MATHS

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DIFFERENTIALS AND PARTIAL DERIVATIVES

Worked Example

1. Using the approximation to find approximate value of

$(123)^{\frac{2}{3}}$

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2. A spherical balloon increase its surface area as the radius of the balloon increases from 10 cm to[10.4 cm. Use linear approximation to approximate the increase in the surface area. Also find the percentage error.

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3. A circular plate expands uniformly under the influence of heat. If it's radius increases from 10.5 cm to 10.75 cm, then find an approximate change in the area and the approximate percentage change in the area.

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4. Let f,g: $(a, b) \to R$ be differentiable functions show that $d\left(\frac{f}{g}\right) = \frac{gf'dx - fg'dx}{g^2}$ (where $g \neq 0$)

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5. If $f(x) = xe^x \sin x$ then find $f'(x)$.

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6. If the radius of the sphere, with radius 5 cm, has to increase by 0.1 cm approximately. How much will its volume increase ?

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7. Let $F(x, y) = \frac{2x - 3y + 4}{x^2 + y^2 + 4}$ for all $(x, y) \in R^2$, Show that f is continuous on R^2.

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8. Let $f(x, y) = \frac{2xy}{x^2 + 2y^2}(x, y) \neq (0, 0)$

$= 0 \quad \text{if} \quad (x, y) = (0, 0)$

Show that f (x,y) is not continuous at (0,0) through continuous at all other points of R^2.

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9. If $f = x^3 + y^3 + 3x^2y^2 + 4x^2y$ find $\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}, \frac{\partial^2 f}{\partial x \partial y}, \frac{\partial^2 f}{\partial y \partial x}, \frac{\partial^2 f}{\partial x^2}, \frac{\partial^2 f}{\partial y^2}$.

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10. Let $(x, y) = 2xy^2 + 3x^2y$ calculate $u_x(2, 1)$ and $u_y(1, -2)$.

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11. If $u = \sin(xy) + e^{x^2 + y^2}$ Find u_{xy} and u_{yx} are they are equal ?

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12. If $u = \frac{x}{y^2} - \frac{y}{x^2}$, then

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13. Show that $z = e^{x}(x\cos y - y\sin y)$ is tarmonic function.

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14. If $W = x^2 + y^2 + z^2, x, y, z \in R$ find the differential dW.

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15. If $U(x, y, z) = x^2 + 2xy + y^2z - z^2$ find the linear approximation for U at $(1, -1, 2)$

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16. Let

$W(x, y) = x^2 + xy + y^2$ and $x = \sin t, y = \cos t \in t \in (0, 2\pi)$

verify the above theorem.

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17. If $f(x, y) = 3x^2 + 2xy$ where $x = r + 2s^2, y = r^2 - s$ find $\frac{\partial f}{\partial r}, \frac{drlf}{\partial s}$.

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18. Show that $f(x, y) = \frac{2x^2 - y^2}{\sqrt{x^2 + y^2}}$ is a homogeneous function of degree 1.

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19. If $u = \sin^{-1}\left(\frac{x^3 + y^3}{x - y}\right)$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2\tan u.$

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Exercise 8 1

1. Let $f(x) = \sqrt[3]{x}$. Find the linear approximation at x = 27. Use the linear approximation to approximate $\sqrt[3]{27.2}$

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2. Using the approximation to find approximate value of $(123)^{\frac{2}{3}}$

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3. Using the approximation to find approximate value of

$\sqrt[4]{15}$

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4. Using differentials, find the approximate value of each of the up to 3 places of decimal.

$(26)^{\frac{1}{3}}$

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5. Find a linear approximation for the following functions at the indicated points.

$f(x) = x^3 - 5x + 12, x_0 = 2$

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6. Find a linear approximation for the functions at the indicated point

$g(x) = \sqrt{x^2 + 9}, x_9 = -4$

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7. Find a linear approximation for the functions at the indicated point

$h(x) = \frac{x}{x+1}, x_a = 1$

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8. The radius of a circular plate is measured as 12.65 cm instead of the actual length 12.5 cm. Find the following is calculating the area of the circular plate:

(i) Absolute error

(ii) Relative error

(iii) Percentage error

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(i) Absolute error

(ii) Relative error

(iii) Percentage error

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11. A sphere is made of ice having radius 10 cm. Its radius decreases from 10 cm to 9.8 cm. Find approximations for the following:

(i) change in the volume

(ii) change in the surface area

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13. The time T, taken for a complete oscillation of a single pendulam with length l, is given by the equation $T = 2\pi\sqrt{\frac{l}{g}}$, where g is a constant. Find the approximate percentage error in the calculated value of T corresponding to an error of 2 percent in the value of l.

