

Level : B.E.

Course : PHYS 101

Year : I

Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 15

Registration No.:

Date 1:2 JAN 2025

SECTION "A"
[15Q. × 1 = 15 marks]

Choose and encircle the most appropriate answer. Symbols have their usual meanings.

1. A force acting on a particle varies with x as shown in Figure A-1. Calculate the work done by the force on the particle as it moves from $x = 0$ to $x = 6.0$ m .

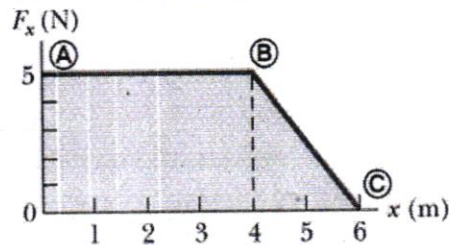


Figure A-1

- a. 25 J b. 20 J c. 15J. d. 5J.
2. The force a spring exerts on a body is a conservative force because
- a spring always exerts a force opposite to the displacement of the body.
 - a spring always exerts a force parallel to the displacement of the body.
 - the net work a spring does on a body is zero when the body returns to its initial position.
 - the work a spring does on a body is equal for compressions and extensions of equal magnitude.
3. The work-energy theorem states that the change in:
- kinetic energy of a particle is equal to the work done on it by the net force
 - kinetic energy of a particle is equal to the work done by one of the forces acting on it
 - potential energy of a particle is equal to the work done on it by the net force
 - total energy if a particle is equal to the work done on it by the net force
4. On which laws is the principle of rocket propulsion based?
- Laws of thermodynamics
 - Newton's law of gravitation
 - Newton's first law of motion
 - Newton's second and third laws of motion
5. Which of the following statements correctly describes Bernoulli's equation?
- The sum of pressure and temperature remains constant in an ideal fluid.
 - Bernoulli's equation applies to fluids with varying density and viscosity.
 - Bernoulli's equation accounts for energy losses due to friction in turbulent flow.
 - The sum of pressure energy, kinetic energy per unit volume, and potential energy per unit volume remains constant along a streamline.
6. The modulus of elasticity is defined as the ratio of:
- Stress to strain
 - Strain to stress
 - Force to area
 - Displacement to length

7. The uniform solid 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 A-1. The moment of inertia of the solid sphere about this axis is _____

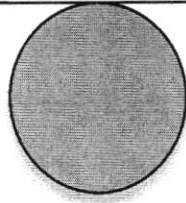


Figure A-1

- a. $\frac{2}{5}MR^2$ b. $\frac{7}{5}MR^2$ c. $\frac{1}{5}MR^2$ d. $\frac{3}{2}MR^2$
8. Monochromatic light ($\lambda = 500$ nm) is incident on a soap bubble ($n = 1.4$) that is 50 nm thick. What is the change of phase of the light reflected from the front surface?
a. 0 b. 90° c. 180° d. 55°
9. When waves encounter an edge, an obstacle, or an aperture the size of which is comparable to the wavelength of the waves, those waves spread out as they travel and, as a result, undergo interference. This is called _____.
a. interference b. diffraction c. polarization d. dispersion
10. Unpolarized light is passed through three successive Polaroid filters, each with its transmission axis at 45° to the preceding filter. What percentage of light gets through?
a. 0% b. 50% c. 25% d. 12.5%

Fill the following blanks with appropriate answers.

11. An m kg object moving at v m/s collides with and sticks to an M kg object initially at rest. The kinetic energy lost by the system as a result of this collision is given by the expression $\Delta K =$ _____.
12. A hydrogen atom is made up of an electron with mass m_e and a much heavier nucleus (proton) with mass m_p , which are attracted to each other by electrostatic attraction. The reduced mass of hydrogen atom is nearly equal to the mass of _____.
13. When the damping is small, the forced oscillations reach their maximum displacement amplitude when the driving frequency is equal to the natural frequency. This condition is known as _____.
14. _____ is a necessary condition for laser action. It means the number of atoms in higher energy states is greater than the number of atoms in lower energy states.
15. The SI unit of thermal conductivity of the material is _____.

