

KATHMANDU UNIVERSITY  
End Semester Examination  
February, 2023

Marks Scored:

Level : B.Pharm.

Year : I

Exam. Roll No. :

Time: 30 mins.

Course : PHYS 104

Semester: I

F.M. : 20

Registration No.:

Date : 023-feb-08

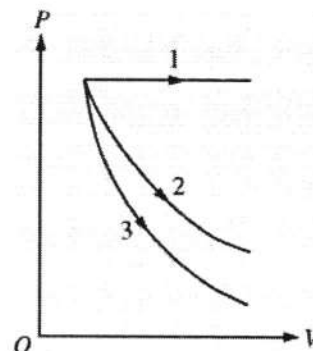
SECTION "A"  
[20Q × 1 = 20 marks]

Encircle the most appropriate alternative from each set of choices.

- Equal amount of work is performed on two bodies, A and B, initially at rest, and of masses  $M$  and  $2M$  respectively. The relation between their speeds immediately after the work has been done on them is  
a.  $V_B = \sqrt{2}V_A$       b.  $V_A = \sqrt{2}V_B$       c.  $V_B = 2V_A$       d.  $V_A = 2V_B$
- The potential energy of a conservative system is given by  $U = ar^2 - br$ , where  $a$  and  $b$  are positive constants and  $r$  is the distance from the center of field. The force acting on the system is  
a.  $-ar$       b.  $-br$       c.  $2ar - b$       d.  $b - 2ar$
- One end of horizontal, massless spring is attached to a wall. A mass of 0.3 kg is attached to the other end of the spring and rests on a table. The mass is displaced 0.03 m from its equilibrium position and then released. It has a speed of 0.04 m/s as it passes through its equilibrium position. In the absence of friction, what is the total mechanical energy of the system?  
a. 0.24 mJ      b. 0.38 mJ      c. 0.48 mJ      d. 0.75 mJ
- A thin circular ring of radius  $R$  and mass  $M$  is rotating about its axis with a constant angular velocity  $\omega$ . Two objects each of mass  $m$  are attached gently to the opposite ends of a diameter of the ring. The wheel now rotates with an angular velocity  
a.  $\frac{M\omega}{M+m}$       b.  $\frac{M\omega}{M+2m}$       c.  $\frac{2M\omega}{M+m}$       d.  $\frac{M\omega}{m+2M}$
- The differential equation of simple harmonic motion (SHM) is given by  $\frac{d^2x}{dt^2} + 100x = 0$ . The frequency of motion is  
a. 1      b. 10      c.  $10 / 2\pi$       d.  $100 / 2\pi$
- Water flowing steadily through the horizontal tube of non-uniform cross-section. If the velocity of flow is  $2 \text{ ms}^{-1}$  at a point where cross-section is  $0.02 \text{ m}^2$ , then the velocity at a point where the cross-section reduces to  $0.01 \text{ m}^2$  is  
a. 1 m/s      b. 2 m/s      c. 3 m/s      d. 4 m/s
- A bullet of mass  $A$  and velocity  $B$  is fired into a block of mass  $C$  and sticks to it. The final velocity of system is equal to  
a.  $\frac{BC}{A+B}$       b.  $\frac{AB}{A+C}$       c.  $\frac{A+B}{AC}$       d.  $\frac{AC}{A+B}$

8. Which one of the following statements is **NOT CORRECT** for Raman spectrum?
- The Stoke's lines are always more intense than anti-Stoke's lines.
  - The Raman lines are symmetrically displaced about the parent line.
  - Frequency of Stoke's line is more than that of anti-Stoke's line.
  - Frequency of anti-Stoke's line is more than that of Stoke's line.
9. In a Carnot cycle the temperature of the working substance at the end of the cycle is
- Less than that at the beginning
  - More than that at the beginning
  - Equal to that at the beginning
  - Zero

10. For an ideal gas, consider three thermodynamics processes labeled 1, 2, and 3 as shown in PV-indicator diagram. Each process has the same initial state and same final volume. One process is adiabatic, one is isobaric and one is isothermal. Which of the following correctly identifies the three processes?
- 1 adiabatic, 2 isobaric and 3 isothermal
  - 2 adiabatic, 1 isobaric and 3 isothermal
  - 2 adiabatic, 3 isobaric and 1 isothermal
  - 3 adiabatic, 1 isobaric and 2 isothermal



11. Entropy remains constant in
- isothermal process
  - isobaric process
  - isochoric process
  - adiabatic process
12. Two coherent monochromatic light beams of intensities  $I$  and  $4I$  are superposed. The maximum and minimum possible intensities in the resulting beam due to superposition of these beams are
- $5I$  and  $I$
  - $9I$  and  $I$
  - $5I$  and  $3I$
  - $9I$  and  $3I$
13. The temperature of a furnace is  $2324^{\circ}\text{C}$  and the intensity is maximum in its radiation spectrum nearly at  $12000 \text{ \AA}$ . If the intensity in the spectrum of a star is maximum nearly at  $4800 \text{ \AA}$ , then the surface temperature of the star is
- $6492.5^{\circ}\text{C}$
  - $6942.5^{\circ}\text{C}$
  - $6219.5^{\circ}\text{C}$
  - $6192.5^{\circ}\text{C}$
14. The conditions for observing Fraunhofer diffraction from a single slit is that the light wave-front incident on the slit must be
- spherical
  - cylindrical
  - plane
  - elliptical
15. A ray of light is incident on the surface of a glass plate of refractive index 1.5 at the polarizing angle. The angle of refraction of the ray is \_\_\_\_\_ degree.
- 3.75
  - 33.7
  - $56.3^{\circ}$
  - 62.8

**Fill in the blanks with most appropriate answer.**

16. For a compound pendulum of length 20 cm and radius of gyration 10 cm, the length of equivalent simple pendulum for minimum time period is equal to .....

