

KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks Scored:

Level : B.Pharm.
Year : I

Course : PHYS 104
Semester: I

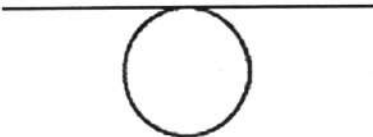
Exam. Roll No. :
Registration No.:

Time: 30 mins.

F.M. : 20
Date :

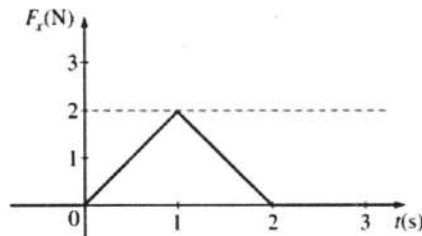
SECTION "A"
[21Q × 1 = 20 marks]

Choose and tick the most appropriate answer.

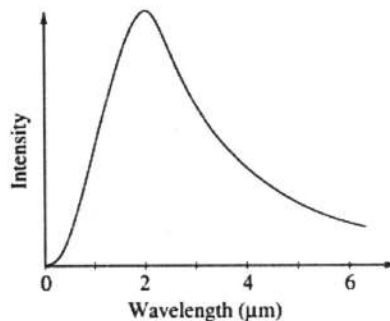
- The frictional force is
[a] conservative and can be expressed as a negative gradient of potential energy.
[b] non-conservative and can be expressed as a negative gradient of potential energy.
[c] conservative and cannot be expressed as a negative gradient of potential energy.
[d] non-conservative and cannot be expressed as a negative gradient of potential energy.
- Two bodies are moving along the same direction with accelerations 3ms^{-2} and 5ms^{-2} respectively. If both of them are acted by equal forces, then acceleration of centre of mass will be
[a] $\frac{15}{8}\text{ms}^{-2}$ [b] $\frac{15}{4}\text{ms}^{-2}$ [c] $\frac{8}{15}\text{ms}^{-2}$ [d] $\frac{8}{30}\text{ms}^{-2}$
- Two springs 1 and 2 have force constants k_1 and k_2 respectively, where $k_1 > k_2$. Which of the following is true about the extensions Δx_1 and Δx_2 of the two springs if same external force is applied to both springs?
[a] $\Delta x_1 < \Delta x_2$ [b] $\Delta x_1 > \Delta x_2$ [c] $\Delta x_1 \geq \Delta x_2$ [d] $\Delta x_1 \leq \Delta x_2$
- A uniform sphere of radius R and mass M rotates freely about a horizontal axis that is tangent to an equatorial plane of the sphere, as shown in figure below. The moment of inertia of the sphere about this axis is

[a] $\frac{2}{5}MR^2$ [b] $\frac{5}{4}MR^2$ [c] $\frac{5}{7}MR^2$ [d] $\frac{7}{5}MR^2$
- In an engine, a piston oscillates with simple harmonic motion so that its position varies according to the expression $x = 10 \sin\left(2t + \frac{\pi}{4}\right)$, where x is in centimeter and t is in second.
The time period of the piston is
[a] π sec [b] 2π sec [c] $\frac{3\pi}{4}$ sec [d] $\frac{5\pi}{4}$ sec
- Which of the following statement is true for the viscosity of fluid?
[a] Viscosity of gas increases with increase in temperature
[b] Viscosity of liquid increases with increase in temperature
[c] Viscosity of gas increases with decrease in temperature
[d] Viscosity of liquid decreases with decrease in temperature

7. A ballistic pendulum consists of large wooden block of mass 5 kg hanging vertically by two cords. When a bullet of mass 10 gm is fired into the block, it gets embedded and the block-bullet combination swings upward, rising a maximum vertical height 10 cm . The percentage of the initial kinetic energy that remains after collision is
 [a] 0.18 % [b] 0.20 % [c] 0.32 % [d] 0.50 %

8. The figure below shows a plot of the time dependence force $F_x(t)$ acting on a particle in motion along x -axis. The total impulse delivered to the particle is



- [a] 1 kg.m/s [b] 2 kg.m/s [c] 3 kg.m/s [d] 4 kg.m/s
9. Stars originate as large bodies of slowly rotating gas. Because of gravity, these clumps of gas slowly decrease in size. The angular velocity of a star increases as it shrinks because of
 [a] conservation of angular momentum [b] conservation of linear momentum
 [c] conservation of energy [d] the law of universal gravitation
10. A Carnot engine takes 300 cal of heat at 500 K and rejects 150 cal of heat to the sink. The temperature of sink is
 [a] 125 K [b] 250 K [c] 750 K [d] 1000 K
11. Which of the following thermodynamic processes is the increase in the internal energy of an ideal gas equal to heat added to the gas?
 [a] constant temperature [b] constant volume
 [c] constant pressure [d] adiabatic process
12. Young's double slit experiment established that
 [a] light consists of waves [b] light consists of particles
 [c] light is neither particle nor wave [d] light is both particle and a wave
13. The distribution of relative intensity $I(\lambda)$ of black body radiation from a solid object versus the wavelength λ is shown in the figure below. If the Wien displacement law constant is 2.9×10^{-3} m.K , what is the approximate temperature of the object?



