S6 PHYSICS (THEORY) MARKING GUIDE

1. A. False **(1 mark)**
B. True **(1 mark)**
C. True **(1 mark)**
D. False **(1 mark)**

2. – i) Gauge boson **(1 mark)**

ii) Quarks and leptons **(1 mark)**

iii) The positron **(1 mark)**

3. a) Attenuation is the reduction in power of the light signal as it is transmitted or transmission loss, is the reduction in intensity of the light beam (or signal) as it travels through the transmission medium **(1 mark)**

b) Repeaters; regenerators and optical amplifiers. **(3marks; one per each)**

4.

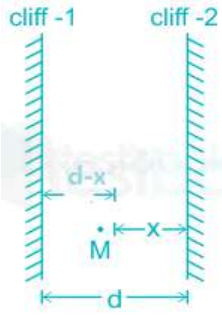
Interaction /force	**Force carrier**
- Strong **/1**	- Gluons **/ 0.5**
- Gravitational **/1**	- Graviton **/ 0.5**
- Weak **/1**	- W boson and Z boson **/ 0.5**
- Electromagnetic **/1**	- Photons **/ 0.5**

5.

- $i \rightarrow c$ **(1mark)**
- $ii \rightarrow e$ **(1mark)**
- $iii \rightarrow a$ **(1mark)**
- $iv \rightarrow b$ **(1mark)**
- $v \rightarrow d$ **(1mark)**

6. Time taken to hear first echo: $t_1 = 2\ secs$ and time taken to hear second echo: $t_2 = 3secs$

- Velocity of sound : v= 340 m/s



Let d be the distance between two cliffs, x is the distance between the man and cliff 2, and (d-x) is the distance between the man and cliff 1.

The speed of sound is $v = \frac{distance\ (d)}{Time\ (t)}$

The distance between the man and the cliff 2 is

$$2x = vt_1 \qquad \textbf{/ 1}$$

$$x = \frac{vt_1}{2} \quad /\mathbf{1}$$

$$x = \frac{vt_1}{2}$$

$$x = \frac{340 \times 2}{2} = 340\,m \quad /\mathbf{1}$$

The distance between the man and cliff 1 is

$$2(d - x) = vt_2 \quad /\mathbf{0.5}$$

$$(d - x) = \frac{vt_2}{2}$$

$$(d - 340) = \frac{340 \times 3}{2} = 510 \quad /\mathbf{0.5}$$

$$d = (510 + 340)m = 850m \quad /\mathbf{1}$$

7. The frequency of the source: $f_s = 216\,Hz$ and the frequency of the observer $f_L = 225\,Hz$. Since the frequency heard is greater than the frequency of the source, the **car is moving toward the observer** (listener) or the car is approaching the observer **/1**

$f_L = f_s\left(\frac{v+v_L}{v-v_s}\right)$ **/ 1**

where v is the speed of sound; v_L: the speed of listener and v_s the speed of the source the car.

$225 = 216\left(\frac{343+0}{343-v_s}\right)$ /1

$-v_s = \frac{216}{225} \times 343 - 343$; $v_s = 13.72\,m/s$ /1

Note! The correct answer with the wrong unit is awarded **0.5 marks**

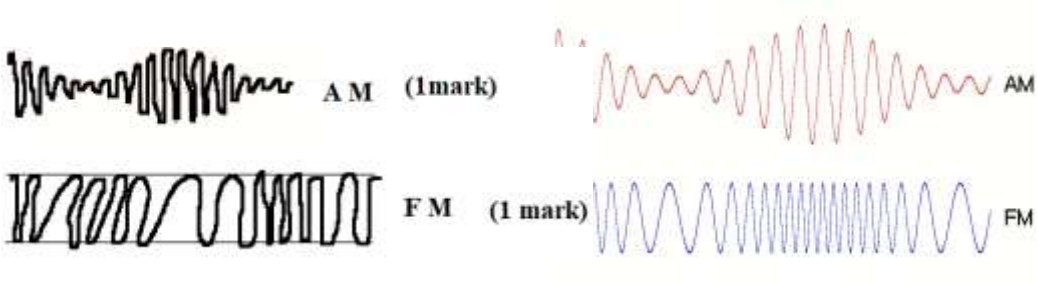
8. The evidences that show that climate is changing are:

- Temperatures are rising world-wide due to greenhouse gases trapping more heat in the atmosphere. **/1**
- Droughts are becoming longer and more extreme around the world. **/1**
- Overall, glaciers are melting at a faster rate **/ 1**
- Sea levels are rising, threatening coastal communities and estuarine ecosystems.
- Water scarcity,
- severe fires,
- flooding,
- melting polar ice,
- catastrophic storms and declining biodiversity. (any three)

9. i) Gravity is a reason why atmosphere is denser closer to the earth's surface **/1**

ii) The rocks contract slightly when the temperatures cool down **/ 1**

10. a)



b) A distinct advantage that FM has over AM is that FM radio has better sound quality than AM radio**. (1 mark)** The disadvantage of FM signal is that it is more local and cannot be transmitted over long distance. **(1mark)**

