PREVIOUS YEAR QUESTIONS

1. A necessary and sufficient conditions that the line Integral $\int_C \bar{F}.d\bar{r}$ for every closed curve C vanishes is
   1) div $\bar{F} \neq 0$ 2) curl $\bar{F} = 0$
   3) curl $\bar{F} \neq 0$ 4) div $\bar{F} = 0$

2. The value of $\int_C (y^2dx + x^2dy)$ where C is the boundary of the square $-1 \leq x, y \leq 1$ is
   1) 2 2) 4/3
   3) 4 4) 0

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3. The value of 'a' for which the vector (x+3y)i + (y-2z)j + (x+az)k is a solenoidal vector is
   1) 2 2) 1
   3) -2 4) 3

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4. If $\bar{F}$ = xi + 2yj + 3zk and S is the surface of a unit sphere, then the value of $\iint_S \bar{F}.\hat{n}dS$ is
   1) 8π 2) 6π
   3) 4π 4) $\frac{8\pi}{3}$

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5. The directional derivative of $\phi(x, y, z) = x^2yz + 4xz^2$ at the point (1, -2, -1) in the direction PQ. Where p = (l, 2, -1) and Q = (-1, 2, 3) is
   1) yi+zj-xk 2) zi-xj-yk
   3) yi-zj+xk 4) -(yi+zj+xk)

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6. The unit normal vector to the surface $x^2 + 2y^2 + z^2 = 7$ at (1, -1, 2) is
   1) 2i-4j + 4k 2) 2i-4j-4k
   3) $\frac{1}{3}$(i-2j-2k) 4) -(1-2j+2k)

- ME 2008

7. If $\bar{F} = xz^3i - 2x^2yzj + 2yz^4k$, then div (curl $\bar{F}$) equal to
   1) $z^3-2x^2z+8yz^3$ 2) $3xz^2-4xyz+2z^4$
   3) $3xz^2-2x^2z+8yz^3$ 4) 0

- ME 2008

8. The value of the integral $\int(x - 2y)dx + xdy$ taken over the circle $x^2 + y^2 = 1$ is
   1) 4π 2) 3π
   3) 2π 4) π

- ME 2008

9. Let S be the closed surface which bounds the volume V, $\iint_S (xi + yj + zk).\hat{n}dS$ is equal to
   1) 3 S 2) 4 S
   3) 3 V 4) 4 V

- ME 2008

10. The unit normal to the surface $x^2y+2xz=4$ at the point (2, -2, 3) is
    1) –i + 2j + 2k 2) $\frac{1}{3}$(-i + 2j + 2k)
    3) $\frac{1}{3}$(i-2j+2k) 4) i-2j-2k

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11. If $r = \sqrt{x^2 + y^2 + z^2}$, then $\nabla\left(\frac{1}{r}\right)$ is equal to
    1) $\frac{\bar{r}}{r^3}$ 2) $\frac{\bar{r}}{r^2}$
    3) $\frac{-\bar{r}}{r^2}$ 4) $\frac{-\bar{r}}{r^3}$

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12. If $A = x^2zi-2y^3z^2j + x^2y^2zk$, then div $\bar{A}$ at (1, -1, 1) is
    1) 0 2) -3
    3) 3 4) 1

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13. If $\bar{A} = x^2yi-2xzj + 2yzk$ then curl curl $\bar{A}$ is
    1) (x+2)j 2) (2x+2)j
    3) (2x+1)j 4) (2x+2y)j

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14. If $\bar{v}$ = (x+2y+az)i + (bx-3y-z)j + (4x+cy+2z)k in irrotational, then
    1) a=4, b=-1, c=2 2) a=2, b=-1, c=4
    3) a=4, b=2, c=-1 4) a=4, b=-2, c=1

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15. The directional derivative of $\frac{1}{r}$ in the direction of the vector $\bar{r}$ =xi + yj + zk where r=|$\bar{r}$| is
1) r^2 2) $-r^2$
3) $\frac{1}{r^2}$ 4) $\frac{-1}{r^2}$

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16. Angle between the tangent planes to the surfaces xlogz = y^2-1 and x^2y = 2-z at (1, 1, 1) in
1) $\cos^{-1}\left(\frac{1}{\sqrt{30}}\right)$ 2) $\cos^{-1}\left(\frac{-1}{\sqrt{30}}\right)$
3) $\cos^{-1}\left(\sqrt{30}\right)$ 4) $\cos^{-1}\left(-\sqrt{30}\right)$

