_____ 1. Which is a renewable source of energy?

(a) Coal
(b) Ethanol
(c) Gasoline
(d) Natural gas
(e) Oil

_____ 2. Which data support the claim that human activity is contributing to global warming?

(a) Changes in atmospheric CO_2 concentration over the last 100 years versus over the last 200,000 years.
(b) Changes in temperature over the last 100 years versus that over the last 200,000 years.
(c) Decreasing amounts of polar ice.
(d) Rising sea level.
(e) None of these support the claim.

_____ 3. Calculate the energy, in joules, used to power a light bulb measured at 75 W continuously for a 24 hour period. [W = Watt, 1 W = 1 J/s]

(a) 6.5×10^6 J
(b) 2025 J
(c) 6480000 J
(d) 2.03×10^3 J
(e) 75 J

_____ 4. Ethanol, C_2H_5OH, can be used as a gasoline additive. How many moles of O_2 are required to burn 1 mole of ethanol?

(a) 0.065 mol
(b) 2.1 mol
(c) 3.0 mol
(d) 3.5 mol
(e) 6.0 mol

_____ 5. How many mL of O_2 measured at 752 mm Hg and 23.0°C are expected if 3.00 g of H_2O_2 are completely decomposed?

$$2\ H_2O_2(\ell) \rightarrow 2\ H_2O(\ell) + O_2(g)$$

(a) 1.08 mL
(b) 1.42 mL
(c) 84.1 mL
(d) 1080 mL
(e) 2.08×10^3 mL

_____ 6. A pair of students completing the laboratory during Week 4 found that an average of 0.3541 g of sodium carbonate (105.9888 g/mol) was required to react with 25.00 mL of HCl. Given the balanced chemical equation below, calculate the concentration of the HCl solution.

$$Na_2CO_3(s) + 2\ HCl\,(aq) \rightarrow 2\ NaCl(aq) + CO_2\,(g) + H_2O(\ell)$$

(a) 0.07068 M
(b) 0.08352 M
(c) 0.1336 M
(d) 0.2673 M
(e) 0.5346 M

_____ 7. Elemental phosphorus is made by heating calcium phosphate [$Ca_3(PO_4)_2$] with carbon and sand in an electric furnace. What is the weight percent of phosphorus in calcium phosphate?

(a) 9.98 %
(b) 14.4 %
(c) 20.0 %
(d) 25.4 %
(e) 32.5 %

_____ 8. What mass of $^{141}_{56}Ba$ is produced by the fission of 0.250 grams of $^{235}_{92}U$ according to the reaction:

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{92}_{36}Kr + {}^{141}_{56}Ba + 3\,{}^{1}_{0}n$$

(a) about 0.250 g
(b) about 0.150 g
(c) about 0.0979 g
(d) about 0.0595 g
(e) about 0.0383 g

_____ 9. When a neutron collides with ^{239}Pu, one reaction could result in production of ^{146}Ce, three neutrons and another nuclide. What is the other nuclide?

(a) $^{91}_{36}Kr$

(b) $^{91}_{74}W$

(c) $^{94}_{94}Pu$

(d) $^{93}_{36}Kr$

(e) $^{93}_{74}W$

_____ 10. What happens to the values of A (the mass number) and Z (the atomic number) of a nucleus as it undergoes positron emission?

(a) A and Z both increase
(b) A and Z both decrease
(c) A increases and Z decreases
(d) A stays the same, Z increases
(e) A stays the same, Z decreases

_____ 11. Calculate the binding energy in kJ/mole for $^{12}_{6}C$.

$^{12}_{6}C$ = 12.000000 amu
$^{1}_{1}H$ = 1.007825 amu
$^{1}_{0}n$ = 1.008665 amu

(a) $8.90\ 10^{12}$ kJ/mol
(b) 1.10×10^{12} kJ/mol
(c) 8.90×10^{11} kJ/mol
(d) 2.97×10^{1} kJ/mol
(e) 8.90×10^{9} kJ/mol

_____ 12. If 75% of a radionuclide has decayed after 30 days, then what is the half-life of the nuclide?

(a) 10 days
(b) 15 days
(c) 5 days
(d) 30 days
(e) 20 days

_____ 13. How many atoms of Americium-241 are contained in a smoke detector that contains 2.0×10^{-4} mg of Americium-241 when it is first made? [^{241}Am = 241.0047 amu]. This radionuclide decays via alpha emission and has a half life of 432.2 years.