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14. Show that the percentage error in the nth root of a number is approximately $\frac{1}{n}$ times the percentage error in the number.

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Exercise 8 2

1. Find differential dy for $y = \frac{(1-2x)^3}{3-4x}$.

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2. Find differential dy for each of the function :

$y = 3(3 + \sin(2x))^{\frac{2}{3}}$

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3. Find differential dy for each of the function :

$y = \left(e^{x^2 - 5x + 7}\right) \cos\left(x^2 - 1\right)$

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4. Find df for $f(x) = x^2 + 3x$ and evalaute it for

(i) x=2 and dx = 0.1

(ii) x=3 and dx= 0.02

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5. Find df for $f(x) = x^2 + 3x$ and evalaute it for

(i) x=2 and dx = 0.1

(ii) x=3 and dx= 0.02

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6. Find Δf and df for the function f for the indicated values of x,Δx and compare

$f(x) = x^3 - 2x^2, x = 2, \Delta x = 0.5$

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7. Find Δf and df for the function f for the indicated values of x,Δx and compare

$f(x) = x^2 + 2x + 3, x = -0.5, \Delta x = dx = 0.1$

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8. Assuming $\log_{10} e = 0.4343$, find an approximate value of $\log_{10} 1003$.

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9. The trunk of a tree has diameter 30 cm. During the following year, the circumference grew 6 cm.

(i) Approximately, how much did the tree's diameter grow?

(ii) What is the percentage increase in area of the tree's cross-section?

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11. An egg of a particular bird is very nearly spherical. If the radius to the inside of the shell is 5mm and radius to the outside of the shell is 5.3 mm, find the volume of the shell approximately.

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12. Assume that the cross section of the artery of human is circular. A drug is given to a patient to dilate his arteries. If the radius of an artery is increased from 2 mm to 2.1 mm, how much is cross-sectional area increased approximately?

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13. In a newly developed city, it is estimated that the voting population (in thousands) will increase according to $V(t) = 30 + 12t^2 - t^3, 0 \leq t \leq 8$ where t is the time in years. Find the approximate change in voters for the time change from 4 to $4\left(\frac{1}{6}\right)$ year.

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14. The relation between the number of words y a person learns in x hours is given by $y = 52\sqrt{x}, 0 \leq x \leq 9$. What si the approximate number of words learned when x changes from

(i) 1 to 1.1 hour?

(ii) 4 to 4.1 hour?

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17. A coat of paint of thickness 0.2 cm is applied to the faces of a cube whose edge is 10 cm. Use the differentials to find approximately how many cubic centimeters of paint is used to paint this cube. Also calculate the exact amount of pain used to pain this cube.

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Exercise 8 3

1. Evaluate $\lim_{(x,y)\to(1,2)}$, g(x,y) , if the limit exist where g(x,y) $= \frac{3x^2 - xy}{x^2 + y^2 + 3}$

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2. Evaluate $\lim_{(x,y)\to(0,0)} \cos\left(\frac{x^3 + y^3}{x + y + 2}\right)$. If the limit exists.

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3. Let $f(x, y) = \frac{y^2 - xy}{\sqrt{x} - \sqrt{y}}$ for $(x, y) \neq (0, 0)$. Show that $\lim_{(x,y)\to(0,0)} f(x, y) = 0$

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4. Evaluate $\lim_{(x,y)\to(0,0)} \cos\left(\frac{e^x \sin y}{y}\right)$, if the limit exists.

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5. Let $g(x, y) = \frac{x^2 y}{x^4 + y^2}$ for (x,y) $\neq$ (0,0) and f(0,0)=0.

(i) Show that $\lim_{(x,y)\to(0,0)} g(x, y) = 0$ along every line $y = mx, m \in R$.