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17. If the circulation of the velocity vector $\bar{v}$ of a fluid around every closed curve C in region D vanishes, then is said to be
1) Solenoidal in D 2) Irrotational in D
3) Rotational in D 4) None of these

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18. Stoke's theorem establishes a relationship between
1) line and double integrals
2) line and surface integrals
3) double and surface integrals
4) surface and volume integrals

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19. For any closed surface S enclosing a volume V the value of $\iint_S$ curl $\bar{F}.\hat{n}dS$ is
1) always zero 2) always non-zero
3) $\iiint_V$ curl div $\bar{F}dv$ 4) $-\iiint_V$ curl div $\bar{F}dv$

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20. Using Gauss Divergence theorem to evaluate $\iint \bar{A}.\bar{n}ds$, leads to
1) $\int_V$ div $\bar{n}dv$ 2) $\int_V$ div$.\bar{A}.\bar{n}dv$
3) $\int_V$ div$.\bar{A}dv$ 4) zero

- ME 2005

21. Divergence of curl of any vector is equal to
1) one 2) zero
3) infinity 4) not defined

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22. If $\bar{a}$ is a constant vector and $\bar{r} = x\bar{i} + y\bar{j} + z\bar{k}$ then $\nabla\times(\bar{a}\times\bar{r})$ is equal to
1) zero 2) $\bar{a}$
3) $2\bar{a}$ 4) $|\bar{a}|$

23. The unit normal to the surface x^3-xyz + z^3 = 1 at the point (1, 1, 1) is
1) $\frac{1}{3}(2\bar{i}-\bar{j}+2\bar{k})$ 2) $\frac{1}{3}(-2\bar{i}-\bar{j}+2\bar{k})$
3) $\frac{1}{3}(2\bar{i}+\bar{j}-2\bar{k})$ 4) $\frac{1}{3}(-2\bar{i}+\bar{j}+2\bar{k})$

- ME 2004

24. The angle between the normals to the surface xy=z^1 ®t the points (-2, -2, 2) and (1, 9, -3) is
1) $\cos^{-1}\left(\frac{22}{\sqrt{177}}\right)$ 2) $\cos^{-1}\left(\frac{-44}{\sqrt{177}}\right)$
3) $\cos^{-1}\left(\frac{9}{\sqrt{177}}\right)$ 4) $\cos^{-1}\left(\frac{9}{177}\right)$

- ME 2004

25. If $\bar{r}$ is the position vector of the point (x, y, z) with respect to the origin then $\nabla(r^n)$ is
1) $(n-1)r^{n-2}(\bar{r})^2$ 2) $nr^{n-1}\bar{r}$
3) $nr^{n-2}\bar{r}$ 4) $nr^{n-1}\bar{r}$

- ME 2004

26. When $\phi = x^3 + y^3 + z^3$-3xyz then $\nabla\times\nabla\phi$ at (1, 2, 3) is
1) 3i+3j+3k 2) 3i-3j-3k
3) 1 4) 0

- ME 2004

27. If $\bar{F} = (axy + bz^3)\bar{i}+(3x^2-cz)j + (3xz^2-y)\bar{k}$ is irrotational then the values of (a, b, c) are
1) a=6, b= 1, c= 1
2) a=5, b=-1; c=-l
3) a = 7, b=-1, c=1
4) a=5, b=-1, c=-2

28. The directional derivative of ϕ = xy + yz + zx at (1, 2, 3) in the direction of $3\bar{i} + 4\bar{j} + 5\bar{k}$ is
1) $\frac{\sqrt{50}}{46}$ 2) $\frac{48}{50}$

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3) $\frac{46}{\sqrt{50}}$ 4) $\frac{50}{46}$

- ME 2004

29. If $\nabla\phi = (2xy + y^2)\bar{i} + (x^2 + 2xy)\bar{j} + 2z\bar{k}$ then ϕ is
1) $4xy+y^2+x^2+2z$ 2) $2x^2y+2y^2x+z^z$
3) $x^2y+y^2x+z^2$ 4) $x^2y+2y^2x+2z^2$

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30. If $\bar{F} = (ax - 5y)\bar{i} + (x - y)\bar{j} + (3x - z)\bar{k}$ is solenoidal, then the value of a is
1) 5 2) 2
3) -2 4) -4

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31. The value of $\int(4ydx + 7xdy)$ over the circle $x^2 + y^2 = 4$ is
1) 3π 2) 4π
3) 11π 4) 12π

