L-1/T-2/NAME **Date : 16/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **MATH 183** (Co-ordinate Geometry and Ordinary Differential Equation)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) The equation $3x^2+2xy+3y^2-18x-22y+50=0$ is transformed to $4x^2+2y^2=1$ when referred to rectangular axes through the point (2, 3). Find the inclination of latter axes to the former. **(18)**

(b) Show that the area of the triangle formed by the lines represented by $ax^2+2hxy+by^2=0$ and $lx+my+n=0$ is $\dfrac{n^2\sqrt{h^2-ab}}{am^2-2hlm+bl^2}$. **(17)**

2. (a) Show that the equation $ax^2+2hxy+by^2+2gx+2fy+c=0$ represents two parallel lines if $\frac{a}{h}=\frac{h}{b}=\frac{g}{f}$ and when these conditions are satisfied, the distance between the parallel lines is $2\sqrt{\left\{\dfrac{g^2-ca}{a(a+b)}\right\}}$. **(18)**

(b) Show that if one of the lines given by the equation $ax^2+2hxy+by^2=0$ perpendicular to one of lines given by $a'x^2+2h'xy+b'y^2=0$ then $(aa'-bb')^2+4(ah'+b'h)(a'h+bh')=0$ **(17)**

3. (a) Find the common external tangents to the two circles $x^2+y^2=16$ and $x^2+y^2+6x-8y=0$. **(18)**

(b) Find the co-ordinates of limiting points of the coaxial system to which circles $x^2+y^2+4x+2y+5=0$ and $x^2+y^2+2x+4y+7=0$ belong. **(17)**

4. (a) Show that, if θ be the angle between the tangents to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ drawn from the point (*h*, *k*), then $\tan\theta\left(h^2+k^2-a^2-b^2\right)=2ab\sqrt{\dfrac{h^2}{a^2}+\dfrac{k^2}{b^2}-1}$ **(18)**

(b) Show that if tangents be drawn to the parabola $y^2=4ax$ from a point on the line $x+4a=0$ then their chord of contact will subtend a right angle at the vertex. **(17)**

Contd P/2

MATH 183(NAME)

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) Form a differential equation from $x = a\,sin(b + ct)$ where a, b, c are constants. **(11)**

   (b) Solve: $\left(x^3 + y^2\sqrt{x^2 + y^2}\right)dx = xy\sqrt{x^2 + y^2}\,dy$. **(12)**

   (c) Solve: $\left(1 + e^{x/y}\right)dx + e^{x/y}\left(1 - \dfrac{x}{y}\right)dy = 0$. **(12)**

6. (a) Find the integrating factor and solve: $\left(12y + 4y^3 + 6x^2\right)dx + 3\left(x + xy^2\right)dy = 0$. **(11)**

   (b) Solve: $\left(1 - x^2\right)\dfrac{dy}{dx} - xy = \left(1 - x^2\right)^{3/2} sin\,x$. **(12)**

   (c) Solve the equation for $\dfrac{dy}{dx} + \dfrac{y}{2x} = \dfrac{x}{y^3}$ at $y(1) = 2$. **(12)**

7. (a) Solve: $\left(D^2 - 2D + 1\right)y = x\,sin\,x$. **(11)**

   (b) Solve: $\left(D^3 - 3D^2 + 4D - 2\right)y = e^x + cos\,x$. **(12)**

   (c) Solve: $\left(D^2 - 4D + 4\right)y = x^2 e^{2x}$. **(12)**

8. (a) Solve: $(1 + x)^2 \dfrac{d^2y}{dx^2} + (1 + x)\dfrac{dy}{dx} + y = 2\,sin[\ell n(1 + x)]$. **(13)**

   (b) Solve: $y'' = x(y')^3$. **(11)**

   (c) Solve: $3yy'y'' = (y')^3 - 1$. **(11)**

L-1/T-2/NAME **Date : 22/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **NAME 123** (Fluid Mechanics)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value if needed. Symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) A venturimeter with a 90 mm throat is installed vertically in a 100 mm diameter pipeline. A certain oil of specific gravity 0.84 flows at a rate of 0.05 m^3/s in the upward direction. At first, deduce an equation for the actual flow rate of fluid through a venturimeter and then find the difference of pressure between the inlet and throat. Find also the deflection the inlet and throat. Find also the deflection of mercury in the manometer shown in Figure 1(a). Take $C_d = 0.97$. **(25)**

   (b) Explain Reynold's experiment to distinguish between laminar and turbulent flow with a sketch. Also define true critical Reynold's number. **(10)**

2. (a) A vertical cylindrical tank 2 m diameter has, at the bottom, a 0.05 m diameter sharp edged orifice for which the discharge coefficient is 0.6. **(25)**

   (i) If water centers the tank at a constant rate of 0.0095 m^3/s find the depth of water above the orifice when the level in the tank become stable.

   (ii) Find the time for the level to fall from 3 m to 1 m above the orifice when the inflow is turned off.

   (iii) If water now runs into the task at 0.02 m^3/s, the orifice remaining open, show that the rate of rise in water level is 0.252 m/min when the level has reached a depth of 1.7 m above the orifice.

   (b) Express the Bernoulli equation in three different ways using energies, pressures and heads. What are the major assumptions used in the derivation of the Bernoulli equation? Explain. **(10)**

3. (a) The outlet pipe from a pump is bend of 45° rising in the vertical plane as shown in Figure for Q. No. 3(a). The bend is 150 mm diameter at its inlet and 300 mm diameter at its outlet. The pipe axis at the inlet is horizontal and at the outlet is 1 m higher. By neglecting friction, calculate the force and its direction if the inlet pressure is 100 kN/m^2 and the flow of water through the pipe is $0.3 m^3/s$. The volume of the pipe is 0.075 m^3. **(20)**

   (b) Mention the advantages of pitot static tube over pitot tube. A pitot-static probe, shown in Figure 3(b), connected to a water manometer, is used to measure the velocity of air. If the deflection is 7.5 cm, determine the air velocity. **(8)**

   (c) Write a short notes on cavitation. **(7)**

Contd P/2

NAME 123

4. (a) Water is flowing at the rate of 40 l/s through a horizontal 100 mm diameter and 200 m long last iron pipe. Find the power lost due to friction. Take $\mu = 1.02 \times 10^{-3}$ Ns/m^2(water) $\varepsilon = 0.00026$ m (cast iron) and f = 0.0255 **(10)**

(b) In a fluid mechanics experimental setup, water is flowing over an 80° V-notch with a constant head of 0.3 m into a vertical cylindrical tank of diameter 0.5 m. If the level in the tank rises 0.8 m in 20 seconds, determine the co-efficient of discharge of the notch. **(10)**

(c) Define the following terms. **(15)**

(i) Boundary layer thickness.

(ii) Karman Vortex street

(iii) Stalling Angle

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) Explain why the viscosity of a liquid decreases while that of a gas increases with a temperature rise. **(8)**

(b) The velocity distribution of a viscous liquid (dynamic viscosity, $\mu = 0.9$ Ns/m^2) flowing over a fixed plate is given by $u = 0.68y - y^2$, where u is velocity in m/s. y is the distance from the plate in m. What are the shear stresses at the plate surface and at y = 0.34 m? **(10)**

(c) A retaining wall against a mud slide is to be constructed by placing 0.8 m high and 0.2 m wide rectangular concrete block ($\rho = 2700$ kg/m^3) side by side as shown in Figure for Q. 5(c). The friction coefficient between the ground and the concrete blocks is f = 0.3 and the density of the mud is about 1800 kg/m^3. There is concern that the concrete blocks may slide or tip over the lower left edge as the mud level rises. Determine the mud height at which

(i) the blocks will overcome friction and start sliding and

(ii) the blocks will tip over.

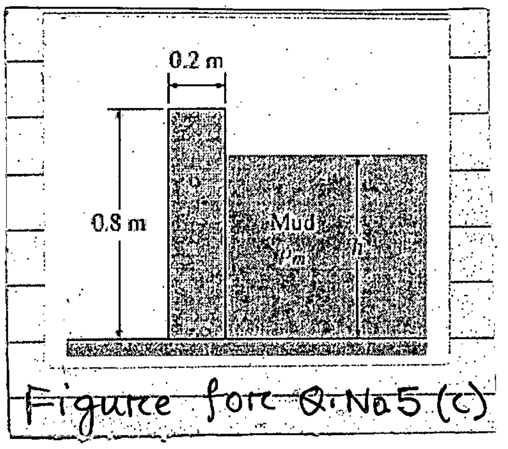

Figure for Q. No 5 (c)

6. (a) The pressure difference between an oil pipe and water pipe is measured by a double fluid manometer as shown in Figure for Q. 6(a). For the given fluid heights and specific gravities, calculate the pressure difference $\Delta P = P_B - P_A$. **(12)**

NAME 123

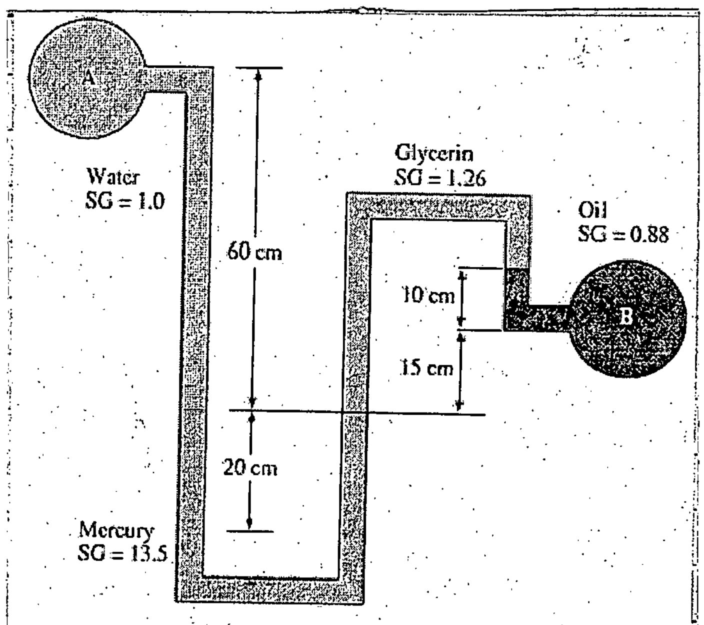

Figure for Q.No. 6 (a)

