Max Marks: 60

Read the following instructions carefully before attempting the question paper.

1. Match the Paper Code shaded on the OMR Sheet with the Paper code mentioned on the question paper and ensure that both are the same.
2. This question paper contains 60 questions of 1 mark each. 0.25 marks will be deducted for each wrong answer.
3. Attempt all the questions in serial order.
4. Do not write or mark anything on the question paper and/or on rough sheet(s) which could be helpful to any student in copying, except your registration number on the designated space.
5. Submit the question paper and the rough sheet(s) along with the OMR sheet to the invigilator before leaving the examination hall.

Q1)

If $\begin{bmatrix} a+b & 3 \\ 5 & ab \end{bmatrix} = \begin{bmatrix} 4 & 3 \\ 5 & 3 \end{bmatrix}$, then what are the values of a and b?

(a) (2, 1) or (1, 2) (b) (2, 4) or (4, 2) (c) (0, 3) or (3, 0) (d) (1, 3) or (3, 1)

Q2) CO1, L1

If $B = \begin{bmatrix} 1 & 7 \\ 3 & 1 \end{bmatrix}$, $C = \begin{bmatrix} 4 & 1 \\ 6 & 8 \end{bmatrix}$, and $2A + 3B - 6C = 0$, then what is the value of A?

(a) $\begin{bmatrix} 21/2 & 27/2 \\ -15/2 & 45/2 \end{bmatrix}$

(b) $\begin{bmatrix} 21/4 & 27/4 \\ -15/4 & 45/4 \end{bmatrix}$

(c) $\begin{bmatrix} 21/4 & -15/4 \\ 27/4 & 45/4 \end{bmatrix}$

(d) $\begin{bmatrix} 21/2 & -15/2 \\ 27/2 & 45/2 \end{bmatrix}$

Q3) If $A = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then what is the value of k for which $A^2 = 8A + kI$? CO

(a) 7 (b) -7 (c) 10 (d) 8

Q4) CO1,

For what values of λ, the given set of equations has a unique solution?

$$2x + 3y + 5z = 9$$
$$7x + 3y - 2z = 8$$
$$2x + 3y + \lambda z = 9$$

(a) $\lambda = 15$ (b) $\lambda = 5$

(c) For all values except $\lambda = 15$ (d) For all values except $\lambda = 5$

Q5) If two of the eigen values of a matrix of order 3 x 3, whose determinant is 36 are 2 & 3 than the third eigen value is.

(a) 2 (b) 3 (c) 4 (d) 6

CO1, L1

Q6) Find the solution to $9y'' + 6y' + y = 0$ for $y(0) = 4$ and $y'(0) = -1/3$.

(a) $y = (4 + x)e^{-x/3}$ (b) $y = (4 - x)e^{-x/3}$ (c) $y = (8 - 2x)e^{x/3}$ (d) $y = (1 - x)e^{-x/3}$.

CO2, L2

Q7) Find the solution to $y'' - y = 0$.

(a) $y = c_1e^{x} - c_2e^{x}$ (b) $y = c_1(e^{x} + e^{-x})$ (c) $y = c_1e^{x} + c_2e^{-x}$ (d) $y = c_1e^{x} - c_2e^{-x}$.

CO2, L2

Q8) Complementary Function of differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 2y = 0$ is

(a) $y = e^{-x}(\cos x + \sin x)$ (b) $y = c_1e^{x}\cos(x + c_2)$ (c) $y = c_1\cos x + c_2\sin x$ (d) $y = e^{-x}(c_1\cos x + c_2\sin x)$

CO2, L2

Q9) If one root of the auxiliary equation is in the form $\alpha + i\beta$, where α, β are real and $\beta \neq 0$ then complementary part of solution of differential equation is

(a) $e^{\alpha x}(c_1\cos\alpha x + c_2\sin\alpha x)$ (b) $e^{\alpha x}(c_1\cos\beta x + c_2\sin\beta x)$ (c) $e^{\alpha x}(c_1\cos\alpha x + c_2\sin\beta x)$