(ii) Show that $\lim_{(x,y)\to(0,0)} g(x, y) = \frac{k}{1 + k^2}$, along every parabola $y = kx^2, k \in R\{0\}$.

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6. Let $g(x, y) = \frac{x^2 y}{x^4 + y^2}$ for (x,y) $\neq$ (0,0) and f(0,0)=0.

(i) Show that $\lim_{(x,y) \to (0,0)} g(x, y) = 0$ along every line $y = mx, m \in R$.

(ii) Show that $\lim_{(x,y) \to (0,0)} g(x, y) = \frac{k}{1 + k^2}$, along every parabola $y = kx^2, k \in R\{0\}$.

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7. Show that $f(x, y) = \frac{x^2 - y^2}{y^2 + 1}$ is continous at every, $(x, y) \in R^2$.

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8. Let $g(x, y) = \frac{e^y \sin x}{x}$, for $x \neq 0$ and g(0,0) =1. Show that g is continous at (0,0).

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Exercise 8 4

1. Find the partial derivatives of the functions at the indicated point

$f(x, y) = 3x^2 - 2xy + y^2 + 5x + 2, (2, -5)$

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2. Find the partial derivatives of the functions at the indicated point

$g(x, y) = 3x^2 + y^2 + 5x + 2, (1, -2)$

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3. Find the partial derivatives of the functions at the indicated point

$h(x, y, z) = x\sin(xy) + z^2x, \left(2, \frac{\pi}{4}, 1\right)$

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4. Find the partial derivatives of the functions at the indicated point

$G(x, y) = e^{x+3y}\log\left(x^2 + y^2\right), (-1, 1)$

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5. For each of the functions find the $f_x, f_y,$ and show that $f_{xy} = f_{yx}$.

$$f(x, y) = \frac{3x}{y + \sin x}$$

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6. For each of the functions find the $f_x, f_y,$ and show that $f_{xy} = f_{yx}$.

$$f(x, y) = \tan^{-1}\left(\frac{x}{y}\right)$$

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7. For each of the functions find the $f_x, f_y,$ and show that $f_{xy} = f_{yx}$.

$$f(x, y) = \cos\left(x^2 - 3xy\right)$$

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8. If U(x,y,z) $= \frac{x^2+y^2}{xy} + 3z^2y$, find $\frac{\partial U}{dx} + \frac{\partial U}{dy} + \frac{\partial U}{dz}$

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9. If $U(x, y, z) = \log(x^3 + y^3 + z^3)$ find $\frac{\partial U}{dx} + \frac{\partial U}{dy} + \frac{\partial U}{dz}$

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10. For each of the function find the g_{xy}, g_{yy} and g_{yx},

$g(x, y) = xe^y + 3x^2y$

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11. For each of the function find the g_{xy}, g_{yy} and g_{yx},

$g(x, y) = \log(5x + 3y)$

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12. For each of the function find the g_{xy}, g_{yy} and g_{yx},

$g(x, y) = x^2 + 3xy - 7y + \cos(5x)$

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13. Let $w(x, y, z) = \dfrac{1}{\sqrt{x^2 + y^2 + z^2}} (x, y, z) \neq (0, 0, 0)$.

Show that $\dfrac{\partial^2 w}{\partial x^2} + \dfrac{\partial^2 w}{\partial y^2} + \dfrac{\partial^2 w}{\partial z^2} = 0$

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14. If $V(x, y) = e^x(x \cos y - y \sin y)$, then prove that $\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} = 0$

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15. If $w(x, y) = xy + \sin(xy)$, then prove that $\frac{\partial^2 w}{\partial y \partial x} = \frac{\partial^2 w}{\partial x \partial y}$

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16. If $v(x, y, z) = x^3 + y^3 + z^3 + 3xyz$, show that $\frac{\partial^2 v}{\partial y \partial z} = \frac{\partial^2 v}{\partial z \partial y}$

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17. A firm produces two types of calculators each week, x number of type A and y number of type B. The weekly revenue and cost functions (in rupees) are R(x,y) $= 80x + 90y + 0.04xy - 0.05x^2 - 0.05y^2$ and $C(x, y) = 8x + 6y + 2000$ respectively.

(i) Find the profit function P(x,y).