(b) A room in the lower level at a cruise ship has a 30 cm diameter circular window. If the midpoint of the window is 5 m below the water surface, determine the hydrostatic force acting on the window, and the pressure center. Take the specific gravity of seawater to be 1.025. **(13)**

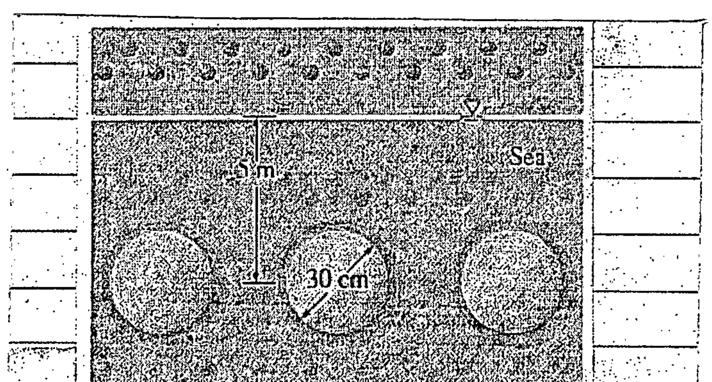

Figure for Q.No. 6(b)

(c) What are the Newtonian and non –Newtonian fluids? Explain with the help of shear stress vs. rate of strain diagram. **(10)**

7. (a) Distinguish between: **(10)**

(i) Compressible and Incompressible Flow

(ii) Steady and Unsteady Flow

(iii) Laminar and Turbulent Flow

(iv) Ideal Fluid and Real Fluid

(v) Uniform and non-uniform Flow

(b) The drag force F on a boat depends on its length L, Velocity v, acceleration due to gravity g, density of water ρ and viscosity of water μ. Using Buckingham π-theorem show that the relationship between F and other variables can be written as, **(15)**

$$F = \rho V^2 L^2 f(F_r, N_{Re})$$

NAME 123

(c) Water flows in a circular pipe which increases in diameter from 400 mm at point A to 500 mm at point B. The pipe then splits into two branches of diameters 0.3 m and 0.2 m discharging at C and D respectively.

If the velocity at A is 1.0 m/s and at D is 0.8 m/s, what are the discharges at C and D and the velocities at B and C? **(10)**

8. (a) With necessary diagrams, explain the different conditions of stability for completely immersed bodies. **(5)**

(b) State and explain the physical significance of Reynold's Number in fluid flow. **(5)**

(c) A block of wood having specific gravity of 0.8 floats in water. Find the metacentric height if the size of the block is 1.2 m × 0.6 m × 0.5 m. **(13)**

(d) List and describe the three necessary conditions for complete similarity between a model and a prototype. **(12)**

L-1/T-2/NAME **Date : 26/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **PHY 161** (Waves and Oscillation, Geometrical Optics and Wave Mechanics)

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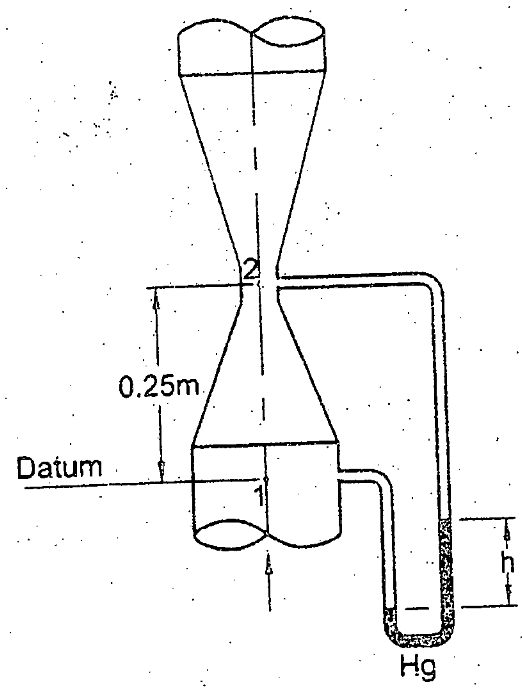

Fig. for Q. NO. 1(a)

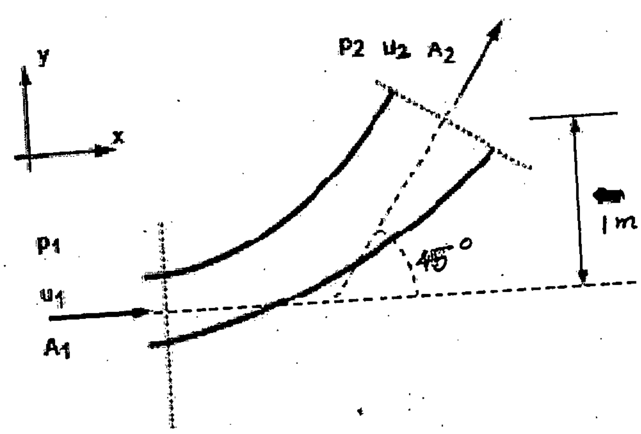

Fig. for Q. NO. 3(a)

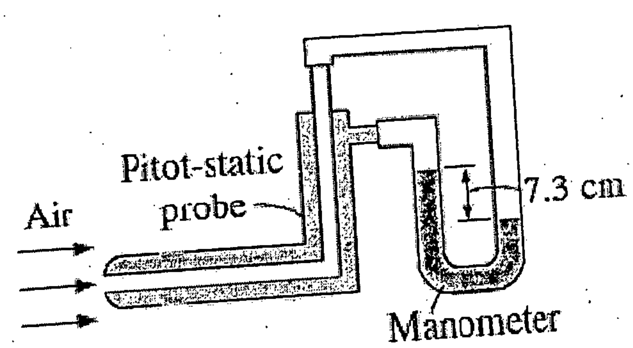

Fig. for Q. NO. 3(b)

PHY 161(NAME)

3. (a) Write down some of the fundamental postulates of statistical mechanics. **(5)**

(b) Write down the mathematical expressions of the three statistical distribution functions by mentioning each term. Distinguish between them with examples. **(20)**

(c) Define the term root mean square (rms) speed. Find the rms speed of oxygen molecules at 0°C. **(10)**

4. (a) Explain with suitable diagrams spherical aberration and astigmatism of optical images formed by ordinary lenses. **(10)**

(b) What is aplanatic lens? What are the conditions that must be satisfied for a lens to be aplanatic? **(15)**

(c) Two plano convex lenses of focal lengths 32 cm and 20 cm and of the same material are used to exhibit minimum spherical aberration. Find the distance between them. If refractive index of the material of the lenses is 1.5, find the radii of curvature of the lens surfaces. **(10)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Discuss with a suitable diagram the principal points and principal planes for a thick lens. Show that the deviation produced by a lens is independent of the position of the object. **(12)**

(b) What is an equivalent lens? Calculate the equivalent focal length of two thin co-axial lenses separated by a finite distance. **(13)**

(c) Two thin converging lenses of power 5 diopters and 4 diopters are placed co-axially 10 cm apart. Find the focal length of the combination and the position of the principal points. **(10)**

6. (a) What is meant by dispersive power? Deduce the relation, $\omega = \frac{d\mu}{\mu - 1}$, where the terms have their usual meaning. **(7)**

(b) Calculate the magnifying power of a compound microscope. **(20)**

(c) Two converging lenses of focal lengths 4 cm and 5 cm form the objective and eye-piece respectively of a compound microscope. The lenses are placed 20 cm apart. Where must an object be placed so that a virtual image is formed at a distance of 25 cm from the eye? **(8)**

PHY 161(NAME)

7. (a) Define Lissajous figures. Suppose a particle is simultaneously acted upon by two simple harmonic vibrations at right angle to each other. The incident vibrations have same time periods, but different amplitudes and phases. Derive the general expression for the resultant vibration of the particle. What type of Lissajous figures will be observed if the phase difference between the incident vibrations are (i) $\pi/4$ and (ii) $\pi/2$ radians. **(20)**

   (b) A two-body system consisting of blocks of masses m_1 and m_2 which are separated by a spring with the spring constant k and moving on a horizontal smooth surface. Prove that the type of vibration showed by the system can be considered as simple harmonic vibration. **(10)**

   (c) A two body oscillator consists of two point masses 0.2 g and 0.5 g and the system is undergoing horizontal motion. The point masses are connected by a spring with the spring constant of 500 dynes/cm. What is the time period of oscillation of the two body oscillator? **(5)**

8. (a) Differentiate between particle velocity and wave velocity. If the equation of a plane progressive wave is given by, $y = a\,sin\frac{2\pi}{\lambda}(vt - x)$, establish a relation between particle velocity and wave velocity. (The symbols carry their usual meaning) **(10)**

   (b) Which of the following equations represents the solution of the one dimensional wave equations? (i) $y = x^2 - 2v^2t^2$, (ii) $y = 2 \sin x \cos vt$. **(10)**

   (c) Find the expression for resultant stationary wave due to the superposition of sound waves reflected at a rigid boundary by using analytical treatment. Discuss nodes and antinodes with respect to the change of position. **(15)**

L-1/T-2/NAME **Date : 31/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **EEE 161** (Electrical Engineering Principles)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

Assume usual meaning for symbols if not stated otherwise.

