

等 別：三等考試

類 科：機械工程

科 目：熱力學

考試時間：2 小時

座號：\_\_\_\_\_

※注意：(一)可以使用電子計算器。

(二)不必抄題，作答時請將試題題號及答案依照順序寫在試卷上，於本試題上作答者，不予計分。

(三)本科目除專門名詞或數理公式外，應使用本國文字作答。

一、試回答下列問題或解釋其意涵：(每小題 5 分，共 25 分)

(一)舉例說明工程上有利用等焓過程 (constant enthalpy process) 之熱機元件

(二)增熵原理 (principle of the increase of entropy)

(三)噴嘴之絕熱效率 (nozzle adiabatic efficiency)

(四)物質之臨界點 (critical point)

(五)一冷凍噸 (one ton of refrigeration)

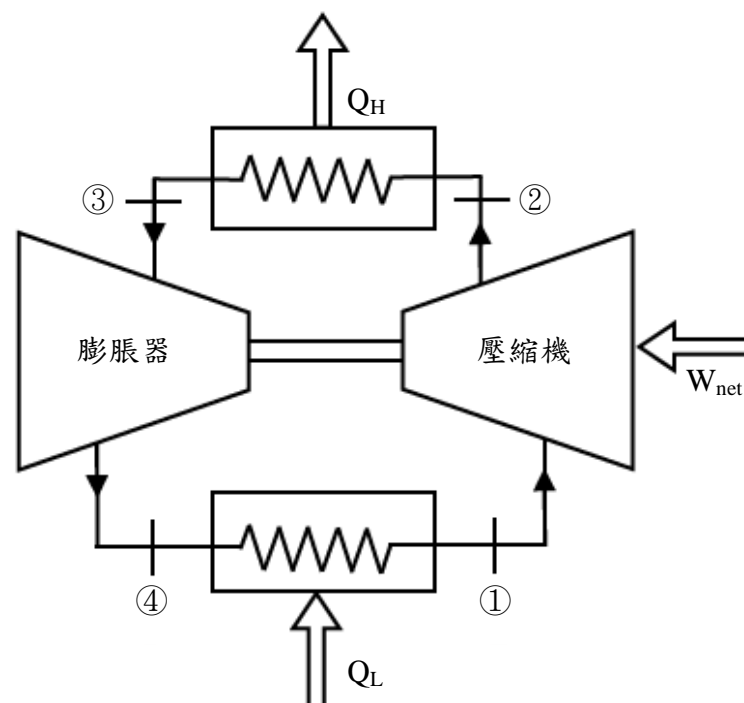
二、一理想之標準空氣 (air-standard) 冷凍循環，如圖一所示。已知壓縮機之壓縮比為 3:1，

其入口 (圖一①處) 空氣溫度為 270 K，壓力 100 kPa；另在膨脹器 (expander) 入口

處 (圖一③處) 空氣之溫度為 300 K。假設壓縮及膨脹過程均為可逆絕熱過程，試求：

(一)繪出本冷凍循環之 T-S 圖 (temperature-entropy diagram)。(5 分)

(二)本循環之性能係數 (coefficient of performance)。(20 分)

註：1. 空氣定壓比熱  $C_p = 1.004 \text{ kJ/kg K}$ ，定容比熱  $C_v = 0.717 \text{ kJ/kg K}$ 2. 空氣氣體常數  $R = 0.287 \text{ kJ/kg K}$ 

圖一

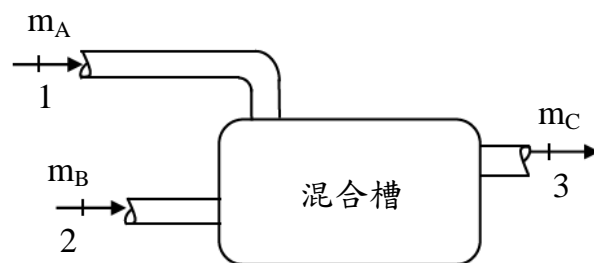
(請接第二頁)

