T M S C A H I G H S C H O O L

S C I E N C E

T E S T # 1 ©

O C T O B E R 2 1, 2 0 1 7

GENERAL DIRECTIONS

1. DO NOT OPEN EXAM UNTIL TOLD TO DO SO.
2. You will be given 120 minutes to take this test.
2. All answers must be written on the answer sheet/Scantron form/Chatsworth card provided. If you are using an answer sheet, be sure to use **CAPITAL BLOCK PRINTED LETTERS**.
3. If using a Scantron answer form, be sure to correctly denote the number of problems not attempted.
4. You may write anywhere on the test itself. You must write only answers on the answer sheet.
5. You may use additional scratch paper provided by the contest director.
6. All problems have **ONE** and **ONLY ONE** correct (BEST) answer. There is a penalty for all incorrect answers.
7. On the back of this page is a copy of the periodic table of the elements as well as a list of some potentially useful information in answering the questions. Other scientific relationships are listed also.
8. The following is a list of UIL approved calculators for this test:
   - **Casio FX-260 Solar**
   - **Sharp EL-501X**
   - **TI-30Xa**

   Only the models listed above are allowed during the contest. <u>NO GRAPHING CALCULATORS</u>.
9. All problems answered correctly are worth **SIX** points. **TWO** points will be deducted for all problems answered incorrectly. No points will be added or subtracted for problems not answered.
10. In case of ties, percent accuracy will be used as a tie breaker.
11. If a question is omitted, no points are given or subtracted.

B01. Nonnative rabbits were introduced to Australia in the late 1700's, where they found abundant resources and favorable environmental conditions. Choose the scenario below that is the most likely ecological outcome.

A) Some native insects will develop a new phenotype helping them hide from rabbits.
B) Increased erosion due to the loss of vegetation eaten by the rabbits
C) Non-random mating will cause the population to reach Hardy-Weinberg equilibrium
D) Plant species diversity will increase
E) The introduced rabbits will turn cannibalistic when other food runs out

B02. Which of the following best explains the process of hydrolysis?

A) An increase in plasma membrane aquaporins causes a cell to swell and explode
B) A plant cell exposed to a hypertonic solution has it's cell membrane pull away from the cell wall
C) The breakdown of macromolecules by the enzymatic addition of water.
D) Programmed cell death

B03. Which of the following cellular organelles would be most important in the recycling of older organelles?

A) peroxisome
B) lysosome
C) Golgi apparatus
D) nucleolus
E) ribosome

B04. Which functional group is always found on the three prime end of nucleic acids?

A) amino
B) phosphate
C) carboxyl
D) carbonyl
E) hydroxyl

B05. If sucrase is in a solution saturated with sucrose, then what would be the most effective way a biologist could increase the speed of product formation?

A) Adding more enzyme
B) Heating the solution to 100°C
C) Adding more sugar
D) Addition of an allosteric inhibitor
E) Addition of a noncompetitive inhibitor

B06. What is the oxidizing agent in the following reaction:

$CH_4 + 2O_2 \rightarrow CO_2 + \text{energy} + 2H_2O$

A) CH_4
B) $2O_2$
C) CO_2
D) $2H_2O$
E) energy

B07. Which of the following is the correct order in protein synthesis beginning with transcription?

A) RNA → DNA → protein
B) DNA → protein → DNA
C) protein → DNA → RNA
D) DNA → RNA → protein
E) protein → RNA → DNA

B08. If a female salamander is heterozygous for eye color and produces hundreds of offspring with the same male and 25% show the recessive eye color. What is the phenotype of the male?

A) heterozygous
B) homozygous
C) normal eye color
D) recessive eye color
E) impossible to determine

B09. A biologist from Texas A&M is studying a bird species in Costa Rica. They have been measuring the length of the beaks in a population for many years. Over the past three years they have noticed a decrease in beak length and an increase in beak height. Which of the following scenarios would most likely be responsible for this change in beak shape of the population?

A) A brood parasite has recently infiltrated the population
B) Genetic drift, as the population has grown too large
C) A drought has recently ended and the birds are now feeding lower in the canopy
D) An increase in carbon dioxide in the atmosphere is causing the production of harder shelled nuts in the forest
E) An introduced fungus has killed off most of the plants that produce the fruit this species depends on

B10. Which of the following is the most primitive invertebrate?