KATHMANDU UNIVERSITY
End Semester Examination [C]
January 2025

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

12 JAN 2025

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

SECTION "B"
[5Q. \times 3 = 15 marks]

1. State Hooke's law. Deduce an expression for the energy stored in a stretched wire.
2. What is an elastic collision? Derive the relation that shows in a one-dimensional elastic collision, the relative velocity of approach before the impact is equal to the relative velocity of separation after the impact.

OR

The ballistic pendulum (Figure B-1) is an apparatus used to measure the speed of a fast-moving projectile such as a bullet. A projectile of mass m is fired into a large block of wood of mass M suspended from some light wires. The projectile embeds in the block, and the entire system swings through a height h . How can we determine the speed of the projectile from a measurement of h ?

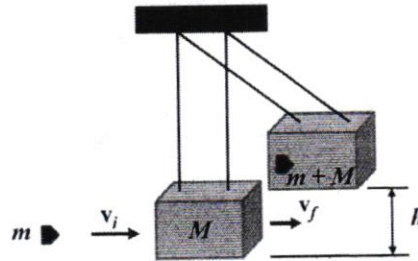


Figure B-1

3. What does LASER stand for? Explain the concept of stimulated emission in laser physics.
4. A man pulls a 27.215 kg block 9.144 m along a level floor at constant speed. The force is applied at an angle of 45° above the horizontal. If coefficient of kinetic friction between the block and the floor is 0.2, how much work does the man do on the block?

OR

Find the center of mass of a homogeneous semicircular plate of radius R .

5. What is the ultraviolet catastrophe, and how did Max Planck's hypothesis resolve this problem?

OR

The radiation emitted by a star is 10,000 times more than that of the sun. If the surface temperature of the sun and the star is 6000 K and 2000 K respectively, then calculate the ratio of the radii of the star and the sun.

P.T.O.

SECTION "C"
[5Q. × 5 = 25 marks]

6. State the perpendicular axis theorem for the moment of inertia. Calculate the moment of inertia of a uniform thin rod of length L and mass M (i) about an axis perpendicular to the rod and passing through its center of mass, and (ii) about an axis perpendicular to the rod and passing through its one end of the rod.
7. Derive Poiseuille's formula for the volume flow rate of a Newtonian fluid through a horizontal tube with uniform cross-section under steady-state laminar flow conditions.

OR

What is damped harmonic oscillation? Derive the differential equation of motion for a damped harmonic oscillator and obtain an expression for displacement. Discuss the cases of under damping.

8. What is plane-polarized light? Name any two methods to produce plane-polarized light. What is Brewster's angle? Derive Brewster's law, using Snell's law.
9. What are coherent sources? Derive an expression for fringe width in the case of Young's double slit experiment.

OR

A plano-convex lens with an index of refraction μ and a curved side with a radius of curvature R rest on a flat glass surface with the same index of refraction, with air between them.

- a. Describe an experimental setup, including a diagram, to produce Newton's rings.
 - b. Derive expressions for the radii of the bright and dark Newton's rings observed under these conditions and establish a formula to determine the wavelength of monochromatic light.
10. Monochromatic light from helium-neon laser ($\lambda = 632.8 \text{ nm}$) is incident on a diffraction grating containing 6000 grooves per centimeter. Find the grating element and the angles at which the first- and second-order maxima are observed. What if you looked for the third maximum? Would you find it?

OR

A force acting on a particle moving in the xy plane is given by $\vec{F} = (2y\hat{i} + x^2\hat{j}) \text{ N}$, where x and y are in meters. The particle moves from the origin to a final position having coordinates $x = 5.00 \text{ m}$ and $y = 5.00 \text{ m}$ as shown in Figure C-1. Calculate the work done by \vec{F} on the particle as it moves along (a) OAC, (b) OBC, and (c) OC. (d) Is \vec{F} conservative or nonconservative? Explain.

