

K21U 3477



Reg. No. :

Name :

II Semester B.Sc. Degree (CBCSS – OBE – Reg./Sup./Imp.)
Examination, April 2021
(2019 Admission Onwards)
CORE COURSE IN PHYSICS
2B02PHY – Mathematical Physics and Error Analysis

Time : 3 Hours

Max. Marks : 40

SECTION – A

Answer **all** questions. **Each** question carries **1** marks.

1. What is the geometrical meaning of divergence ?
2. Explain the law of cosines.
3. Write down the RHS of the following equations :
 - i) $\vec{A} \times (\vec{B} \times (\vec{C} \times \vec{D})) =$
 - ii) $\vec{A} \times (\vec{B} \times \vec{C}) =$
4. Express the gradient in cylindrical coordinate system.
5. Give the general formula for error propagation.
6. What are random and systematic errors ?

(6×1=6)

SECTION – B

Answer **any 6** questions. **Each** question carries **2** marks.

7. Define and explain the fundamental theorem of divergence.
8. Define curl and explain its geometrical interpretation.
9. What is the superposition principle of homogeneous linear differential equations ?
Prove it.

P.T.O.



10. What is meant by the general solution, the particular solution, and the basis of a homogeneous linear second order differential equation ?
11. What is a nonlinear differential equation ?
12. What is meant by an exact differential equation ?
13. What is the integrating factor ? Give an example.
14. Briefly explain the uncertainty in sum and difference rule for error propagation.

(6×2=12)

SECTION – C

Answer **any 4** questions. **Each** question carries **3** marks.

15. Check the fundamental theorem for gradients, using the function $T = x^2 + 4xy + 2yz^3$ and the points $a = (0, 0, 0)$, $b = (1, 1, 1)$, through the following two paths :
 - a) $(0,0,0) \rightarrow (1, 0, 0) \rightarrow (1, 1, 0) \rightarrow (1, 1, 1)$
 - b) $(0, 0, 0) \rightarrow (0, 0, 1) \rightarrow (0, 1, 1) \rightarrow (1, 1, 1)$
16. Let $\vec{C} = \vec{A} - \vec{B}$. Calculate the dot product of \vec{C} with itself and prove the law of cosines.
17. Find the divergence and curl of the function $\vec{V} = r(2 + \sin^2 \phi)\hat{r} + r \sin \phi \cos \phi \hat{\phi} + 3z^2 \hat{z}$.
18. Compute the gradient and Laplacian of the function $T = r(\cos \theta + \sin \theta \cos \phi)$.
19. Solve the initial value problem $y'' + y' - 6y = 0$, $y(0) = 10$, $y'(0) = 0$.
20. A student makes 5 measurements of the magnitude of electron's charge e as follows :

15, 17, 18, 14, 16

all in units of 10^{-20} Coulombs. Find the best estimate for e and its uncertainty as standard deviation of mean.

(4×3=12)



SECTION – D

Answer **any 2** questions. **Each** question carries **5** marks.

21. Define and explain the fundamental theorems of gradient, divergence and curl.
22. a) What is a spherical polar coordinate system ?
b) Find the expression for volume of a sphere using spherical polar coordinates.
23. a) Derive the general formula for uncertainty.
b) The atwood machine consists of 2 masses M and m with $M > m$ attached to the ends of a light string that passes over a light frictionless pulley. When the masses are released, the mass M is easily shown to accelerate down with an acceleration $a = g \frac{M - m}{M + m}$. Suppose that M and m are measured as $M = 100 \pm 1$ and $m = 50 \pm 1$, both in grams. Use the general rule to derive a formula for the uncertainty in the expected acceleration δa in terms of the masses and their uncertainties and then find δa for the given numbers.
24. a) Briefly explain a method to solve a second order homogeneous linear differential equations with constant coefficients.
b) Find the solution for $y'' - 4y' + 4y = 0$, $y(0) = 3$, and $y'(0) = 1$. **(2×5=10)**