

OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE
DEPARTMENT OF PHYSICS AND ENGINEERING PHYSICS
2021/2022 RAIN SEMESTER EXAMINATION

PHY 202 – Introduction to Environmental Physics Time: 2 1/2 hours

USEFUL CONSTANTS

$1 \text{ AE} = 1 \times 10^9 \text{ yrs}$, Stefan Boltzmann Constant $= 5.7 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$, Universal gas constant, $R = 8.381 \times 10^3 \text{ J/kilomole K}^{-1}$, Boltzmann constant $k = 1.381 \times 10^{-23} \text{ J molecule}^{-1} \text{ K}^{-1}$,
The molecular weight of air = 28.97, Avogadro's number = $6.023 \times 10^{23} \text{ molecules/gmol}$.

SECTION A IS COMPULSORY AND ANSWER ONLY TWO QUESTIONS IN SECTION B

SECTION A: 1 HOUR (ATTEMPT ALL 30 QUESTIONS)

1. Which of the following statements is FALSE?

- A. Cosmogony deals with theories of the origin of the universe, while Cosmology is the study of the fundamental structures of the universe already in existence.
- B. The Evolution Model of Origins postulates a continuing naturalistic Origin of all Basic Systems
- C. The Evolution Model postulates a net present increase in Organized Complexity of Basic Systems
- D. The Creation Model postulates a net present decrease in Organized Complexity of Basic Systems
- E. Both the Evolution Model and the Creation Model can be blended together to form a common Hybrid Model.

2. Which of the following statements is TRUE?

- A. We can authoritatively affirm that the Earth has always existed, and has no origin
- B. We can authoritatively affirm that the Earth has an origin
- C. We can scientifically confirm that the Earth does NOT have a Creator/Designer
- D. We can NOT scientifically confirm that the Earth will cease to exist some day in the future
- E. Ongoing radioactive decay is the sole source of the heat within the earth

3. The name of the ancient city of Ile-Ife suggests that:

- A. It is a city of Love
- B. The city was once totally submerged by flood
- C. It was a city where the fossils of the evolutionary "missing links" were found
- D. It was founded by the warrior named Ife
- E. None of the above is correct

4. "One has only to contemplate the magnitude of this task to concede that the spontaneous generation of a living organism is impossible. Yet here we are – as a result, I believe, of spontaneous generation" Who made this statement in the Scientific American of August 1954?
- A. Carl Linnaeus, often called the Father of Taxonomy
 - B. Anton Van Leeuwenhoek, the Father of bacteriology and microbiology
 - C. Gregor Mendel, the first person to trace the characteristics of successive generations of a living thing.
 - D. George Wald, a Nobel Laureate in Biology from Harvard
 - E. A confused non scientist

5. The Sustainable Development tripod comprises of the following:
- A. Environment – Social – Economy
 - B. Environment – Health – Economy
 - C. Environment – Energy – Economy
 - D. Environment – Social – Energy
 - E. None of the above

6. Sustainable Development can be defined as:

- A. Development that sustains society in good health over several generations
- B. Development that meets the needs of today without jeopardizing those of future generations
- C. Development that sustains the economy of the society from generation to generation
- D. The introduction of Modern ICT infrastructure into a Community
- E. Availability of renewable energy over long periods, such that industries can run without hitches.

7. Which of the following statements is FALSE?

- A. Mercury is a major toxic element associated with exploitation of coal for energy production
- B. Mercury is a major component of many childhood vaccines used exclusively in developing countries like Nigeria
- C. Mercury is never used in cosmetic industry
- D. Mercury is used extensively in the beneficiating processes of artisanal gold mining
- E. Mercury is present extensively in the coal ore deposit at Enugu.

8. Which of these is irrelevant in determining the true history of the earth?

- A. Oral traditions, especially of events that are reported among different cultures and traditions all over the world
- B. Geographical features such as gorges and mountains
- C. Study of ice-core layers
- D. Ongoing separation of the continents
- E. None of the above

14. Changes in C-14/C-12 ratio can be due to
- A. variations in the amount of cosmic rays reaching the earth from the sun due to earth's passage through magnetic clouds
 - B. known decreasing intensity of the earth's magnetic field
 - C. discrimination by plants to different extents, against carbon-dioxide containing C-14,
 - D. Anthropogenic (Industrial age) contributions
 - E. All of the above

15. A fossil is found to contain 10 percent carbon-14 compared to a living sample, estimate the age of that fossil if the half-life for C-14 is 5,700 years

- A. 1,894 years
- B. 18,940 years
- C. 189,400 years
- D. 1,894,000 years
- E. 18,940,000 years

16. Which of these is not used to obtain information about the interior of the Earth?

- A. Study of Earthquakes and Volcanoes
- B. Echo Sounding using Seismic waves
- C. Meteorites
- D. Radiometry
- E. All of them are employed to obtain information about the interior of the Earth.