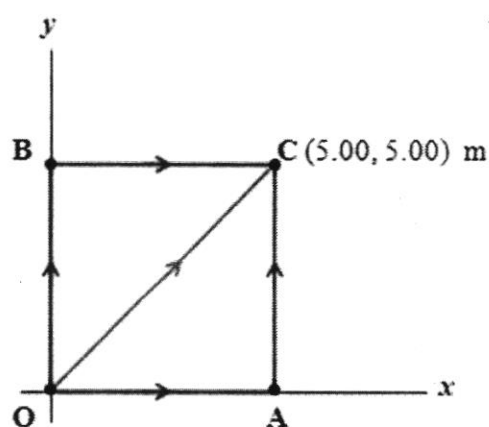


Figure C-1

Level : B.E.
Year : I

Course : ENGG 111
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

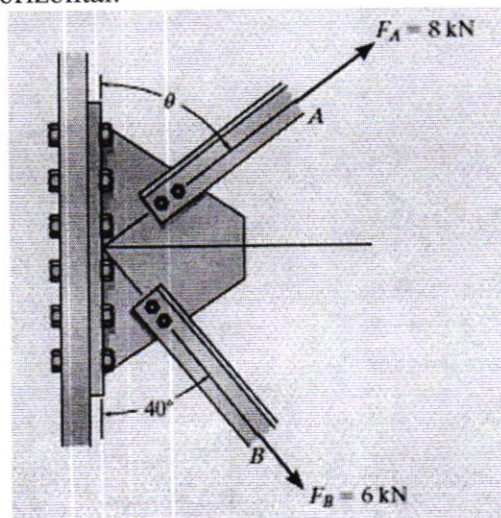
Date

15 JAN 2025

SECTION "A"
[20Q. \times 1 = 20 marks]

Choose and encircle the most appropriate answer. Symbols have their usual meanings.

- Which of the following is not a shallow foundation
a. Pile foundation b. Mat foundation c. Strap foundation d. Isolated foundation
- Early strength in cement is due to
a. C_2S b. C_3A c. C_4AF d. C_3S
- Brick masonry wall having alternative layer of stretcher and header courses are
a. Stretcher bond b. Header bond c. English bond d. Flemish bond
- For sharp valley with good rock in abutment. Dam suitable is
a. Gravity dam b. Arch dam c. Buttress dam d. Earth dam
- The fluid velocity $U = U(x,y,z,t)$ where x and y represent the x -coordinate, and the y -coordinate, and t is time. For the mentioned equations, the following conditions are defined.
I) The fluid flows in one direction.
II) The flow represents the unsteady state.
III) The fluid flows in two directions.
IV) The flow is in a steady state.
V) The fluid flows in three direction
Choose which of these options correctly represents the flow
a. I and II only b. I and IV only c. II and III only d. None of the above
- Determine the magnitude of the resultant of these two forces and its direction measured clockwise from the horizontal.



- a. 10.80 kN, 3.16^0 b. 10.80 kN, 6.16^0 c. 12.80 kN, 3.16^0 d. 12.80 kN, 6.16^0

17. Which of the following is not a common remote sensing platform?
a. Satellite b. Drone c. Buoy d. Aircraft
18. What type of data represents the shape and location of geographic features in GIS?
a. Spatial data b. Attribute data c. Tabular data d. Statistical data
19. What is the length of an engineer's chain?
a. 60 feet b. 66 feet c. 50 feet d. 100 feet
20. GLONASS is a satellite navigation system developed by which country?
a. United States b. Russia c. China d. European Union

KATHMANDU UNIVERSITY
End Semester Examination [C]
January 2025

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

Course : ENGG 111
Semester : I
F. M. : 55

Instructions:

- Attempt all the question.
- Assume data suitably if required.
- **Use different answer sheets for different Sections B, C and D**
- Numbers in the bracket refer to the marks the question carries

SECTION "B"

[33 marks]

1. Determine the location of the centroid for Fig.1. [6]

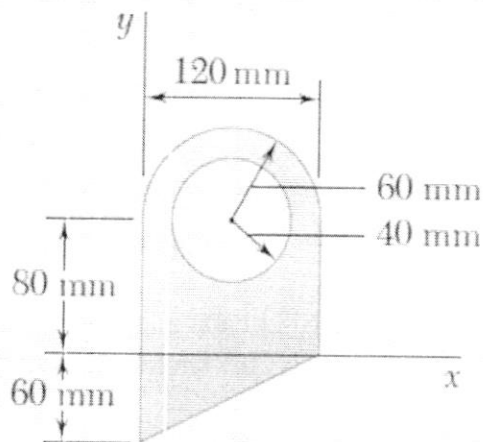


Fig. 1.