1. (a) A sinusoidal voltage $v = V_1\cos(wt - 45°)$ is applied to a capacitor C. Find the expression of instantaneous power and calculate average power from it. Explain why this setup does not consume any real power. **(17)**

(b) Find the average power delivered to the 16 Ω resistance in the circuit shown in Fig. for Q. 1(b). **(18)**

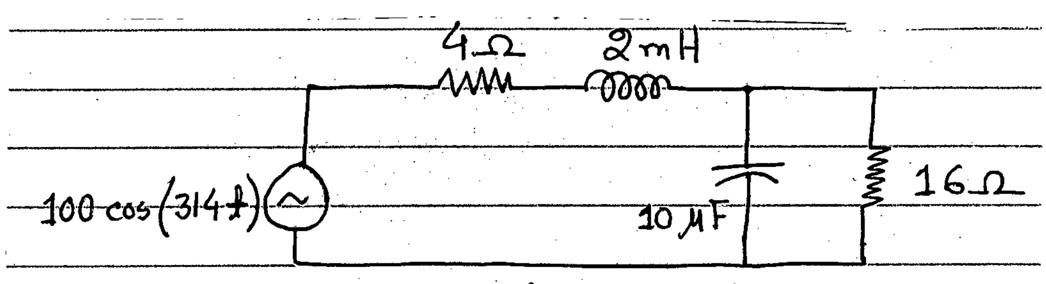

Fig. for Q. 1(b)

2. (a) Determine the value of Z_A in order to deliver maximum power in the 10 + j4 Ω load. Calculate the power delivered to the load. **(18)**

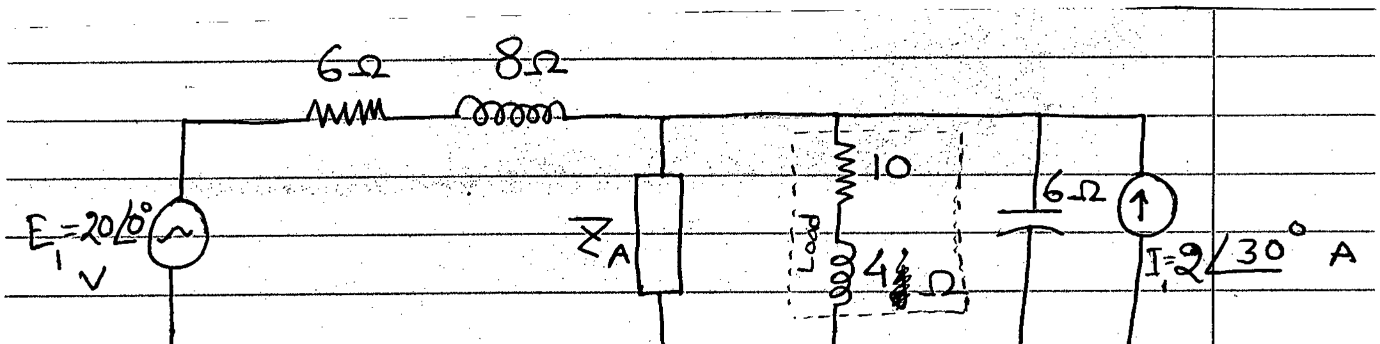

Fig. for Q.2(a)

(b) What is the advantage of a 3-phase system over a single-phase system of equal power rating? Explain your answer with proper mathematical derivation. **(17)**

3. (a) Find the value of real power, reactive power, apparent power and power factor of a balanced 3-phase system where line voltage V_L leads line current I_L by an angle θ. **(10)**

Contd P/2

EEE 161(NAME)

Contd ... Q. No. 3

(b) For a balanced 3-phase system, show that **(10)**

$$I_L = I_P \text{ and } V_L = \sqrt{3}\, V_P \text{for } Y-\text{connection and}$$

$$I_L = \sqrt{3} I_P \text{ and } V_L = V_P \text{for } \Delta-\text{connection}.$$

(c) A single phase motor in Figure for Q. No. 3(c) takes 10 kVA at 0.6 p.f. lagging from a source of 220 V. Consider a line impedance of 2 + 4j Ω. Design a system where you can reduce line loss by at least 100 times by installing transformers. **(15)**

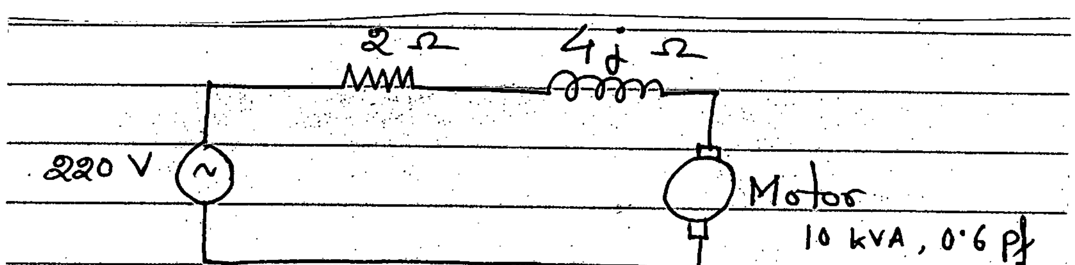

Fig. for Ques. 3(c)

4. (a) A 3-phase motor consumes 20 kVA at 0.8 p.f. (lagging) from a Y-connected 3-phase source. It is in parallel with a balanced 3-phase Δ-connected inductive load that has an impedance 10 + j 20 Ω at each phase. Line-to-line voltage is 220 V. Calculate (i) line current, (ii) total real power consumption, (iii) power factor of the combined system and (iv) kVA rating of capacitor bank to be connected to improve overall power factor to 0.95 (lagging). **(20)**

(b) A 15 kVA 2300/230 V transformer has been tested to determine its excitation branch components and series impedances. The following data has been acquired.

Open Cricuit Test		Short Circuit Test	
V_{oc}	= 2300 V	V_{sc}	= 20 V
I_{oc}	= 0.4 A	I_{sc}	= 5 A
P_{oc}	= 100 W	P_{sc}	= 120 W

Draw the approximate equivalent circuit of this transformer with exact value of each component. **(15)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

Symbols have their usual meanings.

5. (a) Consider the infinite ladder network circuit shown in Fig. for Q. 5(a). Find the equivalent input resistance R_{in} given all the resistances have an equal resistance R = 2017 Ω. Note, you can safely assume that, the resistance does not change if we add another ladder section in front of the network. **(10)**

Contd P/3

EEE 161(NAME)

Contd ... Q. No. 5(a)

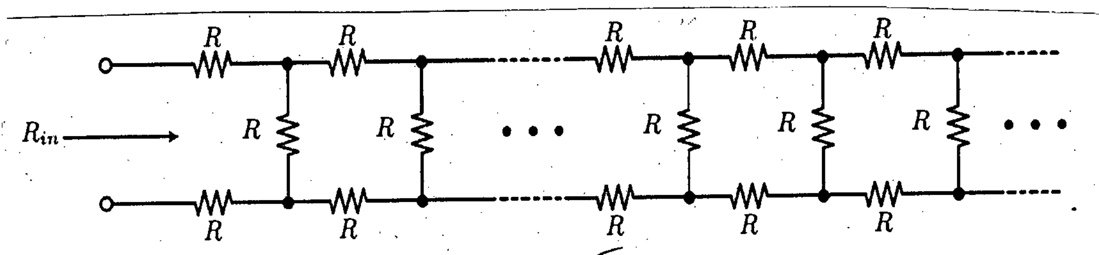

Fig. for Q. 5(a)

(b) For the circuit shown in Fig. for Q. 5(b), output voltage v_O is either 26 V or 24 V. The value of v_O depends on whether the switch is closed or open. Determine R_2 and R_3. **(8)**

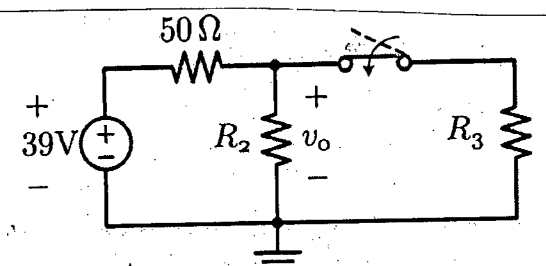

Fig for Q. 5(b)

(c) Consider the circuit shown in Fig. for Q. 5(c). Device 1 and Device 2 are rated as shown in the circuit. Find the values of the resistors R_1 and R_2 needed to power the devices using a 24 V battery. Please make sure that the fuse rating is not exceeded in your designed final circuit. **(17)**

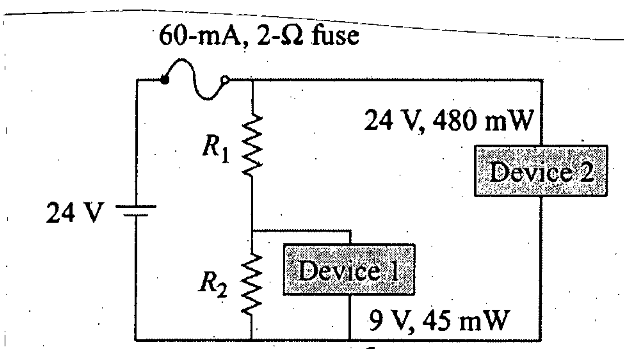

Fig for Q. 5(c)

6. (a) A black box with a circuit in it is connected to a variable resistor with resistance R as shown in the Fig. for Q. 6(a). An ammeter with zero resistance and a voltmeter with infinite resistance are used to measure the current and voltage respectively, as shown in the circuit. The readings of the ammeter and voltmeter are shown in Table for Q. 6(a). Determine the maximum power that can be obtained from the black box. **(15)**