(ii) Find $\frac{\partial P}{\partial x}(1200, 1800)$ and $\frac{\partial P}{\partial y}(1200, 1800)$ and interpret these results.

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18. A firm produces two types of calculators each week, x number of type A and y number of type B. The weekly revenue and cost functions (in rupees) are R(x,y) $= 80x + 90y + 0.04xy - 0.05x^2 - 0.05y^2$ and

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Exercise 8 5

1. If $w(x, y) = x^3 - 3xy + 2y^2, x, y \in R,$ find the linear approximation for w at (1,-1).

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2. Let z(x,y) $= x^2y + 3xy^4, x, y \in R$. Find the linear approximation for z at (2,-1).

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3. If $v(x, y) = x^2 - xy + \frac{1}{4}y^2 + 7, x, y \in R$, find the differential dv.

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4. Let W(x,y,z) $= x^2 - xy + 3\sin z, x, y, z \in R$, Find the linear approximation at (2,-1,0).

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5. Let V(x,y,z) =xy + yz + zx, x, y, $z \in R$. Find the differential dV.

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Exercise 8 6

1. If $u(x, y) = x^2y + 3xy^4$, $x = e^t$ and y= sin t, find $\frac{du}{dx}$ and evaluate it at t=0.

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2. If $u(x, y, z) = xy^2z^3$, $x = \sin t$, $y = \cos t$, $z = 1 + e^{2t}$, find $\frac{du}{dx}$.

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3. If $w(x, y, z) = x^2 + y^2 + z^2, x = e^t, y = e^t \sin t$ and $z = e^t \cos t$, find $\frac{dw}{dt}$.

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4. Let

$U(x, y, z) = xyz, x = e^{-t}, y = e^{-t} \cos t, z = \sin t, t \in R$.

Find $\frac{dU}{dt}$.

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5. If w(x,y) $= 6x^3 - 3xy + 2y^2, x = e^s, y = \cos s \in R$, find $\frac{dw}{ds}$, and evaluate at s=0.

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6. If $z(x, y) = x \tan^{-1}(xY), x = t^2, ty = se^t, s, t \in R$. Find $\frac{\partial z}{\partial s}$ and $\frac{\partial z}{\partial t} ats = t = 1$.

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7. Let U(x,y) $= e^x \sin y$, where $x = st^2, y = s^2 t, s, t \in R$. Find $\frac{\partial U}{\partial S}, \frac{\partial U}{\partial t}$ and evaluate them at s=t=1.

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8. Let z(x,y) $= x^3 - 3x^2 y^3$, where $x = se^t, y = se^{-t}, s, t \in R$. Find $\frac{\partial z}{\partial s}$ and $\frac{\partial z}{\partial t}$

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9. W(x,y,z) = xy + yz + zx, x = u - v, y = uv, z = u + v, u, v $\in$ R. Find

$\frac{\partial w}{\partial u}, \frac{\partial w}{\partial v}$ and evaluate then at $\left(\frac{1}{2}, 1\right)$.

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Exercise 8 7

1. In each of the following cases , determine whether the following function is homogeneous or not. If it is so , find the degree. (i) $f(x, y) = x^2y + 6x^3 + 7$ (ii)

$$h(x, y) = \frac{6x^2y^3 - \pi y^5 + 9x^4y}{2020x^2 + 2019y^2}$$

(iii) $g(x, y, z) = \frac{\sqrt{3x^2 + 5y^2 + z^2}}{4x + 7y}$ (iv)

$$U(x, y, z) = xy + \sin\left(\frac{y^2 - 2z^2}{xy}\right)$$

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2. In each of the following cases , determine whether the following function is homogeneous or not. If it is so , find the degree. (i) $f(x, y) = x^2y + 6x^3 + 7$ (ii)

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(iii) $g(x, y, z) = \frac{\sqrt{3x^2 + 5y^2 + z^2}}{4x + 7y}$ (iv) $U(x, y, z) = xy + \sin\left(\frac{y^2 - 2z^2}{xy}\right)$

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4. In each of the following cases , determine whether the following function is homogeneous or not. If it is so , find the degree. (i) $f(x, y) = x^2y + 6x^3 + 7$ (ii) $h(x, y) = \frac{6x^2y^3 - \pi y^5 + 9x^4y}{2020x^2 + 2019y^2}$ (iii) $g(x, y, z) = \frac{\sqrt{3x^2 + 5y^2 + z^2}}{4x + 7y}$ (iv) $U(x, y, z) = xy + \sin\left(\frac{y^2 - 2z^2}{xy}\right)$

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5. Prove that $f(x, y) = x^3 - 2x^2y + 3xy^2 + y^3$ is homogenous, what is the degree? Verify Euler's Theorem for f.