(d) $e^{\alpha x}(c_1\cos\beta x + c_2\sin\alpha x)$

CO2, L2

Q10) The functions $f_1, f_2, f_3, \ldots, f_n$ are said to be linearly dependent if Wronskian of the functions $W(f_1, f_2, f_3, \ldots, f_n) =$

(a) 0 (b) 1 (c) Non-Zero (d) None of these

CO2, L2

Q11) Value of $\frac{1}{D^2 + a^2}\cos ax =$

(a) $-\frac{x}{2a}\sin ax$ (b) $\frac{x}{2a}\sin ax$ (c) $-\frac{x}{2a}\cos ax$ (d) $\frac{x}{2a}\cos ax$

CO2, L2

Q12) Find the particular integral of $(D^2 + 3D + 2)y = e^x$

(a) $\frac{e^x}{6}$ (b) $\frac{e^x}{12}$ (c) $\frac{e^x}{18}$ (d) $\frac{e^x}{24}$

CO2, L2

Q13) If function $X = k\cos(ax+b)$, then a trial solution (in method of undetermined coefficients) will be

(a) $c_1\sin(ax+b) + c_2\cos(ax+b)$ (b) $c_1\sin(ax+b)$ (c) $c_1\cos(ax+b)$ (d) none of these

CO2, L2

Q14) The P.I. of $y'' + 4y = 9\sin x$ is

(a) 2 cos x (b) 3 cos x (c) 4 cos x (d) 5 cos x

CO2, L2

Q15) The general solution of the equation $y'' - 5y' + 9y = \sin 3x$ is

(a) $y = Ae^{-x} + Be^{-4x} + 15\cos 2x$ (b) $y = Ae^{x} + Be^{4x} + 15\sin 2x$ (c) $y = Ae^{-x} + Be^{-x} + 15\sin 2x$

(d) $y = Ae^{x} + Be^{4x} + \frac{1}{15}\cos 2x$

CO2, L2

Q16) Which of the following is an "even" function of t?

(a) t^2 (b) $t^2 - 4t$ (c) $\sin 2t + 3t$ (d) $t^3 + 6$

CO3, L3

Q17) Given the periodic function $f(x) = \begin{cases} -x, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$, then the value of the fourier coefficient b_n can be computed as

(a) $\frac{(-1)^n}{n\pi}$ (b) $\frac{1}{n\pi}$ (c) 0 (d) none of these

CO3, L3

Q18) In the Fourier series of function $f(x) = \sin x,\ 0 < x < 2\pi$, the value of the Fourier coefficient b_n is

(a) $b_n = 0\ \forall n$ (b) $b_n = \frac{(-1)^n}{n\pi}$ (c) $b_n = 0; n \neq 1$ and $b_1 = 1$ (d) none of these

CO3, L3

Q19) For Fourier series expansion of periodic function $f(x)$ defined in $(-1,1)$ .if $f(x)$ is an even function then,

(a) $a_n = 0$ (b) $b_n = 0$ (c) $a_0 = 0$ (d) both a_0 and a_n is zero

CO3, L3

Q20) Fourier series of the periodic function with period 2π defined by

$f(x) = \begin{cases} 0, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$ is $\frac{\pi}{4} + \sum\left[\frac{1}{\pi n^2}(\cos n\pi - 1)\cos nx - \frac{1}{n}\cos n\pi \sin nx\right]$.

Then the value of the sum of the series $1 + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$ is

(a) $\frac{\pi^2}{4}$ (b) $\frac{\pi^2}{6}$ (c) $\frac{\pi^2}{8}$ (d) $\frac{\pi^2}{12}$

CO3, L3

Q21) Which of the following condition is necessary for Fourier series expansion of f(x) in $(c, c+2l)$.

(a) f(x) should be continuous in $(c, c+2l)$
(b) f(x) should be periodic.
(c) f(x) should be even function
(d) f(x) should be odd function.