17. Which is FALSE?

- A. Seismic waves travel faster in a medium of lower refractive index than one with higher refractive index
- B. The diameter of the Earth is about 6400 km
- C. Oceanic Crust is thinner than Continental Crust
- D. Oceanic Crust is less dense than Continental Crust
- E. Convective motions within the earth are the cause of earthquakes and volcanoes

18. Which of the following Ordering of regions is INCORRECT, moving from the Earth' surface inward:

- A. Crust – Moho – Upper Mantle – Lower Mantle
- B. Lithosphere –Aesthenosphere - Mesospheric Mantle – Core
- C. Crust – Upper Mantle – Lower Mantle – Outer Core – Inner Core
- D. Crust – Mantle – Mohorovicic Discontinuity – Core
- E. None. They are all correct

19. Which of the following statements is FALSE?

- A. Convective motions within the earth are the cause of volcanoes
- B. Convective motions within the earth are associated with the earth's magnetic field'
- C. Mountains within the oceanic crust are called Oceanic Ridges
- D. The asthenosphere is more brittle than the lithosphere
- E. The lithosphere is strong and brittle

20. Which of the statements in A-D below is FALSE?

- A. Ongoing radioactive decay is the sole source of the heat within the earth
- B. Convective motions within the earth are the cause of earthquakes and volcanoes
- C. Convective motions within the earth are the cause of volcanoes
- D. Convective motions within the earth are associated with the earth's magnetic field'
- E. None of the above

21. Which of the statements in A-D below is FALSE?

- A. Rifting and subduction are the dominant forces that sculpt the landscape
- B. Rifting and subduction may trigger earthquakes and volcanoes
- C. The US National Aeronautical and Space Agency considers the possible collision of massive objects from space on the planet earth a more serious threat to the planet than the possible eruption of Yellowstone supervolcano.
- D. The US National Aeronautical and Space Agency (NASA) is considering cooling Yellowstone supervolcano with water as one option of preventing its eruption.
- E. None of the above.

22. In the famous book, *Ogboju Ode Ninu Igbo Irunmole*, by D.O. Fagunwa, the strength of (bio)diversity is portrayed through which Character?

- A. Kaako B. Akara-Ogun C. Aramoda Okunrin D. Imodoye E. Olohun Iyo

23. Which of the following represents increasing magnitude of Volcanic eruptions in recent history:

- A. Mt St Helens (1980) – Krakatoa (Indonesia, 1883) – Vesuvius (Italy 79 AD) – Tambora (Indonesia 1815)
- B. Mt St Helens (1980) – Vesuvius (Italy 79 AD) – Krakatoa (Indonesia, 1883) – Tambora (Indonesia 1815)
- C. Mt St Helens (1980) – Vesuvius (Italy 79 AD) – Tambora (Indonesia 1815) – Krakatoa (Indonesia, 1883)
- D. Mt St Helens (1980) – Tambora (Indonesia 1815) – Vesuvius (Italy 79 AD) – Krakatoa (Indonesia, 1883)
- E. D. Krakatoa (Indonesia, 1883) – Mt St Helens (1980) – Tambora (Indonesia 1815) – Vesuvius (Italy 79 AD) –

