

2013 Mathematics (2)

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Section A

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Section B

11S

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12W

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13X

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14Z

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15T

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16R

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17Y

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Solution(s):

From user: ar857

2013 2 17

because dU is exact mixed ~~different~~ partial derivatives must be equal

$$dU = TdS - PdV$$

$$T = \left(\frac{\partial U}{\partial S}\right)_V \quad -P = \left(\frac{\partial U}{\partial V}\right)_S$$

$$\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$$

a) ① $H = U + PV$
 $dH = TdS + VdP$ $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

② $dG = TdS + PdV + VdP - TdS - SdT = VdP - SdT$
 $\left(\frac{\partial V}{\partial P}\right)_T = -\left(\frac{\partial S}{\partial T}\right)_P$

③ $dF = TdS - PdV - TdS - SdT = -PdV - SdT$
 $\left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$

b) $\left(\frac{\partial U}{\partial V}\right)_T = \left(\frac{\partial U}{\partial S}\right)_V \left(\frac{\partial S}{\partial V}\right)_T + \left(\frac{\partial U}{\partial V}\right)_S \left(\frac{\partial S}{\partial V}\right)_T = T \left(\frac{\partial P}{\partial T}\right)_V - P$

c

$$P = \frac{RT}{V-b} - \frac{a}{V^2}$$

$$\left(\frac{\partial U}{\partial V}\right)_T = T \frac{R}{V-b} - \frac{RT}{V-b} + \frac{a}{V^2} = \frac{a}{V^2}$$

$$dU = U = -\frac{a}{V} + cT$$

18T

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19R*

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20Z*

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