CO3, L3

Q13) If function $X = k\cos(ax+b)$, then a trial solution (in method of undetermined coefficients) will be

(a) $c_1\sin(ax+b) + c_2\cos(ax+b)$ (b) $c_1\sin(ax+b)$ (c) $c_1\cos(ax+b)$ (d) none of these

CO2, L2

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CO2, L2

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(d) $y = Ae^{x} + Be^{4x} + \frac{1}{15}\cos 2x$

CO2, L2

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CO3, L3

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CO3, L3

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(a) $a_n = 0$ (b) $b_n = 0$ (c) $a_0 = 0$ (d) both a_0 and a_n is zero

CO3, L3

Q20) Fourier series of the periodic function with period 2π defined by $f(x) = \begin{cases} 0, -\pi < x < 0 \\ x,\ 0 < x < \pi \end{cases}$ is $\frac{\pi}{4} + \Sigma\left[\frac{1}{\pi n^2}(\cos n\pi - 1)\cos nx - \frac{1}{n}\cos n\pi \sin nx\right]$.

Then the value of the sum of the series $1 + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$ is

(a) $\frac{\pi^2}{4}$ (b) $\frac{\pi^2}{6}$ (c) $\frac{\pi^2}{8}$ (d) $\frac{\pi^2}{12}$

CO3, L3

Q21) Which of the following condition is necessary for Fourier series expansion of f(x) in (c,c + 2l).

(a) f(x) should be continuous in (c,c + 2l)
(b) f(x) should be periodic
(c) f(x) should be even function
(d) f(x) should be odd function.

CO3, L3

Q22) Given the periodic function $f(t) = \begin{cases} 1 \; for -1 \le t < 0 \\ -2 \; for \; 0 \le t < 1 \end{cases}$
The coefficient a_0 of the continuous Fourier series associated with the given function $f(t)$ can be computed as

(a) 0 (b) 1 (c) -1 (d) -2

CO3, L

Q23) Given the periodic function $f(x) = \begin{cases} 1 + x \; for -\pi \le x \le 0 \\ 1 - x \; for \; 0 \le x \le \pi \end{cases}$
The coefficient a_0 of the continuous Fourier series associated with the given function $f(x)$ can be computed as

(a) 2 (b) π (c) $\frac{\pi}{2}$ (d) $2-\pi$

CO3, L

Q24) The value of cos $2n\pi$ is
(a) -1 (b) 0 (c) 1 (d) π

CO3, L

Q25) Given the periodic function $f(x) = x \sin x, -\pi \le x \le \pi$ with period 2π. The coefficient a_0 of the continuous Fourier series associated with the given function $f(x)$ can be computed as

(a) 0 (b) 2π (c) $\frac{2}{\pi}$ (d) 2

CO3, L

Q26) The half range Fourier sine series of $f(x) = 1$ in $(0, \pi)$ is
(a) 0 (b) $\frac{4}{\pi}(\sin x + \frac{\sin 3x}{3} + \frac{\sin 5x}{5} + \cdots)$
(c) $\frac{4}{\pi}(\sin x - \frac{\sin 3x}{3} + \frac{\sin 5x}{5} - \cdots)$
(d) $\frac{4}{\pi}(\sin 2x + \frac{\sin 4x}{2} + \frac{\sin 6x}{3} + \cdots)$

CO3, L

Q27) The function sin nx cosnx is.
(a) Odd fuction (b) even function (c) cannot determined (d) none of these

CO3, L

Q28) Given the periodic function $f(t) = \begin{cases} t^2 \; for \; 0 \le t \le 2 \\ -t + 6 \; for \; 2 \le t \le 6 \end{cases}$
The coefficient a_0 of the continuous Fourier series associated with the given function $f(t)$ can be computed as

(a) $\frac{8}{9}$ (b) $\frac{16}{9}$ (c) $\frac{24}{9}$ (d) $\frac{32}{9}$

CO3, L

Q29) The period of the $f(x) = \cos 2x$ is
(a) π (b) $\frac{\pi}{2}$ (c) 2π (d) 4π