(a) 2.5×10^{14} atoms
(b) 5.0×10^{14} atoms
(c) 5.0×10^{17} atoms
(d) 2.9×10^{22} atoms
(e) 6.02×10^{23} atoms

_____ 14. A patient was injected with 10.0 mg of F-18 labeled glucose for a PET scan. Fluorine-18 has a half-life of 110 minutes. How much time is required to reduce the radioactivity of F-18 to 1/16 of its original activity?

(a) 1760 minutes
(b) 6.3×10^{-3} minutes
(c) 1.01 minutes
(d) 69 minutes
(e) 440 minutes

_____ 15. Gallium-67 citrate is used as a radiopharmaceutical for diagnosing tumors and infections. What type of radioactive decay would you predict for this nuclide? The stable isotopes of gallium are Ga-69 and Ga-71.

(a) alpha emission
(b) beta emission
(c) electron capture
(d) neutron capture
(e) Cannot predict from given information

_____ 16. The decay of Rb-87 proceeds by beta emission as follows:

$$^{87}_{37}\text{Rb} \rightarrow {}^{87}_{38}\text{Sr} + {}^{0}_{-1}\beta$$

Rb-87 has a half life of 4.8×10^{10} years. If a fossil is found that contains 95.1% of the original amount of Rb-87, what is the age of the fossil?

(a) 3.5×10^{9} y
(b) 7.2×10^{-13} y
(c) 3.2×10^{11} y
(d) 6.6×10^{-11} y
(e) 4.6×10^{10} y

_____ 17. Control rods in a nuclear reactor moderate the reaction by:

(a) absorbing uranium.
(b) absorbing heat from the reaction to keep it at the proper temperature.
(c) absorbing neutrons.
(d) absorbing gamma rays.
(e) maintaining the proper level of "critical mass" by converting ^{235}U to ^{238}U.

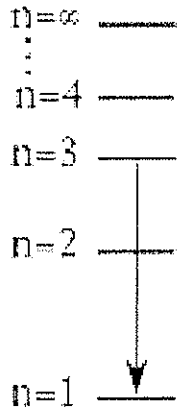
_____ 18. Compared to dim blue light, bright red light has:

(a) the same frequency and a lower amplitude.
(b) a higher frequency and a higher amplitude.
(c) a higher frequency and a lower amplitude.
(d) a lower frequency and a higher amplitude.
(e) a lower frequency and a lower amplitude.

_____ 19. What is the wavelength of the blue-violet light that has a frequency of 7.22×10^{14} Hz?

(a) 217 nm
(b) 4.20 nm
(c) 2.17×10^{23} nm
(d) 2.41×10^{6} nm
(e) 416 nm

_____ 20. One transition between energy states of the hydrogen atom as described by the Bohr model is represented by the picture on the left. Which describes the energy change and electron motion?



	Energy is …	**The electron moves …**
(a)	absorbed.	closer to the nucleus.
(b)	absorbed	further from the nucleus.
(c)	emitted.	closer to the nucleus.
(d)	emitted.	further from the nucleus.

END of EXAM

USEFUL INFORMATION

$K = 273.15 + °C$

$PV = nRT$

$E = h\upsilon = \frac{hc}{\lambda}$

$\Delta E = \Delta mc^2$

$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$\frac{dN}{dt} = k[N]$

$\ln\left(\frac{N_0}{N_t}\right) = kt$

$k\,t_{1/2} = \ln 2$

$1\ ft^3 = 28.32\ L$

$R = 8.206 \times 10^{-2}\ L{\cdot}atm/(mol{\cdot}K)$

$c = 3.00 \times 10^8\ m/s$

$1\ amu = 1.661 \times 10^{-27}\ kg$

$h = 6.63 \times 10^{-34}\ J{\cdot}s$

$1\ amu = 931.5\ MeV$

$1\ MeV = 6.602 \times 10^{-13}\ J$

R_H (Rydberg constant) $= 1.096776 \times 10^7\ m^{-1}$

$1\ J = 1\ kg{\cdot}m^2/s^2$

$1\ atm = 760\ mm\ Hg$ (exactly)

Periodic Table of the Elements

1A (1)												3A (13)	4A (14)	5A (15)	6A (16)	7A (17)	8A (18)
1 H 1.008	2A (2)																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 24.31	3B (3)	4B (4)	5B (5)	6B (6)	7B (7)	(8)	- 8B - (9)	(10)	1B (11)	2B (12)	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 (98)	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	72 Hf 178.5	73 Ta 180.9	74 W 183.9	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)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (285)				

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	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
90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

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