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FACULTY OF HEALTH SCIENCES
DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCE
FINAL EXAMINATION [MAY 2013]

TITLE OF PAPER : ENVIRONMENTAL PHYSICS II
COURSE CODE : EHS 412
ACADEMIC YEAR : 2012/2013
TIME : 2 HOURS
MARKS : 75

INSTRUCTIONS

1. DO NOT OPEN THIS EXAMINATION PAPER UNTIL YOU ARE INSTRUCTED TO DO SO BY THE INVIGILATOR.
2. QUESTION ONE IS COMPULSORY. CHOOSE ANY OTHER TWO QUESTIONS IN ADDITION TO QUESTION ONE [THREE QUESTIONS IN TOTAL].
3. BEGIN YOUR ANSWERS TO EACH QUESTION ON A FRESH PAGE OF THE ANSWER BOOKLET. ENSURE THAT ALL PAGES OF THE ANSWER BOOKLET ARE NUMBERED ACCORDINGLY.
4. NO MARKS SHALL BE AWARDED FOR POOR HANDWRITING AND POOR ENGLISH LANGUAGE GRAMMAR.
5. NECESSARY PENALTIES SHALL BE APPLIED FOR ANY UNACCEPTABLE BEHAVIOUR DURING THE COURSE OF THIS EXAMINATION.

QUESTION ONE [TOTAL NUMBER OF MARKS = 25]

1. Salmon usually move towards upstream areas to reproduce. Hydroelectric dams, which are built across rivers, are particularly a problem because;
 - a. The advancing fish often come against cold water, and so they are forced to return to sea.
 - b. Dams eliminate current.
 - c. Dams are so deep and so most pregnant fish often struggle to swim past such deep water.
 - d. Fish cannot see anything, since in deep water light cannot reach to lower levels, so fish lose their way.
2. Fish reproduction and aquatic biodiversity in general is often poor in areas downstream of hydroelectric dams. This is mainly associated with;
 - a. Temperature
 - b. Displacement of people
 - c. Ladders
 - d. The impact of turbines
3. Uranium ore while on the ground (before mining) contains 100% usable energy. On the other hand, the sun also emits 100% usable energy. At the point of use however;
 - a. There is more usable energy from uranium than from the sun
 - b. There is more usable energy from the sun than from uranium
 - c. Usable energy is equal for both uranium and the sun
 - d. Usable energy is in the range of 65 – 80% for uranium while the sun will still provide 100% usable energy.
4. In answering question one above, you relied on;
 - a. First law of thermodynamics and the number of steps during processing of the energy from source to the point of use.
 - b. Second law of thermodynamics and the number of steps during processing of the energy from source to the point of use.
 - c. Third law of thermodynamics and the number of steps during processing of the energy from source to the point of use.
 - d. Fourth law of thermodynamics and the number of steps during processing of the energy from source to the point of use.
5. One of the most important factors that affect the longevity of hydroelectric dams is;
 - a. Global climate change
 - b. Sediment
 - c. Ever increasing demands for power
 - d. Seismic activity

6. The renewable energy type that provides more flexibility in meeting fluctuating power demands is;
 - a. Solar energy
 - b. Wind power
 - c. Geothermal power
 - d. Hydropower
7. In hydroelectric dams, the construction of fish ladders is important in;
 - a. Enabling reservoir employees to climb into the reservoir and carry out inspections on biodiversity.
 - b. Enabling fish to have sites where they could lay their eggs because they cannot do so in the middle of the reservoir.
 - c. Fish movement to spawning sites.
 - d. The cleaning of reservoirs.
8. At the Mbabane Industrial Site, there are two main companies, namely A and B. Company A generates electricity from coal (i.e., coal burning → water boiling → steam generation → turbine spinning → electricity). Company B burns coal to boil tar road making ingredients and also generates its own electricity for lighting within the factory. Of the two companies, cogeneration is well understood by;
 - a. Company A because it generates steam and electricity
 - b. Company B
 - c. Both companies
 - d. None of the two companies
9. Health effects associated with exposure to low level radiation are;
 - a. Often delayed and therefore, harder to determine with certainty.
 - b. Immediately experienced and quite easy to determine.
 - c. Often delayed but once they are determined, treatment is easy using current medical advances.
 - d. Often delayed, hard to determine and lead to death immediately.
10. With regard to farming, the main causes of hardship for communities that are displaced during dam construction are related to;
 - a. Reduced sediment
 - b. Increased flooding
 - c. Reduced water for irrigation
 - d. Increased number of animals eating crops