A) sponge
B) jellyfish
C) starfish
D) snail
E) crayfish

B11. Which of the following floral organs helps enclose and protect unopened floral buds.

A) pedals
B) sepals
C) carpel
D) stigma
E) stamen

B12. Which of the following would be found in a dandelion but not a fungus?

A) cell wall
B) ribosome
C) mitochondrion
D) chloroplast
E) cytoskeleton

B13. Choose the organ system that includes the pharynx, liver and pancreas.

A) digestive
B) circulatory
C) lymphatic
D) excretory
E) endocrine

B14. Which vitamin would a veterinarian most likely suggest adding to a pets diet if the pet is having trouble with its eyes?

A) vitamin C
B) vitamin B
C) vitamin A
D) vitamin E
E) vitamin K

B15. Which of the following would **NOT** be a component of the innate immunity of vertebrates?

A) histamine
B) macrophages
C) neutrophils
D) B cells
E) natural killer cells

B16. During which phase of the cell cycle is DNA replicated?

A) prophase
B) metaphase
C) anaphase
D) telophase
E) interphase

B17. Choose the biological process that produces pyruvate as the final product.

A) cellular respiration
B) fermentation
C) glycolysis
D) Krebs cycle
E) chemiosmosis

B18. Which of the following would most likely denature an enzyme that is found in the human stomach?

A) maintaining at 37°C
B) maintaining at a low pH
C) maintaining at a high pH
D) providing no substrate
E) providing ample substrate

B19. Which part of the cytoskeleton is composed of actin?

A) cilia
B) flagella
C) microtubules
D) microfilaments
E) intermediate filaments

B20. Which polysaccharide is used as storage in the vertebrate liver?

A) cellulose
B) glycogen
C) cellulose
D) chitin
E) polypeptide

C01. Robert needs 0.872 moles of lead (IV) acetate. How many grams of lead (IV) acetate does Robert need?
A) 231 g
B) 284 g
C) 312 g
D) 386 g
E) 441 g

C02. Which of the following is a strong acid?
A) HF
B) H_2SO_3
C) HClO
D) HBr
E) HCN

C03. How many sodium atoms are there in 12.7 g of Na_2SO_4?
A) 1.08×10^{23}
B) 3.02×10^{24}
C) 4.21×10^{23}
D) 6.11×10^{24}
E) 5.38×10^{22}

C04. What is the molecular geometry of PCl_3?
A) tetrahedral
B) trigonal pyramid
C) irregular tetrahedral
D) trigonal planar
E) T-shape

C05. A sealed, rigid container is pressurized to 12.6 atm at a temperature of 25.0°C. The container is then placed into a freezer at −25.0°C. What is the pressure inside the container at the new temperature?
A) 6.3 atm
B) 25.2 atm
C) 3.2 atm
D) 18.9 atm
E) 10.5 atm

C06. A block of ice measures 18.9 cm × 10.2 cm × 13.5 cm is removed from a freezer at −25.0°C. How much heat is required to melt this block of ice?
A) 797 kJ
B) 687 kJ
C) 1060 kJ
D) 869 kJ
E) 982 kJ

C07. What is the electron configuration of the strontium ion?
A) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^6$
B) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}4p^4 5s^2$
C) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^6 5s^2$
D) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^8\,4p^6 5s^2$
E) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^8\,4p^6$

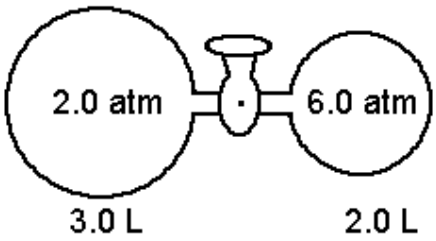
C08. According to the following equation, how many grams of $AlCl_3(s)$ could be produced from 27.4 grams of $Cl_2(g)$?

$$2\ Al(s) + 3\ Cl_2(g) \rightarrow 2\ AlCl_3(s)$$

A) 18.3 g
B) 24.0 g
C) 34.4 g
D) 133.4 g
E) 46.1 g

C09. Which of the following molecules is polar?
A) N_2
B) CCl_4
C) HCl
D) Cl_2
E) CO_2

C10. The valve between the two flasks containing He(g) in the figure below is closed.



What is the pressure inside the system once the valve is opened?

