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Mr. Joseph Bertrand, PMP MBA **Engineering Management**
BS Computer Science
BS Chemistry
Tennessee State University

Handbook of Chemistry and Physics
French Système International d'Unités

Sample calculations for applications in science and information technology

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PPM = Parts Per Million PPB = Parts Per Billion 1 PPM = 1000 PPB

1 ppm = 1 mg/L 2.2 lbs = 1 Kg 1 000 000 ug = 1 gram
1000 mg = 1 gram 1 ppb = 1 µg /L 3.79 Liter = US Gallon

1000 gram = 1 Kg 1000 ml = 1 Liter 1000 ug = 1 mg
5280 feet = 1 mile 1 cm = 2.54 inch mile = 1.15 Nautical mile

pH = pKa + Log [Base/ Acid] , pH + pOH = 14

Molarity = Moles / L , Liter = 0.265 US Gals
Mole = Atoms in 12 grams of Carbon - 12
= 6.02214076 × 10 E23 atoms
= Physicist Amedeo Avogadro (1811)

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Analysis for Hydrogen (L) @ STP - (H2)

Analysis Results

Analyzer #	Test/Units	Specs	Analysis Results	Limit of Detection
Organoleptic	Odor	None	None	
Note 1	PPM O2	<= 2.00	1.26	0.10
Note 1	PPM CO	<= 1.00	0.21	0.10
Lab	PPM CO2	<= 1.00	0.10	0.00
Batch	PPM H2O	<= 1.00	0.10	0.10
Lab	PPM THC	<= 1.00	0.10	0.10
Lab	PPM Nitrogen	<= 1.00	0.20	0.20
Assay Results (by difference)	Hydrogen Min %	≥ 99.0%	99.99980	

PPM O2 Method Used :
PPM CO Method Used : Note 1

Manufacturer/Model# :
Manufacturer/Model# : Note 1

Note 1 :

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Free with the purchase of scientific or engineering consultations.

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Hydrogen Thermodynamics

A joint venture among The State of Denmark and a Manhattan Energy Producer plus a Picardie Software Company bid to supply electricity in United States Virgin Islands as a reasonable rate near the current price in Denmark at 0.487$ per KwH.

The State , New York Producer , and The French Software Company plans to secure the energy using small scale nuclear reactions . If possible , portable plants might be employed on unhibited keys near St. Thomas, St. Croix , and St. John.

The French Software Company from Picardie was asked to calculate the revenues produces in 1 hour if one mole of 3/1 Hydrogen (Tritium) is combined with one mole of 2/1 Hydrogen (Deuterium) to produce 1 mole of Helium (He).

At - negative 320 F , The New York Energy Producer from Manhattan plans to use Nitrogen (N2) to immediately cool down the reactions if an emergency. Again, The Picardie Software Company was asked to calculate the cost to cool down the reactions using mole of Nitrogen (N2) if Nitrogen sells for $ 1.78 USDollars /L in Denmark.

Solution

The State , New York Producer , and The French Software Company purchased a certified copy of The Software JBertrandCalculer . Software JBertrandCalculer was also available as a consultant for business ,scientific and engineering concerns with this project in New York , France , Denmark , and US Virgin Islands .

Hydrogen Thermodynamics

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Estimated thermodynamics masses for Hydrogen , Helium , and Neutrons [1]

3/1 H Tritium = 3.02 gm / mol   2/1 H Deuterium = 2.01 gm / mol

4/1 H Helium = 4.00 gm / mol   1/0 N Neutron = 1.01 gm / mol

1 For use in small scale scientific and engineering research to produce only clean energy for small communities.

Energy = MC^2

Force = (Mass) (Acceleration) , Acceleration = Velocity ^2 , lbs = 453.59 gm
= Newton = 1 kg (m/s ^2) , lbs = 4.45 Newton = 32.2 ft/s^2
= Gravity = 9.8 m/s^2

Velocity = meter/s = 2.24 miles/ hour = 3.6 km/hr = 3.28 feet/ second
= miles /hr = 0.450 meters /second

C = Speed of light = 2.998 x 10 E10 cm/sec

Energy = MC^2 = Joules = Newton (meter)
= 1 BTU/ lbs = 2.32 Kilojoules / Kilogram
= 1 BTU = 1055 Joules = 252.16 Calories = 778.16 ft/lbs
= 4.184 Joules = 1 Calories

1 kilowatt hour = 3 600 000 Joules

Power = 1 Watt = Joules / second = 3.41 BTU / hour = 860.42 Cal/hr
= horsepower = 746 Watts = 550 ft.lbs/seconds = 2545 BTU/hr