CO3, L

Q30) Which of the following is an "odd" function of t?
(a) t^2 (b) $t^2 - 4t$ (c) $\sin 2t + 3t$ (d) $t^3 + 6$

$\frac{1}{3}\left[\int_0^2 t^2 dt + \int_2^6 (-t+6)\, dt\right]$

$= \frac{1}{3}\left[\frac{t^3}{3}\Big|_0^2 + \left(-\frac{t^2}{2} + 6t\right)\Big|_2^6\right]$

$= \frac{1}{3}\left[\frac{8}{3} - \frac{36}{2} + 36 - (-2+12)\right]$

$= \frac{1}{3}\left[\frac{8}{3} - \frac{36}{2} - 10\right] = \frac{1}{3}\left[\frac{16-10}{6}\right.$

$\frac{x^2 mx}{x^4+m^2x^2} = \frac{mx^3}{x^4+m^2x^2} = \frac{x^2(mx)}{x^2(x^2+m^2)}$

$= \frac{mx}{x^2+m^2}$ $\frac{0}{m}$ $= 0$

$= \frac{x^3(m)}{x^3\left(x^3+\frac{m^2}{x}\right)} = \frac{m}{x^3+\frac{m^2}{0}} = \frac{m}{0+\infty}$

Q31) The value of $\lim_{(x,y)\to(0,0)} \frac{x^2y}{x^4+y^2}$

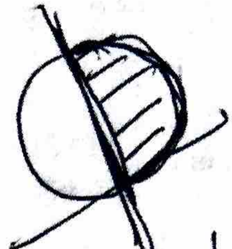
(a) 0 (b) 1 (c) 2 (d) Does not exist

CO1, L3

Q32) If $u = y^x$ then $\frac{\partial u}{\partial x}$ is

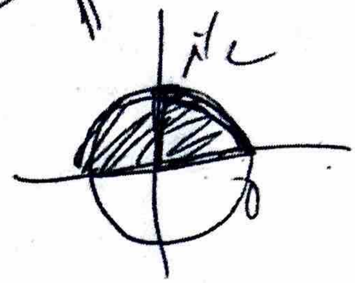
(a) xy^{x-1} (b) 0 (c) $y^x \log y$ (d) none of these

CO1, L3



Q33) If $x = r\cos\theta$, $y = r\sin\theta$ then $\frac{\partial r}{\partial x}$ is

(a) $\sec\theta$ (b) $\sin\theta$ (c) $\cos\theta$ (d) $\mathrm{cosec}\,\theta$



CO1, L3

Q34) If $u = \frac{x^2+y^2+xy}{x+y}$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ equals

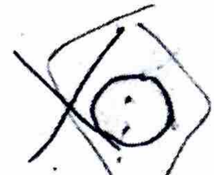
(a) 1 (b) 0 (c) u (d) 2u

CO1, L3

Q35) If p=0 and q=0 , $rt - s^2 > 0$, $r < 0$ then $f(x,y)$ is

(a) Minimum (b) Maximum (c) saddle point (d) None of these

CO1, L3



Q36) $u = x^2 + y^2$ then $\frac{\partial u}{\partial x}$ is

(a) 0 (b) 2 (c) 2x+2y (d) 2x

CO1, L3

Q37) If $u = f\left(\frac{x}{y}\right)$ then

(a) $x\frac{\partial u}{\partial x} - y\frac{\partial u}{\partial y} = 0$ (b) $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 0$ (c) $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = u$ (d) $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 1$

CO1, L3

Q38) If u is a homogeneous of x, y of order n, then

(a) $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = nu$ (b) $x\frac{\partial u}{\partial x} - y\frac{\partial u}{\partial y} = nu$ (c) $y\frac{\partial u}{\partial x} + x\frac{\partial u}{\partial y} = nu$ (d) $y\frac{\partial u}{\partial x} - x\frac{\partial u}{\partial y} = nu$

L3
CO1,

Q39) If $u = x^2\tan^{-1}\left(\frac{y}{x}\right)$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ at $x = y = 1$ is