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6. Prove that $g(x, y) = x \log\left(\frac{y}{x}\right)$ is homogenous, what is the degree? Verify Euler's Theorem for g.

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7. If $u(x, y) = \frac{x^2 + y^2}{\sqrt{x + y}}$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{3}{2}u$.

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8. If $v(x, y) = \log\left(\frac{x^2 + y^2}{x + y}\right)$, prove that $x\frac{\partial v}{\partial x} + y\frac{\partial v}{\partial y} = 1.$

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9. If $w(x, y, z) = \log\left(\frac{5x^3y^4 + 7y^2xz^4 - 75y^3z^4}{x^2 + y^2}\right)$, find $x\frac{\partial w}{\partial x} + y\frac{\partial w}{\partial y} + z\frac{\partial w}{\partial z}$,

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Exercise 8 8

1. A circular template has a radius of 10 cm. The measurnment of the radius has an approximate error of 0.02 cm. Then the percentage error in calculating area of this template is

A. 0.2%

B. 0.4%

C. 0.04%

D. 0.08%

Answer: B

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2. The percentage error of fifth root of 31 is approximately how many times the percentage error in 31?

A. $\frac{1}{31}$

B. $\frac{1}{5}$

C. 5

D. 31

Answer: B

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3. If u(x,y) $= e^{x^2 + y^2}$, then $\frac{\partial u}{\partial x}$ is equal to

A. $e^{x^2 + y^2}$

B. $2xu$

C. $x^2 u$

D. $y^2 u$

Answer: B

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4. If $v(x, y) = \log(e^x + e^y)$, then $\frac{\partial v}{\partial x} + \frac{\partial v}{\partial y}$ is equal to

A. $e^x + e^y$

B. $\frac{1}{e^x + e^y}$

C. 2

D. 1

Answer: D

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5. If $w(x, y) = x^y, x > 0$, then $\frac{\partial w}{\partial x}$ is equal to

A. $x^y \log x$

B. $y \log x$

C. yx^{y-1}

D. $x \log y$

Answer: C

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6. If $f(x, y) = e^{xy}$, then $\frac{\partial^2 f}{\partial x \partial y}$ is equal to

A. xye^{xy}

B. $(1 + xy)e^{xy}$

C. $(1 + y)e^{xy}$

D. $(1 + x)e^{xy}$

Answer: A

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7. If we measure the side of a cube to be 4 cm with an error of 0.1 cm, then the error in our calculation of the volume is

A. 0.4 cu.cm

B. 0.45 cu.cm

C. 2 cu.cm

D. 4.8 cu.cm

Answer: D

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8. The change in the surface area $S = 6x^2$ of a cube when the edge length varies from x_0 to $x_0 + dx$ is

A. $12x_0 + dx$

B. $12x_0dx$

C. $6x_0dx$

D. $6x_0dx.$

Answer: B

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9. The approximate change in the volume V of a cube of side x metres caused by increasing the side by 1% is

A. $0.3xdxm^3$

B. $0.0. xm^3$

C. $0.03x^2m^3$

D. $0.03x^3m^3$

Answer: B

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10. If $g(x, y) = 3x^2 - 5y + 2y^2, x(t) = e^t$ and $y(t) = \cos t$, then $\frac{dg}{dt}$ is equal to

A. $6e^{2t} + 5\sin t - 4\cos t \sin t$

B. $6e^{2t} - 5\sin t + 4\cos t \sin t$

C. $3e^{2t} + 5\sin t + 4\cos t \sin t$

D. $3e^{2t} - 5\sin t + 4\cos t \sin t$

Answer: A

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11. If $f(x) = \frac{x}{x+1}$, then its differential is given by