Velocity = meter/s = 2.24 miles/ hour = 3.6 km/hr = 3.28 feet/ second
= miles /hr = 0.450 meters /second

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Energy = MC^2 = Joules = Newton (meter)
= 1 BTU/ lbs = 2.32 Kilojoules / Kilogram
= 1 BTU = 1055 Joules = 252.16 Calories = 778.16 ft/lbs
= 4.184 Joules = 1 Calories

Universal Gas Constant = 8.31 Joules/((gm) (mole)(K))

Power = 1 Watt = Joules / second = 3.41 BTU / hour = 860.42 Cal/hr
= horsepower = 746 Watts = 550 ft.lbs/seconds = 2545 BTU/hr

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Based on the volume of 1 US Gallon @ STP

LIQUID	SCF	LBS	Latent Heat BTU/LB	SCF/LB
Oxygen	115.10	9.527	91.7	12.08
Nitrogen	93.11	6.745	85.6	13.80
Argon	112.50	11.628	69.7	9.67
Hydrogen	113.66	0.592	192.7	191.99
Helium	100.87	1.043	8.8	96.71
Carbon Dioxide	74.03	8.470	113.0	8.74

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SOLUTION

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$${}^{3}_{1}H + {}^{2}_{1}H \longrightarrow {}^{4}_{2}HE + {}^{1}_{0}N$$

1 mole of ${}^{3}_{1}H$ + 1 mole of ${}^{2}_{1}H$ $\longrightarrow$ 1 mole of ${}^{4}_{2}HE$ + 1 mole of ${}^{1}_{0}N$

mass of mole = grams

1 mole ${}^{3}_{1}H$ = 3.02 grams/mole

1 mole ${}^{2}_{1}H$ = 2.01 grams/mole

1 mole ${}^{4}_{2}HE$ = 4.00 grams/mole

1 mole ${}^{1}_{0}$ = 1.01 grams/mole

$\left[{}^{3}_{1}H + {}^{2}_{1}H\right]$ = 5.03 grams/mole

$-\left[{}^{4}_{2}HE + {}^{1}_{0}N\right]$ = -5.01 grams/mole

$\left[{}^{3}_{1}H + {}^{2}_{1}H\right] - \left[{}^{4}_{2}HE + {}^{1}_{0}N\right]$ = $0.02 \frac{grams}{mole}$

5.03 grams - 5.01 grams = $0.02 \frac{grams}{mole}$

Decrease in mass = $0.02 \frac{grams}{mole}$

Decrease in mass = $0.02 \frac{grams}{mole}$

SOLUTION (con't)

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$X \frac{Kg}{mole} = 0.02 \frac{grams}{mole}$ = mass decrease

X Kg of decrease mass $= \left(\frac{\cancel{mole}}{1}\right)\left(\frac{0.02\ \cancel{grams}}{\cancel{mole}}\right)\left(\frac{1\ Kg}{1000\ \cancel{grams}}\right)$

M = X Kg of mass $= 2.00 * 10^{-5}$ Kg

$E = MC^2$ = (mass decrease)(speed of light)^2

$E = (2.00 * 10^{-5}\ Kg)(3.00 * 10^{8}\ M/S)^2$

$E = 1.08 * 10^{12}$ Joules

French SI Unit = Kilowatt Hour = 3600000 Joules

Unit Cost Code Denmark = Cost of Electricity in Denmark = 0.487 USD Kilowatt Hour

Revenue made if energy is produced and sold in one hour using hydrogen nuclear fusion

$X\ \$ = \left(\frac{0.487\ USD}{Kilowatt\ \cancel{Hour}}\right)\left(\frac{Kilowatt\ \cancel{Hour}}{3600000\ \cancel{Joules}}\right)\left(\frac{1.08 * 10^{12}\ \cancel{Joules}}{1}\right)$

X \$ = 243 500 USDollars per hour

X \$ = 243,500 USDollars per hour

SOLUTION (con't)

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-320F° = cool down with nitrogen (N_2)

-320F° = nitrogen (N_2)

-320F° = temperature

Price of (N_2) = 1.78 USDollars/Liter

STP Chart (Nitrogen in liquid form)

