

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

07 MAR 2019

Level : B. Sc.
Year : II
Time : 2 hrs. 30 mins.

Course : PHYS 206
Semester: I
F.M. : 55

SECTION "B"

[5 Q. × 4 = 20 marks]

Attempt *ALL* questions.

1. Write short notes on
(a) albedo
(b) lapse rate

OR

What is meant by coefficient of thermal conductivity and thermal resistance of a material? Temperature inside a room is 25°C and outside is 10°C. Calculate the amount of heat that will leave the room in 10 minutes through a glass window ($K = 0.002 \text{ W.cm}^{-1}.\text{K}^{-1}$) 2 m long, 1 m wide and 0.4 m thick.

2. What is meant by noise? How is it measured? Describe the methods of reducing the effect of noise.
3. Explain the theory of radioactive decay. How is the half-life period defined? A carbon specimen found in a cave contained $1/16$ as much C^{14} as an equal amount of carbon in living matter. Calculate the approximate age of the specimen. Half-life period of C^{14} is 5730 years.
4. What is the basic principle used in a refrigerator? An ideal refrigerator takes heat from water at 0°C and transfers it to a room at 27°C. If 100 kg of water is to be changed into ice at 0°C, determine the required work in joules. (Latent heat of ice = $3.4 \times 10^5 \text{ J/kg}$)

OR

Describe the construction and working of hydrogen/oxygen fuel cell.

5. Discuss the management of nuclear fuel cycle.

SECTION "C"

[5 Q. × 7 = 35 marks]

Attempt *ALL* questions.

6. Define the terms entropy, exergy and anergy. Discuss the loss of exergy in combustion and estimate the loss of exergy with cold reservoir temperature $T_C = 300 \text{ K}$ and hot reservoir temperature $T_H = 2240 \text{ K}$.
7. Define solar constant. Discuss, in detail, with well labeled diagrams, the solar photovoltaic cell/system.

OR

What are the conditions for nuclear fusion? Describe the working of a nuclear fusion reactor with a well labeled diagram.

8. Describe the principle of Thompson's mass spectrometer. Alpha particles are accelerated through a potential difference of 1000 volts and then enter a magnetic field of flux density 0.2 Wb/m^2 perpendicular to their direction of motion. Calculate the radius of the path. (Mass of alpha particle $M_\alpha = 6.68 \times 10^{-27} \text{ kg}$ and charge $= 3.2 \times 10^{-19} \text{ C}$)
9. Describe the different layers of earth's atmosphere. Explain the importance of ozone layer and describe the processes leading to the formation and depletion of this layer.
10. What are the differences and similarities between nuclear fission and nuclear fusion? It is given that the energy released by fission of a single U^{235} nucleus is 200 MeV. Calculate the energy released by fission of 0.5 kg of U^{235} .

OR

What do you mean by radiation inversion? Explain how an inversion layer is formed and how it affects the vertical movement of air. Give a brief account of the different shapes of plumes and atmospheric stability.

Mark Scored:

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Registration No.:

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SECTION "A"

[20 Q. × 1 = 20 marks]

Choose and tick the most appropriate answer.

- During an adiabatic expansion, the increase in volume is associated with
[a] increase in pressure and increase in temperature
[b] increase in pressure and decrease in temperature
[c] decrease in pressure and increase in temperature
[d] decrease in pressure and decrease in temperature
- The maximum possible efficiency of an ideal heat engine that absorbs heat at 327°C and exhausts heat at 127°C is
[a] $1/2$ [b] $1/3$ [c] $1/4$ [d] $2/3$
- The dependence of extraterrestrial solar radiation on time of year (measured on the plane normal to the radiation) is indicated by the equation
[a] $G = G_{\text{SC}} \left[1 + 0.33 \cos \frac{365n}{360} \right]$ [b] $G = G_{\text{SC}} \left[1 + 0.033 \cos \frac{365n}{360} \right]$
[c] $G = G_{\text{SC}} \left[1 + 0.33 \cos \frac{360n}{365} \right]$ [d] $G = G_{\text{SC}} \left[1 + 0.033 \cos \frac{360n}{365} \right]$
- Heavy water is used as a moderator in a nuclear fission reactor. The function of the moderator is
[a] to cool down the reactor
[b] to control the energy released in the reactor
[c] to slow down the neutron to thermal energies
[d] to absorb neutrons and stop the chain reaction
- Fusion reaction takes place at high temperature because
[a] nuclei break up at high temperature
[b] atoms are ionized at high temperature
[c] molecules break up at high temperature
[d] kinetic energy is high enough to overcome repulsion at high temperature
- The effect of clouds which will have on earth with respect to short wavelength radiation is
[a] decrease albedo [b] reflect more radiation
[c] absorb more radiation [d] add to the green house effect
- The intensity of a sound from a source is 10^{-5} W/m^2 . The intensity level of this sound is
[a] 50 dB [b] 60 dB [c] 70 dB [d] 100 dB

8. Which one of the following statements about nuclear radiation is true?
 [a] α -particles are more ionizing than γ -rays
 [b] α -particles are less ionizing than β -particles
 [c] α -particles are more penetrating than γ -rays
 [d] β -particles are less penetrating than α -particles
9. It was found in an experiment that a radioactive element emits 4500 α -particles per second per gram. One gram of the element contains 2.61×10^{21} atom. Its half-life should be to
 [a] 5.4 years [b] 128 years
 [c] 1.28×10^{10} years [d] 5.4×10^{11} years
10. Saturated adiabatic lapse rate
 [a] is always equal to dry adiabatic lapse rate
 [b] is always lower than dry adiabatic lapse rate
 [c] is always higher than dry adiabatic lapse rate
 [d] can be higher or lower than dry adiabatic lapse rate depending upon the atmospheric stability

Fill in the blanks.

11. A beam of ions enter a Bainbridge's mass spectrograph with a velocity selector having electric and magnetic fields 1.5 kV/m and 0.3 Tesla respectively. If the deflecting magnetic field is 0.5 T, radius of the path followed by the isotope of mass 24 will be
12. Ozone layer is responsible for the absorption of solar radiation of wavelength mainly in the range of
13. The energy of a photon in (eV) of a radiation of wavelength 500 nm is equal to
14. A radioactive nucleus ${}_Z X^A$ emits a beta-particle. The new nucleus formed after the decay is represented by
15. If two sources of loudness 40 dB are combined, the resultant loudness is equal to
16. In an ideal refrigerator, if heat from inside at 277 K is transferred to a room at 300 K, then joules of heat will be delivered to the room for each joule of electrical energy consumed.
17. The renewable energy supplies which are mechanical in origin are usually best distributed by
18. During the simulation of convective energy loss, a student volunteer with surface area 1.8 m^2 and skin temperature 31°C is placed in a wind tunnel with air temperature -2°C and velocity 40 km/h. If the convective energy transfer coefficient is $44.8 \text{ W/m}^2/\text{K}$, the rate of convective energy loss is about W.
19. For a HEP station with a head height h and volume flow rate Q , the maximum power output is about kW.
20. Nuclear waste recycling is a new waste disposal method in which the nuclear waste is turned into isotopes.