\sin\theta_p = \cos c$ (3)

From (1) and (2) and using trigonometrically relation: $cos^2C + sin^2C = (\frac{n_c}{n_f})^2 + (\frac{sin\theta_c}{n_f})^2$=1

Simplifying $\sin\theta_{max} = \pm\sqrt{(n_f^2 - n_c^2)}$

(5marks)