2. Determine the beam reactions at the supports (Fig.2). [5]

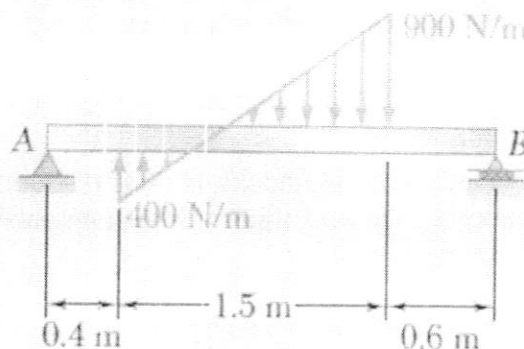


Fig. 2

- 3.
- Define Newton's law of viscosity. [1]
 - Define Reynolds number and write its expression. [1]
 - Write one major difference between a Pump and a Turbine providing one example of each. [2]

P.T.O.

4. The 80-kg exerciser is doing an exercise as shown in Fig. 1. The tension $T = 65 \text{ N}$ is developed against an exercise machine (not shown) as he is about to begin a biceps curl. Determine the minimum coefficient of static friction that must exist between his shoes and the floor if he is not to slip. [5]

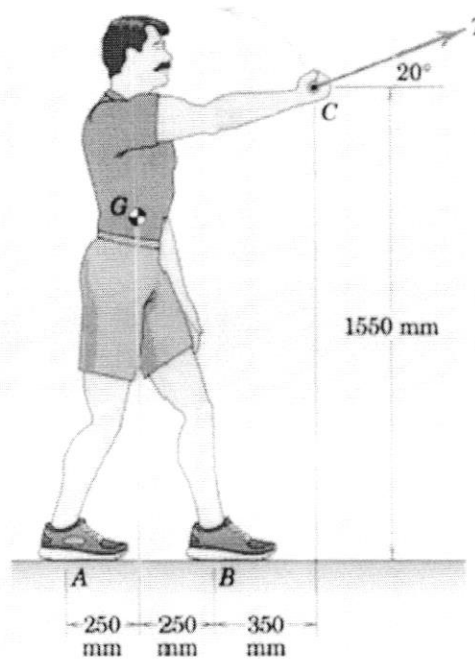


Fig. 3.

5. A very large tank contains air at 102 kPa at a location where the atmospheric air is at 100 kPa and 20° C . Now a 2-cm-diameter tap is opened. Determine the maximum flow rate of air through the hole. [4]
- 6.
- A heat engine exchanges heat with a thermal reservoir at temperature T and produces some work W . Is it possible to have such a heat engine? Write yes or no with proper reasoning. [1+0.5]
 - State the concept of internal energy from the first law of thermodynamics. [1]
 - Name the various processes during the Carnot cycle using the P-V and T-S diagram. [3]
 - Write a difference between a heat pump and a refrigerator using a neat sketch. [0.5+1]
7. A student tries to apply Hook's law to find the amount of strain developed during the plastic deformation of the material. Do you think his/her approach would lead to the correct answer? Justify with proper reasoning. [0.5+0.5]

SECTION "C"

[11 marks]

8. What are the requirements of an ideal foundation? List out the types of deep foundations and explain pile foundation with a neat sketch. [1+1+2=4]
9. Write down the advantages and disadvantages of concrete. What is the function of each ingredient of the cement? [2+2=4]

10. If you have to propose a gravity dam to be constructed on a site, explain what factors you will consider. Write down the ideal requirement of a bridge. [2+1=3]

SECTION "D"

[11 marks]

11. Introduce the term surveying and describe the primary division of surveying. [1+2]
12. What do you understand by bearing? Explain the relationship between fore and back bearing with proper illustration. [1+2]
13. Define remote sensing and explain in detail the procedure included in remote sensing data capture. [1+4]

Level : B.E./B.Sc.