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三、二個流體（A 及 B）分別流入一個混合槽內互相混合，如圖二所示。混合前流體 A 為飽和水蒸汽，其壓力為 0.6 MPa；另一個流體 B 為過熱水蒸汽，其溫度為 600°C，壓力 0.6 MPa。混合後之流體 C 以單一流道流出此水槽，其溫度為 400°C，壓力 0.6 MPa，質量流率為  $m_C = 1 \text{ kg/s}$ 。假設此過程為絕熱之穩態流（steady state, steady flow），且飽和水的性質如附表所示，試求：

(一)流體 A 及流體 B 之質量流率  $m_A$ 、 $m_B$  分別為何？（kg/s）（12 分）

(二)本過程其熵之變化（entropy change）為何？（kW/K，W 為瓦特）（13 分）

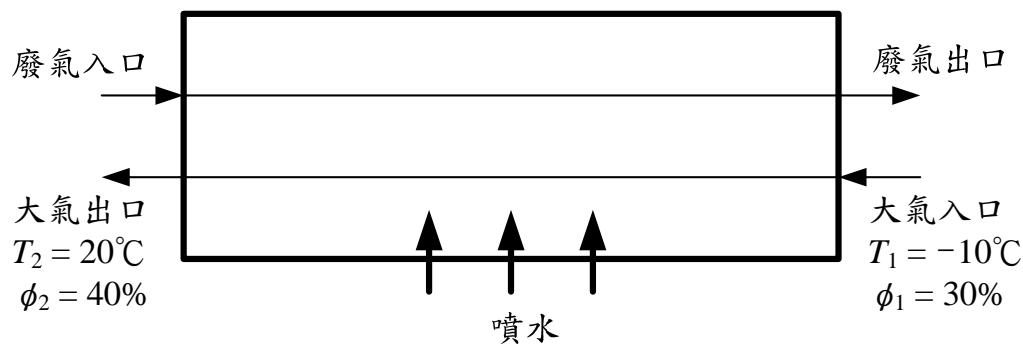


圖二

四、有一家用加熱系統使用排出之廢空氣來加熱入口新鮮空氣，如圖三所示。已知外界大氣溫度為  $-10^\circ\text{C}$ ，相對濕度為 30%，壓力為 100 kPa。當入口空氣體積流率為  $1 \text{ m}^3/\text{s}$  時，試問要加入多少水流量（kg/hr），才能使空氣之出口之溫度及相對濕度控制在  $20^\circ\text{C}$  及 40%。（25 分）

註：1. 水蒸汽於  $-10^\circ\text{C}$  及  $20^\circ\text{C}$ ，所對應之飽和壓力分別為 0.2601 kPa、2.339 kPa