1 Gallon of Nitrogen (N_2) = 6.78 Lbs

Calculate the cost of a cool down of the nuclear reactions using only one mole of N_2 in liquid form at -320F°

$$X\$ = \left(\frac{1 \text{ mole } N_2}{1}\right)\left(\frac{28.02 \text{ grams}}{1 \text{ mole } N_2}\right)\left(\frac{Kg}{1000 \text{ grams}}\right)\left(\frac{2.2 \text{ lbs}}{1 \text{ Kg}}\right)\left(\frac{1 \text{ gal}}{6.75 \text{ lbs}}\right)\left(\frac{3.79 L}{1 \text{ gal}}\right)\left(\frac{1.78 \text{ USD}}{L}\right)$$

$$X\$ = \frac{(28.02)(2.2)(3.79)(1.78 \text{ USD})}{(1000)(6.75)}$$

$$X\$ = \frac{415.86 \text{ USD}}{6750}$$

$X\$$ = 0.062 USD per mole of Nitrogen (N_2)

Cost of a cool down = 0.062 USD per mole of nitrogen (N_2)

Cost of a cool down = 0.062 USD per mole of nitrogen (N_2)

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CALCULATION

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BEFORE: DRAFT

SOLUTION

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$${}^{3}_{1}H + {}^{2}_{1}H \longrightarrow {}^{4}_{2}HE + {}^{1}_{0}N$$

one line

1 mole + 1 mole $\longrightarrow$ 1 mole + 1 mole
of ${}^{3}_{1}H$ + of ${}^{2}_{1}H$ $\longrightarrow$ of ${}^{4}_{2}HE$ of ${}^{1}_{0}N$

MASS of mole = grams

1 mole ${}^{3}_{1}H$ = 3.02 grams/mole

1 mole ${}^{2}_{1}H$ = 2.01 grams/mole

1 mole ${}^{4}_{2}HE$ = 4.00 grams/mole

Replace

$\left[{}^{3}_{1}H + {}^{2}_{1}H\right]$ = 5.03 grams/mole

$-\left[{}^{4}_{2}HE + {}^{1}_{0}N\right]$ = -5.01 grams/mole

1 mole ${}^{1}_{0}$ = 1.01 grams/mole

$$\left[{}^{3}_{1}H + {}^{2}_{1}H\right] - \left[{}^{4}_{2}HE + {}^{1}_{0}N\right] = 0.02\ \frac{\text{grams}}{\text{mole}}$$

$$5.03\text{gm} - 5.01\text{gm} = 0.02\ \frac{\text{grams}}{\text{mole}}$$

4/7 **Decrease IN Mass = 0.02 grams/mole**

SOLUTION (CON'T)

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$X \frac{kg}{mole} = 0.02 \frac{grams}{mole}$ = MASS decrease

X kg of decrease mass = $\left(\frac{mole}{1}\right)\left(\frac{0.02\ gm}{mole}\right)\left(\frac{1\ kg}{1000\ gm}\right)$

remove

m = X kg of mass = $2.00 * 10^{-5}$ kg

$E = mc^2$ = (mass decrease) (speed of light)^2

$E = (2.00 \times 10^{-5}\ kg)(3.00 * 10^8 \ m/s)^2$

$E = 1.08 * 10^{12}$ Joules

2 lines between

French SI unit = kiloWATT HOUR = 3 600 000 Joules

NO BOX

Unit Cost Code Denmark = Cost of Electricity IN DenMark $= \frac{0.487\ \$\ US\ Dollars}{KiloWATT\ HOUR}$

and sold

Revenues produced if Produce Energy IN 1 hour USING Nuclear FUSION ~~on an unpopulated key~~

$X\$ = \frac{0.487\ US\ Dollars}{KiloWATT\ HOUR}\left(\frac{KiloWATT\ HR}{3\ 600\ 000\ Joules}\right)\left(\frac{1.08 \times 10^{12}\ Joules}{1}\right)$

X\$ = \$243 500 dollars US Dollars / per hour

SOLUTION (CON'T)

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−320F − Cool Down with Nitrogen (N_2)

At −320F Nitrogen (N_2)
Negative 320 F below zero = Temperature

PRICE of N_2 = $1.78 US DOLLAR / L

lbs per gallon of N_2 in liquard = STP chart

BASED ON 1 gallon = 6.75 lbs

Calculate cost of A cool down
For 1 mole of (N_2) Nitrogen

$$X\$ = \left(\frac{1\,mole\,N_2}{1}\right)\left(\frac{28.02\,gm}{1\,mole\,N_2}\right)\left(\frac{kg}{1000\,gm}\right)\left(\frac{2.2\,lbs}{1\,kg}\right)\left(\frac{1\,gal}{6.75\,lbs}\right)\left(\frac{3.79\,L}{1\,gal}\right)\left(\frac{\$1.78\,USD}{L}\right)$$

$$X\$ = \frac{(28.02)(2.2)(3.79)(1.78\ US\ Dollars)}{(1000)(6.75)}$$

$$X\$ = \frac{415.86\ USD}{6750}$$

X$ = 0.062 US Dollars per mole of N_2