A) 2.4 atm
B) 4.0 atm
C) 3.6 atm
D) 8.0 atm
E) 6.2 atm

C11. You have 250. mL of a saturated solution of PbF_2. All of the water evaporates. How many grams of solid PbF_2 are left?

A) 0.089 g
B) 0.12 g
C) 0.32 g
D) 0.49 g
E) 0.63 g

C12. The wavelength of red light is 760 nm. What is the frequency of this wavelength of light?

A) 8.3×10^{11} Hz
B) 3.9×10^{11} Hz
C) 6.2×10^{12} Hz
D) 6.2×10^{13} Hz
E) 3.9×10^{14} Hz

C13. How much heat is produced when 12.5 grams of $C_3H_8(g)$ is combusted completely under standard conditions?

A) 893 kJ
B) 1350 kJ
C) 1620 kJ
D) 631 kJ
E) 2220 kJ

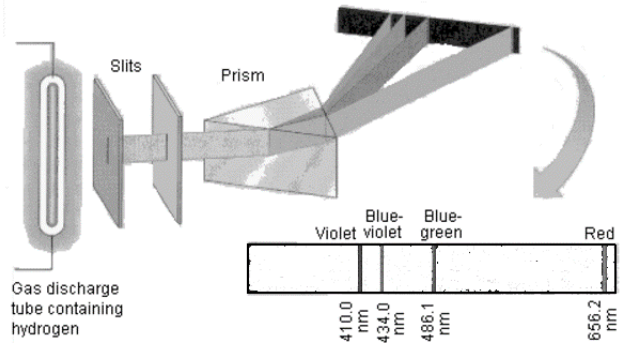
C14. Which of the following is <u>NOT</u> true about most ionic compounds?

A) soluble in water
B) conducts electricity when melted
C) high melting point
D) aqueous solutions conduct electricity
E) conducts electricity as solid

C15. Which of the following molecules exhibits hydrogen bonding?

A) CH_4
B) CH_3Cl
C) CH_3F
D) CH_3Br
E) CH_3OH

C16. When the light emitted from a hydrogen discharge tube is passed through a slit and a prism, the light emitted is seen as discrete wavelengths



What's the best explanation for this observation?

A) The slits used in the apparatus allow only certain wavelengths of light through to the prism.
B) The energy of electrons are quantized so as electrons jump energy levels, the emission lines are discrete.
C) The prism used absorbs various wavelengths of light and only allows certain wavelengths of light through.
D) There our isotopes of hydrogen and those four isotopes are responsible for the four wavelengths of light.

C17. Which of the following reactions has the greatest (most positive) ΔS?

A) $Pb(s) + O_2(g) \rightarrow PbO_2(s)$
B) $2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(l)$
C) $2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$
D) $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

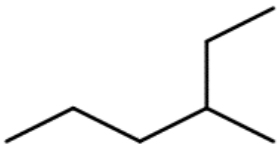
C18. Iodine-131 is an important radioactive isotope used in treatment of Graves disease and nuclear imaging. The half-life of I-131 is 8.02 days. How long will it take for 81.2% of a sample of I-131 to decay?

A) 18.1 days
B) 19.3 days
C) 20.4 days
D) 21.2 days
E) 22.6 days

C19. Under the same conditions, a gas diffuses half as fast as He. What could be the formula of this gas?

A) H_2
B) CH_4
C) SO_2
D) N_2
E) He_2

C20. What is the chemical formula of the following compound?



A) C_7H1_6
B) C_7H_{18}
C) C_7H_{14}
D) C_6H_{14}
E) C_6H_{12}
F) C_6H_{16}

P1. According to Neil deGrasse Tyson, Einstein's general theory of relativity, put forth in _____, gives us our modern understanding of gravity.
A) 1896
B) 1916
C) 1936
D) 1956
E) 1976

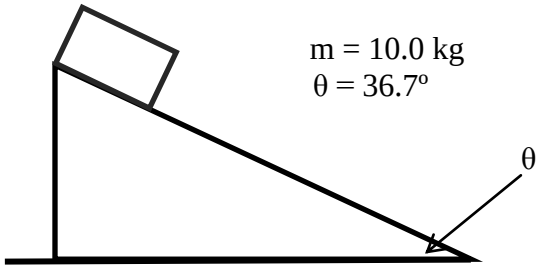
P2. According to Neil deGrasse Tyson, if you insert low mass and low speeds into Einstein's equations they mathematically become the equations of _____.
A) Christiaan Huygens
B) Galileo Galilee
C) Ernest Rutherford
D) Isaac Newton
E) J.J. Thomson