2. 水蒸汽及乾空氣之分子量分別為 18、28.97，空氣氣體常數  $R = 0.287 \text{ kJ/kg K}$



圖三

（請接第三頁）

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科 目：熱力學

附表 1-1

Saturated Water Pressure Entry

| Press.<br>(kPa) | Temp.<br>(°C) | Specific Volume, m <sup>3</sup> /kg |                   |                     | Internal Energy, kJ/kg |                   |                     |
|-----------------|---------------|-------------------------------------|-------------------|---------------------|------------------------|-------------------|---------------------|
|                 |               | Sat. Liquid<br>$v_f$                | Evap.<br>$v_{fg}$ | Sat. Vapor<br>$v_g$ | Sat. Liquid<br>$u_f$   | Evap.<br>$u_{fg}$ | Sat. Vapor<br>$u_g$ |
| 0.6113          | 0.01          | 0.001000                            | 206.131           | 206.132             | 0                      | 2375.3            | 2375.3              |
| 1               | 6.98          | 0.001000                            | 129.20702         | 129.20802           | 29.29                  | 2355.69           | 2384.98             |
| 1.5             | 13.03         | 0.001001                            | 87.97913          | 87.98013            | 54.70                  | 2338.63           | 2393.32             |
| 2               | 17.50         | 0.001001                            | 67.00285          | 67.00385            | 73.47                  | 2326.02           | 2399.48             |
| 2.5             | 21.08         | 0.001002                            | 54.25285          | 54.25385            | 88.47                  | 2315.93           | 2404.40             |
| 3               | 24.08         | 0.001003                            | 45.66402          | 45.66502            | 101.03                 | 2307.48           | 2408.51             |
| 4               | 28.96         | 0.001004                            | 34.79915          | 34.80015            | 121.44                 | 2293.73           | 2415.17             |
| 5               | 32.88         | 0.001005                            | 28.19150          | 28.19251            | 137.79                 | 2282.70           | 2420.49             |
| 7.5             | 40.29         | 0.001008                            | 19.23674          | 19.23775            | 168.76                 | 2261.74           | 2430.50             |
| 10              | 45.81         | 0.001010                            | 14.67254          | 14.67355            | 191.79                 | 2246.10           | 2437.89             |
| 15              | 53.97         | 0.001014                            | 10.02117          | 10.02218            | 225.90                 | 2222.83           | 2448.73             |
| 20              | 60.06         | 0.001017                            | 7.64835           | 7.64937             | 251.35                 | 2205.36           | 2456.71             |
| 25              | 64.97         | 0.001020                            | 6.20322           | 6.20424             | 271.88                 | 2191.21           | 2463.08             |
| 30              | 69.10         | 0.001022                            | 5.22816           | 5.22918             | 289.18                 | 2179.22           | 2468.40             |
| 40              | 75.87         | 0.001026                            | 3.99243           | 3.99345             | 317.51                 | 2159.49           | 2477.00             |
| 50              | 81.33         | 0.001030                            | 3.23931           | 3.24034             | 340.42                 | 2143.43           | 2483.85             |
| 75              | 91.77         | 0.001037                            | 2.21607           | 2.21711             | 394.29                 | 2112.39           | 2496.67             |
| 100             | 99.62         | 0.001043                            | 1.69296           | 1.69400             | 417.33                 | 2088.72           | 2506.06             |
| 125             | 105.99        | 0.001048                            | 1.37385           | 1.37490             | 444.16                 | 2069.32           | 2513.48             |
| 150             | 111.37        | 0.001053                            | 1.15828           | 1.15933             | 466.92                 | 2052.72           | 2519.64             |
| 175             | 116.06        | 0.001057                            | 1.00257           | 1.00363             | 486.78                 | 2038.12           | 2524.90             |
| 200             | 120.23        | 0.001061                            | 0.88467           | 0.88573             | 504.47                 | 2025.02           | 2529.49             |
| 225             | 124.00        | 0.001064                            | 0.79219           | 0.79325             | 520.45                 | 2013.10           | 2533.56             |
| 250             | 127.43        | 0.001067                            | 0.71765           | 0.71871             | 535.08                 | 2002.14           | 2537.21             |
| 275             | 130.60        | 0.001070                            | 0.65624           | 0.65731             | 548.57                 | 1991.95           | 2540.53             |
| 300             | 133.55        | 0.001073                            | 0.60475           | 0.60582             | 561.13                 | 1982.43           | 2543.55             |
| 325             | 136.30        | 0.001076                            | 0.56093           | 0.56201             | 572.88                 | 1973.46           | 2546.34             |
| 350             | 138.88        | 0.001079                            | 0.52317           | 0.52425             | 583.93                 | 1964.98           | 2548.92             |
| 375             | 141.32        | 0.001081                            | 0.49029           | 0.49137             | 594.38                 | 1956.93           | 2551.31             |
| 400             | 143.63        | 0.001084                            | 0.46138           | 0.46246             | 604.29                 | 1949.26           | 2553.55             |
| 450             | 147.93        | 0.001088                            | 0.41289           | 0.41398             | 622.75                 | 1934.87           | 2557.62             |
| 500             | 151.86        | 0.001093                            | 0.37380           | 0.37489             | 639.66                 | 1921.57           | 2561.23             |
| 550             | 155.48        | 0.001097                            | 0.34159           | 0.34268             | 655.30                 | 1909.17           | 2564.47             |
| 600             | 158.85        | 0.001101                            | 0.31457           | 0.31567             | 669.88                 | 1897.52           | 2567.40             |
| 650             | 162.01        | 0.001104                            | 0.29158           | 0.29268             | 683.55                 | 1886.51           | 2570.06             |
| 700             | 164.97        | 0.001108                            | 0.27176           | 0.27286             | 696.43                 | 1876.07           | 2572.49             |
| 750             | 167.77        | 0.001111                            | 0.25449           | 0.25560             | 708.62                 | 1866.11           | 2574.73             |
| 800             | 170.43        | 0.001115                            | 0.23931           | 0.24043             | 720.20                 | 1856.58           | 2576.79             |

