

Reg. No. :

Name :

Second Semester B.Sc. Degree Examination, September 2022

First Degree Programme Under CBCSS

Physics

Complementary Course For Chemistry

PY 1231.2 : THERMAL PHYSICS

(2020 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions in a sentence or **two**. Each carries **1** mark.

1. Define diffusion.
2. Define coefficient of diffusion.
3. State Wien's displacement law.
4. Write the expression for Stefan's law.
5. What is emissivity of a body?
6. Define solar constant.
7. Define isothermal process.
8. What is heat engine?

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9. What is the change in entropy of a reversible process?
10. Define latent heat of fusion of ice.

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions, in a paragraph. **Each** question carries **2** marks.

11. Explain Graham's law of diffusions in liquids.
12. Explain Fick's law.
13. Explain a method for the determination of coefficient of diffusivity.
14. Define the coefficient of thermal conductivity of a solid.
15. State and explain Weidman Franz law.
16. Write Planck's equation for quantization of energy. Explain the terms.
17. What is a perfect blackbody?
18. Explain Kirchhoff's law of heat radiation.
19. Write and explain the expression for efficiency of a Carnot's engine.
20. Explain Isothermal elasticity.
21. Explain isothermal process. Give an example.
22. Compare the efficiencies of a petrol engine and a diesel engine.
23. Explain the principle of increase in entropy.
24. State and explain the second law of thermodynamics.
25. The available energy of the universe is always decreasing. Justify this statement.
26. Draw the T-S diagram for a Carnot's engine.

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six** questions. **Each** question carries **4** marks.

27. A steel tank contain nitrogen at a constant pressure of 5 atm and with vacuum outside. The nitrogen concentration at the inner tank is 5 kg/m^3 . Given that the diffusion coefficient of nitrogen is $10^{-19} \text{ m}^2\text{s}^{-1}$. Calculate the rate at which the Nitrogen escape through a hole on a wall of the tank of thickness 1 cm. Area of the hole is 1 cm^2 .
28. Explain the method for the determination of coefficient of diffusivity using diffusion cell.
29. The thermal conductivity of copper at 200K is $413 \text{ W m}^{-1}\text{K}^{-1}$ and its electrical conductivity at this temperature is $84.6 \times 10^6 \text{ seimens/m}$. What will be the ratio of thermal conductivity to the electrical conductivity of copper at 373 K? Given that Lorentz number is $2.44 \times 10^{-8} \text{ W ohm K}^{-2}$.
30. Given that the thermal conductivity of the material of a slab is $8.4 \times 10^{-2} \text{ Wm}^{-1}\text{K}^{-1}$. Calculate the amount of heat flows through the slab per second when the difference in temperature between the slab is 100 K. Given that the thickness of the slab is 2 cm and its area of cross section is 10^{-2} m^2 .
31. The surface temperature of the Sun is 6000K. Calculate the maximum wavelength which can be emitted from the Sun. Given that Wein's constant is $0.292 \times 10^{-2} \text{ metre K}$.
32. A blackbody at 300K is radiates energy at the rate of 460 Wm^{-2} . Calculate the value of Stefan's constant.
33. Derive the expression for work done in an isothermal process.
34. Prove that the work done in an adiabatic change is equal to its change in internal energy.
35. Calculate the entropy change when 1 kg of ice at 0°C is converted to water at the same temperature. Given that the latent heat of ice is $3.35 \times 10^5 \text{ J kg}^{-1}$.
36. Compare the efficiencies of a petrol engine when it is used two qualities of fuels of $\rho = \frac{V_1}{V_2} = 5$ and 6. Given that $\gamma = \frac{C_v}{C_p} = 1.4$.

37. A Carnot's cycle is performed by 1 litre of air at $\gamma = \frac{C_v}{C_p} = 1.4$, initially at a pressure of 12 atm. Each state represent a compression ratio $\rho = \frac{V_1}{V_2} = 6$. Calculate the efficiency and lower temperature of the system. Initial temperature $T_1 = 600$ K.
38. Calculate the efficiency of a Carnot's engine works between 600K and 300K.

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions. **Each** question carries **15** marks.

39. With necessary theory and description of experimental arrangement, explain the method of determination of thermal conductivity of a bad conductor using Lees disc method.
40. Explain the black body spectrum and derive the theory of blackbody radiation.
41. Explain the working of a Carnot's engine as an ideal heat engine. Derive the expression for the efficiency of a Carnot's engine.
42. Write the principle and working of a petrol engine and derive the expression for its efficiency.
43. (a) Derive the expression for the change in entropy in an irreversible process.
(b) Derive the change in entropy in a reversible process.
44. Derive the expression for entropy and establish its relation with the second law of thermodynamics. Explain the conceptual relation between disorder and entropy.

(2 × 15 = 30 Marks)