- [a] 100 K [b] 500 K [c] 1000 K [d] 1500 K

14. A calcite crystal is placed over a dot on a piece of paper and rotated. On seeing through the calcite, one will see
 [a] two rotating dots [b] two stationary dots
 [c] one dot only [d] one dot rotating about other
15. A beam of light strikes a piece of glass at an angle of incidence 60° . It is found that the reflected beam is completely plane polarized. Then the refractive index of glass is
 [a] 1.5 [b] 2 [c] $\sqrt{3}$ [d] 3

Fill in the blank with appropriate answer.

16. For a compound pendulum of length 40 cm and radius of gyration 25 cm, the equivalent length of simple pendulum for minimum time period is equal to.....
17. The moment of force is called.....
18. The nuclear reaction is given by ${}_2\text{He}^4 + {}_7\text{N}^{14} \rightarrow {}_a\text{Y}^b + {}_1\text{H}^1$. The nucleus Y is.....
19. The condition of observing Fraunhofer diffraction from a single slit is that the light wavefront incident on the slit must be.....
20. Vibrational transitions occur between different vibrational levels of theelectronic state.



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F. M. : 55

SECTION "B"
[5Q × 4 = 20 marks]

1. With a well labeled diagram, show that work done by conservative force is path independent and work done by non-conservative force is equal to change in mechanical energy.
2. Calculate the reduced mass of: (a) Hydrogen atom, and (b) Positronium.

OR

A projectile is fired from a gun at angle of 45° with the horizontal and with a muzzle speed of 457.2 m/s. At the highest point in its flight the projectile explodes into two fragments of equal mass. One fragment, whose initial speed is zero, falls vertically. How far from the gun does the other fragment land, assuming a level terrain?

3. Explain the construction of Nicol prism. How it can be used as a polarizer and analyzer?
4. What is superconductivity? Explain Meissner effect. A superconducting tin has a critical temperature of 3.7 K in zero magnetic field and a critical field of 0.0306 T at 0 K. Find the critical field at 2 K.

OR

Prove that the work done by an ideal gas with constant heat capacities during quasi-static adiabatic expansion is equal to $W = -C_V(T_i - T_f)$, where symbol carry their usual meanings.

5. Describe the working principle of nuclear fission reactor with details.

OR

Explain Plank's hypothesis for black body radiation. Deduce Plank's radiation law and hence obtain Rayleigh-Jean's law from Plank's law.

SECTION "C"
[5Q × 7 = 35 Marks]

6. Derive Newton's second law for the system of variable mass and hence prove the relation $M_f = M_0 e^{-\frac{v_f}{v_{rel}}}$ for rocket, where symbols have their usual meaning.

OR

Establish the differential equation of compound pendulum and obtain its time period. Show that point of suspension and point of oscillation are interchangeable. Also find the minimum time period.

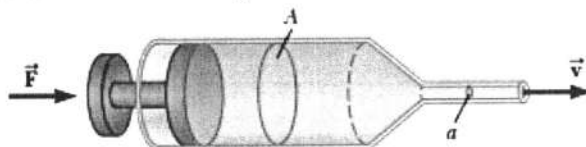
7. What are the differences between constructive and destructive interference? Explain the interferent phenomenon in thin film due to reflected light.

8. Obtain equation of continuity for the flow of an ideal fluid flowing through a pipe. State and prove Bernoulli's theorem for non-viscous and incompressible flow.

OR

Define torque and angular momentum. Show that rate of change of angular momentum is equal to torque acting on it. State and explain the principle of conservation of angular momentum.

9. Explain how Carnot's cycle is reversible. Show that the efficiency of Carnot cycle depends upon the temperature of source and the sink and is independent of the nature of working substance.
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 $A = 2.5 \times 10^{-5} \text{ m}^2$, and the needle has a cross-sectional area $a = 1 \times 10^{-8} \text{ m}^2$. 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 diffraction grating used at normal incidence gives a line, $\lambda_1 = 6000 \text{ \AA}$ in a certain order superimposed on another line $\lambda_2 = 4500 \text{ \AA}$ of the next higher order. If the angle of diffraction is 30° , how many lines are there (in cm) in the grating?