Contd P/4

EEE 161(NAME)

Contd ... Q. No. 6

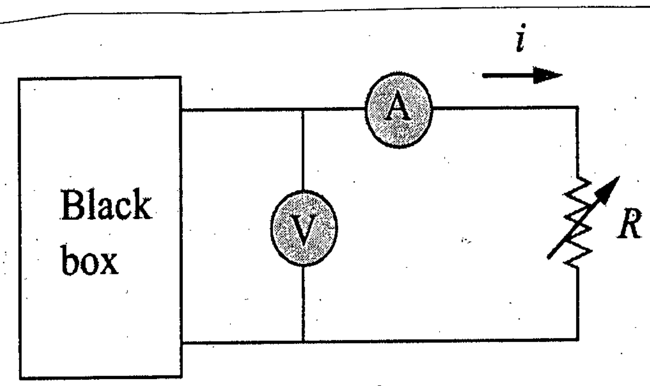

Fig for Q. 6(a)

R (Ω)	V (V)	I (A)
2	3	1.5
8	8	1.0
14	10.5	0.75

Table for Q. 6(a)

(b) Using superposition theorem find the Thevenin and Norton equivalents between terminals a-b of the circuit shown in Fig. for Q. 6(b). **(20)**

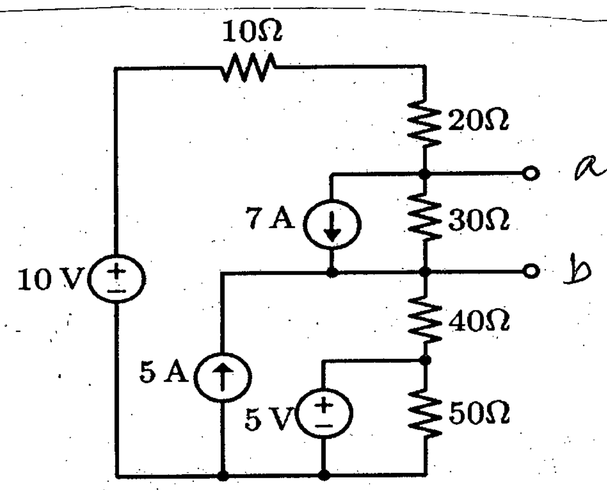

Fig for Q. 6(b)

7. (a) Using nodal analysis find the power developed by the 20 V source in the circuit in Fig. for Q. 7(a). **(25)**

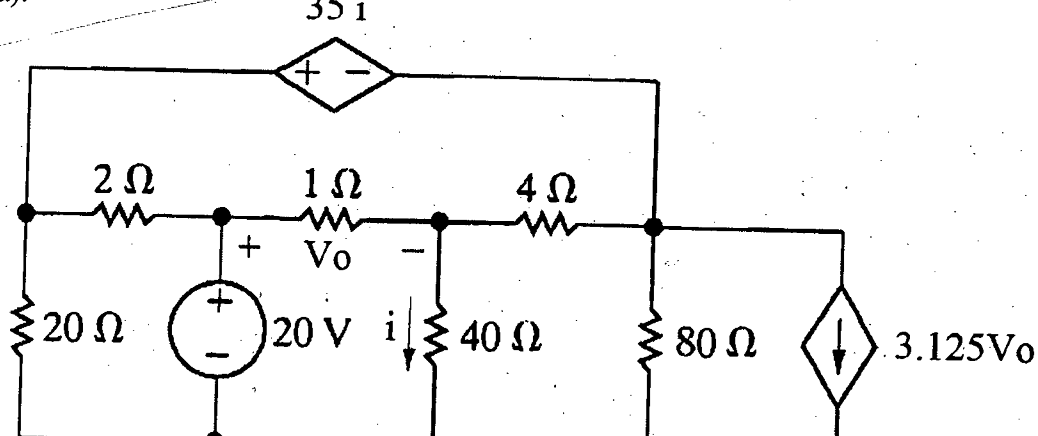

Fig for Q. 7(a)

EEE 161(NAME)

Contd ... Q. No. 7

(b) Consider the circuit shown in Fig. for Q. 7(b). If $\frac{V_{out}}{V_S} = 9$, Find the value of A. **(10)**

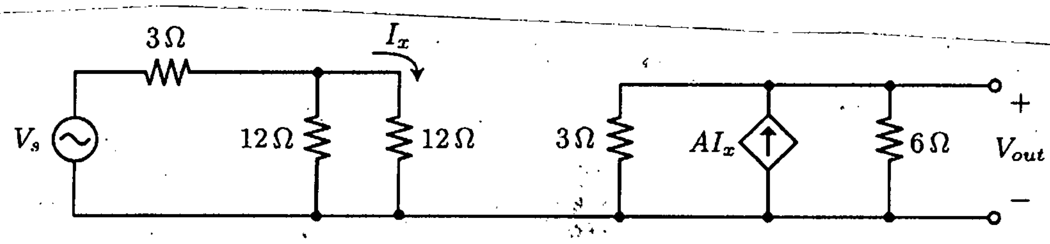

Fig for Q. 7(b)

8. (a) Consider the circuit shown in Fig. for Q. 8(a). i (Current through the 6 k Ω resistor) was calculated to be 3.5 mA before the 5 mA current source was attached to the terminals a, b. **(20)**

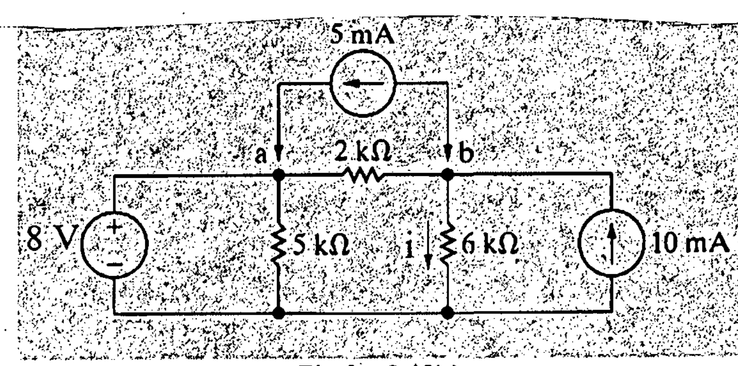

Fig for Q.8(a)

(i) Using superposition theorem, find the value of i after the 5 mA current source is attached.

(ii) Using mesh analysis, verify your solution obtained in (i) when all three sources are acting simultaneously.

(b) For the circuit shown in Fig. for Q. 8(b), find the voltage V_{ab} between terminal a-b. **(15)**

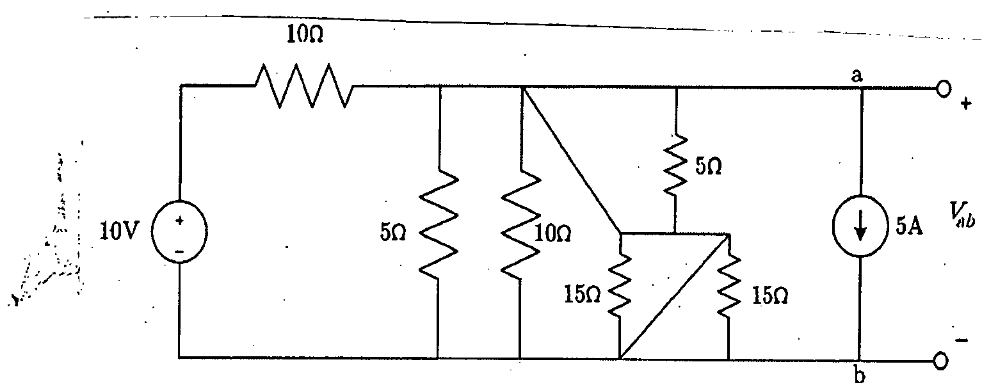

Fig. for Q.8(b)

L-1/T-2/NAME **Date : 06/02/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **ME 169** (Basic Thermal Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) With a schematic diagram, briefly describe the working principle of a single cylinder 4-stroke IC engine. **(12)**

   (b) Draw the value timing diagram and indicator diagram for a four stroke SI engine. **(8)**

   (c) What is detonation of IC engines? Discuss its effects and their remedies. **(15)**

2. (a) Write short notes on (i) IC engine scavenging, (ii) Boiler safety valve and (iii) Bourden pressure gauge. **(15)**

   (b) Draw he schematic of a Babcock and Wilcox boiler. **(10)**

   (c) What are the four accessories of a boiler? Discuss their functions and usefulness. **(10)**

3. (a) Describe briefly a combined cycle power plant with a schematic diagram. **(10)**

   (b) Draw the T-s diagram for each of the modes of thermal improvement of a simple gas turbine. **(9)**

   (c) In a Brayton cycle gas turbine, air enters in the compressor at 0.1 MPa and 15°C. Maximum pressure and temperature of the cycle are 1 MPa and 1000°C. Determine the net work and thermal efficiency of the turbine. Also calculate the optimum pressure if compression is done in two-stages. **(16)**

4. (a) Why turbine staging is important? Draw the pressure and velocity profiles along the turbine axis from entrance to exit of the steam for impulse and reaction turbines. **(10)**

   (b) In a single stage steam turbine: steam velocity is 360 m/s, blade velocity is 160 m/s, nozzle angle is 20°, axial thrust is negligible and ratio between the exit to inlet relative velocities is 0.9. Calculate the work done per kg of steam and turbine efficiency. **(17)**

   (c) Draw the schematic and T-s diagram of a simple regenerative steam turbine with one feed water heater. **(8)**

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

Assume any data if necessary. Symbols have their usual meaning and interpretation.