A. $\frac{-1}{(x+1)^2}dx$

B. $\frac{1}{(x+1)^2}dx$

C. $\frac{1}{x+1}dx$

D. $\frac{-1}{x+1}dx$

Answer: B

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12. If $u(x, y) = x^2 + 3xy + y - 2019$, then $\left(\frac{\partial u}{\partial x}\right)_{4 \quad -5}$ is equal to

A. -4

B. -3

C. -7

D. 13

Answer: C

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13. Linear approximation for g(x) = cos x at $x = \frac{\pi}{2}$ is

A. $x + \frac{\pi}{2}$

B. $-x+\frac{\pi}{2}$

C. $x-\frac{\pi}{2}$

D. $-x-\frac{\pi}{2}$

Answer: B

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14. If w(x,y,z) $=x^2(y-z)+y^2(z-x)+z^2(x-y)$, then $\frac{\partial w}{\partial x}+\frac{\partial w}{\partial y}+\frac{\partial w}{\partial z}$ is

A. $xy+yz+zx$

B. $x(y+z)$

C. $y(z+x)$

D. 0

Answer: D

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15. If f(x,y,z) =xy + yz + zx, then $f_x - f_z$ is equal to

A. $z - x$

B. $y - z$

C. $x - z$

D. $y - x$

Answer: A

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Problems For Practice

1. The percentage error of the seventh root of 700 is approximate how many times the percentage of 700:

A. $\frac{5}{7}$

B. $\frac{1}{5}$

C. $\frac{1}{10}$

D. $\frac{1}{7}$

Answer: D

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2. If $u = \log\left(\frac{x^2y + y^2x}{xy}\right)$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$

A. u^{-1}

B. $2u$

C. 1

D. $2u$

Answer: C

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3. If $z = e^{\frac{x+y}{x-y}}$ then $x\frac{\partial xz}{\partial x} + y\frac{\partial z}{\partial y} =$

A. 2

B. 0

C. 1

D. -1

Answer: B

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4. If $w(x, y) = x^y, x > 0$, then $\frac{\partial w}{\partial x}$ is equal to

A. $x^y \log x$

B. $y \log x$

C. yx^{y-1}

D. $x \log y$

Answer: A

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5. If u= y sin x then $\frac{\partial^2 u}{\partial x\,\partial y}$=__________

A. $\cos x$

B. $\cos y$

C. $\sin x$

D. 20

Answer: A

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6. If $u = \frac{1}{\sqrt[3]{x^3 + y^2}}$ then $x\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}$ is:

A. $\frac{3}{2}u$

B. $\frac{2}{3}u$

C. $\frac{-2}{3}u$

D. $\frac{-3}{2}u$

Answer: C

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7. If $f(x, y) = e^{xy}$ then $\frac{\partial^2 f}{\partial x \, \partial y}$ at (1,1) is:

A. $-e$

B. $\frac{2}{e}$

C. $2e$

D. e

Answer: C

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8. A cube of side is without the top. If the edge length varies from x_0 to $x_0 + dx$, then the change in the surface of this cubic (without top) is:

A. $5x_0dx$

B. $6x_0dx$

C. $12x_0dx$

D. $10x_0dx$

Answer: D

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9. If $u = f\left(\frac{y}{x}\right)$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ =__________

A. 2u

B. 1

C. 0

D. u

Answer: C

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10. If $x = r\cos\theta, u = r\sin\theta$ then $\frac{\partial\theta}{\partial x}$ is:

A. r

B. $\frac{-y}{x^2 + y^2}$

C. 1

D. 0

Answer: B

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11. If $f(x, y) = x^2 + xy + y^2, x = t, y = t^2$ then $\frac{df}{dt} =$

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12. If $f(x) = \frac{1}{x+1}$ then its differentiate is given by :

A. $\frac{-1}{(x+1)^2}dx$

B. $\frac{1}{(x+1)^2}dx$

C. $\frac{x}{(x+1)}dx$

D. $\frac{-x}{x+1}dx$

Answer: A

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13. If $u(x, y) = x^2 + 2xy - y^2$ then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}$ is:

A. $4x + 2y$

B. $4x$

C. $\frac{1}{4x}$

D. 0

Answer: B

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14. Linear approximation of $f(x) = 2x^2 + 3xatx = 1$ is:

A. $2x + 5$

B. $2x - 7$

C. $7x - 2$

D. 0

Answer: C

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15. The approximate value of $\sqrt{9.2}$ is:

A. 3.11111

B. 3.30303

C. $3.3331.$

D. 3.03333

Answer: D

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16. If the absolute error while calculating the absolute error in volume of a sphere of radius 10 cm is 0.1 cm. Which is the absolute error in volume of the sphere ?