Course : PHYS 102

Year : I

Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 15

Registration No.:

Date 08 JAN 2025

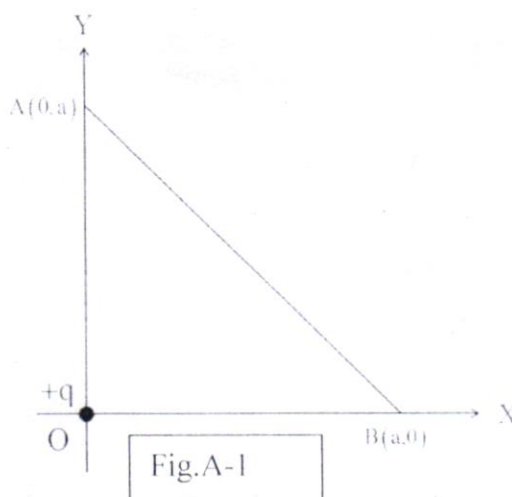
SECTION "A"
[15Q. × 1 = 15 marks]

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

- The curl of curl of a vector function $\vec{v} = -x^2 \hat{k}$ is
 a. $2x \hat{j}$ b. -2 c. $2 \hat{k}$ d. $-2 \hat{k}$
- Which of the following statements is not TRUE?
 a. The gradient ∇T points in the direction of maximum increase of the function T.
 b. The curl of a gradient is always zero.
 c. The divergence of a curl is always zero.
 d. The divergence of a gradient is always zero

- A point charge $+q$ is placed at the origin as shown in the Fig. A-1. Work done in taking another point charge $-Q$ from the point A (0, a) to another point B (a, 0) along the straight path AB is:

- $\left(\frac{1}{4\pi\epsilon_0} \frac{qQ}{a^2} \right) \sqrt{2} a$
- $\left(-\frac{1}{4\pi\epsilon_0} \frac{qQ}{a^2} \right) \sqrt{2} a$
- $\left(-\frac{1}{4\pi\epsilon_0} \frac{qQ}{a^2} \right) \frac{a}{\sqrt{2}}$
- zero



- Which one of the following relations is NOT correct?

- $\nabla^2 V = \frac{\rho}{\epsilon_0}$
- $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$
- $\sigma_b = \vec{P} \cdot \hat{n}$
- $\rho_b = -\frac{\sum_c \rho_c}{1 + \sum_c \epsilon_c} \rho_f$

- A nucleus of binding energy E_b contains Z protons and N neutrons. Let m_p denotes the mass of a proton and m_n that of a neutron. The mass M (N, Z) of the nucleus is given by

- $M(N, Z) = Nm_n + Zm_p - E_b c^2$
- $M(N, Z) = Nm_n + Zm_p + E_b c^2$
- $M(N, Z) = Nm_n + Zm_p - \frac{E_b}{c^2}$
- $M(N, Z) = Nm_n + Zm_p + \frac{E_b}{c^2}$

6. A charge particle is circling in a magnetic field with cyclotron frequency f_o . If speed of charge particle is tripled, the new cyclotron frequency is
- a. $3f_o$ b. $\frac{f_o}{2}$ c. f_o d. zero
7. The area of M-H hysteresis loop is an indication of the
- a. retentivity of the materials
 b. permeability of material
 c. energy dissipated per unit volume of the substance per cycle
 d. susceptibility of materials
8. The unit of $\frac{1}{\mu_0}(\vec{E} \times \vec{B})$ is
- a. W b. $J m^{-2}$ c. $W m^2$ d. $J s^{-1} m^{-2}$
9. The power of an inductor of 6H and current 2.5A after 4 seconds is
- a. 4.68 b. 5.62 c. 12.4 d. 24.8
10. Release of energy from sun is due to
- a. nuclear fission. b. nuclear fusion c. burning of gases d. chemical reaction

Fill the following blanks with appropriate answers.

