This print-out should have 8 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

Determine $\dfrac{dz}{dt}$ when

$$z = x\ln(x+11y)$$

and

$$x = \sin t\,, \qquad y = \cos t\,.$$

1. $\dfrac{dz}{dt} = \ln(x+11y)\cos t + \dfrac{x\cos t - 11x\sin t}{x+11y}$

2. $\dfrac{dz}{dt} = \ln(x+11y)\cos t - \dfrac{11x\sin t}{x+11y}$

3. $\dfrac{dz}{dt} = \dfrac{\ln(x+11y)\sin t - 11x\cos t}{x+11y}$

4. $\dfrac{dz}{dt} = \ln(x+11y)\sin t + \dfrac{x\sin t - 11x\cos t}{x+11y}$

5. $\dfrac{dz}{dt} = \ln(x+11y)\cos t + \dfrac{x(\sin t - \cos t)}{x+11y}$

002 10.0 points

Use the Chain Rule to find $\dfrac{\partial z}{\partial u}$ when

$$z = e^r\cos\theta$$

and

$$r = 6uv\,, \qquad \theta = \sqrt{u^2+v^2}\,.$$

1. $\dfrac{\partial z}{\partial u} = e^r\Big(6v\cos\theta - \dfrac{\sin\theta}{2\sqrt{u^2+v^2}}\Big)$

2. $\dfrac{\partial z}{\partial u} = ue^r\Big(6v\cos\theta + \dfrac{\sin\theta}{\sqrt{u^2+v^2}}\Big)$

3. $\dfrac{\partial z}{\partial u} = e^r\Big(6v\cos\theta + \dfrac{\sin\theta}{\sqrt{u^2+v^2}}\Big)$

4. $\dfrac{\partial z}{\partial u} = e^r\Big(6v\cos\theta + \dfrac{u\sin\theta}{2\sqrt{u^2+v^2}}\Big)$

5. $\dfrac{\partial z}{\partial u} = e^r\Big(6v\cos\theta - \dfrac{u\sin\theta}{\sqrt{u^2+v^2}}\Big)$