A. $-10\pi cm^3$

B. $-20\pi cm^3$

C. $-80\pi cm^3$

D. $-40\pi cm^3$

Answer: D

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17. $\lim_{(x,y) \to (1,0)} \frac{x^2+y^2}{x-2y}$ is :

A. 0

B. $-\frac{1}{2}$

C. 1

D. $\frac{1}{2}$

Answer: C

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18. $f(x, y) = \sin^{-1}\left(\frac{x}{y}\right) + \tan^{-1}\left(\frac{y}{x}\right)$ is homogeneous function of degree:

A. -1

B. 0

C. 3

D. 2

Answer: B

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19. A function $f(x, y)$ is said to be harmonic if $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} =$

A. 0

B. 1

C. -1

D. none of the these

Answer: A

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20. If $f(x, y) = e^{2x+3y}$ find $3f_x(0, 0) - 2f_y(0, 0)$:

A. 0

B. 1

C. -1

D. 5

Answer: A

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21. Find dy if $y = \frac{x-2}{2x+3}$ for $x = 2, dx = 1.$

A. $\frac{1}{7}$

B. $\frac{1}{70}$

C. $\frac{1}{700}$

D. 9

Answer: A

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22. If $u = x^2 + y^2$ evaluate $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{dy^2}$:

A. -2

B. 0

C. 4

D. 2

Answer: C

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23. If $u(x, y) = \frac{x^2}{y} - \frac{2y^2}{x}$ then $\frac{\partial^2 u}{\partial x \partial y} - \frac{\partial^2 u}{\partial y \partial x}$ is :

A. 2

B. -1

C. 1

D. 0

Answer: D

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24. If $f(x, y)$ is homogeneous function of degree 5 then $x\frac{\partial f}{\partial x} + y\frac{\partial f}{\partial y} =$

A. $2f$

B. $3f$

C. $4f$

D. $5f$

Answer: D

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25. Computer the values of dy if $f(y) = x^3 + x^2 - 2x + 1$ where x changes from 2 to 2.01.

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26. use differentials to find the approximate value of $\sqrt[3]{65}$.

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27. Find the differential dy for given x and dx, $y = (x^2 + 5)^3, x = 1, dx = 0.05$

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28. The approximate value of $\frac{1}{10.1}$.

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29. If $u = x^4 + y^3 + 3x^2y^2 + 3x^2y$ find $\frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}, \frac{\partial^2 u}{\partial x^2}, \frac{\partial^2 u}{\partial x \, \partial y}$.

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30. If $u = x^3 + 2xy^2 - x^2y$ show that $\frac{\partial^2 u}{\partial x \, \partial y} = \frac{\partial^2 u}{\partial y \, \partial x}$.

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31. If $w = u^2e^v$ where $u = \frac{x}{y}$, $v = y \log x$ find $\frac{\partial w}{\partial x}$

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32. If u $= \sqrt{x^4 + y^4}$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2u$.

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33. If $w = e^{xy}$ wh4ere $x = t^2, y = t^3$ show that $\frac{dw}{dt} = 5t^4 e^{t^5}$.

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34. If w=xy + z, where x=cos t, y = sin t, z=t, find $\frac{dw}{dt}$.

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35. If $u = \tan^{-1}\left(\frac{x^4 + y^4}{x^2 - y^2}\right)$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin 2u.$

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36. Find $(26)^{\frac{1}{3}})$.

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37. Find the value of $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y}$ if $z = \log\left(\frac{x^3 - y^3}{x^2 + y^2}\right)$.

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38. Verify Euler's theorem for $w = x^2 \sin\left(\frac{y}{x}\right)$.

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39. If $u = \cos^{-1}\left(\frac{x}{y}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 0.$

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40. If u $= \sin\left(\frac{x}{y}\right)$ prove that $u_{xy} = u_{yz}$.

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