11. a) City **A**, which is surrounded by a dark-colored rocky surface, would likely have the highest average summer air temperature. Dark surfaces absorb more sunlight **(1mark)** and heat up more quickly than lighter surfaces, leading to higher air temperatures above them**. (1mark)**

b) Sand; silt and clay **(1+1+1)**

12. a) The Richter magnitude scale measures the amount of **Seismic energy** released by an earthquake. **(1 mark)**

b) The intensity of an earthquake is measured with a **Seismograph (1mark)**

The main difference between a cyclone and an anticyclone is that cyclone has **a low pressure** and anticyclone has a **high pressure** **(2mark)**

13. a) The half – life of a radioactive nuclide is the time taken for the number of un decayed nuclei to reduce to half its original number. **(1mark)**

b) Isotopes are elements that have the same atomic number but differ in their atomic mass. Isotones are elements that have the same amount of neutrons. **(1+1)**

c) Let original activity be 1. After $t = 2.303$

$A = A_0 e^{-\lambda t}$ **(1mark)**

$\frac{A}{A_0} = e^{-\lambda t}$

$-\lambda = \frac{\ln\left(\frac{A}{A_0}\right)}{t} = \frac{\ln\left(\frac{1}{10}\right)}{2.303} = -1$ **(1mark)**

$\lambda = 1$

$T_{\frac{1}{2}} = \frac{\ln 2}{\lambda} = \frac{\ln 2}{1} = 0.693\ seconds$ **(1mark)**

14.

- Both positron and proton are positively charged **(1mark)**
- Proton is matter particle while a positron is antimatter particle **(1mark)**
- Proton is a hadron while a positron is a lepton **(1mark)**
- Proton has greater rest mass than positron **(1mark)**
- Proton is made up of quarks while positron is not composed of other particles

15. a)We cannot measure both the position and momentum of an object precisely at the same time. **(2 marks)**

Or $(\Delta x \Delta p) \geq \frac{\hbar}{2}$ /1 Δx: **Change in position**

$(\Delta x)(\Delta p_x) \geq \frac{h}{4\pi}$ /1 Δp **: Change in momentum**

h: Plank's constant

b) i) $\Delta x = 5 \times 10^{-11} m$

$\Delta x \Delta p > \frac{h}{4\pi}$ **/1** $so\ \Delta p = \frac{6.626 \times 10^{-34} Js}{4\pi \times 5 \times 10^{-5} m} = 1.05 \times 10^{-24} kgm/s$ **/1**

The change in momentum is $1.05 \times 10^{-24} kgm/s$

ii) $K_e = \frac{mv^2}{2} = \frac{P^2}{2m}$ /1

$\frac{P^2}{2m} = \frac{(1.05 \times 10^{-24} kgm/s)^2}{2 \times 9.11 \times 10^{-31} kg} = 6.05 \times 10^{-19} J$ = 3.78 ev **/1 +1**

SECTION B

16. a) Climate change is a long-term change in temperature **(1mark)** and weather patterns. **(1mark)**

b) Greenhouse gases such as $CO2$ are the gases in the Earth's atmosphere that trap the sun's heat, stop it from leaking back into space **(1 mark)** and radiate it toward Earth's surface **(1 mark)** and cause global warming which is one aspect of climate change. **(1 mark)**

c) -prevent deforestation **(1 mark)**
- roll out electrical vehicles **(1 mark)**
- encourage people to use renewable energy instead of charcoal or firewood. **(1 mark)**
-Deploy hydro and solar energy equipment
- Introduce vehicle emission standards
- Improve energy efficiency in industry processes
- Practice afforestation and reforestation
-Prohibit the use of refrigerators that contain chlorofluorocarbon (CFCS) **(any three)**

d) The negative effect of climate change is not alarming but nowadays we registered:
- Intensity of extreme events such as floods and droughts have increased in Rwanda **(1mark)**
- Irregularity in rainfall frequencies in RWANDA **(1 mark)**
- Variability in rain intensity in RWANDA

17. a) An earthquake is the movement, shaking or rolling of the Earth's surface caused by the sudden release of energy accumulated in rocks beneath the Earth's crust. **(1mark)**

b)

✓ geological faults **(1mark)**

- ✓ volcanic activity**(1mark)**
- ✓ Landslides**(1mark)**
- ✓ Mine blasts
- ✓ Nuclear weapon tests (any three)

c)

✓ **Positive impacts**

Like many other natural hazards, earthquakes provide many natural service functions. Thus the positive effects of earthquakes include:

- influencing the flow of underground water, **(1mark)**
- oil and natural gas, **(1mark)**
- make mineral resources available,
- landform development,
- monitoring the inside of Earth and producing seismic hazard assessments for designing earthquake-resistant structures.

