{Problem 1}

humidity_relative=0.40
temp_dry=38[C]
P=14.696***convert**(psia, kPa)

enthalpy=**enthalpy**(***AirH2O***,***P***=P,***T***=temp_dry,***R***=humidity_relative) {Enthalpy: enthalpy = 81.17 kJ/kg}
temp_wetBulb=**wetbulb**(***AirH2O***,***P***=P,***T***=temp_dry,***R***=humidity_relative) {Wetbulb Temperature: temp_wetBulb = 26.27 C}
temp_dewPoint=**dewpoint**(***AirH2O***,***P***=P,***T***=temp_dry,***R***=humidity_relative) {Dewpoint Temperature: temp_dewPoint = 22.05 C}
volume_specific=**volume**(***AirH2O***,***P***=P,***T***=temp_dry,***R***=humidity_relative) {Specific Volume: volume_specific = 0.9051 m^3/kg}
humidity_specific=**humrat**(***AirH2O***,***P***=P,***T***=temp_dry,***R***=humidity_relative) {Specific Humidity: humidity_specific = 0.01672}

SOLUTION
Unit Settings: SI C kPa kJ mass deg

enthalpy = 81.17
$humidity_{specific}$ = 0.01672
$temp_{dewPoint}$ = 22.05
$temp_{wetBulb}$ = 26.27
$humidity_{relative}$ = 0.4
P = 101.3 [kPa]
$temp_{dry}$ = 38 [C]
$volume_{specific}$ = 0.9051

4 potential unit problems were detected.

{Probelm 3E}

```
$UNITS ENGLISH
P=1*convert(atm,psi)
temp_dry=80[F]
humidity_relative=0.60

humidity_absolute=humrat(AirH2O,P=P,T=temp_dry,R=humidity_relative) {Absolute Humidity: humidity_absolute = 0.01316 }
enthalpy=enthalpy(AirH2O,P=P,T=temp_dry,R=humidity_relative) {Enthalpy: enthalpy = 33.61 BTU/lb_m}
volume=volume(AirH2O,P=P,T=temp_dry,R=humidity_relative) {Specific Volume: volume = 13.89 ft^3/lm_m}
temp_wetBulb=wetbulb(AirH2O,P=P,T=temp_dry,R=humidity_relative) {Wetbulb Temperature: temp_wetBulb = 69.65F}
temp_dewPoint=dewpoint(AirH2O,P=P,T=temp_dry,R=humidity_relative) {Dewpoint Temperature: temp_dewPoint = 64.88 F}
```

SOLUTION

Unit Settings: Eng F psia mass deg

enthalpy = 33.61 [Btu/lb$_m$]	$humidity_{absolute}$ = 0.01316
$humidity_{relative}$ = 0.6	P = 14.7 [psi]
$temp_{dewPoint}$ = 64.88 [F]	$temp_{dry}$ = 80 [F]
$temp_{wetBulb}$ = 69.65 [F]	volume = 13.89 [ft^3/lb$_m$]

No unit problems were detected.

EES suggested units (shown in purple) for enthalpy temp_dewPoint temp_wetBulb volume .

{Problem 3E}

```
$UnitSystem ENGLISH
Vdot_air=100[ft^3/min]
T_1=80[F]
P=1*convert(atm,psi)
humidity_relative1=0.70
T_2=40[F]
T_3=60[F]

humidity_absolute1=humrat(AirH2O,P=P,T=T_1,R=humidity_relative1)
volume1=volume(AirH2O,P=P,T=T_1,R=humidity_relative1)
enthalpy1=enthalpy(AirH2O,P=P,T=T_1,R=humidity_relative1)

T_dewPoint1=dewpoint(AirH2O,P=P,T=T_1,R=humidity_relative1) {Dew Point in the Cold-Water Chiller: T_dewPoint1 = 69.34 F}
mdot_air=vdot_air/volume1 {Mass Flow Rate of the Air: mdot_air = 7.172 lb_m/min}

humidity_relative_condensate=1.0 {Humidity of WATER condensate is 1.0}
humidity_absolute_condensate=humrat(AirH2O,P=P,T=T_2,R=humidity_relative_condensate)
volume_condensate=volume(Water,P=P,T=T_2)
enthalpy_condensate=enthalpy(AirH2O,P=P,T=T_2,R=humidity_relative_condensate)

mdot_condensate=mdot_air*(humidity_absolute1-humidity_absolute_condensate) {Mass Flow Rate of Condensate: mdot_condensate = 0.07326 lb_m/min}
vdot_condensate=mdot_condensate*volume_condensate {Volumetric Flow Rate of Condensate: vdot_condensate = 0.001174 ft^3/min}

Qdot_chilledWaterCoil=mdot_air*(enthalpy1-enthalpy_condensate) {Rate of Heat Transfer to the Chilled Water Cooler: qdot_chilled = 149.8 BTU/min}
```

