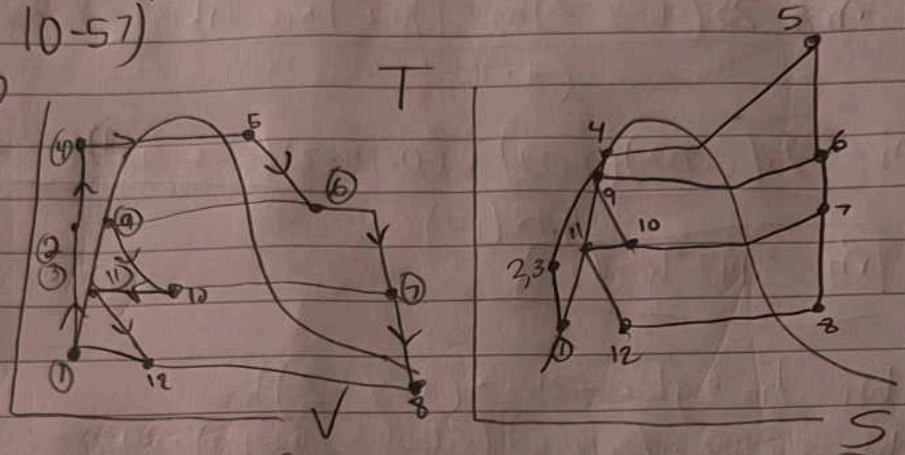
HW 2.2

10-57)



①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
$P_1 = 20kPa$	$P_2 = 5Mpa$		$P_4 = 5Mpa$	$P_5 = 5Mpa$	$P_6 = 1.4Mpa$	$P_7 = 245$	$P_8 = 20kPa$		$P_{10} = 245$
$x = 0$	$h_2 = 256$		$h_4 = 830$	$T_5 = 700°C$	$h_6 = 3406$	$T_7 = 500°C$	$T_8 = 325°C$		$h_{10} = 830$
$h_1 = 251$		$P_3 = 5Mpa$		$h_3 = 3900$		$h_7 = 2477$	$h_8 = 2477$		
$s_1 = 0.832$		$x_3 = 0$						$P_9 = 1.4Mpa$	
$V_1 = 0.00102$		$h_3 = 533$						$h_9 = 830$	

$h_2 = 251 + 0.00102(5000 - 20)$

$h_2 = 256\ kJ/kg$

$h_5 = h_{11} = h_{12} = 553\ kJ/kg$

$h_4 = h_9 = h_{10} = 830\ kJ/kg$

$W_p = h_2 - h_1$

$W_p = V_1(P_2 - P_1)$

$h_2 = V_1(P_2 - P_1) + h_1$

B) $z = (h_3 - h_2) + y(h_{11} - h_{10})$

$z = \dfrac{(533 - 256) + 0.1446(533 - 830)}{(2918 - 533)}$

$z = 0.098$

C) $\dot{m} = \frac{75(1-y-z)h_4 + (y+z)h_{12} - 1 \cdot h_1}{C_p \cdot 10^\circ C}$

$\dot{m} = \frac{75(0.757)(2477) + (0.2427)(533-251)}{4.18(10)}$

$\boxed{\dot{m} = 3147 \text{ kg/s}}$

D) $W_T = h_5 - gh_6 - 2h_7 - (1-y-z)h_8$

$W_T = 3900 - (0.1446)(3406 - (0.0981) \cdot 2918 - (0.757)(2477)$

$W_T = 1245 \text{ kJ/kg}$

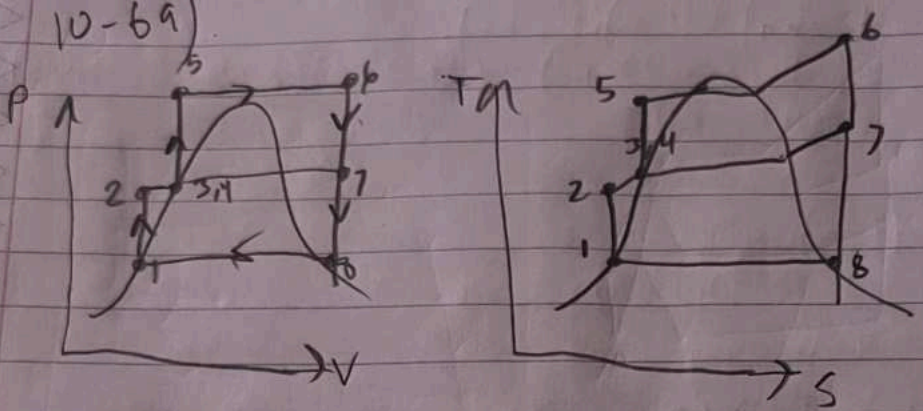
$W_{net} = 1245 - 5 = \boxed{1240 \text{ kJ/kg}}$

