VOLUME-01 Part B and C

MCQs/ Objectives

I. Mathematical Methods of Physics

1. The vectors $\bar{a} = 3i - k, \bar{b} = i + 2j$ are adjacent sides of a parallelogram. Its area is:
   a) $\frac{1}{2}\sqrt{17}$ b) $\sqrt{14}$
   c) $\sqrt{41}$ c) $\frac{1}{2}\sqrt{7}$

2. If $\bar{a} = 2i + 2j + 3k, \bar{b} = -i + 2j + k$ and $\bar{c} = 3i + j$ then $\bar{a} + t\bar{b}$ is perpendicular to $\bar{c}$ if t is equal to:
   a) 8 b) 4
   c) 6 d) 2

3. If $\bar{A}, \bar{B}, \bar{C}, \bar{D}$ be any four vectors then which of the products is meaningful?
   a) $\bar{A} \times (\bar{B}.\bar{C})$ b) $\bar{A}.(\bar{B} \times \bar{C})$
   c) $\bar{A} \times \bar{B} \times \bar{C}$ d) $[\bar{A} \times \bar{B}] \times [\bar{C} \times \bar{D}]$

4. The amount of flux diverging from a point per unit area per second is called:
   a) Divergence of a vector field b) Divergence of a scalar field
   c) Gradient of a scalar field d) Gradient of a vector field

5. The value of a if $\vec{A} = a\hat{i} + \hat{j} + \sqrt{5}\hat{k}$ subtends an angle of 60^0 with $4\hat{i} - 5\hat{j} + \sqrt{5}\hat{k}$ is:
   a) $\sqrt{\frac{2}{3}}$ b) $\sqrt{\frac{26}{3}}$
   c) $\sqrt{\frac{46}{3}}$ d) $\sqrt{\frac{35}{3}}$

6. The third side of a triangle whose base is given by $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ and one of the other two sides by $\vec{b} = 2\hat{j} + 3\hat{k}$ is:
   a) $\hat{i} - 3\hat{j} + 2\hat{k}$ b) $\hat{i} + 3\hat{j} - 2\hat{k}$
   c) $-\hat{i} + \hat{j} - 2\hat{k}$ d) $-\hat{i} + \hat{j} + 2\hat{k}$

7. The projection of vector $\vec{a} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ on vector $\vec{b} = \hat{i} + 2\hat{j} + 2\hat{k}$:
   a) $\frac{8}{5}$ b) $\frac{8}{3}$
   c) $\frac{8}{7}$ d) $\frac{8}{9}$

8. A vector field which can be expressed as negative gradient of a scalar field is called:
   a) Lamellar field b) Non-lamellar field
   c) Non-conservative field d) Conservative field

9. If $r^3 = x^2 + y^2 + z^2$ then $\vec{\nabla}.\left(\frac{\vec{r}}{r}\right)$ is equal to:

a) 0 b) $3r$

c) r^2 d) $\frac{2}{r}$

10. Let $f(x, y, z) = c$ represent the equation of a surface. The unit normal to this surface is:

a) grand (f) / | grand (f) | b) grand (f)

c) div [grand (f)] d) curl [grand (f)]

11. The direction of a grad ϕ is:

a) Tangential to level surface b) Normal to level surface

c) Inclined at 45^0 to level surface d) Arbitrary

12. If $\vec{r}$ is position vector, then curl $\vec{r}$ is:

a) 0 b) 3

c) $r^{-2}r$ d) $r^{3/2}$

13. The value of a, b and c such that $\vec{F} = (3x - 4y + az)\hat{i} + (cx + 5y - 2z)\hat{j} + (x - by + 7z)\hat{k}$ is irrotational, are respectively:

a) $1, 2, -4$ b) $-4, 2, 1$

c) $2, 1, -4$ d) $-4, 1, 2$

14. If $\vec{A} = \hat{i}x$ and $\vec{B} = (\hat{j}y)$, then $\vec{\nabla}(\vec{A}.\vec{B})$ is equal to:

a) $\hat{i}y + \hat{j}x$ b) 0

c) $\frac{1}{2}yx^2\hat{i} + \frac{1}{2}xy^2\hat{j}$ d) 2

15. If the line integral of a vector field depends only upon the co-ordinates of the two points in the field and independent of actual path take between them, then the field is said to be:

a) Non-conservative b) Curled

c) Non-lamellar d) Conservative

16. From the following type of matrix, the diagonal elements of which matrix must be pure imaginary numbers of zero –

a) Skew-Hermitian b) Symmetric

c) Hermitian d) Skew symmetric

17. Which one of the following matrices is Hermitian?

a) $\begin{bmatrix} 0 & i \\ i & 0 \end{bmatrix}$ b) $\begin{bmatrix} 0 & i \\ -i & 0 \end{bmatrix}$

c) $\begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$ d) $\begin{bmatrix} i & 0 \\ 0 & -i \end{bmatrix}$

18. Inverse of the matrix $A=\begin{bmatrix}1 & 3 & 3\\ 1 & 4 & 3\\ 1 & 3 & 4\end{bmatrix}$ is:

a) $\begin{bmatrix}7 & -3 & 3\\ 1 & 0 & 1\\ 1 & 1 & 0\end{bmatrix}$ b) $\begin{bmatrix}7 & -3 & -3\\ -1 & 1 & 0\\ -1 & 0 & 1\end{bmatrix}$

c) $\begin{bmatrix}-1 & 1 & -3\\ -1 & 0 & 0\\ 7 & -3 & 1\end{bmatrix}$ d) $\begin{bmatrix}-1 & -3 & 3\\ -1 & 0 & 0\\ 7 & 1 & 1\end{bmatrix}$

19. The rank of the matrix $\begin{bmatrix}1 & 2 & 3\\ 2 & 4 & 5\end{bmatrix}$ is:

a) 0 b) 1
c) 2 d) 3

20. The rank of the matrix $\begin{bmatrix}2 & -4 & 6\\ -1 & 2 & -3\\ 3 & -6 & 9\end{bmatrix}$ is:

a) 3 b) 2
c) 0 d) 1

21. The rank of matrix $\begin{bmatrix}\mu & -1 & 0\\ 0 & \mu & -1\\ -1 & 0 & \mu\end{bmatrix}$ is 2, for μ equal:

a) any row number b) 3
c) 1 d) 2

22. A necessary and sufficient condition that line integral $\int_c A.dr = 0$ for every closed curve c is that:

a) div $a = 0$ b) curl $A = 0$
c) div $A \neq 0$ d) curl $A \neq 0$

23. $(AB)^{-1}$ is equal to:

a) $A^{-1}B^{-1}$ b) $B^{-1}A^{-1}$
c) $(A')^{-1}.B^{-1}$ d) $A^{-1}.(B')^{-1}$

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