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附表 1-2

| Press.<br>(kPa) | Temp.<br>(°C) | Enthalpy, kJ/kg      |                   |                     | Entropy, kJ/kg·K     |                   |                     |
|-----------------|---------------|----------------------|-------------------|---------------------|----------------------|-------------------|---------------------|
|                 |               | Sat. Liquid<br>$h_f$ | Evap.<br>$h_{fg}$ | Sat. Vapor<br>$h_g$ | Sat. Liquid<br>$s_f$ | Evap.<br>$s_{fg}$ | Sat. Vapor<br>$s_g$ |
| 0.6113          | 0.01          | 0.00                 | 2501.3            | 2501.3              | 0                    | 9.1562            | 9.1562              |
| 1.0             | 6.98          | 29.29                | 2484.89           | 2514.18             | 0.1059               | 8.8697            | 8.9756              |
| 1.5             | 13.03         | 54.70                | 2470.59           | 2525.30             | 0.1956               | 8.6322            | 8.8278              |
| 2.0             | 17.50         | 73.47                | 2460.02           | 2533.49             | 0.2607               | 8.4629            | 8.7236              |
| 2.5             | 21.08         | 88.47                | 2451.56           | 2540.03             | 0.3120               | 8.3311            | 8.6431              |
| 3.0             | 24.08         | 101.03               | 2444.47           | 2545.50             | 0.3545               | 8.2231            | 8.5775              |
| 4.0             | 28.96         | 121.44               | 2432.93           | 2554.37             | 0.4226               | 8.0520            | 8.4746              |
| 5.0             | 32.88         | 137.79               | 2423.66           | 2561.45             | 0.4763               | 7.9187            | 8.3950              |
| 7.5             | 40.29         | 168.77               | 2406.02           | 2574.79             | 0.5763               | 7.6751            | 8.2514              |
| 10              | 45.81         | 191.81               | 2392.82           | 2584.63             | 0.6492               | 7.5010            | 8.1501              |
| 15              | 53.97         | 225.91               | 2373.14           | 2599.06             | 0.7548               | 7.2536            | 8.0084              |
| 20              | 60.06         | 251.38               | 2358.33           | 2609.70             | 0.8319               | 7.0766            | 7.9085              |
| 25              | 64.97         | 271.90               | 2346.29           | 2618.19             | 0.8930               | 6.9383            | 7.8313              |
| 30              | 69.10         | 289.21               | 2336.07           | 2625.28             | 0.9439               | 6.8247            | 7.7686              |
| 40              | 75.87         | 317.55               | 2319.19           | 2636.74             | 1.0258               | 6.6441            | 7.6700              |
| 50              | 81.33         | 340.47               | 2305.40           | 2645.87             | 1.0910               | 6.5029            | 7.5939              |
| 75              | 91.77         | 384.36               | 2278.59           | 2662.96             | 1.2129               | 6.2434            | 7.4563              |
| 100             | 99.62         | 417.44               | 2258.02           | 2675.46             | 1.3025               | 6.0568            | 7.3593              |
| 125             | 105.99        | 444.30               | 2241.05           | 2685.35             | 1.3739               | 5.9104            | 7.2843              |
| 150             | 111.37        | 467.08               | 2226.46           | 2693.54             | 1.4335               | 5.7897            | 7.2232              |
| 175             | 116.06        | 486.97               | 2213.57           | 2700.53             | 1.4848               | 5.6868            | 7.1717              |
| 200             | 120.23        | 504.68               | 2201.96           | 2706.63             | 1.5300               | 5.5970            | 7.1271              |
| 225             | 124.00        | 520.69               | 2191.35           | 2712.04             | 1.5705               | 5.5173            | 7.0878              |
| 250             | 127.43        | 535.34               | 2181.55           | 2716.89             | 1.6072               | 5.4455            | 7.0526              |
| 275             | 130.60        | 548.87               | 2172.42           | 2721.29             | 1.6407               | 5.3801            | 7.0208              |
| 300             | 133.55        | 561.45               | 2163.85           | 2725.30             | 1.6717               | 5.3201            | 6.9918              |
| 325             | 136.30        | 573.23               | 2155.76           | 2728.99             | 1.7005               | 5.2646            | 6.9651              |
| 350             | 138.88        | 584.31               | 2148.10           | 2732.40             | 1.7274               | 5.2130            | 6.9404              |
| 375             | 141.32        | 594.79               | 2140.79           | 2735.58             | 1.7527               | 5.1647            | 6.9174              |
| 400             | 143.63        | 604.73               | 2133.81           | 2738.53             | 1.7766               | 5.1193            | 6.8958              |
| 450             | 147.93        | 623.24               | 2120.67           | 2743.91             | 1.8206               | 5.0359            | 6.8565              |
| 500             | 151.86        | 640.21               | 2108.47           | 2748.67             | 1.8606               | 4.9606            | 6.8212              |
| 550             | 155.48        | 655.91               | 2097.04           | 2752.94             | 1.8972               | 4.8920            | 6.7892              |
| 600             | 158.85        | 670.54               | 2086.26           | 2756.80             | 1.9311               | 4.8289            | 6.7600              |
| 650             | 162.01        | 684.26               | 2076.04           | 2760.30             | 1.9627               | 4.7704            | 6.7330              |
| 700             | 164.97        | 697.20               | 2066.30           | 2763.50             | 1.9922               | 4.7158            | 6.7080              |
| 750             | 167.77        | 709.45               | 2056.98           | 2766.43             | 2.0199               | 4.6647            | 6.6846              |
| 800             | 170.43        | 721.10               | 2048.04           | 2769.13             | 2.0461               | 4.6166            | 6.6627              |