5. (a) Explain Microscopic and Macroscopic views of thermodynamics. Differentiate between Intensive and Extensive properties with examples. **(5+5)**

   (b) State Zeroth law of thermodynamics with proper explanations. Mention the basic difference between Closed System and Open System. **(10+5)**

   (c) Deduce the relation $C_p - C_v = R$, for an ideal gas where C_p and C_v are the specific heats and R is the gas constant. **(10)**

6. (a) Prove that, whenever a system undergoes a cycle, $\oint \frac{\delta Q}{T} \leq 0$. **(17)**

   (b) Satisfy Clausius inequality for the following simple steam power plant in the Fig. Q. 6(b). **(18)**

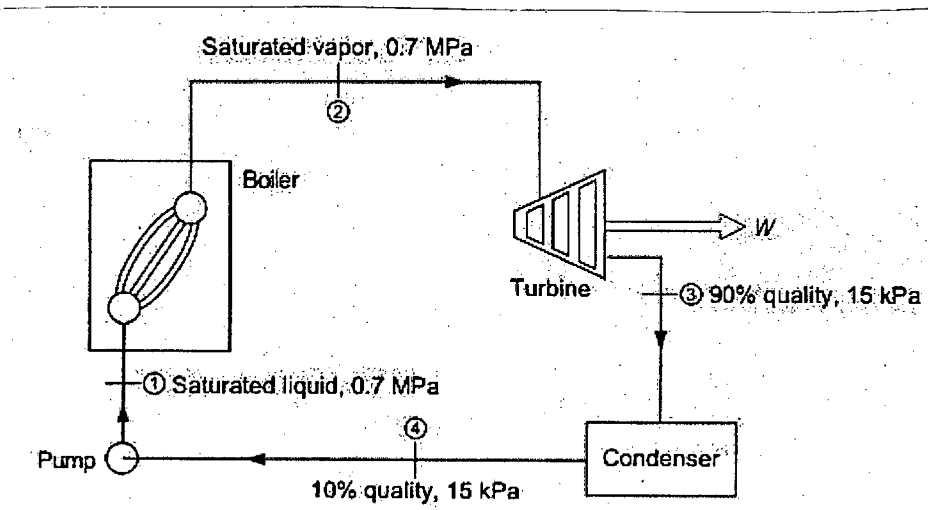

Fig: Q6(b)

7. (a) Write down the steady state, steady flow energy equation and explain each term of that equation. List the assumptions made in its derivation. **(20)**

   (b) Steam enters a turbine operating at steady state with a mass flow rate of 4600 kg/h. The turbine develops a power output of 1000 kW. At the inlet, the pressure is 60 bar, the temperature is 400°C, and the velocity is 10 m/s. At the exit, the pressure is 0.1 bar, the quality is 0.9 (90%), and the velocity is 30 m/s. Calculate the rate of heat transfer between the turbine and surroundings, in kW. **(15)**

8. (a) State the two important propositions regarding the efficiency of a Carnot cycle and prove with illustrations. **(20)**

   (b) A heat source at 800 K loses 2000 kJ of heat to a sink at (i) 500 K and (ii) 750 K. Determine entropy generation in each case and then mention in which heat transfer process is more irreversible and why? **(15)**

Saturated Water, Temperature Table

Table C.1b Saturated Water, Temperature Table (Metric Units)

T, °C	p, MPa	Volume, m³/kg v_f	v_g	Energy, kJ/kg u_f	u_g	Enthalpy, kJ/kg h_f	h_{fg}	h_g	Entropy, kJ/(kg·K) s_f	s_{fg}	s_g
0.010	0.0006113	0.001000	206.1	0.0	2375.3	0.0	2501.3	2501.3	0.0000	9.1571	9.1571
2	0.0007056	0.001000	179.9	8.4	2378.1	8.4	2496.6	2505.0	0.0305	9.0738	9.1043
5	0.0008721	0.001000	147.1	21.0	2382.2	21.0	2489.5	2510.5	0.0761	8.9505	9.0266
10	0.001228	0.001000	106.4	42.0	2389.2	42.0	2477.7	2519.7	0.1510	8.7506	8.9016
15	0.001705	0.001001	77.93	63.0	2396.0	63.0	2465.9	2528.9	0.2244	8.5578	8.7822
20	0.002338	0.001002	57.79	83.9	2402.9	83.9	2454.2	2538.1	0.2965	8.3715	8.6680
25	0.003169	0.001003	43.36	104.9	2409.8	104.9	2442.3	2547.2	0.3672	8.1916	8.5588
30	0.004246	0.001004	32.90	125.8	2416.6	125.8	2430.4	2556.2	0.4367	8.0174	8.4541
35	0.005628	0.001006	25.22	146.7	2423.4	146.7	2418.6	2565.3	0.5051	7.8488	8.3539
40	0.007383	0.001008	19.52	167.5	2430.1	167.5	2406.8	2574.3	0.5723	7.6855	8.2578
45	0.009593	0.001010	15.26	188.4	2436.8	188.4	2394.8	2583.2	0.6385	7.5271	8.1656
50	0.01235	0.001012	12.03	209.3	2443.5	209.3	2382.8	2592.1	0.7036	7.3735	8.0771
55	0.01576	0.001015	9.569	230.2	2450.1	230.2	2370.7	2600.9	0.7678	7.2243	7.9921
60	0.01994	0.001017	7.671	251.1	2456.6	251.1	2358.5	2609.6	0.8310	7.0794	7.9104
65	0.02503	0.001020	6.197	272.0	2463.1	272.0	2346.2	2618.2	0.8934	6.9384	7.8318
70	0.03119	0.001023	5.042	292.9	2469.5	293.0	2333.8	2626.8	0.9549	6.8012	7.7561
75	0.03858	0.001026	4.131	313.9	2475.9	313.9	2321.4	2635.3	1.0155	6.6678	7.6833
80	0.04739	0.001029	3.407	334.8	2482.2	334.9	2308.8	2643.7	1.0754	6.5376	7.6130
85	0.05783	0.001032	2.828	355.8	2488.4	355.9	2296.0	2651.9	1.1344	6.4109	7.5453
90	0.07013	0.001036	2.361	376.8	2494.5	376.9	2283.2	2660.1	1.1927	6.2872	7.4799
95	0.08455	0.001040	1.982	397.9	2500.6	397.9	2270.2	2668.1	1.2503	6.1664	7.4167
100	0.1013	0.001044	1.673	418.9	2506.5	419.0	2257.0	2676.0	1.3071	6.0486	7.3557
110	0.1433	0.001052	1.210	461.1	2518.1	461.3	2230.2	2691.5	1.4188	5.8207	7.2395
120	0.1985	0.001060	0.8919	503.5	2529.2	503.7	2202.6	2706.3	1.5280	5.6024	7.1304
130	0.2701	0.001070	0.6685	546.0	2539.9	546.3	2174.2	2720.5	1.6348	5.3929	7.0277
140	0.3613	0.001080	0.5089	588.7	2550.0	589.1	2144.8	2733.9	1.7395	5.1912	6.9307
150	0.4758	0.001090	0.3928	631.7	2559.5	632.2	2114.2	2746.4	1.8422	4.9965	6.8387

T, °C	p, MPa	Volume, m³/kg v_f	v_g	Energy, kJ/kg u_f	u_g	Enthalpy, kJ/kg h_f	h_{fg}	h_g	Entropy, kJ/(kg·K) s_f	s_{fg}	s_g
160	0.6178	0.001102	0.3071	674.9	2568.4	675.5	2082.6	2758.1	1.9431	4.8079	6.7510
170	0.7916	0.001114	0.2428	718.3	2576.5	719.2	2049.5	2768.7	2.0423	4.6249	6.6672
180	1.002	0.001127	0.1941	762.1	2583.7	763.2	2015.0	2778.2	2.1400	4.4466	6.5866
190	1.254	0.001141	0.1565	806.2	2590.0	807.5	1978.8	2786.4	2.2363	4.2724	6.5087
200	1.554	0.001156	0.1274	850.6	2595.3	852.4	1940.8	2793.2	2.3313	4.1018	6.4331
210	1.906	0.001173	0.1044	895.5	2599.4	897.7	1900.8	2798.5	2.4253	3.9340	6.3593
220	2.318	0.001190	0.08620	940.9	2602.4	943.6	1858.5	2802.1	2.5183	3.7686	6.2869
230	2.795	0.001209	0.07159	986.7	2603.9	990.1	1813.9	2804.0	2.6105	3.6050	6.2155
240	3.344	0.001229	0.05977	1033.2	2604.0	1037.3	1766.5	2803.8	2.7021	3.4425	6.1446
250	3.973	0.001251	0.05013	1080.4	2602.4	1085.3	1716.2	2801.5	2.7933	3.2805	6.0738
260	4.688	0.001276	0.04221	1128.4	2599.0	1134.4	1662.5	2796.9	2.8844	3.1184	6.0028
270	5.498	0.001302	0.03565	1177.3	2593.7	1184.5	1605.2	2789.7	2.9757	2.9553	5.9310
280	6.411	0.001332	0.03017	1227.4	2586.1	1236.0	1543.6	2779.6	3.0674	2.7905	5.8579
290	7.436	0.001366	0.02557	1278.9	2576.0	1289.0	1477.2	2766.2	3.1600	2.6230	5.7830
300	8.580	0.001404	0.02168	1332.0	2563.0	1344.0	1405.0	2749.0	3.2540	2.4513	5.7053
310	9.856	0.001447	0.01835	1387.0	2546.4	1401.3	1326.0	2727.3	3.3500	2.2739	5.6239
320	11.27	0.001499	0.01549	1444.6	2525.5	1461.4	1238.7	2700.1	3.4487	2.0883	5.5370
330	12.84	0.001561	0.01300	1505.2	2499.0	1525.3	1140.6	2665.9	3.5514	1.8911	5.4425
340	14.59	0.001638	0.01080	1570.3	2464.6	1594.2	1027.9	2622.1	3.6601	1.6765	5.3366
350	16.51	0.001740	0.008815	1641.8	2418.5	1670.6	893.4	2564.0	3.7784	1.4338	5.2122
360	18.65	0.001892	0.006947	1725.2	2351.6	1760.5	720.7	2481.2	3.9154	1.1382	5.0536
370	21.03	0.002213	0.004931	1844.0	2229.0	1890.5	442.2	2332.7	4.1114	0.6876	4.7990
374.136	22.088	0.003155	0.003155	2029.6	2029.6	2099.3	0.0	2099.3	4.4305	0.0000	4.4305

