

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, DECEMBER 2018

FIRST YEAR (BATCH 2018-21)

PHYSICS (General)

Paper : I

Date : 21/12/2018

Time : 11.00 am – 1.00 pm

Full Marks : 50

Group – A

Answer **any seven** questions of the following:

[7×5]

1. a) Prove that the area of a parallelogram with sides $\vec{A}$ and $\vec{B}$ is $|\vec{A} \times \vec{B}|$. (2)
b) Define with examples axial and polar vectors. (3)
2. a) Prove that $\vec{\nabla} \cdot (\vec{\nabla} r^n) = n(n+1)r^{n-2}$ where $r^2 = x^2 + y^2 + z^2$ (4)
b) State the Gauss's Divergence Theorem. (1)
3. A particle of mass m is moving in a conservative force field. Show that at any two points in the path of the motion of the particle, the sum of Kinetic and potential energy of the particle is constant. (5)
4. Prove that in polar co-ordinates
a) the velocity of a particle is given by $\vec{v} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta}$ and (2)
b) acceleration is given by $\vec{a} = (\ddot{r} - r\dot{\theta}^2)\hat{r} + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\hat{\theta}$, where the symbols have their usual meanings. (3)
5. a) Established the Newton's equation of motion in an accelerated frame of reference. (3)
b) Explain what coriolis force is? (2)
6. a) Show that a pure shear strain is equivalent to two equal and opposite strains of right angles to each other. (3)
b) A metal tube, 1 metre long and of internal and external radii 4cm and 4.2 cm respectively, is clamped at one end. Find the couple which must be applied to the other end to twist it through 30° . The module of rigidity of the material is 2.5×10^{11} dynes / cm^2 . (2)
7. a) Define stream line motion and streamline for a fluid flow. (2)
b) What is meant by a Newtonian fluid? Define co-efficient of viscosity of a Newtonian fluid. (1+2)
8. a) What is bending moment? (1)
b) A straight horizontal beam of rectangular cross section is rigidly clamped at one end. The free end is loaded with a weight W . When the bending is small obtain an expression for the deflection of the free end. (4)

9. a) Find the expression for excess pressure in a curved liquid film. (4)
- b) A sphere of water of radius 1 mm is sprayed into a million drops all of the same size. Find the energy expended in doing so. Surface tension of water = 72 dyne/ cm. (1)
10. a) Explain why water rises in a capillary tube dipped partially in water. (2)
- b) The two arms of a U-tube have diameter 10mm and 1mm. The tube is partially filled with water and is held with the arms vertical. Find the difference in the levels of water in the two limbs if the surface tension of water is 0.072 Nm^{-1} . (3)
11. Deduce Poiseuille's equation for the rate of steady flow of a liquid through a narrow tube. What are the conditions to be satisfied for the deduction of the equation? (4+1)

Group – B

Answer **any three** questions of the following :

[3×5]

12. Deduce the relation $\frac{\mu}{v} - \frac{1}{u} = \frac{\mu - 1}{R}$ for refraction at spherical surface and hence deduce the formula $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$, where symbols have usual meaning. (5)
13. a) Define optical path. (1)
- b) Using Fermat's principle prove the laws of reflection for a plane surface. (4)
14. What do you mean by the dispersive power of a lens? Show that an achromatic combination of two lenses with dispersive powers ω_1 and ω_2 and focal lengths f_1 and f_2 is possible when $\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$. (5)
15. Describe Ramsden's and Huygen's eye-piece with ray diagrams and mention their merits and demerits. (5)
16. a) Show that the angular magnification of astro telescope is equal to the ratio of the focal length of the objective and the eyepiece. (3)
- b) A Ramsden eye-piece is made up of two convex lenses each of focal length 2.5cm and separated by a distance 1.5 cm. Find the equivalent focal length. (2)

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