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附表 2-1

## Superheated Vapor Water

| Temp.<br>(°C)                | $v$<br>(m <sup>3</sup> /kg) | $u$<br>(kJ/kg) | $h$<br>(kJ/kg) | $s$<br>(kJ/kg·K) | $v$<br>(m <sup>3</sup> /kg)  | $u$<br>(kJ/kg) | $h$<br>(kJ/kg) | $s$<br>(kJ/kg·K) |
|------------------------------|-----------------------------|----------------|----------------|------------------|------------------------------|----------------|----------------|------------------|
| <i>P = 10 kPa (45.81 °C)</i> |                             |                |                |                  | <i>P = 50 kPa (81.33 °C)</i> |                |                |                  |
| Sat.                         | 14.67355                    | 2437.89        | 2584.63        | 8.1501           | 3.24034                      | 2483.85        | 2645.87        | 7.5939           |
| 50                           | 14.86920                    | 2443.87        | 2592.56        | 8.1749           | —                            | —              | —              | —                |
| 100                          | 17.19561                    | 2515.50        | 2687.46        | 8.4479           | 3.41833                      | 2511.61        | 2682.52        | 7.6947           |
| 150                          | 19.51251                    | 2587.86        | 2782.99        | 8.6881           | 3.88937                      | 2585.61        | 2780.08        | 7.9400           |
| 200                          | 21.82507                    | 2661.27        | 2879.52        | 8.9037           | 4.35595                      | 2659.85        | 2877.64        | 8.1579           |
| 250                          | 24.13559                    | 2735.95        | 2977.31        | 9.1002           | 4.82045                      | 2734.97        | 2975.99        | 8.3555           |
| 300                          | 26.44508                    | 2812.06        | 3076.51        | 9.2812           | 5.28391                      | 2811.33        | 3075.52        | 8.5372           |
| 400                          | 31.06252                    | 2968.89        | 3279.51        | 9.6076           | 6.20929                      | 2968.43        | 3278.89        | 8.8641           |
| 500                          | 35.67896                    | 3132.26        | 3489.05        | 9.8977           | 7.13364                      | 3131.94        | 3488.62        | 9.1545           |
| 600                          | 40.29488                    | 3302.45        | 3705.40        | 10.1608          | 8.05748                      | 3302.22        | 3705.10        | 9.4177           |
| 700                          | 44.91052                    | 3479.63        | 3928.73        | 10.4028          | 8.98104                      | 3479.45        | 3928.51        | 9.6599           |
| 800                          | 49.52599                    | 3663.84        | 4159.10        | 10.6281          | 9.90444                      | 3663.70        | 4158.92        | 9.8852           |
| 900                          | 54.14137                    | 3855.03        | 4396.44        | 10.8395          | 10.82773                     | 3854.91        | 4396.30        | 10.0967          |
| 1000                         | 58.75669                    | 4053.01        | 4640.58        | 11.0392          | 11.75097                     | 4052.91        | 4640.46        | 10.2964          |
| 1100                         | 63.37198                    | 4257.47        | 4891.19        | 11.2287          | 12.67418                     | 4257.37        | 4891.08        | 10.4858          |
| 1200                         | 67.98724                    | 4467.91        | 5147.78        | 11.4090          | 13.59737                     | 4467.82        | 5147.69        | 10.6662          |
| 1300                         | 72.60250                    | 4683.68        | 5409.70        | 14.5810          | 14.52054                     | 4683.58        | 5409.61        | 10.8382          |