P3. According to Neil deGrasse Tyson, the precisely measured temperature of the cosmic microwave background is ____ degrees Kelvin.
A) 2.725
B) 6.052
C) 9.995
D) 14.117
E) 18.291

P4. The Milky Way is surrounded by more than 20 dwarf galaxies; the largest among them are the Large and Small _____ Clouds, named after the famous explorer.
A) Balboic
B) Vespuccic
C) Magellanic
D) Cortesic
E) Pizarric

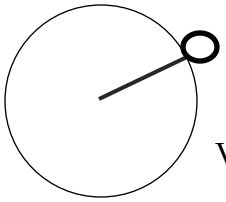
P5. The SI base unit for length is the _____.
A) millimeter
B) centimeter
C) meter
D) hectometer
E) kilometer

P6. Joe stands on the roof of the Pampa State Bank and drops a baseball, which falls to the ground. If the ball is released from a height of 38.7 m, how long does it take the ball to reach the ground?
A) 3.37 s
B) 3.23 s
C) 3.09 s
D) 2.95 s
E) 2.81 s



P7. A wooden block is placed at the top of an inclined plane and released. The block travels 4.88 m down the frictionless surface to the bottom of the inclined plane. How fast is the block traveling just as it reaches the bottom?
A) 6.56 m/s
B) 6.89 m/s
C) 7.22 m/s
D) 7.56 m/s
E) 7.89 m/s

P8. The spring of a dart gun has a spring constant of 325 N/m. A 125-g dart is pressed against the spring, compressing the spring 5.84 cm. The dart gun is held horizontally, the trigger is pulled, the spring is released, and the dart detaches from the spring. What speed does the dart acquire?
A) 2.75 m/s
B) 2.98 m/s
C) 3.21 m/s
D) 3.43 m/s
E) 3.66 m/s



View from above

P9. Find the amount of force that a person must exert on a string attached to a 175-g ball to make the ball revolve in a horizontal circle of radius 75.2 cm and at a rotational speed of 2.25 revolutions per second.
A) 23.6 N
B) 24.5 N
C) 25.4 N
D) 26.3 N
E) 27.2 N

P10. A long wire is stretched between two poles. The 125-m-long wire has a mass of 20.0 kg and it is under a tension of 1200 N. If a pulse sends a wave down the wire, find the speed at which the wave travels.
A) 86.6 m/s
B) 97.7 m/s
C) 109 m/s
D) 120 m/s
E) 131 m/s

P11. Ava lives in Valley View where the surface of the city water storage tank is 28.3 m above the water faucet in her kitchen. Find the water pressure at her faucet.
A) 244 kPa
B) 277 kPa
C) 310 kPa
D) 343 kPa
E) 376 kPa

P12. Eric has a circuit with four resistors connected in parallel. Their respective resistances are 6.00 Ω, 9.00 Ω, 12.0 Ω and 15.0 Ω. If he connects this arrangement to a 24.0-V battery, what is the current that flows through the 12.0-Ω resistor?
A) 1.52 A
B) 1.64 A
C) 1.76 A
D) 1.88 A
E) 2.00 A

P13. A particle with a charge of 12.0 μC is located on the x-axis at x = 4.49 cm. A second particle with a charge of −18.0 μC is located on the x-axis at x = 5.12 cm. A third particle with a charge of 15.0 μC is located at the origin. Find the magnitude of the net electrostatic force exerted on the charged particle located at the origin.
A) 8.77 N
B) 35.2 N
C) 123 N
D) 9020 N
E) 44500 N

P14. A vertical electric wire carries a dc current of 60.0 A downward. Find the strength of the magnetic field at a point 6.29 cm due south of the wire.
A) 191 μT
B) 8.85 mT
C) 65.2 mT
D) 466 mT
E) 1.04 T

P15. An Air Force jet plane is flying at a speed of 304 m/s in a region where the Earth's magnetic field is almost vertical. The magnitude of the field is 5.17×10^{-5} T. The distance between the wing tips is 44.8 m. Find the potential difference between the wing tips.
A) 1.52 V
B) 1.32 V
C) 1.11 V
D) 0.908 V
E) 0.704 V