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Saturated Water, Pressure Table

Table C.2b Saturated Water, Pressure Table (Metric Units)

p, Mpa	T, °C	Volume, m³/kg		Energy, kJ/kg		Enthaply, kJ/kg			Entropy, kJ/(kg·K)		
		v_f	v_g	u_f	u_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
0.000611	0.01	0.001000	206.1	0.0	2375.3	0.0	2501.3	2501.3	0.0000	9.1571	9.1571
0.0008	3.8	0.001000	159.7	15.8	2380.5	15.8	2492.5	2508.3	0.0575	9.0007	9.0582
0.001	7.0	0.001000	129.2	29.3	2385.0	29.3	2484.9	2514.2	0.1059	8.8706	8.9765
0.0012	9.7	0.001000	108.7	40.6	2388.7	40.6	2478.5	2519.1	0.1460	8.7639	8.9099
0.0014	12.0	0.001001	93.92	50.3	2391.9	50.3	2473.1	2523.4	0.1802	8.6736	8.8538
0.0016	14.0	0.001001	82.76	58.9	2394.7	58.9	2468.2	2527.1	0.2101	8.5952	8.8053
0.0018	15.8	0.001001	74.03	66.5	2397.2	66.5	2464.0	2530.5	0.2367	8.5259	8.7626
0.002	17.5	0.001001	67.00	73.5	2399.5	73.5	2460.0	2533.5	0.2606	8.4639	8.7245
0.003	24.1	0.001003	45.67	101.0	2408.5	101.0	2444.5	2545.5	0.3544	8.2240	8.5784
0.004	29.0	0.001004	34.80	121.4	2415.2	121.4	2433.0	2554.4	0.4225	8.0529	8.4754
0.006	36.2	0.001006	23.74	151.5	2424.9	151.5	2415.9	2567.4	0.5208	7.8104	8.3312
0.008	41.5	0.001008	18.10	173.9	2432.1	173.9	2403.1	2577.0	0.5924	7.6371	8.2295
0.01	45.8	0.001010	14.67	191.8	2437.9	191.8	2392.8	2584.6	0.6491	7.5019	8.1510
0.012	49.4	0.001012	12.36	206.9	2442.7	206.9	2384.1	2591.0	0.6961	7.3910	8.0871
0.014	52.6	0.001013	10.69	220.0	2446.9	220.0	2376.6	2596.6	0.7365	7.2968	8.0333
0.016	55.3	0.001015	9.433	231.5	2450.5	231.5	2369.9	2601.4	0.7719	7.2149	7.9868
0.018	57.8	0.001016	8.445	241.9	2453.8	241.9	2363.9	2605.8	0.8034	7.1425	7.9459
0.02	60.1	0.001017	7.649	251.4	2456.7	251.4	2358.3	2609.7	0.8319	7.0774	7.9093
0.03	69.1	0.001022	5.229	289.2	2468.4	289.2	2336.1	2625.3	0.9439	6.8256	7.7695
0.04	75.9	0.001026	3.993	317.5	2477.0	317.6	2319.1	2636.7	1.0260	6.6449	7.6709
0.06	85.9	0.001033	2.732	359.8	2489.6	359.8	2293.7	2653.5	1.1455	6.3873	7.5328
0.08	93.5	0.001039	2.087	391.6	2498.8	391.6	2274.1	2665.7	1.2331	6.2023	7.4354
0.1	99.6	0.001043	1.694	417.3	2506.1	417.4	2258.1	2675.5	1.3029	6.0573	7.3602
0.12	104.8	0.001047	1.428	439.2	2512.1	439.3	2244.2	2683.5	1.3611	5.9378	7.2989
0.14	109.3	0.001051	1.237	458.2	2517.3	458.4	2232.0	2690.4	1.4112	5.8360	7.2472
0.16	113.3	0.001054	1.091	475.2	2521.8	475.3	2221.2	2696.5	1.4553	5.7472	7.2025
0.18	116.9	0.001058	0.9775	490.5	2525.9	490.7	2211.1	2701.8	1.4948	5.6683	7.1631
0.2	120.2	0.001061	0.8857	504.5	2529.5	504.7	2201.9	2706.6	1.5305	5.5975	7.1280
0.3	133.5	0.001073	0.6058	561.1	2543.6	561.5	2163.8	2725.3	1.6722	5.3205	6.9927
0.4	143.6	0.001084	0.4625	604.3	2553.6	604.7	2133.8	2738.5	1.7770	5.1197	6.8967
0.6	158.9	0.001101	0.3157	669.9	2567.4	670.6	2086.2	2756.8	1.9316	4.8293	6.7609
0.8	170.4	0.001115	0.2404	720.2	2576.8	721.1	2048.0	2769.1	2.0466	4.6170	6.6636
1	179.9	0.001127	0.1944	761.7	2583.6	762.8	2015.3	2778.1	2.1391	4.4482	6.5873
1.2	188.0	0.001139	0.1633	797.3	2588.8	798.6	1986.2	2784.8	2.2170	4.3072	6.5242
1.4	195.1	0.001149	0.1408	828.7	2592.8	830.3	1959.7	2790.0	2.2847	4.1854	6.4701
1.6	201.4	0.001159	0.1238	856.9	2596.0	858.8	1935.2	2794.0	2.3446	4.0780	6.4226
1.8	207.2	0.001168	0.1104	882.7	2598.4	884.8	1912.3	2797.1	2.3986	3.9816	6.3802
2	212.4	0.001177	0.09963	906.4	2600.3	908.8	1890.7	2799.5	2.4478	3.8939	6.3417
3	233.9	0.001216	0.06668	1004.8	2604.1	1008.4	1795.7	2804.1	2.6462	3.5416	6.1878
4	250.4	0.001252	0.04978	1082.3	2602.3	1087.3	1714.1	2801.4	2.7970	3.2739	6.0709
6	275.6	0.001319	0.03244	1205.4	2589.7	1213.3	1571.0	2784.3	3.0273	2.8627	5.8900
8	295.1	0.001384	0.02352	1305.6	2569.8	1316.6	1441.4	2758.0	3.2075	2.5365	5.7440
9	303.4	0.001418	0.02048	1350.5	2557.8	1363.3	1378.8	2742.1	3.2865	2.3916	5.6781
10	311.1	0.001452	0.01803	1393.0	2544.4	1407.6	1317.1	2724.7	3.3603	2.2546	5.6149
12	324.8	0.001527	0.01426	1472.9	2513.7	1491.3	1193.6	2684.9	3.4970	1.9963	5.4933
14	336.8	0.001611	0.01149	1548.6	2476.8	1571.1	1066.5	2637.6	3.6240	1.7486	5.3726
16	347.4	0.001711	0.009307	1622.7	2431.8	1650.0	930.7	2580.7	3.7468	1.4996	5.2464
18	357.1	0.001840	0.007491	1698.9	2374.4	1732.0	777.2	2509.2	3.8722	1.2332	5.1054
20	365.8	0.002036	0.005836	1785.6	2293.2	1826.3	583.7	2410.0	4.0146	0.9135	4.9281
22.088	374.136	0.003155	0.003155	2029.6	2029.6	2099.3	0.0	2099.3	4.4305	0.0000	4.4305

Superheated Water Vapour

Table C.3b Superheated Water Vapor (Metric Units)