$W_{net} = 1240(75) = \boxed{93000 \text{ kW}}$

$Q_{in} = 75(3900 - 830) = 230,250 \text{ kW}$

$\eta_{th} = \frac{93000}{230250} = 0.404 = \boxed{40.4\%}$

10-69)



①	②	③	④	⑤	⑥	⑦	⑧
$P_1 = 10kPa$	$P_2 = 1.2MPa$	$P_3 = 1.2MPa$	$P_4 = 1.2MPa$		$P_6 = 4MPa$	$P_7 = 1.2MPa$	$P_8 = 10kPa$
$h_1 = 191.8$	$h_2 = 193$	$h_3 = 798.3$	$h_4 = 344.3$		$T_6 = 500°C$	$h_7 = 3080$	$h_8 = 191.8$
$V_1 = 0.00101$			$V_4 = 0.00103$		$h_6 = 3446$	$s_7 = 56$	$s_8 = 57$
				$P_5 = 7MPa$	$s_6 = 7.08$		
				$h_5 = 347$			$h_8 = h_1$

$h_2 = V_1(P_2 - P_1) + h_1$

$h_2 = 0.00101(1200 - 10) + 191.8$

$h_2 = 193\ kJ$

$h_4 = \dfrac{\dot{m}_2 h_2 + \dot{m}_3 h_3}{\dot{m}_4}$

$h_4 = \dfrac{22.5(193) + 7.5(798.3)}{30}$

$h_4 = 344.3\ kJ/kg$

$h_5 = V_4(P_5 - P_4) + h_4$

$h_5 = 0.00103(7 - 1.2) + 344.3$

$h_5 = 347\ kJ/kg$

$W_T = \dot{m}_6(h_6 - h_7) + \dot{m}_7(h_7 - h_8)$

$W_T = 55(3446 - 3080) + (41.25)(3080 - 191.$

$W_T = 54494\ kW$

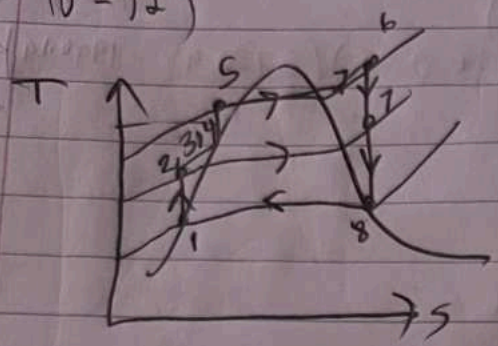
$W_p = (41.25)(1.2) + 55(2.84)$

$W_p = 208\ kW$

$W_{net} = 54494 - 208$

$W_{net} = 54286\ kW$

10-72)



① $P_1 = 10 kPa$
$h_1 = 191.8$
$V_1 = 0.0010$

② $P_2 = 1.6 MPa$
$h_2 = 193 kJ/kg$

③ $P_3 = 1.6 = P_4$
$h_3 = h_4 = 858$
$V_4 = 0.00159$

④ $P_5 = 9 MPa$

⑤ $P_6 = 9 MPa$
$T_6 = 400°C$
$h_6 = 3118.8$

⑥ $P_7 = 1.6$
$h_7 = 2729$

⑦

⑧ $P_8 = 10 kPa$
$h_8 = 1990 kJ/kg$

$W_{p1} = V_1 (P_2 - P_1)$
$= (0.00101)(1600 - 10)$
$= 1.606$

$W_{p1} = h_2 - h_1$
$h_2 = W_{p1} + h_1$
$h_2 = 1.606 + 191.8$
$h_2 = 193$

$W_{p2} = V_4 (P_5 - P_4)$
$= 0.00159 (9000 - 1600)$
$= 8.576 kJ/kg$

$W_{p2} = h_5 - h_4$
$h_5 = W_{p2} + h_4$
$h_5 = 8.576 + 858.5$
$h_5 = 867.076$

$S_7 = S_f + x_7 (S_{fg})$
$6.28 = 2.34 + x_7 (4.2204)$
$x_7 = 0.9675$

$h_7 = h_f + x_7 (h_{fg})$
$= 858.5 + 0.9675 (1434.3)$
$= 2729.93 kJ/kg$

$$(W_T)_{out} = (h_6 - h_7) + (1-m)(h_7 - h_8)$$
$$= (3116.8 - 2729.43) + (1 + 0.35)(2729.43 - 1990.19)$$
$$= 869.69 \text{ kJ/kg}$$

$$(W_p)_{in} = (1-m)W_{p1} + W_{p2}$$
$$= (1 - 0.35)(1.606) + 8.576$$
$$= 9.619 \text{ kJ/kg}$$

$$W_{net} = (W_T)_{out} - (W_p)_{in}$$
$$= 869.69 - 9.619$$
$$= 860 \text{ kJ/kg}$$

$$P = \dot{m}(W_{net})$$
$$25 \times 10^3 = \dot{m}(860)$$

$$\boxed{\dot{m} = 29.1 \text{ kg/s}}$$