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32. The value of $\iint_S (\nabla \times \bar{F}).\hat{n}dS$ where $\bar{F} = (x + 2y)\bar{i} - 3z\bar{j} + x\bar{k}$ and S is the surface - of the solid bounded by x=0, y = 0, z=0 and x + y + z = 1 is
1) 0 2) 1
3) 3 4) $\frac{1}{6}$

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33. The value of $\iint_C xdx + ydy + zdz$ where C is the circle $x^2 + y^2 + z^2 = 16$, z = 0 is
1) 4π 2) 16π
3) 64π 4) 0

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34. The angle between the surfaces $x^2+y^2+z^2=9$ and $x^2 + y^2 - z = 3$ at (2, -1, 2) is
1) $\cos^{-1}\left(\frac{8}{\sqrt{21}}\right)$ 2) $\cos^{-1}\left(\frac{8}{3\sqrt{21}}\right)$
3) $\sin^{-1}\left(\frac{8}{\sqrt{21}}\right)$ 4) $\sin^{-1}\left(\frac{8}{3\sqrt{21}}\right)$

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35. The directional derivative of $\phi(x, y, z) = xyz$ at (2, 1, 1) in the direction of $\bar{j} + \bar{k}$ is
1) $\frac{2}{\sqrt{5}}$ 2) $\frac{4}{\sqrt{2}}$
3) $\frac{\sqrt{2}}{4}$ 4) $\frac{4}{\sqrt{5}}$

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36. If $\bar{F} = 3xy\bar{i} - y^2\bar{j}$, then the value of $\int_{(0,0)}^{(1,2)} \bar{F}.d\bar{r}$ along any path is
1) $\frac{-7}{6}$ 2) $\frac{6}{7}$
3) $\frac{7}{6}$ 4) $\frac{-6}{7}$

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37. If $\bar{W} \times \bar{r}$ is solenoidal then the vector $\bar{W}$ is
1) solenoidal 2) irrotational
3) a constant vector 4) none of these

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38. If $\bar{n}$ is the unit normal vector drawn outward to any closed surface S enclosing a volume V, if $\bar{F} = ax\bar{i} + by\bar{j} + cz\bar{k}$, then the value of $\iint_S \bar{F}.\bar{n}dS$ is
1) $v(a+b+c)^2$ 2) $v(a+b+c)$
3) $v(a^2+b^2+c^2)$ 4) $v(a^3+b^3+c^3)$

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39. The unit normal to the surface $x^2-2y^2 - z^2 = 3$ at the point (1, 1, 2) is
1) $\frac{\bar{i}-2\bar{j}+2\bar{k}}{\sqrt{3}}$ 2) $\frac{\bar{i}-2\bar{j}-2\bar{k}}{\sqrt{3}}$

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40. The directional derivative of $2x^2 + 3y^2 + z^2$ the point (2, 1, 3) in the direction of th vector $\bar{i}-2\bar{k}$ is
1) $\frac{4}{\sqrt{5}}$ 2) $\frac{2}{\sqrt{5}}$
3) $\frac{-4}{\sqrt{5}}$ 4) $\frac{-2}{\sqrt{5}}\frac{-2}{\sqrt{5}}$

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41. If $\bar{n}$ is the unit normal vector drawn outward to any closed surface S enclosing a volume V, then the value of $\iint_s \bar{r}.\bar{n}dS$ is
1) v 2) 2v
3) 3v 4) 4v

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42. If $\bar{F} = x^2\bar{i} + xy\bar{j}$, then the value of $\iint_{(0,0)}^{(11)} \bar{F}\, d\bar{r}$ along any path is
1) $\frac{5}{12}$ 2) $\frac{1}{12}$
3) $\frac{7}{12}$ 4) $\frac{1}{4}$

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43. If curl curl $\bar{F} = \nabla.\nabla\bar{F} - \nabla^2\bar{F}$. and if $\nabla.\bar{F} = 0$ then the value of curlcurlcurlcurl $\bar{F}$ is
1) $\nabla^4\bar{F}$ 2) $-\nabla^4\bar{F}$
3) $-\nabla^2\bar{F}$ 4) $\nabla^2\bar{F}$

- ME 2000

44. What is the greatest rate of increase of the notion $u = x^2 + yz^2$ at the point (1, -1, 3)?
1) $\sqrt{89}$ 2) $\sqrt{20}$
3) 11 4) 17

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45. If the vector $\bar{F} = (y + ax)\bar{i} + (z + 2y)\bar{j} - (x + z)\bar{k}$ is solenoidal, what is the value of a?
1) -1 2) 1
3) 0 4) 2