11. The useful operating life of a nuclear power plant is estimated to be;
 - a. 20-30 years
 - b. 30-40 years
 - c. 40-50 years
 - d. 50-60 years
12. In nuclear power plant decommissioning, covering the reactor with reinforced concrete is practiced in;
 - a. Mothballing
 - b. Immediate dismantling
 - c. Entombment
 - d. Cask storage
13. Nuclear energy production (uranium mining; transportation to processing and purification plants; production of fuel pellets, fuel rods, fuel assemblies, etc) is less expensive compared to decommissioning of old power plants.
 - a. I fully agree
 - b. I do not agree
 - c. Energy production and dismantling are equally expensive
 - d. Energy production is more expensive only when there are accidents, otherwise it is far less expensive than dismantling.
14. Permanent safe storage facilities for nuclear waste are presently;
 - a. Available under the ocean
 - b. Not available
 - c. Available under mountains
 - d. Available in former underground mine sites
15. With regard to air pollution, many renewable energy types are usually not a problem. However, there are some air pollution concerns when it comes to;
 - a. Passive solar
 - b. Power tower
 - c. Geothermal energy
 - d. Wind energy
16. The earth's core is a molten mass of material which is as hot as 400°C . Practically speaking, geothermal energy is a very good source of renewable energy. The only main concern is that;
 - a. It induces volcanic eruptions
 - b. It requires controlled production
 - c. It is not suitable for small households, because as the heat comes from the ground it is around 400°C , and so, only suitable for large industries.
 - d. It leads to pollution of nearby groundwater sources

17. The main purpose of a nuclear power plant is;
- To enable nuclear fusion
 - To concentrate uranium
 - To boil water
 - To enable nuclear fission
18. High level radioactive waste;
- Gives off small amounts of ionizing radiation for a short time and large amounts for a long time.
 - Gives off large amounts of non-ionizing radiation for a long time and small amounts for a short time.
 - Gives off large amounts of ionizing radiation for a short time and small amounts non-ionizing radiation a long time.
 - Gives off large amounts of ionizing radiation for a short time and small amounts for a long time.
19. The increased rate of erosion below hydroelectric dams is related to;
- Reduced sediment
 - Increased flow rate
 - Increased sediment
 - Reduced flow rate
20. Wind power is actually a form of;
- Nuclear energy
 - Hydropower
 - Solar energy
 - Geothermal energy
21. Wind farms are often located along ridges to take advantage of higher winds. In many cases, this practice has led to significant impacts on birds due to the fact that;
- In many cases, turbines are often placed in ridges, which serve as natural corridors for migrating birds
 - Birds often like to land on cables where they get electrocuted
 - Turbines create a suction force which drags birds towards the blades and they get killed
 - Most farms under turbines are used for growing maize, which attracts a lot of rats. Therefore, as birds dive down for rats, they get killed by the turbines
22. One of the greatest challenges facing solar energy is;
- Conversion from AC current to DC
 - The disposal of used batteries which contain plutonium
 - Intermittency
 - Unaffordable costs

23. One of the chief environmental threats that are associated with even the best of nuclear power plant is;
- Release of huge quantities of radioactive emissions during normal power production
 - Possibility of perishing of aquatic species
 - SO₂ emissions
 - Respiratory problems, especially amongst nuclear power plant employees
24. Due to the many problems that are associated with nuclear power production, the rate at which new nuclear power plants are constructed has dropped to approximately;
- 15 – 20 per year worldwide
 - 10 – 15 per year worldwide
 - 0 – 5 per year worldwide
 - 5 – 10 per year worldwide
25. The atomic number;
- Tells us the number of positively charged protons and the equal number of negatively charged electrons outside its nucleus.
 - Tells us the number of positively charged neutrons and the equal number of negatively charged electrons outside its nucleus.
 - Tells us the number of positively charged atoms in the periodic table
 - Tells us the number of neutrons that are released during fission reactions in a nuclear power plant.