P16. A 1.50-in-tall candle is positioned 22.0 cm from a converging lens. The focal length of the lens is 16.0 cm. How far is the image from the lens?
A) 53.5 cm
B) 58.7 cm
C) 63.9 cm
D) 69.1 cm
E) 74.3 cm

P17. Find the energy of a photon of red light with a wavelength of 622 nm.
A) 1.20 eV
B) 1.43 eV
C) 1.66 eV
D) 1.99 eV
E) 2.22 eV

P18. A quark configuration of uud will produce a/an _____.
A) proton
B) neutron
C) electron
D) alpha particle
E) beta particle

P19. Planet X has three times the radius and 6 times the mass of Earth. Find the acceleration of gravity at the surface of Planet X.
A) 3.27 m/s^2
B) 4.90 m/s^2
C) 6.53 m/s^2
D) 9.80 m/s^2
E) 19.6 m/s^2

P20. A 12.0-V battery, a switch, a 36.0-Ω resistor and a 120-mF capacitor are connected in series. The switch is initially open and the capacitor is uncharged. At t = 0, the switch is closed. What is the current in the circuit at t = 1.60 s?
A) 0.305 A
B) 0.280 A
C) 0.255 A
D) 0.230 A
E) 0.205 A

17-18 TMSCA HSSC Test #1

Chemistry

1A 1												3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
1 H 1.01	2A 2																2 He 4.00
3 Li 6.94	4 Be 9.01											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	8B 8	8B 9	8B 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 47.87	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 65.38	31 Ga 69.72	32 Ge 72.64	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 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.9	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	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 (264)	108 Hs (277)	109 Mt (268)	110 Ds (281)	111 Rg (281)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (289)	116 Lv (293)	117 Ts (293)	118 Og (294)

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 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	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 (262)

Constants

R = 0.08206 L·atm/mol·K
R = 8.314 J/mol·K
R = 62.36 L·torr/mol·K
e = 1.602×10^{-19} C
N_A = 6.022×10^{23} mol^{-1}
k = 1.38×10^{-23} J/K
h = 6.626×10^{-34} J·s
c = 3.00×10^{8} m/s
$\mathcal{R}$ = 2.178×10^{-18} J
m_e = 9.11×10^{-31} kg

Water data

T_{mp} = 0°C
T_{bp} = 100°C
C_{ice} = 2.09 J/g K
C_{water} = 4.184 J/g K
C_{steam} = 2.03 J/g K
ΔH_{fus} = 334 J/g
ΔH_{vap} = 2260 J/g
K_f = 1.86 °C/m
K_b = 0.512 °C/m

Densities

ρair,dry = 0.001184 g/mL
ρwater = 1.00 g/mL
ρice = 0.917 g/mL
ρFe = 7.87 g/mL
ρAu = 19.3 g/mL
ρHg = 13.6 g/mL

Standard Thermodynamic Data

substance	ΔH_f^o (kJ/mol)	$S°$ (kJ/mol)
CO_2 (g)	−394	214
CO (g)	−111	198
CH_4 (g)	−75	186
C_3H_8 (g)	−104	270
$COCl_2$ (g)	−220	284
H_2O (l)	−286	70
H_2O (g)	−242	189

Conversions

1 atm = 760 torr
= 101325 Pa
= 14.7 psi
1 bar = 105 Pa
1 cal = 4.184 J
1 L·atm = 101.325 J
1 eV = 1.602×10^{-19} J
1 lb = 453.6 g
1 ton = 2000 lbs
1 tonne = 1000 kg
1 in = 2.54 cm

Some equilibrium constants

water K_w = 1.0×10^{-14}
PbF_2 K_{sp} = 3.3×10^{-8}
CH_3CO_2H K_a = 1.8×10^{-5}
CH_3NH_2 K_b = 4.4×10^{-4}

PHYSICS

Useful Constants

quantity	**symbol**	**value**
Free-fall acceleration	g	9.80 m/s^2
Coulomb constant	k	8.99×10^9 $N \cdot m^2/C^2$
Electron mass	m_e	9.11×10^{-31} kg
Fundamental charge	e	1.602×10^{-19} C
Speed of light in a vacuum	*c*	3.00×10^8 m/s
Density of water	ρ	1000 kg/m^3
Permeability of free space	μ_0	$4\pi \times 10^{-7}$ T·m/A
Planck's constant	h	6.626×10^{-34} J·s
Gravitational constant	G	6.67×10^{-11} $N \cdot m^2/kg^2$