11. The maximum torque in a rectangular conductor having current 5A, flux density 70 T, length 25cm and breadth 2m is _____ Nm
12. A solenoid of length 0.6 m has a radius of 2 cm and is made up of 600 turns. If it carries a current of 4 A, then the magnitude of the magnetic field outside the solenoid is _____
13. A metallic spherical shell of radius 0.15 m has 10^{-13} C of charge uniformly spread over it. The electric field intensity at point 11 cm away from the centre is _____
14. The magnetic lines of force cannot penetrate the body of a superconductor. The phenomenon is known as _____
15. It is estimated that the energy released in the atomic bomb explosion at Hiroshima was 6.4×10^{13} J. If on the average 200 MeV energy were released on fission of one ${}_{92}U^{235}$ atom, the number of uranium atoms fissioned was _____

SOE.

KATHMANDU UNIVERSITY
End Semester Examination [C]
January 2025

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

08 JAN 2025

Course : PHYS 102
Semester : II
F. M. : 40

SECTION "B"
[5Q. × 3 = 15 marks]

1. Let $\vec{F}_1 = x^2\hat{k}$ and $\vec{F}_2 = x\hat{i} + y\hat{j} + z\hat{k}$. Calculate the divergence and curl of \vec{F}_1 and \vec{F}_2 . Which one can be written as gradient of scalar and which one as curl of a vector?
2. Define polarization. Show that volume bound charge density, $\rho_b = -\nabla \cdot \vec{P}$

OR

Show that volume bound current density, $\vec{J}_b = \nabla \times \vec{M}$.

3. Define magnetic dipole moment. Calculate the net force and the torque on a rectangular current loop placed in uniform external magnetic field.

OR

Prove the reciprocity theorem of mutual induction.

4. Find the electric field outside and inside a uniformly charged solid sphere of radius R and charge q using Gauss law.
5. Find the magnetic field a distance z above the centre of a circular loop of radius R, which carries a steady current I.

OR

A long coaxial cable carries current I (the current flows down the surface of the inner cylinder, radius a, and back along the outer cylinder, radius b) as shown in Fig.B-1. Find the energy stored in a section of length l. Also find coefficient of self- induction.

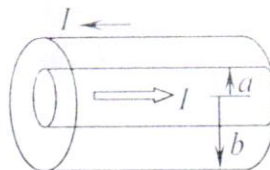


Fig.B-1

SECTION "C"
[5Q × 5 = 25 marks]

6. What is magnetic vector potential? Show that magnetic vector potential is given by $\vec{A} = \frac{\mu_0}{4\pi} \int \frac{\vec{J}}{r} d\tau$. Also show that the line integral of vector potential around the closed loop is equal to the magnetic flux through the loop.

OR

Explain how Maxwell fixed up Ampere's law. Derive the wave equation for \vec{E} and \vec{B} for electromagnetic waves in vacuum.

7. Obtain expression for potential energy of the configuration of three charges and generalize the result for a system of n point charges. Converting the result for a continuous charge distribution, show that the energy density in an electric field \vec{E} is $\frac{\epsilon_0}{2} E^2$.
8. Define Poynting vector. Deduce theoretically Poynting's theorem for the flow of energy in an electromagnetic field.
9. 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

Differentiate between nuclear fission and fusion. The energy released by fission of one ${}_{92}\text{U}^{235}$ atom is 200 MeV. Calculate the energy released when 1 kg of ${}_{92}\text{U}^{235}$ undergoes fission.

10. Find the electric field a distance z above the centre of a flat circular disk of radius R (Fig.C-1), which carries a uniform surface charge σ . What does your formula give in the limit $R \rightarrow \infty$? Also check the case $z \gg R$.

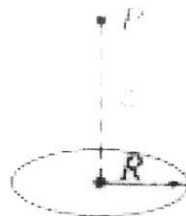


Fig.C-1

OR

Develop an expression for the electric field at the center of a spherical cavity inside a polarized dielectric due to the charges on the wall of the cavity. Also deduce Clausius-Mossotti relation.