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46. If $\vec{r}\ x\vec{i} + y\vec{j} + z\vec{k}$, then $\nabla \times \left(\frac{\vec{r}}{r^2}\right)$ is equal to
1) 1 2) -1
3) 0 4) 2

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47. If $\vec{r} = xi + yj + zk$ and n is the unit outward normal vector to the unit space S, then $\iint_S \vec{r}.\hat{n}ds =$
1) 0 2) $\frac{\pi^2}{4}$
3) $\frac{3\pi}{4}$ 4) $\frac{4\pi}{3}$

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48. What is the value of the line integral $\int_C [\sin y\vec{i} + x(1 + \cos y)j].d\vec{r}$ where C is the curve $x^2 + y^2 = a^2$, z = 0 and r is the position vector $x\vec{i} + y\vec{j} + z\vec{k}$
1) $2\pi a^2$ 2) πa^2
3) 0 4) $2\pi a$

49. The vector $\vec{A} = 3y^4z^2\vec{i} + 4x^3y^2\vec{j} - 3x^2y^2\vec{k}$
1) irrotajional and not solenoidal
2) solenoidal and not irrotational
3) both irrotational and solenoidal
4) neither irrotational nor solenoidal

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50. If $\frac{d\vec{f}}{dt} = \vec{h} \times \vec{f}$ and $\frac{d\vec{g}}{dt} = \vec{h} \times \vec{g}$, then $\frac{d}{dt} = (\vec{f} \times \vec{g})$ 1) $(\vec{h} \times \vec{f}) \times \vec{g}$ 2) $[\vec{f}, \vec{g}, \vec{h}]$
3) 0 4) $\vec{h} \times (\vec{f} \times \vec{g})$

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51. Given that curl $\vec{F} = \vec{j} + 2(x - y)\vec{k}$ the value of $\int_C \vec{F}.d\vec{r}$ where C is the plane triangle with vertices (0, 0), (1, 0) and (1, 1) is
1) 3 2) 1
3) $\frac{1}{3}$ 4) $\frac{1}{\sqrt{3}}$

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52. If $\hat{e_r}, \hat{e_\theta}$ are unit vectors along radial and transverse direction, then $\frac{d\hat{e_r}}{dt}$ is
1) 0 2) $\vec{0}$
3) $\hat{e_\theta}$ 4) $-\hat{e_\theta}$

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53. The position vector of a particle at time t is $\vec{r} = \cos(t - 1)\vec{i} + \sin(t - 1)\vec{j} + at^3\vec{k}$. What should be the value of 'a' so that at time t= 1, the acceleration is normal to the position vector?
1) $\frac{1}{\sqrt{6}}$ 2) $\sqrt{6}$
3) $-\sqrt{6}$ 4) 0

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54. If $\vec{r}$ is the position vector of any point (x, y, z) on the surface S enclosing a volume then $\iint_S \vec{r}.d\vec{S}$ equals
1) 0 2) v
3) 2v 4) 3v

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55. A unit normal to the surface xy-z — 0 at the point (4, 1, 2) is

1) $\frac{1}{\sqrt{33}}(\vec{i}+4\vec{j}-4\vec{k})$ 2) $\frac{1}{\sqrt{33}}(\vec{i}-4\vec{j}-4\vec{k})$

3) $\frac{1}{26}(\vec{i}+4\vec{j}+3\vec{j})$ 4) $\frac{1}{\sqrt{26}}(\vec{i}+4\vec{j}+3\vec{k})$

56. If $\vec{a}$ is a constant vector and f is the position vector of anypoint (x, y, z) then which of the following is not true?

1) $\nabla(\vec{a}.\vec{r}) = \vec{a}$ 2) curl $\vec{r} = 0$

3) div $\vec{r} = 3$ 4) $\nabla.(\vec{a}\times\vec{r}) = \vec{a}$

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57. If $\vec{r} = \vec{a}\cos nt + \vec{b}\sin nt$ where $\vec{a}, \vec{b}$, n are independent of t, then $\vec{r}\times\frac{d\vec{r}}{dt}$ is

1) $\vec{a}\times\vec{b}$ 2) 0

3) $n(\vec{a}\times\vec{b})$ 4) $-n(\vec{a}\times\vec{b})$

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58. If $\vec{F}$ = (x + y + 1)$\vec{i}$ + $\vec{i}+\vec{j}$(x + y)$\vec{k}$, then $\vec{F}$ curl $\vec{F}$ is

1) x-y-1 2) 0

3) 1 4) x+y+1

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