| <i>100 kPa (99.62 °C)</i>    |                             |                |                |                  | <i>200 kPa (120.23 °C)</i>   |                |                |                  |
| Sat.                         | 1.69400                     | 2506.06        | 2675.46        | 7.3593           | 0.88573                      | 2529.49        | 2706.63        | 7.1271           |
| 150                          | 1.93636                     | 2582.75        | 2776.38        | 7.6133           | 0.95964                      | 2576.87        | 2768.80        | 7.2795           |
| 200                          | 2.17226                     | 2658.05        | 2875.27        | 7.8342           | 1.08034                      | 2654.39        | 2870.46        | 7.5066           |
| 250                          | 2.40604                     | 2733.73        | 2974.33        | 8.0332           | 1.19880                      | 2731.22        | 2970.98        | 7.7085           |
| 300                          | 2.63876                     | 2810.41        | 3074.28        | 8.2157           | 1.31616                      | 2808.55        | 3071.79        | 7.8926           |
| 400                          | 3.10263                     | 2967.85        | 3278.11        | 8.5434           | 1.54930                      | 2966.69        | 3276.55        | 8.2217           |
| 500                          | 3.56547                     | 3131.54        | 3488.09        | 8.8341           | 1.78139                      | 3130.75        | 3487.03        | 8.5132           |
| 600                          | 4.02781                     | 3301.94        | 3704.72        | 9.0975           | 2.01297                      | 3301.36        | 3703.96        | 8.7769           |
| 700                          | 4.48986                     | 3479.24        | 3928.23        | 9.3398           | 2.24426                      | 3478.81        | 3927.66        | 9.0194           |
| 800                          | 4.95174                     | 3663.53        | 4158.71        | 9.5652           | 2.47539                      | 3663.19        | 4158.27        | 9.2450           |
| 900                          | 5.41353                     | 3854.77        | 4396.12        | 9.7767           | 2.70643                      | 3854.49        | 4395.77        | 9.4565           |
| 1000                         | 5.87526                     | 4052.78        | 4640.31        | 9.9764           | 2.93740                      | 4052.53        | 4640.01        | 9.6563           |
| 1100                         | 6.33696                     | 4257.25        | 4890.95        | 10.1658          | 3.16834                      | 4257.01        | 4890.68        | 9.8458           |
| 1200                         | 6.79863                     | 4467.70        | 5147.56        | 10.3462          | 3.39927                      | 4467.46        | 5147.32        | 10.0262          |
| 1300                         | 7.26030                     | 4683.47        | 5409.49        | 10.5182          | 3.63018                      | 4683.23        | 5409.26        | 10.1982          |
| <i>300 kPa (133.55 °C)</i>   |                             |                |                |                  | <i>400 kPa (143.63 °C)</i>   |                |                |                  |
| Sat.                         | 0.60582                     | 2543.55        | 2725.30        | 6.9918           | 0.46246                      | 2553.55        | 2738.53        | 6.8958           |
| 150                          | 0.63388                     | 2570.79        | 2760.95        | 7.0778           | 0.47084                      | 2564.48        | 2752.82        | 6.9299           |
| 200                          | 0.71629                     | 2650.65        | 2865.54        | 7.3115           | 0.53422                      | 2646.83        | 2860.51        | 7.1706           |

