KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.Sc./B.Tech.
Year : I

Course : PHYS 104
Semester : I

Exam. Roll No. :

Time: 30 mins.

F.M. : 20

Registration No.:

Date : 04 DEC 2023

SECTION "A"
[20Q. × 1 =20 marks]

Choose and encircle the most appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings.

1. The potential energy of a stretched spring is given by the relation $U(x) = 40x^2$. The elastic force exerted by the spring is equal to
   a. 80x b. $-64x$ c. zero d. $-80x$

2. Which one of the following is not a conservative force?
   a. Electrostatic force b. Frictional force
   c. Gravitational force d. Spring force

3. Specific rotation of a solution at a temperature depends on the
   a. angle of rotation b. concentration of the solution
   c. length of the tube d. wavelength of the light used

4. If the fission rate of U^{235} is 6.25×10^{10} fissions per second. Given that the energy released per fission is 200 MeV. Then the power produced in fission is
   a. 4 watt b. 2 watt c. 6 watt d. 8 watt

5. Which one of the following statement is true for the isothermal process?
   a. change in pressure is equal to zero b. change in temperature is equal to zero
   c. change in volume is equal to zero d. change in entropy is equal to zero

6. The precessional frequency of an electron orbit when placed in a magnetic field of 5 T is equal to
   a. 7×10^{14} Hz b. 7×10^{15} Hz c. 7×10^{10} Hz d. 7×10^{12} Hz

7. X-rays of wavelength 0.1 nm are scattered at such an angle that the recoil electron has the maximum kinetic energy. Then the wavelength of the scattered ray is
   a. 0.104500 nm b. 0.104000 nm c. 0.10486 nm d. 0.10800 nm

8. To observe diffraction, the size of the obstacle
   a. has no relation to wavelength
   b. should be exactly one third the wavelength
   c. should be of the same order as the wavelength
   d. should be much larger than the wavelength

9. If temperature rises, the coefficient of viscosity of a liquid will
   a. decrease
   b. increase
   c. remain unchanged
   d. increase for some liquids and decreases for others

10. Which of the following nuclei has the largest binding energy per nucleon? (Consider the most abundant isotope of each element)
   a. Iron b. Helium c. Carbon d. Uranium

Fill the following blanks with appropriate answers.

11. Unpolarized light is incident on two ideal polarizers in series. The polarizers are oriented so that no light emerges through the second polarizer. A third polarizer is now inserted between the first two and its orientation direction is continuously rotated through 180^{o}. The maximum fraction of the incident power transmitted through all three polarizers is.....

12. The path difference corresponding to a phase difference of 2π is .....

13. In thermodynamics, the P-V diagram indicates the.....

14. The process in which no heat enters or leaves the system is called .....

15. Newton's rings are viewed by reflection of light of wavelength 6250Å . The diameter of 10^{th} dark ring is 0.50 cm. The radius of curvature of the lens is.....

16. A 10.6 kg object oscillates at end of the vertical spring has spring constant of 2.05×10^{4} N/m. The effect of air resistance is represented by damping coefficient b = 3.00 Ns/m. Then frequency of the damped oscillation is equal to .....

17. The unit of entropy in SI system is .....

18. The radiation emitted by a star is 10000 times than that of sun. If the surface temperature of sun and the star is 6000 K and 2000 K respectively. Then the ratio of the radii of the star and the sun is equal to .....

19. The moment of inertia of slender rod of mass M and length L passing through its centre and perpendicular to its length is given by.....

20. The reduced mass of hydrogen atom is nearly equal to mass of .....

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Semester : I
F. M. : 55

SECTION "B"
[5Q.× 4 = 20 marks]

1. In Young's double slit experiment, two slits are 0.5 mm apart and the distance of screen from the slit is 1 m. It is observed that the fourth bright fringes is at a distance of 2.945 mm from the second dark fringes. Calculate the wavelength of light used.

OR

A 200 mm long tube and containing 120 cm^3 of sugar solution produces an optical rotation of 6.6°.If the specific rotation of sugar is 66°. Calculate the quantity of sugar contained in the tube in the form of a solution.

2. Show that $C_p - C_v = R$ graphically for a ideal gas. Where the symbols have their usual meanings.

OR

Explain the concept of entropy. Show that the entropy of perfect gas increases in an irreversible process. Also show that the entropy of perfect gas remains constant in a reversible process.

3. Write short note on MRI.

4. Show that conservative force is negative gradient of potential energy.

OR

What do you mean by radius of gyration? Obtain an expression for moment of inertia of solid sphere (a) about z axis (at diameter) (b) about tangent.

5. Describe the construction and working principle of G. M. counter with the help of well labeled diagram.

SECTION "C"
[5Q.×7 = 35 marks]

6. Describe the Carnot's engine and Carnot's cycle. Obtain an expression for thermal efficiency of such engine.

7. Derive an expression for Poiseuille's formula for liquid flow in a capillary tube.

OR

What is compound pendulum? Develop its time period. Show that point of suspension a point of oscillation is interchangeable. Also obtain an expression for minimum time period of such pendulum.

8. Describe the Raman effect with well labeled diagram. Explain the quantum mechanical explanation of Raman spectra with energy level diagram.

9. Describe the construction and theory for the formation of Newton's rings. Obtain an expression for diameter of rings formed due to the reflected light and also derive and expression for wavelength of light used in this experiment.

OR

Derive the expressions for plane, circular and elliptical polarization of light.

10. a. A plane transmission grating has 6000 lines/cm. It is used to obtain a spectrum of light from sodium lamp in second order. Calculate the angular separation between two sodium lines 5890 $\mathring{A}$ and 5896 $\mathring{A}$.

OR

Assume that limits of the visible spectrum are arbitrarily chosen as 4300 $\mathring{A}$ and 6800 $\mathring{A}$. Design a grating that will spread the first-order spectrum through an angular range of 20^0.

b. Obtain the Wien's displacement law from Planck's radiation law.