2017-2018 TMSCA HSSC Test #1 Key

Biology	**Chemistry**	Physics
B01. B	C01. D	P1. B
B02. C	C02. D	P2. D
B03. B	C03. A	P3. A
B04. E	C04. B	P4. C
B05. A	C05. E	P5. C
B06. B	C06. A	P6. E
B07. D	C07. A	P7. D
B08. C	C08. C	P8. B
B09. E	C09. C	P9. D
B10. A	C10. C	P10. A
B11. B	C11. B	P11. B
B12. D	C12. E	P12. E
B13. A	C13. D	P13. C
B14. C	C14. E	P14. A
B15. D	C15. E	P15. E
B16. E	C16. B	P16. B
B17. C	C17. C	P17. D
B18. C	C18. B	P18. A
B19. D	C19. B	P19. C
B20. B	C20. A	P20. D

SELECTED SOLUTIONS

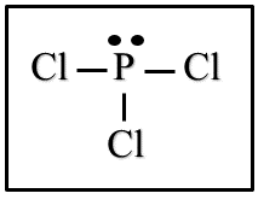
C01. (D) lead (IV) acetate = $Pb(C_2H_3O_2)_4$ = 443.2 g/mol
0.872 mol × 443.2 g/mol = 386 g

C02. (D) The strong acids are HCl, HBr, HI, HNO_3, H_2SO_4, $HClO_3$ and $HClO_4$

C03. (A) Na_2SO_4 = 142 g/mol

$$12.7\ g\ Na_2SO_4 \times \frac{1\ mol\ Na_2SO_4}{142\ g} \times \frac{2\ mol\ Na}{1\ mol\ Na_2SO_4} \times \frac{6.02\times10^{23}\ atoms\ Na}{1\ mol\ Na} = 1.08\times10^{23} atoms$$

C04. (B)



The central atom has 4 domains and 1 lone pair of electrons, so the molecular geometry is trigonal pyramid.

C05. (E) $\frac{12.6\ atm}{298\ K} = \frac{P_2}{248\ K}$ P_2 = 10.5 7atm

C06. (A) $18.9\ cm \times 10.2\ cm \times 13.5\ cm \times \frac{0.917 g}{1\ cm^3} \times \frac{334\ J}{1\ g} \times \frac{1\ kJ}{1000 J} = 797 kJ$

C07. (A) Sr atom loses its 2 valence electrons in the 5s subshell to produce the Sr^{2+} ion.

C08. (C) $27.4\ g\ Cl_2 \times \frac{1\ mol\ Cl_2}{70.9\ g\ Cl_2} \times \frac{2\ mol\ AlCl_3}{3\ mol\ Cl_2} \times \frac{133.4\ g\ AlCl_3}{1\ mol\ AlCl_3} = 34.4\ g\ AlCl_3$

C09. (C) The H – Cl bond is polar and the molecule is asymmetrical so the molecule is polar.

C10. (C) After valve is open, V = 5.0 L
After opening valve, using Boyles Law, gas in left flask: $P_2 = \frac{2.0\ atm \times 3.0\ L}{5.0\ L} = 1.2\ atm$
Gas in right flask: $P_2 = \frac{6.0\ atm \times 2.0\ L}{5.0\ L} = 2.4\ atm$
P_T = 1.2 atm + 2.4 atm = 3.6 atm

C11. (B) $K_{sp} = [Pb^{2+}][F^-]^2 = (x)(2x)^2 = 4x^3 = 3.3\times10^{-8}$
x = $[Pb^{2+}]$ = 0.0020 M,

$$\frac{0.0020\ mol Pb^{2+}}{1\ L} \times 0.250\ L \times \frac{1\ mol\ PbF_2}{1\ mol\ Pb^{2+}} \times \frac{245.2\ g\ PbF_2}{1\ mol\ PbF_2} = 0.12\ g\ PbF_2$$

C12. (E) $760\ nm \times \frac{1\ m}{10^9\ nm} = 7.6\times10^{-7} m$; $f = \frac{3.0\times10^8\ m/s}{7.6\times10^{-7}\ m} = 3.9\times10^{14} Hz$

C13. (D) $C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(l)$
ΔH = 3(−294 kJ/mol) + 4(−286 kJ/mol) – 1(−104 kJ/mol) = −2222 kJ per mole of C_3H_8

$$12.5\ g \times \frac{1\ mol}{44\ g\ C_3H_8} \times \frac{-2222\ kJ}{1\ mol\ C_3H_8} = -631\ kJ$$

C14. (E) Ionic compounds conduct electricity in solution or when melted, but not as solids.