✓ Negative impacts

Basically, earthquake episodes trigger some immediate effects such as:

- ground shaking, **(1mark)**
- surface rupture, **(1mark)**
- damage to human structures and deaths. **(1mark)**

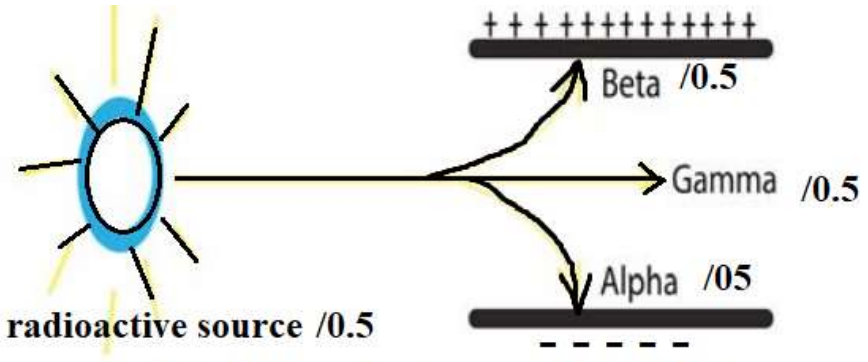
Eventually, some other effects may occur due to sustained vibrations and faulting. Such activities, called secondary effects, can be related to other hazards like tsunamis and landslides. Or they can lead to changes in land elevation, fire and even diseases.

Even though there are positive and negative, the negative is very dangerous because is associated with the loss of lives of persons. **(1mark)**

18. a)

- P: Alpha radiation **(1mark)**
- Q: Beta radiation **(1mark) ;**
- R: Gamma radiation **(1mark)**

b)



Deflections of radiations in electric field

-

- Alpha radiation has positive charge, will be attracted by the negative plate **(1marks)**
- Beta radiation has negative charge, will be attracted by positive plate**(1marks)**
- Gamma radiation has no charge, will not be deflected. **(1marks)**

d) Gamma radiation. **(1marks)** The γ particle is the most penetrating because it has **neither mass nor charge**, hence it interacts relatively weakly with matter. **(1marks)** Gamma rays have the shortest wavelengths (high energy) of all electromagnetic radiation, has the greatest penetrating power.

19. a) i) 215-211=4 and 84-82=2 hence $x = {}^{4}_{2}He$ **(1 mark)**

ii) $x = 214 \ \ and \ y = 83 + 1 = 84$ / **0.5** **+0.5**

iii) $x = 222 + 4 = 226 \ \ and \ y = 86 + 2 = 88$ / **0.5** **+0.5**

b) Background radiation comes from many sources;

- from outer space, **(1 mark)**

Radiation from outer space, called cosmic radiation, comes from exploding stars and from the Sun and includes penetrating gamma rays and fast moving nuclear particles.

- from the earth **(1 mark)**

The rocks and soils on earth contain small quantities of radioactive uranium, thorium and potassium-40 with their daughter products.

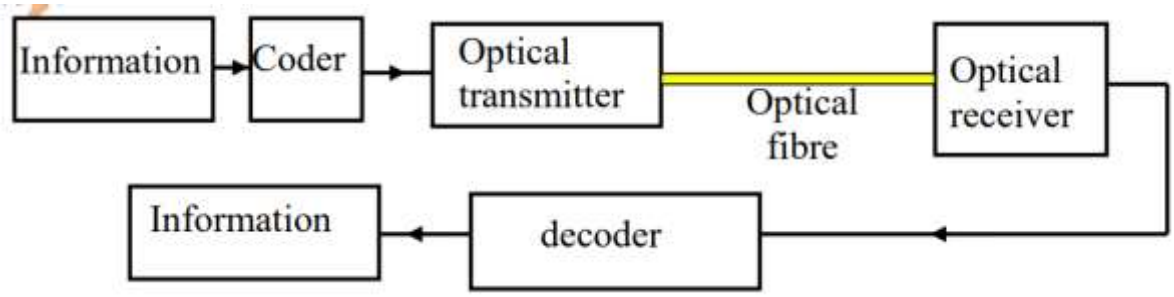
- from inside our bodies

Small traces of naturally occurring isotopes (potassium-40 and carbon-14) are present inside all of our bodies! (any two)

b) **<u>The lungs</u>** generally receive the highest dose of radioactivity **(1mark),** from airborne radioisotopes such as radon-222 gas**. (1 mark)** The lungs exchange more material with the environment than any other organ. **(1 mark)**
Smokers may have a much higher dosage rate than non-smokers as many cigarettes use tobacco which is dried in the open air and accumulates radon dust which settles on it.

c) The background radiation at higher altitudes is greater because of a higher cosmic radiation. **(1 mark)** The atmosphere acts as a shield and attenuates (reduces) the cosmic radiation reaching the earth considerably. **(1 mark)** Thus as one goes to higher altitudes, the 'filtering' action of the atmosphere is reduced.
This is the reason that pilots and flight attendants have a higher exposure to radiation than most other people as they spend a lot of time at high altitudes.

20. a)



((**1 mark**) for each element well placed)

b) A fibre light source is used to inject light into a fibre optic cable for the purpose of testing it. They come in two basic varieties: light emitting diodes (LEDs) **(1 mark)** and laser diodes. **(1 mark)**

c) The core should have greater refractive index than cladding**(1mark)** for TIR to take place because TIR will happen only when light travels from denser to rarer medium. (TIR: Total internal reflection) **(1mark)**