17. The radius of gyration of a uniform circular disc of radius  $R$  and mass  $M$  about diameter is .....
18. In a thermodynamic process, the increase in the internal energy of an ideal gas is equal to the heat added to the gas, this thermodynamic process is called .....
19. An hypothetical radioactive nucleus decays according to the following series:  

$$A \xrightarrow{\alpha} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\gamma} A_3$$
 If the atomic number and mass number of  $A$  are respectively 72 and 180, then the atomic number and mass number of  $A_3$  will be respectively.....
20. The binding energy per nucleon for deuteron ( ${}_1H^2$ ) and helium ( ${}_2H^4$ ) are 1.1 MeV and 7 MeV respectively. The energy released when two deuterons fuse to form a helium nucleus is .....

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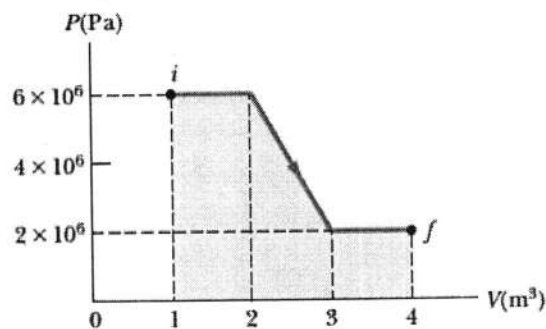
SECTION "B"

[5Q.  $\times$  4 = 20 marks]

1. Locate the center of mass of a semi-circular plate of radius  $R$  and total mass  $M$  which is symmetric about x-axis.
2. A 10.6 kg object oscillates at the end of a vertical spring has a spring constant of  $2.05 \times 10^4$  N/m. The effect of air resistance is represented by the damping coefficient  $b = 3$  N. s/m. Calculate the frequency of the damped oscillation.

OR

Determine the work done by a fluid that expands from  $i \rightarrow f$  as indicated in figure below.



3. Define central force. Show that two body problems can be reduced into one body problem with the concept of reduced mass.
4. Define three different ways of heat transmission processes with examples. Obtain the formula for thermal conductivity of a uniform solid rod of length  $L$  and area of cross-section  $A$ .

OR

Define specific heat capacities of gas. Prove the relation  $C_p - C_v = R$  for one mole of an ideal gas.

5. What do you mean by radiation hazard? What are the precautions to be made against the radiation hazard? Discuss various uses of nuclear radiation.

OR

Give the quantum mechanical explanation of Raman effect.

SECTION "C"

[5Q × 7 = 35 Marks]

6. State and prove the principle of conservation of total momentum during collision. Using an example of perfectly inelastic collision (the ballistic pendulum), show that kinetic energy after collision is less than that before collision.

**OR**

Establish the differential equation of mass loaded horizontal spring and solve it. Obtain its

time period and frequency. Show that total energy  $E = K_{\max} = U_{\max} = \frac{1}{2}kA^2$ .

7. State and prove the theorem of perpendicular axes for moment of inertia. Determine the moment of inertia of a solid sphere of radius  $R$  and total mass  $M$  about a diameter.
8. What are the differences between constructive and destructive interferences? Prove that the fringe width  $\beta$  between two successive bright fringes or dark fringes formed in Young's double slit experiment is  $D\lambda/d$ .

**OR**

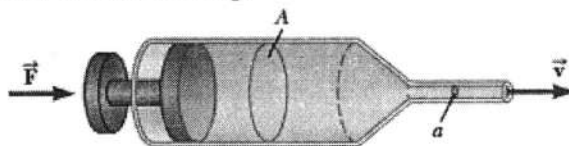
Discuss the phenomenon of double refraction in a crystal. Explain the construction and working principle of Nicol prism as a polarizer and analyzer?

9. Explain the term entropy. Show that entropy always increases for irreversible process. Calculate the change in entropy of perfect gas in terms of temperature and volume.

**OR**

Define Q-value of a nuclear reaction. Derive an expression for the Q-value of the reaction  $X(x, y)Y$  in terms of kinetic energies of the incident and product particles and masses of the various particles and nuclei. Assume the target nucleus to be at rest in the laboratory. Discuss the case when the product particle emerges at right angles to the incident direction.

10. A hypodermic syringe contains a medicine with the density of water as shown in figure below. The barrel of the syringe has a cross-sectional area  $2.5 \times 10^{-5} \text{ m}^2$ , and the needle has a cross-sectional area  $1 \times 10^{-8} \text{ m}^2$ . In the absence of a force on the plunger, the pressure everywhere is 1 atm. A force  $\vec{F}$  of magnitude 2 N acts on the plunger, making medicine squirt horizontally from the needle. Determine the speed of the medicine as it leaves the needle's tip.



**OR**

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  $5890 \text{ \AA}$  and  $5896 \text{ \AA}$ .