003 10.0 points

Use the Chain Rule to find $\dfrac{dw}{dt}$ when

$$w = xe^{y/z}$$

and

$$x = t^2\,, \quad y = 4-t\,, \quad z = 4+t\,.$$

1. $\dfrac{dw}{dt} = \Big(2t - \dfrac{x}{z} - \dfrac{xy}{z}\Big)e^{y/z}$

2. $\dfrac{dw}{dt} = \Big(t - \dfrac{x}{z} - \dfrac{4xy}{z}\Big)e^{y/z}$

3. $\dfrac{dw}{dt} = \Big(2t - \dfrac{x}{z} - \dfrac{xy}{z^2}\Big)e^{y/z}$

4. $\dfrac{dw}{dt} = \Big(2t + \dfrac{x}{z} + \dfrac{xy}{z^2}\Big)e^{y/z}$

5. $\dfrac{dw}{dt} = \Big(t + \dfrac{x}{z} + \dfrac{4xy}{z^2}\Big)e^{y/z}$

6. $\dfrac{dw}{dt} = \Big(t + \dfrac{x}{z} + \dfrac{4xy}{z}\Big)e^{y/z}$

004 10.0 points

Use the Chain Rule to find $\dfrac{\partial z}{\partial s}$ when

$$z = x^2 - 3xy + y^2\,,$$

and

$$x = 2s+3t\,, \qquad y = st\,.$$

1. $\dfrac{\partial z}{\partial s} = 4x - 6y - 3xs + 2ys$

2. $\dfrac{\partial z}{\partial s} = 6x - 6y - 3xs + 2ys$

3. $\dfrac{\partial z}{\partial s} = 4x - 6y - 3xt + 2yt$

4. $\dfrac{\partial z}{\partial s} = 6x - 9y - 3xs + 2ys$

5. $\dfrac{\partial z}{\partial s} \;=\; 6x - 9y - 3xt + 2yt$

6. $\dfrac{\partial z}{\partial s} \;=\; 4x - 9y - 3xt + 2yt$

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005 10.0 points

Use the Chain Rule to find $\dfrac{\partial u}{\partial p}$ for

$$u \;=\; \frac{x+y}{y+z}$$

when

$$x \;=\; p + 8r + 9t, \qquad y \;=\; p - 8r + 9t\,,$$

and

$$z \;=\; p + 8r - 9t\,.$$

1. $\dfrac{\partial u}{\partial p} \;=\; -\dfrac{9t}{p^2}$

2. $\dfrac{\partial u}{\partial p} \;=\; \dfrac{9t^2}{p^3}$

3. $\dfrac{\partial u}{\partial p} \;=\; \dfrac{9}{p^2}$

4. $\dfrac{\partial u}{\partial p} \;=\; -\dfrac{9}{p^2}$

5. $\dfrac{\partial u}{\partial p} \;=\; \dfrac{9t}{p^2}$

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006 10.0 points

The radius of a right circular cylinder is increasing at a rate of 4 inches per minute while the height is decreasing at a rate of 7 inches per minute. Determine the rate of change of the volume when $r = 3$ and $h = 4$.

1. rate $= 29\,\pi$ cu.in./min.

2. rate $= 37\,\pi$ cu.in./min.

3. rate $= 33\,\pi$ cu.in./min.

4. rate $= 25\,\pi$ cu.in./min.

5. rate $= 41\,\pi$ cu.in./min.

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007 10.0 points

If $z = f(x,\, y)$ and

$$x \;=\; r\cos 3\theta\,, \qquad y \;=\; 3r\sin\theta\,,$$

express $\dfrac{\partial z}{\partial r}$ in terms of $\dfrac{\partial z}{\partial x}$ and $\dfrac{\partial z}{\partial y}$.

1. $\dfrac{\partial z}{\partial r} \;=\; 3\dfrac{\partial z}{\partial x}\cos\theta + \dfrac{\partial z}{\partial y}\sin 3\theta$

2. $\dfrac{\partial z}{\partial r} \;=\; \dfrac{\partial z}{\partial x}\sin 3\theta + 3\dfrac{\partial z}{\partial y}\cos\theta$

3. $\dfrac{\partial z}{\partial r} \;=\; 3r\Big(\dfrac{\partial z}{\partial y}\cos\theta - \dfrac{\partial z}{\partial x}\sin 3\theta\Big)$

4. $\dfrac{\partial z}{\partial r} \;=\; \dfrac{\partial z}{\partial x}\cos 3\theta + 3\dfrac{\partial z}{\partial y}\sin\theta$

5. $\dfrac{\partial z}{\partial r} \;=\; 3r\Big(\dfrac{\partial z}{\partial y}\cos\theta + \dfrac{\partial z}{\partial x}\sin 3\theta\Big)$

6. $\dfrac{\partial z}{\partial r} \;=\; r\Big(3\dfrac{\partial z}{\partial y}\cos\theta - \dfrac{\partial z}{\partial x}\sin 3\theta\Big)$

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008 10.0 points

If $z = f(x, y)$ and

$$f_x(4,\,3) \;=\; 4, \qquad f_y(4,\,3) \;=\; -2\,,$$

find $\dfrac{dz}{dt}$ at $t = 5$ when $x = g(t)$, $y = h(t)$ and

$$g(5) \;=\; 4\,, \qquad g'(5) \;=\; 5\,.$$
$$h(5) \;=\; 3\,, \qquad h'(5) \;=\; 2\,.$$

1. $\dfrac{dz}{dt} \;=\; 14$

2. $\dfrac{dz}{dt} \;=\; 18$

3. $\dfrac{dz}{dt} \;=\; 16$

4. $\dfrac{dz}{dt} \;=\; 12$

5. $\dfrac{dz}{dt} \;=\; 20$