SOLUTION

Unit Settings: Eng F psia mass deg

enthalpy1 = 36.07 [Btu/lb$_m$]	$enthalpy_{condensate}$ = 15.19 [Btu/lb$_m$]
$humidity_{absolute1}$ = 0.0154	$humidity_{absolute,condensate}$ = 0.00519
$humidity_{relative1}$ = 0.7	$humidity_{relative,condensate}$ = 1
$mdot_{air}$ = 7.172 [lb$_m$/min]	$mdot_{condensate}$ = 0.07326 [lb$_m$/min]
P = 14.7 [psi]	$Qdot_{chilledWaterCoil}$ = 149.8 [Btu/min]
T_1 = 80 [F]	T_2 = 40 [F]
T_3 = 60 [F]	$T_{dewPoint1}$ = 69.34 [F]
$Vdot_{air}$ = 100 [ft^3/min]	$vdot_{condensate}$ = 0.001174 [ft^3/min]
volume1 = 13.94 [ft^3/lb$_m$]	$volume_{condensate}$ = 0.01602 [ft^3/lb$_m$]

No unit problems were detected.

EES suggested units (shown in purple) for enthalpy1 enthalpy_condensate mdot_air mdot_condensate Qdot_chilledWaterCoil T_dewPoint1

2/27/23	MAE 3524	William Van Dyke

a) ~~V = 600 CFM~~ $V_1 = 600$ cfm
~~$T_1 = 80F$ 70°F~~

① Dry Temp = 80F, Wet Bulb = 70F ⇒ $h_1 = 34$, $V_1 = 13.4$, ~~HR~~ rel. $v_1 = 60\%$, HR = .0135

$$\dot{m} = \frac{\dot{V}}{v} = \frac{600}{13.9} = 43.165$$

$$\dot{m}_{ODA} = 43.165 \frac{lbm}{min}$$

b) $\dot{V}_{RA} = 1200$

$$\dot{m} = \frac{\dot{V}}{v} = \frac{1200}{13.3} = 90.226 \frac{lbm}{min}$$

② WB = 50, HR = 0.0039, h = 20, v = 13.3

$$\dot{m}_{RA} = 90.226 \frac{lbm}{min}$$

c) $\dot{m}_m = 90.226 + 43.165 = 133.391 \frac{lbm}{min}$

$$h_m = \frac{34(43.165) + 26(96.226)}{133.391} = 24.53 \frac{BTU}{lbm}$$

WB = 56 °F
HR = 0.0074

d) DT = 50, WB = 45 ⇒ RH = 69%, h = 18 BTU/lbm, HR = 0.005

$\dot{m} = 133.391 \frac{lbm}{min}$

e) $\dot{Q}_{sens} = \dot{m}\Delta t = 133.391(18 - 24.53)\frac{60}{1} \Rightarrow \dot{Q}_{sens} = -52262 \frac{BTU}{hr}$