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科 目：熱力學

附表 2-2

*Superheated Vapor Water*

| Temp. (°C)           | $v$ (m <sup>3</sup> /kg) | $u$ (kJ/kg) | $h$ (kJ/kg) | $s$ (kJ/kg·K) | $v$ (m <sup>3</sup> /kg) | $u$ (kJ/kg) | $h$ (kJ/kg) | $s$ (kJ/kg·K) |
|----------------------|--------------------------|-------------|-------------|---------------|--------------------------|-------------|-------------|---------------|
| 300 kPa (133.55 °C)  |                          |             |             |               |                          |             |             |               |
| 250                  | 0.79636                  | 2728.69     | 2967.59     | 7.5165        | 0.59512                  | 2726.11     | 2964.16     | 7.3788        |
| 300                  | 0.87529                  | 2806.69     | 3069.28     | 7.7022        | 0.65484                  | 2804.81     | 3066.75     | 7.5661        |
| 400                  | 1.03151                  | 2965.53     | 3274.98     | 8.0329        | 0.77262                  | 2964.36     | 3273.41     | 7.8984        |
| 500                  | 1.18669                  | 3129.95     | 3485.96     | 8.3250        | 0.88934                  | 3129.15     | 3484.89     | 8.1912        |
| 600                  | 1.34136                  | 3300.79     | 3703.20     | 8.5892        | 1.00555                  | 3300.22     | 3702.44     | 8.4557        |
| 700                  | 1.49573                  | 3478.38     | 3927.10     | 8.8319        | 1.12147                  | 3477.95     | 3926.53     | 8.6987        |
| 800                  | 1.64994                  | 3662.85     | 4157.83     | 9.0575        | 1.23722                  | 3662.51     | 4157.40     | 8.9244        |
| 900                  | 1.80406                  | 3854.20     | 4395.42     | 9.2691        | 1.35288                  | 3853.91     | 4395.06     | 9.1361        |
| 1000                 | 1.95812                  | 4052.27     | 4639.71     | 9.4689        | 1.46847                  | 4052.02     | 4639.41     | 9.3360        |
| 1100                 | 2.11214                  | 4256.77     | 4890.41     | 9.6585        | 1.58404                  | 4256.53     | 4890.15     | 9.5255        |
| 1200                 | 2.26614                  | 4467.23     | 5147.07     | 9.8389        | 1.69958                  | 4466.99     | 5146.83     | 9.7059        |
| 1300                 | 2.42013                  | 4682.99     | 5409.03     | 10.0109       | 1.81511                  | 4682.75     | 5408.80     | 9.8780        |
| 500 kPa (151.86 °C)  |                          |             |             |               |                          |             |             |               |
| Sat.                 | 0.37489                  | 2561.23     | 2748.67     | 6.8212        | 0.31567                  | 2567.40     | 2756.80     | 6.7600        |
| 200                  | 0.42492                  | 2642.91     | 2855.37     | 7.0592        | 0.35202                  | 2638.91     | 2850.12     | 6.9665        |
| 250                  | 0.47436                  | 2723.50     | 2960.68     | 7.2708        | 0.39383                  | 2720.86     | 2957.16     | 7.1816        |
| 300                  | 0.52256                  | 2802.91     | 3064.20     | 7.4598        | 0.43437                  | 2801.00     | 3061.63     | 7.3723        |
| 350                  | 0.57012                  | 2882.59     | 3167.65     | 7.6328        | 0.47424                  | 2881.12     | 3165.66     | 7.5463        |
| 400                  | 0.61728                  | 2963.19     | 3271.83     | 7.7937        | 0.51372                  | 2962.02     | 3270.25     | 7.7078        |
| 500                  | 0.71093                  | 3128.35     | 3483.82     | 8.0872        | 0.59199                  | 3127.55     | 3482.75     | 8.0020        |
| 600                  | 0.80406                  | 3299.64     | 3701.67     | 8.3521        | 0.66974                  | 3299.07     | 3700.91     | 8.2673        |