p, MPa (T_{sat}, °C)		Temperature, °C 50	100	150	200	250	300	350	400	500	600	700	800	900
0.002 (17.5)	v, m³/kg	74.52	86.08	97.63	109.2	120.7	132.3	143.8	155.3	178.4	201.5	224.6	247.0	270.7
	u, kJ/kg	2445.2	2516.3	2589.3	2661.6	2730.2	2812.2	2889.8	2969.0	3132.3	3302.5	3478.7	3663.9	3855.1
	h, kJ/kg	2594.0	2688.4	2783.6	2879.9	2977.6	3076.7	3177.4	3279.6	3489.1	3705.5	3928.8	4159.1	4396.5
	s, kJ/(kg · K)	8.9227	9.1936	9.4328	9.6479	9.8442	10.0251	10.1935	10.3513	10.6414	10.9044	11.1465	11.3718	11.5832
0.005 (32.9)	v, m³/kg	29.78	34.42	39.04	43.66	48.28	52.90	57.51	62.13	71.36	80.59	89.82	99.05	108.3
	u, kJ/kg	2444.7	2516.0	2588.1	2661.4	2736.1	2812.2	2889.0	2968.9	3132.3	3302.5	3478.7	3663.9	3855.0
	h, kJ/kg	2593.6	2688.1	2783.3	2879.8	2977.5	3076.6	3177.3	3279.8	3489.1	3705.4	3928.8	4159.1	4396.5
	s, kJ/(kg · K)	8.4982	8.7699	9.0095	9.2248	9.4212	9.6022	9.7706	9.9284	10.2185	10.4815	10.7236	10.9489	11.1603
0.01 (45.8)	v, m³/kg	14.87	17.20	19.51	21.83	24.14	26.45	28.75	31.06	35.68	40.29	44.91	49.53	54.14
	u, kJ/kg	2443.9	2515.5	2587.9	2661.3	2736.0	2812.1	2889.7	2968.9	3132.3	3302.5	3479.0	3663.8	3855.0
	h, kJ/kg	2592.6	2687.5	2783.0	2879.5	2977.3	3076.5	3177.2	3279.5	3489.0	3705.4	3928.7	4159.1	4396.4
	s, kJ/(kg · K)	8.1757	8.4487	8.6890	8.9046	9.1010	9.2821	9.4506	9.6084	9.8985	10.1616	10.4037	10.6290	10.8404
0.02 (60.1)	v, m³/kg	-	8.585	9.748	10.91	12.06	13.22	14.37	15.53	17.84	20.15	22.45	24.76	27.07
	u, kJ/kg	-	2514.5	2587.3	2660.9	2735.7	2811.9	2889.5	2968.8	3132.2	3302.4	3479.8	3663.8	3855.0
	h, kJ/kg	-	2686.2	2782.3	2879.1	2977.0	3076.3	3177.0	3279.4	3488.9	3705.3	3928.7	4159.1	4396.4
	s, kJ/(kg · K)	-	8.1263	8.3678	8.5839	8.7807	8.9619	9.1304	9.2884	9.5785	9.8417	10.0838	10.3091	10.5206
0.05 (81.3)	v, m³/kg	-	3.418	3.889	4.356	4.820	5.284	5.747	6.209	7.134	8.057	8.981	9.904	10.83
	u, kJ/kg	-	2511.6	2585.6	2659.8	2735.0	2811.3	2839.1	2968.4	3131.9	3302.2	3479.5	3663.7	3854.9
	h, kJ/kg	-	2682.5	2780.1	2877.6	2976.0	3075.5	3176.4	3278.9	3488.6	3705.1	3928.5	4158.9	4396.3
	s, kJ/(kg · K)	-	7.6955	7.9409	8.1588	8.3564	8.5380	8.7069	8.8650	9.1554	9.4186	9.6608	9.8861	10.0975
0.07 (89.9)	v, m³/kg	-	2.434	2.773	3.106	3.441	3.772	4.100	4.434	5.095	5.755	6.415	7.074	7.734
	u, kJ/kg	-	2509.6	2584.5	2659.1	2734.5	2811.0	2838.8	2968.2	3131.6	3302.1	3479.4	3663.0	3854.9
	h, kJ/kg	-	2680.0	2778.6	2876.7	2975.8	3075.0	3176.1	3278.6	3489.4	3704.9	3928.4	4158.8	4396.2
	s, kJ/(kg · K)	-	7.5349	7.7829	8.0020	8.2001	8.3821	8.5511	8.7094	8.9999	9.2632	9.5054	9.7307	9.9422
0.1 (99.6)	v, m³/kg	-	1.693	1.936	2.172	2.406	2.639	2.871	3.103	3.565	4.028	4.490	4.952	5.414
	u, kJ/kg	-	2506.6	2582.7	2658.0	2733.7	2810.4	2889.4	2967.8	3131.5	3301.9	3479.2	3663.5	3854.8
	h, kJ/kg	-	2676.2	2776.4	2875.3	2974.3	3074.3	3175.5	3278.1	3488.1	3704.7	3928.2	4156.7	4396.1
	s, kJ/(kg · K)	-	7.3622	7.6142	7.8351	8.0341	8.2165	8.3858	8.5442	8.8350	9.0984	9.3403	9.5660	9.7775

p, MPa (T_{sat}, °C)		Temperature, °C 150	200	250	300	350	400	450	500	550	600	700	800	900
0.15 (111.4)	v, m³/kg	1.285	1.444	1.601	1.757	1.912	2.067	2.222	2.376	2.530	2.685	2.993	3.301	3.609
	u, kJ/kg	2579.8	2656.2	2732.5	2809.5	2887.7	2967.3	3048.4	3131.1	3215.6	3301.6	3478.0	3663.4	3854.6
	h, kJ/kg	2772.6	2872.9	2972.7	3073.0	3174.5	3277.3	3381.7	3487.6	3595.1	3704.3	3927.9	4158.5	4395.9
	s, kJ/(kg · K)	7.4201	7.6441	7.8446	8.0278	8.1975	8.3562	8.5057	8.6473	8.7821	8.9109	9.1533	9.3787	9.5903
0.2 (120.2)	v, m³/kg	0.9596	1.080	1.199	1.316	1.433	1.549	1.665	1.781	1.897	2.013	2.244	2.475	2.706
	u, kJ/kg	2576.9	2654.4	2731.2	2808.6	2886.9	2966.7	3047.9	3130.7	3215.2	3301.4	3478.6	3663.2	3854.5
	h, kJ/kg	2768.8	2870.5	2971.0	3071.8	3173.5	3276.5	3381.0	3487.0	3594.7	3704.0	3927.7	4158.3	4395.8
	s, kJ/(kg · K)	7.2803	7.5074	7.7094	7.8934	8.0636	8.2226	8.3723	8.5140	8.6489	8.7778	9.0203	9.2458	9.4574
0.4 (143.6)	v, m³/kg	0.4708	0.5342	0.5951	0.6548	0.7139	0.7726	0.8311	0.8893	0.9475	1.006	1.121	1.237	1.353
	u, kJ/kg	2564.5	2646.8	2726.1	2804.8	2884.0	2964.4	3046.0	3129.2	3213.9	3300.2	3477.9	3662.5	3853.9
	h, kJ/kg	2752.8	2860.5	2964.2	3066.7	3169.6	3273.4	3378.4	3484.9	3592.9	3702.4	3926.5	4157.4	4395.1
	s, kJ/(kg · K)	6.9307	7.1714	7.3797	7.5670	7.7390	7.8992	8.0497	8.1921	8.3274	8.4566	8.6999	8.9253	9.1370
0.6 (158.9)	v, m³/kg	-	0.3520	0.3938	0.4344	0.4742	0.5137	0.5529	0.5920	0.6309	0.6697	0.7472	0.8245	0.9017
	u, kJ/kg	-	2638.9	2720.9	2801.0	2881.1	2962.0	3044.1	3127.6	3212.5	3299.1	3477.1	3661.8	3853.3
	h, kJ/kg	-	2850.1	2957.2	3061.6	3165.7	3270.2	3375.9	3482.7	3591.1	3700.9	3925.4	4156.5	4394.4
	s, kJ/(kg · K)	-	6.9673	7.1824	7.3732	7.5472	7.7086	7.8600	8.0029	8.1386	8.2682	8.5115	8.7375	8.9494
0.8 (170.4)	v, m³/kg	-	0.2608	0.2931	0.3241	0.3544	0.3843	0.4139	0.4433	0.4726	0.5018	0.5601	0.6181	0.6761
	u, kJ/kg	-	2630.6	2715.5	2797.1	2878.2	2959.7	3042.2	3125.9	3211.2	3297.9	3476.2	3661.1	3852.8
	h, kJ/kg	-	2839.2	2950.0	3056.4	3161.7	3267.1	3373.3	3480.6	3589.3	3699.4	3924.3	4155.7	4393.6
	s, kJ/(kg · K)	-	6.8167	7.0392	7.2336	7.4097	7.5723	7.7245	7.8680	8.0042	8.1341	8.3779	8.6041	8.8161
1 (179.9)	v, m³/kg	-	0.2060	0.2327	0.2579	0.2825	0.3066	0.3304	0.3541	0.3776	0.4011	0.4478	0.4943	0.5407
	u, kJ/kg	-	2621.9	2709.9	2793.2	2875.2	2957.3	3040.2	3124.3	3209.8	3296.8	3475.4	3660.5	3852.2
	h, kJ/kg	-	2827.9	2942.6	3051.2	3157.7	3263.8	3370.7	3478.4	3587.5	3697.9	3923.1	4154.8	4392.9
	s, kJ/(kg · K)	-	6.6940	6.9255	7.1237	7.3019	7.4658	7.6188	7.7630	7.8996	8.0299	8.2740	8.5005	8.7127
1.5 (198.3)	v, m³/kg	-	0.1325	0.1520	0.1697	0.1866	0.2030	0.2192	0.2352	0.2510	0.2668	0.2981	0.3292	0.3603
	u, kJ/kg	-	2598.1	2695.3	2783.1	2867.6	2951.3	3035.3	3120.3	3206.4	3293.9	3473.2	3658.7	3850.8
	h, kJ/kg	-	2796.8	2923.2	3037.6	3147.4	3255.8	3364.1	3473.0	3582.9	3694.0	3920.3	4152.6	4391.2
	s, kJ/(kg · K)	-	6.4554	6.7098	6.9187	7.1025	7.2697	7.4249	7.5706	7.7083	7.8393	8.0846	8.3118	8.5243

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Table C.3b Superheated Water Vapor (Metric Units) *continued*