$\dot{Q}_{Latent} = 133.391(24.53 - 21)(\frac{60}{1}) \Rightarrow \dot{Q}_{Latent} = 28252 \frac{BTU}{hr}$

f) ~~$\dot{m}_{cond} = \dot{m}_m$ (133.3~~

$\dot{m}_{cond} = 133.391(0.0135 - 0.0039)$

$\dot{m}_{cond} = 76.834 \frac{lb}{hr}$

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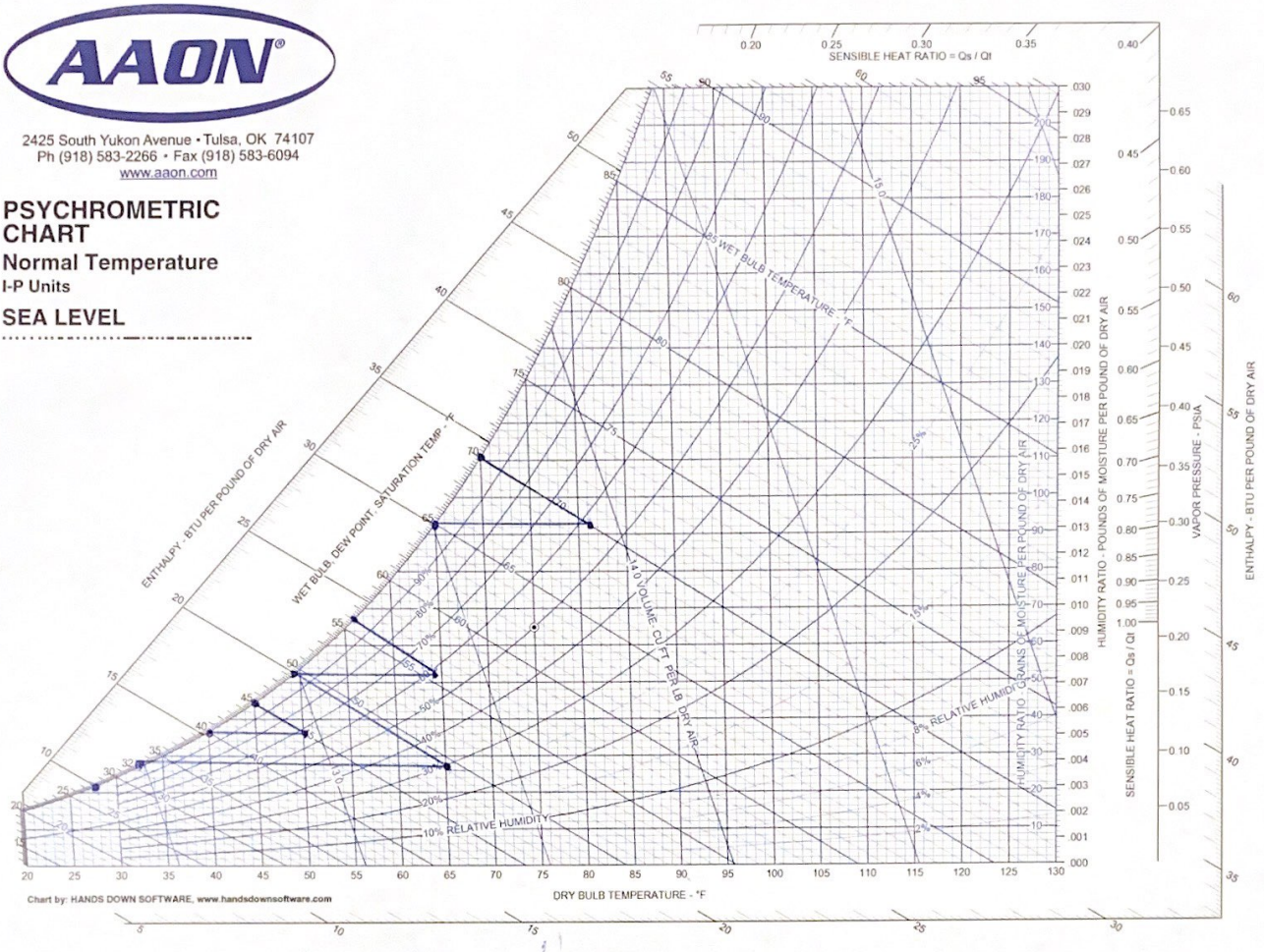
PSYCHROMETRIC CHART