24. Which of the statements below is TRUE?
- A. Genetically Modified Organisms can develop naturally, given sufficiently long time of in-breeding
 - B. Genetically Modified Organisms comprise of genetic materials from different species
 - C. Genetically Modified Organisms and Hybrid Organisms are essentially the same
 - D. The seeds of Genetically Modified Organisms are generally NOT patented.
 - E. None of the statements is True.
25. Which of the statements in (A-D) below is INCORRECT?
- A. The earth's geomagnetic field extends from the Earth's interior up to about 1 km above the earth's surface after which it tapers off to zero.
 - B. The geomagnetic field is believed to be generated by a geodynamo produced by the convective motion of molten iron in the earth's outer core
 - C. The intensity of the earth's magnetic field is currently decaying .at about 5% per century
 - D. The magnetosphere extends several tens of thousands of kilometers into outer space and is responsible for protecting the earth from ionizing radiation from the solar wind and cosmic rays.
 - E. None of them is Incorrect.
26. The continents of South America and Africa (West coast) are separated by the 3,200 km wide Atlantic Ocean; and according to satellite data, they are receding from one another at a rate of 5.7 cm per year. Assuming they were once together, as propounded by modern theories of plate tectonics, and that the UNIFORMITARIAN assumption of a constant drift rate holds, when did the event that caused their separation occur?
- A. 56 million years
 - B. 5.6 billion years
 - C. 1.8 billion years
 - D. 18 million years
 - E. None of the above
27. Which of these is NOT correct?
- A. The Aral Sea is located in Uzbekistan
 - B. The disappearance of the bulk of the Aral Sea is associated with poor crop growth as far as 500km away from the sea
 - C. The 99% depletion of water in the Aral Sea was caused primarily by Climate Change and Global Warming
 - D. The peculiar situation at the Dead Sea is natural, while that at Aral Sea is man-made
 - E. The same reason is responsible for the lack of aquatic life-forms in both the Dead Sea and the Aral Sea

28. The process called exfoliation is associated with:

- A. Fossil formation
- B. Weathering
- C. Erosion
- D. Carbon dating
- E. Mining

29. Which of the statements in A-D below is FALSE?

- A. Vegetative cover reduces erosion rate by making the soil more permeable to rainwater
- B. Vegetative cover reduces erosion rate by shielding soil from wind
- C. Vegetative cover reduces erosion by increasing cohesion in soil particles
- D. Vegetative cover reduces erosion by transforming the slope of the terrain to better oppose erosion
- E. None of the above

30. Which of the statements in A-D below is FALSE?

- A. The anthropic principle deals with the unique design of planet earth to host life
- B. The Sun is the major source of energy for the planet earth.
- C. The skies provide navigation, calendar/clock, etc.
- D. Water is the most abundant item on planet earth
- E. None of the above

SECTION B: ANSWER ONLY TWO QUESTIONS (1 1/2 Hours)

- 1a How is tropospheric Ozone changing globally and regionally, and what drives these long-term trends?
- b (I) For an Isothermal atmosphere, use the hydrostatic approximation and the equation of state to obtain

$$P_z = P_0 e^{-z/H}$$

Where P_z and P_0 are atmospheric pressure at height z and surface pressure, and H is the scale height.

(ii) Hence, establish that lapse-rate of the temperature in an isothermal atmosphere is a constant.

- c How does climate change affect people's health and who is most at risk from the impacts of climate change?
- 2a Briefly explain the three (3) components of the solar atmosphere and why does the temperature in the Chromosphere increase with height?
- b Explain the Ionic reactions in the D, E and F-regions of the Ionosphere.
- c Why is it called the solar system and briefly describe the closest planet to the Sun?
- 3a How does earth maintain its energy balance and what is global energy budget?
- b ✓ The mass of the Earth is $7.72 \times 10^{24} \text{ kg}$ and the gravitational constant is $6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$. Assuming the earth is a uniform sphere of radius $6.37 \times 10^6 \text{ m}$. Find the gravitational force on a mass of 10.2 kg at the earth's surface.
- c (i) Differentiate between a planet and Satellite. (ii) What are the basic assumption made in Homogenous and Isothermal atmosphere?

Handwritten notes and calculations:

$$G \cdot F = \frac{G \cdot M \cdot m}{r^2}$$

$$= \frac{6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2} \times 7.72 \times 10^{24} \text{ kg} \times 10.2 \text{ kg}}{(6.37 \times 10^6 \text{ m})^2}$$

Notes:
 - density is constant and independent of height
 - total amount of energy used is absorbed
 - mesosphere
 - land atmosphere
 - temperature is constant
 - planet orbiting solar system
 - absorption heat and solar radiation
 - 50° and 25°
 - $\frac{50}{25}$
 - $\frac{m \cdot kg}{s^2}$
 - $\frac{m \cdot kg}{s^2}$
 - $F = m \cdot a$
 - (m)