Science

KATHMANDU UNIVERSITY
End Semester Examination [C]
June/July 2024

Marks Scored:

Level : B.E./B.Sc.
Year : I
Course : PHYS 101
Semester : I
Exam Roll No. :
Time: 30 mins.
F. M. : 15
Registration No.:
Date : 04 JUL 2024

SECTION "A"
[15Q. × 1 = 15 marks]

Choose the most appropriate answer and mark [X] in the box. The symbols, unless mentioned otherwise, have their usual meanings.

1. A mass is suspended from a spring and then oscillates. The total energy of the mass will be
   [ ] maximum at the highest point
   [ ] maximum at lowest point
   [ ] maximum at mean position
   [ ] same at all positions

2. If the point of suspension is at midpoint of the rod of length 100 cm, then the time period is
   [ ] 2.4 sec [ ] 0.52 sec [ ] zero [ ] infinity.

3. If length of wire is tripled, then it's Young's modulus
   [ ] remains same [ ] becomes double [ ] becomes half [ ] becomes triple

4. Consider two particle of masses $m_1 = 2\ kg$ and $m_2 = 5\ kg$ at a points (0,2) and (4,0) respectively. The centre of mass of the particles lies at a point
   [ ] $(\frac{5}{2}, \frac{1}{2})$ [ ] $(\frac{1}{2}, \frac{3}{2})$ [ ] $(\frac{3}{4}, \frac{1}{4})$ [ ] $(\frac{4}{3}, \frac{1}{3})$

5. The reduced mass of two masses is 40 gm. One of the mass has weight 50 gm, then the other would have
   [ ] 200 gm [ ] 22.22 gm [ ] 45 gm [ ] 2000 gm

6. Which of the following law states that λ_m (wavelength for maximum intensity) is inversely proportional to absolute temperature?
   [ ] Stefan's law
   [ ] Wien's law
   [ ] Rayleigh- Jean's law
   [ ] Maxwell-Boltzmann law

7. The radius of gyration of a circular disc of radius R about its tangent is
   [ ] $\frac{5}{\sqrt{2}} R$ [ ] R [ ] $\frac{R}{2}$ [ ] $\frac{\sqrt{5}}{2} R$

8. Monochromatic light (λ = 600 nm) is incident on a soap bubble (μ = 1.39) that is 0.5 mm thick. What is the change of phase of the light reflected from the front surface?
   [ ] 0 [ ] π [ ] $\frac{\pi}{2}$ [ ] $\frac{\lambda}{2}$

9. Optically active substances are those substances which
   [ ] produce polarized light.
   [ ] rotate the plane of polarization of polarized light.
   [ ] convert a plane polarized light into circularly polarized light.
   [ ] convert a circularly polarized light into plane polarized light.

10. When light is incident on a transparent surface at the polarizing angle, which of the following is completely polarized?
[ ] Reflected light
[ ] Refracted light
[ ] Neither reflected nor refracted light
[ ] Both reflected as well as refracted light

Fill in the blanks with most appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings.

11. If temperature rises, the coefficient of viscosity of a liquid _____

12. In a thin soap film of refractive index 1.33 it is seen by normally reflected light of sodium of wavelength 5893 A°, it appears black. The minimum thickness of the films is_____

13. A black body at high temperature 'T' radiates energy at the rate of 'E' (in Wm^{-2}), when the temperature falls to 'T/2' the radiated energy (in Wm^{-2}) will be _____

14. The maximum possible exhaust velocity of rocket is 2 kms^{-1}, ratio of $\frac{M_o}{M}$ for it to gain escape velocity of 11.2 kms^{-1} is_____

15. A helium–neon laser (λ = 632.8 nm) is used to calibrate a diffraction grating. If the first-order maximum occurs at 20.5°, what is the spacing between adjacent grooves in the grating? _____

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Level : B.E./B.Sc.
Year : I
Time : 2 hrs. 30 mins.

04 JUL 2024

Course : PHYS 101
Semester : I
F. M. : 40

SECTION "B"
[5Q × 3 = 15 marks]

Attempt ALL questions.

1. Locate the centre of mass form the center of a homogenous semicircular plate of radius R.

OR

What is a central force? Give two characteristics of it. Show that in a central force field the angular momentum of a particle is conserved.

2. Derive Newton's second law for the variable mass system.

3. What is Nicol prism? How it can be used as a polarizer and analyzer?

4. State Stefan-Boltzmann law. Explain how Planck's radiation law reduces to Wien's law and Rayleigh- Jean's law.

OR

What is LASER? Explain the terms: spontaneous and stimulated emission, population inversion, optical pumping.

5. A thin film of refractive index 1.5 and thickness 400 nm is illuminated by white light normal to its surface. What wavelengths within visible spectrum will be intensified in the reflected beam?

SECTION "C"
[5Q × 5 = 25 marks]

Attempt ALL questions.

6. State and prove the parallel axes theorem of moment of inertia. Find the moment of inertia of a circular disc of radius R and mass M about its diameter.

OR

What is compound pendulum? Obtain the time period of it. Show that time period about point of suspension is same as the time period about point of oscillation. Also find the minimum time period.

7. Distinguish between Fresnel's and Fraunhoffer's diffraction. Explain Fraunhoffer's diffraction at single slit and also discuss the intensity distribution.

P.T.O.

8. Define the term collision. A particle of mass m_1 moving with a velocity u_1 collides head on with a particle of mass m_2 at rest such that after the collision they travel with velocity v_1 and v_2 respectively. If the collision is perfectly elastic one, show that $v_2 = \frac{2\,m_1\,u_1}{m_1+m_2}$

OR

State Brewster's law and prove the relation $\mu = \tan i_p$, where μ is refractive index of transparent reflecting medium and i_p is the polarizing angle. Also state and prove Malus' law.

9. What do mean by laminar flow of fluid? Obtain the Poiseulle's formula for a viscous fluid flowing through a capillary tube of radius R.

OR

Define interference. Explain the theory of Newton's rings and hence determine the wavelength of light used.

10. A projectile is fired from a gun at angle of 45^0 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?

OR

A hypodermic syringe contains a medicine having density of water as shown in figure below. The barrel of the syringe has a cross-sectional area $A = 2.50 \times 10^{-5} m^2$, and the needle has cross-sectional area $a = 1.00 \times 10^{-8} m^2$. In the absence of a force on the plunger, the pressure everywhere is 1 atm. A force $\vec{F}$ of magnitude 2.00 N acts on the plunger, making medicine squirt horizontally form the needle. Determine the speed of the medicine as it leaves the needle's tip.