Normal Temperature

I-P Units

SEA LEVEL



```
{Problem #5}

$UNITSYSTEM ENGLISH
P=14.696[psia]

{For Outdoor Air - ODA}
v_dot_oda=600[ft^3/min]
T_oda=80[F]
B_oda=70[F]
h_oda=enthalpy(AirH2O,P=P,T=T_oda,B=B_oda)
v_oda=volume(AirH2O,P=P,T=T_oda,B=B_oda)
R_oda=relhum(AirH2O,P=P,T=T_oda,B=B_oda)
HR_oda=humrat(AirH2O,P=P,T=T_oda,B=B_oda)
m_dot_oda=v_dot_oda/v_oda

{For Return Air - RA}
v_dot_ra=1200[ft^3/min]
T_ra=65[F]
B_ra=wetbulb(AirH2O,P=P,T=T_ra,R=R_ra)
h_ra=enthalpy(AirH2O,P=P,T=T_ra,R=R_ra)
v_ra=volume(AirH2O,P=P,T=T_ra,R=R_ra)
R_ra=0.30
HR_ra=humrat(AirH2O,P=P,T=T_ra,R=R_ra)
m_dot_ra=v_dot_ra/v_ra

{For Mixed Air - ma}
m_dot_ma=m_dot_oda+m_dot_ra
h_ma=(h_oda*m_dot_oda+h_ra*m_dot_ra)/m_dot_ma
HR_ma=((HR_oda*m_dot_oda+HR_ra*m_dot_ra)/m_dot_ma)
B_ma=wetbulb(AirH2O,P=P,h=h_ma,w=HR_ma)

{For Discharge Air - da}
T_da=50[F]
B_da=45[F]
h_da=enthalpy(AirH2O,P=P,T=T_da,B=B_da)
R_da=relhum(AirH2O,P=P,T=T_da,B=B_da)
HR_da=humrat(AirH2O,P=P,T=T_da,B=B_da)
m_dot_da=m_dot_ma

Q_dot_sens=m_dot_ma*(h_da-h_ma)/convert(min,hr)
Q_dot_latent=m_dot_ma*(h_ma-h_ra)/convert(min,hr)
m_dot_cond=m_dot_ma*(HR_oda-HR_ra)*convert(min,hr)
```

SOLUTION

Unit Settings: Eng F psia mass deg

B_{da} = 45 [F]	B_{ma} = 57.08 [F]
B_{oda} = 70 [F]	B_{ra} = 49.37 [F]
HR_{da} = 0.005175	HR_{ma} = 0.00699
HR_{oda} = 0.01343	HR_{ra} = 0.003906
h_{da} = 17.59 [Btu/lb$_m$]	h_{ma} = 24.39 [Btu/lb$_m$]
h_{oda} = 33.91 [Btu/lb$_m$]	h_{ra} = 19.84 [Btu/lb$_m$]
$\dot{m}_{cond}$ = 0.02117 [lb$_m$-hr/min^2]	$\dot{m}_{da}$ = 133.3 [lb$_m$/min]
$\dot{m}_{ma}$ = 133.3 [lb$_m$/min]	$\dot{m}_{oda}$ = 43.17 [lb$_m$/min]
$\dot{m}_{ra}$ = 90.16 [lb$_m$/min]	P = 14.7 [psia]
$\dot{Q}_{latent}$ = 36442 [Btu/hr]	$\dot{Q}_{sens}$ = -54437 [Btu/hr]
R_{da} = 0.6808	R_{oda} = 0.6123
R_{ra} = 0.3	T_{da} = 50 [F]
T_{oda} = 80 [F]	T_{ra} = 65 [F]
$\dot{v}_{oda}$ = 600 [ft^3/min]	$\dot{v}_{ra}$ = 1200 [ft^3/min]

v_{oda} = 13.9 [ft^3/lb_m] v_{ra} = 13.31 [ft^3/lb_m]

No unit problems were detected.
EES suggested units (shown in purple) for B_ma B_ra h_da h_ma h_oda h_ra .