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$ (c) $-\frac{\pi}{4}$ (d) π

CO1, L3

Q40) If $f = x^2 + y^2$, $x = r + 3s$, $y = 2r - s$ then $\frac{\partial f}{\partial r}$ is

(a) 4x+2y (b) 2x+y (c) 2x+4y (d) x+4y

$\cos\theta$ θ ∂

CO1, L3

$\frac{\partial z}{\partial r} =$

Q41) If $z = f(x,y)$ and $x = r\cos\theta$, $y = r\sin\theta$, then $\frac{\partial z}{\partial r}$ is

(a) $\frac{\partial f}{\partial x}\cos\theta + \frac{\partial f}{\partial y}\sin\theta$ (b) $\frac{\partial f}{\partial x}\sin\theta + \frac{\partial f}{\partial y}\cos\theta$ (c) $\frac{\partial f}{\partial x}\cos\theta - \frac{\partial f}{\partial y}\sin\theta$ (d) $\frac{\partial f}{\partial x}\sin\theta - \frac{\partial f}{\partial y}\cos\theta$

CO1, L3

Q42) If $x^4 + y^x = c$, where c is a constant, then value of $\frac{dy}{dx}$ at (1,1) is

(a) 0 (b) 1 (c) -1 (d) -2

CO1, L3

$y^x = c - x^4$

$x \log y = \log(c - x^4)$

$x \cdot \frac{1}{y}\frac{dy}{dx} + \log y = \frac{1}{(c-x^4)}(-4x^3)$

$\frac{x}{y}\frac{dy}{dx} = -\frac{4x^3}{c-x^4} - \log y$

$\frac{dy}{dx} = -\frac{y}{x}\left[\frac{4x^3}{c-x^4} - \log y\right]$

$\left.\frac{dy}{dx}\right|_{1,1} = -\left[\frac{4}{c} - 0\right] = -\frac{4}{c}$

Q43) If $f(x,y) = 0$ then $\frac{dy}{dx}$ is equal to

(a) $\frac{\frac{\partial y}{\partial f}}{\frac{\partial x}{\partial f}}$ (b) $-\frac{\frac{\partial f}{\partial y}}{\frac{\partial f}{\partial x}}$ (c) $-\frac{\frac{\partial f}{\partial x}}{\frac{\partial f}{\partial y}}$ (d) $\frac{\partial y}{\partial x}\cdot\frac{\partial f}{\partial y}$

CO1, L3

Q44) The function $f(x,y) = y^2 - x^3$ has

(a) a minimum at (0,0)
(b) a minimum at (1,1)
(c) neither minimum nor maximum at (0,0)
(d) a maximum at (1,1)

CO1, L3

Q45) The minimum value of $\sqrt{x^2+y^2}$ is

(a) 0 (b) 2 (c) 4 (d) ½

CO1, L3

Q46) The value of $\iiint_V dx\,dy\,dz$, where $V: x^2+y^2+z^2 = 4$ is

(a) 8π (b) $\frac{32\pi}{3}$ (c) $\frac{16\pi}{3}$ (d) $8\frac{\pi}{3}$

$\frac{4}{3}\pi r^3 = \frac{32\pi}{3}$

CO5, L4

Q47) The value of $\iint_R \square \, dx\,dy$, where $R: x^2+y^2 = 2y$ is

(a) 2π (b) π (c) 4π (d) $\frac{\pi}{2}$

CO5, L4

Q48) The value of the integral $\int_0^1\int_0^{1-x} x\,dy\,dx$ is

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) $\frac{1}{6}$

CO5, L4

Q49) The value of the integral $\int_a^b\int_a^b xy\,dx\,dy$ is

(a) $(b-a)^2$ (b) $\frac{(b-a)^2}{2}$ (c) $\frac{(b^2-a^2)^2}{4}$ (d) $\frac{b^2-a^2}{4}$

CO5, L4

Q50) The volume bounded by the planes $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$ is