| 700                  | 0.89691                  | 3477.52     | 3925.97     | 8.5952        | 0.74720                  | 3477.08     | 3925.41     | 8.5107        |
| 800                  | 0.98959                  | 3662.17     | 4156.96     | 8.8211        | 0.82450                  | 3661.83     | 4156.52     | 8.7367        |
| 900                  | 1.08217                  | 3853.63     | 4394.71     | 9.0329        | 0.90169                  | 3853.34     | 4394.36     | 8.9485        |
| 1000                 | 1.17469                  | 4051.76     | 4639.11     | 9.2328        | 0.97883                  | 4051.51     | 4638.81     | 9.1484        |
| 1100                 | 1.26718                  | 4256.29     | 4889.88     | 9.4224        | 1.05594                  | 4256.05     | 4889.61     | 9.3381        |
| 1200                 | 1.35964                  | 4466.76     | 5146.58     | 9.6028        | 1.13302                  | 4466.52     | 5146.34     | 9.5185        |
| 1300                 | 1.45210                  | 4682.52     | 5408.57     | 9.7749        | 1.21009                  | 4682.28     | 5408.34     | 9.6906        |
| 800 kPa (170.43 °C)  |                          |             |             |               |                          |             |             |               |
| Sat.                 | 0.24043                  | 2576.79     | 2769.13     | 6.6627        | 0.19444                  | 2583.64     | 2778.08     | 6.5864        |
| 200                  | 0.26080                  | 2630.61     | 2839.25     | 6.8158        | 0.20596                  | 2621.90     | 2827.86     | 6.6939        |
| 250                  | 0.29314                  | 2715.46     | 2949.97     | 7.0384        | 0.23268                  | 2709.91     | 2942.59     | 6.9246        |
| 300                  | 0.32411                  | 2797.14     | 3056.43     | 7.2327        | 0.25794                  | 2793.21     | 3051.15     | 7.1228        |
| 350                  | 0.35439                  | 2878.16     | 3161.68     | 7.4088        | 0.28247                  | 2875.18     | 3157.65     | 7.3010        |
| 400                  | 0.38426                  | 2959.66     | 3267.07     | 7.5715        | 0.30659                  | 2957.29     | 3263.88     | 7.4650        |
| 500                  | 0.44331                  | 3125.95     | 3480.60     | 7.8672        | 0.35411                  | 3124.34     | 3478.44     | 7.7621        |
| 600                  | 0.50184                  | 3297.91     | 3699.38     | 8.1332        | 0.40109                  | 3296.76     | 3697.85     | 8.0289        |
| 1000 kPa (179.91 °C) |                          |             |             |               |                          |             |             |               |
| Sat.                 | 0.24043                  | 2576.79     | 2769.13     | 6.6627        | 0.19444                  | 2583.64     | 2778.08     | 6.5864        |
| 200                  | 0.26080                  | 2630.61     | 2839.25     | 6.8158        | 0.20596                  | 2621.90     | 2827.86     | 6.6939        |
| 250                  | 0.29314                  | 2715.46     | 2949.97     | 7.0384        | 0.23268                  | 2709.91     | 2942.59     | 6.9246        |
| 300                  | 0.32411                  | 2797.14     | 3056.43     | 7.2327        | 0.25794                  | 2793.21     | 3051.15     | 7.1228        |
| 350                  | 0.35439                  | 2878.16     | 3161.68     | 7.4088        | 0.28247                  | 2875.18     | 3157.65     | 7.3010        |
| 400                  | 0.38426                  | 2959.66     | 3267.07     | 7.5715        | 0.30659                  | 2957.29     | 3263.88     | 7.4650        |
| 500                  | 0.44331                  | 3125.95     | 3480.60     | 7.8672        | 0.35411                  | 3124.34     | 3478.44     | 7.7621        |
| 600                  | 0.50184                  | 3297.91     | 3699.38     | 8.1332        | 0.40109                  | 3296.76     | 3697.85     | 8.0289        |