QUESTION TWO [TOTAL NUMBER OF MARKS = 25]

1. What is meant by energy efficiency? [3]
2. In energy studies, it is said that the net efficiency of the entire energy delivery process for a particular system is determined by the efficiency of each step in the energy conversion process. Mercedes Benz manufacturers have wholly adopted this knowledge and their latest model is said to be 100% energy efficient. Based on this information, answer the questions that follow below;
 - 2.1 Using your knowledge of thermodynamics, do you think it is possible for Mercedes car manufacturers to produce a 100% energy efficient vehicle? [2]
 - a. Yes
 - b. No
 - 2.2 Which law of energy did you apply in answering question 2.1 above? [2]
 - a. First law of thermodynamics
 - b. Second law of thermodynamics
 - c. Third law of thermodynamics
 - d. Fourth law of thermodynamics
 - 2.3 State, in full, the law of thermodynamics which you have chosen in question 2.2 above [3].
3. State any two immediate health effects associated with exposure to high level radiation and two delayed effects [4].
4. Sensitivity to radiation differs among children, fetuses and adults. Arrange these three groups in order of sensitivity from the most sensitive to the least sensitive [3].
5. The most common radioactive emissions are alpha particles, Gamma rays and Beta particles. Rearrange these emissions in order of their penetrative strength, starting with the weakest to the strongest [3].
6. Hydroelectric power production could result to impacts on farmland that may ultimately reduce food production. Explain briefly [3].
7. Explain how the use of solid biomass fuels can be controlled to ensure that there is no net increase in CO₂ emissions [2].

QUESTION THREE [TOTAL NUMBER OF MARKS = 25]

1. As far as nuclear waste is concerned, state two historic disposal methods, two current disposal methods and two proposed disposal methods [6].
2. Hydrogen is a clean fuel; it produces water and heat as it burns, but it produces no sulfur oxides, carbon monoxide, hydrocarbon particulates, or CO₂ emissions. Using your knowledge of production processes and challenges associated with this renewable energy, answer the following questions.

- 2.1 In a coal-powered electricity plant, the main source of fuel in the electricity production process is coal. What is the main source of fuel in hydrogen gas production? [2]
- 2.2 What do you understand by this statement “hydrogen has negative net energy”? [3]
- 2.3 According to the statement given in question two, hydrogen does not release any major pollutants.
 - a. However, under what circumstances would hydrogen really be considered as a truly clean fuel? [3]
 - b. Under what circumstances is hydrogen considered as a contributor to the emission of major air pollutants? [5]
3. State any three examples of solid biomass fuels [4].
4. Explain how dependence on solid biomass fuels could result in increased CO₂ concentrations in the atmosphere [2].

QUESTION FOUR [TOTAL NUMBER OF MARKS = 25]

1. Africa depends solely depends on nuclear power for electricity, Asia depends on hydropower and America depends on hydrogen. Nuclear power production is known to be free from emissions of CO₂ (the most potent greenhouse gas). Hydropower generation also has no CO₂ emissions because the water only spins the turbine and passes on. When burned, hydrogen only releases water and heat with zero CO₂.
 - a. Despite the above information, why is America the number one contributor to global climate change (do not consider any other factors, concentrate only on power generation using hydrogen)? [4]
 - b. Of the three continents given in question one, which one is likely to be ranked in second position with regard to emission of greenhouse gases? [2]
 - c. Describe your reasons for your answer in question one (b) above [4].
 - d. State any two greenhouse gases that, that are likely to be released in the continent you have chosen in question one (b) above [2].
 - e. Amongst the three continents, where are you likely to observe increased seismic activity? [2]
5. State any two high temperature heat and electricity technologies that are based on solar energy [3].
6. Each year, about 1/3 of the spent fuel assemblies in a reactor are removed and placed in large concrete lined pools of water at the plant site. State the two purposes of this practice [2].
7. State the two main categories of nuclear waste. For each of the two categories, state two examples [6].