

PHYS 1020 – Physics of Energy

Equation Sheet

Chapter 1: Introduction

$$N = N_0 + rt \quad N = N_0 e^{rt} \quad \text{Doubling time} = t_2 = \frac{\ln(2)}{r} \approx \frac{70 \text{ (unit of time)}}{\% \text{ growth rate}}$$

Chapter 2: Motion

$$\Delta x = x_f - x_i \quad \text{Speed} = \text{velocity} = \frac{\text{displacement}}{\text{time}} = \frac{\Delta x}{\Delta t} \quad \text{acceleration} = \frac{\text{change in velocity}}{\text{elapsed time}}$$

$$a = \frac{F_{\text{net}}}{m} \quad \text{or} \quad \text{Net Force} = \text{mass} \times \text{acceleration} \quad a_g = g = 32 \frac{\text{ft}}{\text{s}^2} = 9.8 \frac{\text{m}}{\text{s}^2}$$

Chapter 3: Energy

$$\text{Work} = \text{Force} \times \text{displacement} \quad W = \Delta(\text{KE} + \text{PE}) \quad W + Q = \Delta(\text{KE} + \text{PE} + \text{TE})$$

$$PE_G = \text{mass} \times g \times \text{height} \quad KE = \frac{1}{2} \text{mass} \times \text{velocity}^2 \quad \text{Power} = \frac{\text{work done}}{\text{time taken}} = \frac{\text{energy used}}{\text{time taken}}$$

$$1 \text{ watt} = \frac{1 \text{ joule}}{1 \text{ second}} \quad \text{Energy used} = \text{power} \times \text{time in use}$$

Chapter 4: Conservation of Energy

If the system is isolated (no outside influences), then

$$0 = \Delta E \quad \rightarrow \quad E_{\text{in}} = E_{\text{out}} \quad \rightarrow \quad KE_f + PE_f = KE_i + PE_i \quad (E = KE + PE + TE + \dots)$$

$$\text{Efficiency} = \frac{\text{useful energy or work output}}{\text{total energy input}} \times 100\% \quad \text{Overall efficiency} = \text{eff}_1 \times \text{eff}_2 \times \dots$$

Chapter 5: Heat and Work

1<sup>st</sup> Law of Thermodynamics:  $W + Q = \Delta E \quad Q_H = W + Q_C \quad \rightarrow \quad W = Q_H - Q_C$

$$Q = mc(T_f - T_i) \quad Q = mL$$

$$T^{\circ F} = \frac{9}{5} T^{\circ C} + 32 \quad T^{\circ C} = \frac{5}{9} (T^{\circ F} - 32) \quad T^K = T^{\circ C} + 273$$

$$\text{Eff} = \frac{Q_H - Q_C}{Q_H} \times 100\%$$

Maximum Efficiency:  $\text{Eff}_{\text{max}} = \left( \frac{T_H - T_C}{T_H} \right) \times 100\%$  ( $T$  is in  $K$ )

Chapter 6: Home Energy Conservation

$$\frac{Q}{t} = \frac{A(T_2 - T_1)}{R} \quad R = \frac{\text{thickness}}{\text{thermal conductivity}} \quad R_{\text{total}} = R_1 + R_2 + R_3 + \dots$$

Chapter 7: Solar Energy: Characteristics and Heating

$$v = \lambda f \quad \text{Intensity} = \frac{\text{Power}}{\text{Area}} \quad c = 3 \times 10^8 \text{ m/s}$$

## Chapter 11: Electricity

Charge of one electron:  $1.6 \times 10^{-19} C$

$$V = IR \quad P = IV \quad P_{loss} = I^2R$$

## Chapter 12: Electromagnetism and the Generation of Electricity

$$P_{in} = P_{out} \quad \frac{N_s}{N_p} = \frac{V_s}{V_p}$$

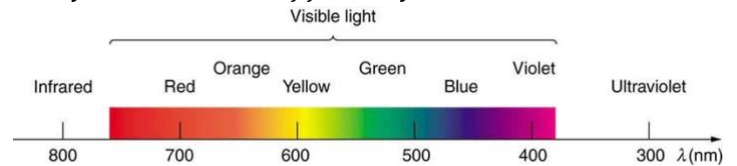
## Chapter 13: Electricity from Solar, Wind, and Hydro

$$v = \lambda f \quad E = hf = \frac{hc}{\lambda} \quad h = 6.626 \times 10^{-34} J \cdot s = 4.136 \times 10^{-15} eV \cdot s \quad c = 300,000,000 m/s$$

$$P = 0.000283 D^2 v^3 kW \quad (D \text{ in meters, } v \text{ in } \frac{m}{s}) = 0.00000236 D^2 v^3 kW \quad (D \text{ in ft, } v \text{ in mph})$$

$$PE = mgh \quad \text{Energy Density} = \frac{PE}{m} = gh$$

$$\text{Power Output} = \text{Energy Density} * \text{Flow Rate} * \text{efficiency}$$



## Chapter 15: The Atom and its Nucleus

$$1u = 1.66 \times 10^{-27} kg \quad E = mc^2 \quad c^2 = \left(3 \times 10^8 \frac{m}{s}\right)^2 = 931.494 \frac{MeV}{u}$$

$$N = N_0 e^{-rt} \quad \text{Half Life} = t_{1/2} = \frac{\ln(2)}{r}$$

1		Transition Metals										18																			
1 H 1.008	2 He 4.003	3 Li 6.941	4 Be 9.012	5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	11 Na 22.99	12 Mg 24.30	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95														
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80														
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.91)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3														
55 Cs 132.9	56 Ba 137.3	57 La (138.9)	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (144.9)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209.0)	85 At (210.0)	86 Rn (222.0)
87 Fr (223.0)	88 Ra (226.0)	103 Lr (262.1)	104 Rf (267)	105 Db (268)	106 Sg (271)	107 Bh (272)	108 Hs (270)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Cn (285)	113 ( )	114 ( )	115 ( )	116 ( )	117 ( )	118 ( )														
Lanthanides		57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (144.9)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0																
Actinides		89 Ac (227.0)	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237.0)	94 Pu (244.1)	95 Am (243.1)	96 Cm (247.1)	97 Bk (247.1)	98 Cf (251.1)	99 Es (252.1)	100 Fm (257.1)	101 Md (258.1)	102 No (259.1)																