(a) 1 (b) $\frac{1}{3}$ (c) $\frac{4}{3}$ (d) $\frac{1}{2}$

$\iiint dx\,dy\,dz$

CO5, L4

Q51) The value of the integral $\int_{z=-1}^{z=1}\int_{y=1}^{y=3}\int_{x=2}^{x=4} x^2y^3 z\, dx\, dy\, dz$ is

(a) 70 (b) $\frac{35}{3}$ (c) $\frac{65}{6}$ (d) 0

Q52) On changing the order of integration, $\int_0^1\int_y^{y^{\frac{1}{3}}} e^{x^2} dx\, dy =$ ______

(a) $\int_0^1\int_x^{x^3} e^{x^2} dy\, dx$ (b) $\int_0^1\int_x^{x^{\frac{1}{3}}} e^{x^2} dy\, dx$ (c) $\int_0^1\int_{x^{\frac{1}{3}}}^{x} e^{x^2} dy\, dx$ (d) $\int_0^1\int_{x^3}^{x} e^{x^2} dy\, dx$

Q53) For evaluating $\iiint_T dx\, dy\, dz$, where T is the boundary of $x^2+y^2+z^2=a^2$, if we transform Cartesian co-ordinate (x, y, z) into spherical polar co-ordinate (r, θ, ϕ) i.e. $x = r\sin\theta\cos\phi$, $y = r\sin\theta\sin\phi$, $z = r\cos\theta$ then the limit for θ will be

(a) 0 to 2π (b) 0 to π (c) 0 to $\pi/2$ (d) 0 to $\frac{\pi}{4}$

Q54) If we change the order of integration for $\int_0^{8a}\int_{\frac{x^2}{4a}}^{2x} xy\, dy\, dx$ then what will be the limit for x in $\int\int xy\, dx\, dy$?

(a) $\frac{y}{2} \le x \le \sqrt{4ay}$ (b) $\sqrt{4ay} \le x \le \frac{y}{2}$ (c) $\sqrt{4ay} \le x \le \frac{y}{4}$ (d) $4ay \le x \le 2y$

Q55) The area of the region bounded by $0 \le x \le 1$, $0 \le y \le x$ is

(a) 1 (b) 1/2 (c) 1/4 (d) none of these

Q56) The polar form of $\iint_R \sqrt{x^2+y^2}\,dx\, dy$, where $R: x^2+y^2 \le 4$, $x \ge y \ge 0$ is

(a) $\int_0^{\pi}\int_0^{2} r\, dr\, d\theta$ (b) $\int_0^{\frac{\pi}{4}}\int_0^{2} r^2\, dr\, d\theta$ (c) $\int_0^{\frac{\pi}{3}}\int_0^{2} r^2\, dr\, d\theta$ (d) $\int_0^{\pi}\int_0^{2} r^2\, dr\, d\theta$

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Q57) If we change the Cartesian coordinates to spherical polar coordinates i.e. $x = r\sin\theta\cos\phi$, $y = r\sin\theta\sin\phi$, $z = r\cos\theta$, then the Jacobian of transformation is

(a) r (b) $r\sin\theta$ (c) $r^2\sin\theta$ (d) $r\cos\phi$

F

$|J| =$

(58) The value of the integral $\int_{-1}^{1}\int_1^{3}\int_2^{4} xyz\, dx\, dy\, dz$ is

(a) 24 (b) 48 (c) 12 (d) 0

Q59) In polar form the equation of circle $x^2+y^2=4y$ is given by $\rightarrow$ $x^2+y^2-4y=0$

(a) $r = 4\sin\theta$ (b) $r = 2\sin\theta$ (c) $r = 4\cos\theta$ (d) $r = 2$

$(x-0)^2+y^2+4$

$(x-0)^2+(y-2$

Q60)

The value of $\int_1^e\int_1^e\int_1^e \frac{1}{xyz}\, dx\,dy\,dz$ is

a) 0 b) $\frac{1}{3}$ c) 1 d) none of these

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$2 \quad x \cdot 4$