P, MPa (T_{sat}, °C)		Temperature, °C: 250	300	350	400	450	500	550	600	650	700	750	800	900
2 (212.4)	v, m³/kg	0.1114	0.1255	0.1386	0.1512	0.1635	0.1757	0.1877	0.1996	0.2114	0.2232	0.2350	0.2467	0.2700
	u, kJ/kg	2679.6	2772.6	2859.8	2945.2	3030.4	3116.2	3203.0	3290.9	3380.2	3471.0	3563.2	3657.0	3849.3
	h, kJ/kg	2902.5	3023.5	3137.0	3247.6	3357.5	3467.6	3578.3	3690.1	3803.1	3917.5	4033.2	4150.4	4389.4
	s, kJ/(kg·K)	6.5461	6.7672	6.9571	7.1279	7.2853	7.4325	7.5713	7.7032	7.8290	7.9496	8.0656	8.1774	8.3903
3 (233.9)	v, m³/kg	0.07058	0.08114	0.09053	0.09936	0.1079	0.1162	0.1244	0.1324	0.1404	0.1484	0.1563	0.1641	0.1798
	u, kJ/kg	2644.0	2750.0	2843.7	2932.7	3020.4	3107.9	3196.0	3285.0	3375.2	3466.6	3559.4	3653.6	3846.5
	h, kJ/kg	2855.8	2993.5	3115.3	3230.8	3344.0	3456.5	3569.1	3682.3	3796.5	3911.7	4028.2	4146.0	4385.9
	s, kJ/(kg·K)	6.2880	6.5398	6.7436	6.9220	7.0842	7.2346	7.3757	7.5093	7.6364	7.7580	7.8747	7.9871	8.2009
4 (250.4)	v, m³/kg	-	0.05884	0.06645	0.07341	0.08003	0.08643	0.09269	0.09885	0.1049	0.1109	0.1169	0.1229	0.1347
	u, kJ/kg	-	2725.3	2826.6	2919.9	3010.1	3099.5	3189.0	3279.1	3370.1	3462.1	3555.5	3650.1	3843.6
	h, kJ/kg	-	2960.7	3092.4	3213.5	3330.2	3445.2	3559.7	3674.4	3789.8	3905.9	4023.2	4141.6	4382.3
	s, kJ/(kg·K)	-	6.3622	6.5828	6.7698	6.9371	7.0908	7.2343	7.3696	7.4981	7.6206	7.7381	7.8511	8.0655
6 (275.6)	v, m³/kg	-	0.03616	0.04223	0.04739	0.05214	0.05665	0.06101	0.06525	0.06942	0.07352	0.07758	0.08160	0.08958
	u, kJ/kg	-	2567.2	2789.6	2892.8	2988.9	3082.2	3174.6	3266.9	3359.6	3453.2	3547.6	3643.1	3837.8
	h, kJ/kg	-	2784.2	3043.0	3177.2	3301.8	3422.1	3540.6	3658.4	3776.2	3894.3	4013.1	4132.7	4375.3
	s, kJ/(kg·K)	-	6.0562	6.3342	6.5415	6.7201	6.8811	7.0296	7.1685	7.2996	7.4242	7.5433	7.6575	7.8735
8 (295.1)	v, m³/kg	-	0.02426	0.02995	0.03432	0.03817	0.04175	0.04516	0.04845	0.05166	0.05481	0.05791	0.06097	0.06702
	u, kJ/kg	-	2590.9	2747.7	2863.8	2966.7	3064.3	3159.8	3254.4	3349.0	3444.0	3539.6	3636.1	3832.1
	h, kJ/kg	-	2785.0	2987.3	3138.3	3272.0	3398.3	3521.0	3642.0	3762.3	3882.5	4002.9	4123.8	4368.3
	s, kJ/(kg·K)	-	5.7914	6.1309	6.3642	6.5559	6.7248	6.8786	7.0214	7.1553	7.2821	7.4027	7.5182	7.7359
10 (311.1)	v, m³/kg	-	-	0.02242	0.02641	0.02975	0.03279	0.03564	0.03837	0.04101	0.04358	0.04611	0.04859	0.05349
	u, kJ/kg	-	-	2699.2	2832.4	2943.3	3045.8	3144.5	3241.7	3338.2	3434.7	3531.5	3629.0	3826.3
	h, kJ/kg	-	-	2923.4	3096.5	3240.8	3373.6	3500.9	3625.3	3748.3	3870.5	3992.6	4114.9	4361.2
	s, kJ/(kg·K)	-	-	5.9451	6.2127	6.4197	6.5974	6.7569	6.9037	7.0406	7.1696	7.2919	7.4086	7.6280
12 (324.8)	v, m³/kg	-	-	0.01721	0.02108	0.02412	0.02680	0.02929	0.03164	0.03390	0.03610	0.03824	0.04034	0.04447
	u, kJ/kg	-	-	2641.1	2786.3	2918.8	3026.6	3128.9	3228.7	3327.2	3425.3	3523.4	3621.8	3820.6
	h, kJ/kg	-	-	2847.6	3051.2	3208.2	3348.2	3480.3	3608.3	3734.0	3858.4	3982.3	4105.9	4354.2
	s, kJ/(kg·K)	-	-	5.7604	6.0754	6.3006	6.4879	6.6535	6.8045	6.9445	7.0757	7.1998	7.3178	7.5390

P, MPa (T_{sat}, °C)		Temperature, °C: 400	450	500	550	600	650	700	750	800	850	900	950	1000
15 (342.2)	v, m³/kg	0.01565	0.01845	0.02080	0.02293	0.02491	0.02680	0.02861	0.03037	0.03210	0.03379	0.03546	0.03711	0.03875
	u, kJ/kg	2740.7	2879.5	2996.5	3104.7	3208.6	3310.4	3410.9	3511.0	3611.0	3711.2	3811.9	3913.2	4015.4
	h, kJ/kg	2975.4	3156.2	3308.5	3448.6	3582.3	3712.3	3840.1	3966.6	4092.4	4218.0	4343.8	4469.9	4596.6
	s, kJ/(kg·K)	5.8819	6.1412	6.3451	6.5207	6.6784	6.8232	6.9580	7.0848	7.2048	7.3192	7.4288	7.5340	7.6356
20 (365.8)	v, m³/kg	0.00994	0.01270	0.01477	0.01656	0.01818	0.01969	0.02113	0.02251	0.02385	0.02516	0.02645	0.02771	0.02897
	u, kJ/kg	2619.2	2806.2	2942.8	3062.3	3174.0	3281.5	3386.5	3490.0	3592.7	3695.1	3797.4	3900.0	4003.1
	h, kJ/kg	2818.1	3060.1	3238.2	3393.4	3537.6	3675.3	3809.1	3940.3	4069.8	4198.3	4326.4	4454.3	4582.5
	s, kJ/(kg·K)	5.5548	5.9025	6.1409	6.3356	6.5056	6.6591	6.8002	6.9317	7.0553	7.1723	7.2839	7.3907	7.4933
22.088 (374.136)	v, m³/kg	0.00818	0.01104	0.01305	0.01475	0.01627	0.01768	0.01901	0.02029	0.02152	0.02272	0.02389	0.02505	0.02619
	u, kJ/kg	2552.9	2772.1	2919.0	3043.9	3159.1	3269.1	3376.1	3481.1	3585.0	3688.3	3791.4	3894.5	3998.0
	h, kJ/kg	2733.7	3015.9	3207.2	3369.6	3518.4	3659.6	3796.0	3929.2	4060.3	4190.1	4319.1	4447.9	4576.6
	s, kJ/(kg·K)	5.4013	5.8072	6.0634	6.2670	6.4426	6.5998	6.7437	6.8772	7.0024	7.1206	7.2330	7.3404	7.4436
30	v, m³/kg	0.00279	0.00674	0.00868	0.01017	0.01145	0.01260	0.01366	0.01466	0.01562	0.01655	0.01745	0.01833	0.01920
	u, kJ/kg	2067.3	2619.3	2820.7	2970.3	3100.5	3221.0	3335.6	3447.0	3555.6	3662.6	3768.5	3873.8	3978.8
	h, kJ/kg	2151.0	2821.4	3081.0	3275.4	3443.9	3598.9	3745.7	3886.9	4024.3	4159.0	4291.9	4423.6	4554.7
	s, kJ/(kg·K)	4.4736	5.4432	5.7912	6.0350	6.2339	6.4066	6.5614	6.7030	6.8341	6.9568	7.0726	7.1825	7.2875
40	v, m³/kg	0.00191	0.00369	0.00562	0.00698	0.00809	0.00906	0.00994	0.01076	0.01152	0.01226	0.01296	0.01365	0.01432
	u, kJ/kg	1854.5	2365.1	2678.4	2869.7	3022.6	3158.0	3283.6	3402.9	3517.9	3629.8	3739.4	3847.5	3954.6
	h, kJ/kg	1930.8	2512.8	2903.3	3149.1	3346.4	3520.6	3681.3	3833.1	3978.8	4120.0	4257.9	4393.6	4527.6
	s, kJ/(kg·K)	4.1143	4.9467	5.4707	5.7793	6.0122	6.2063	6.3759	6.5281	6.6671	6.7957	6.9158	7.0291	7.1365
60	v, m³/kg	0.00163	0.00208	0.00296	0.00396	0.00483	0.00560	0.00627	0.00689	0.00746	0.00800	0.00851	0.00900	0.00948
	u, kJ/kg	1745.3	2053.9	2390.5	2658.8	2861.1	3028.8	3177.2	3313.6	3441.6	3563.6	3681.0	3795.0	3906.4
	h, kJ/kg	1843.4	2179.0	2567.9	2896.2	3151.2	3364.5	3553.6	3726.8	3889.1	4043.3	4191.5	4335.0	4475.2
	s, kJ/(kg·K)	3.9325	4.4128	4.9329	5.3449	5.6460	5.8838	6.0832	6.2569	6.4118	6.5523	6.6814	6.8012	6.9135
80	v, m³/kg	0.00152	0.00177	0.00219	0.00276	0.00339	0.00398	0.00452	0.00502	0.00548	0.00591	0.00632	0.00671	0.00709
	u, kJ/kg	1687.0	1944.9	2218.9	2483.9	2711.8	2904.7	3073.2	3225.3	3365.7	3497.2	3622.3	3742.1	3857.8
	h, kJ/kg	1808.3	2086.9	2393.9	2704.9	2982.7	3222.6	3434.7	3626.6	3803.8	3970.1	4127.9	4279.1	4425.2
	s, kJ/(kg·K)	3.8336	4.2328	4.6432	5.0331	5.3609	5.6264	5.8521	6.0445	6.2137	6.3652	6.5026	6.6289	6.7459