C15. (E) The O−H bond in CH_3OH is highly polar and the H is capable of forming hydrogen bonds With the O atom in another molecule.

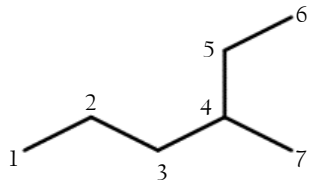
C16. (B) The Bohr model of the atom explains the emission spectrum based on quantized energies of electrons.

C17. (C) Change of entropy (ΔS) increases the most when solids forms gases.

C18. (B) $A_t = A_o(t_{1/2})(0.5)^t$ $0.188 = 1(8.02\ days)(0.5)^t$ t = 19.3 days

C19. (B) $\frac{Rate\ X}{Rate\ He} = \frac{1}{2} = \sqrt{\frac{4\ g/mol}{x}}$ *x = 16 g/mol*

C20. (A)



The alkane has 7 carbons. For alkanes, the number of H = 2 × (# of C) + 2

17-18 TMSC HSSC TEST 1

SELECTED SOLUTIONS

P1-P3 Astrophysics for People in a Hurry; Neil deGrasse Tyson; W. W. Norton & Company; 2017

P1. page 18 P2. page 44 P3. page 52

P4. 21st Century Astronomy; Kay, Palen, Smith, Blumenthal; W.W. Norton & Company; 2013; pages 658

P6. $y = y_0 + v_0 t + .5at^2$

$0 = 38.7 + 0 + .5(-9.8)t^2$

$t = 2.81$ s

P7. $\sum F = ma$

$F_p = ma$

$mg\sin\theta = ma$

$a = g\sin\theta$

$v^2 = v_0^2 + 2a(x - x_0)$

$v = \sqrt{0 + 2(9.8\sin 36.7°)(4.88)}$

$v = 7.56$ m/s

P8. $U + K = U + K$

$.5kx^2 + 0 = 0 + .5mv^2$

$v = \sqrt{\frac{kx^2}{m}} = \sqrt{\frac{325(.0584)^2}{.125}}$

$v = 2.98$ m/s

$\omega = 2.25(2\pi) = 4.5\pi$

$v = \omega r = 4.5\pi(.752)$

$v = 10.63$

P9. $F_c = \frac{mv^2}{r}$

$F_c = \frac{(.175)(10.63)^2}{.752}$

$F_c = 26.3$ N

P10. $v = \sqrt{\frac{T}{\left(\frac{m}{L}\right)}} = \sqrt{\frac{1200}{\left(\frac{20}{125}\right)}}$

$v = 86.6$ m/s

P11. $P = \rho gh$

$P = 1000(9.8)(28.3)$

$P = 277{,}000$ Pa

P12. $V = IR$

$I = \frac{V}{R} = \frac{24}{12}$

$V = 2.00$ V

$F = \frac{kQ_1Q_2}{r^2}$

$F_1 = \frac{\left(8.99x10^9\right)\left(12x10^{-6}\right)\left(15x10^{-6}\right)}{(.0449)^2}$

P13. $F_1 = 802.67$ N, left

$F_2 = \frac{\left(8.99x10^9\right)\left(18x10^{-6}\right)\left(15x10^{-6}\right)}{(.0512)^2}$

$F_2 = 925.94$ N, right

$F_2 - F_1 = 123$ N, right

$B = \frac{\mu_0}{2\pi} \cdot \frac{I}{r}$

P14. $B = \left(2x10^{-7}\right)\frac{60}{.0629}$

$B = .000191$ T

$\xi = BLv$

P15. $\xi = \left(5.17x10^{-5}\right)(44.8)(304)$

$\xi = .704$ V

17-18 TMSC HSSC TEST 1

$$v = f\lambda$$

$$E = hf$$

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

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

P16. $\frac{1}{16} = \frac{1}{22} + \frac{1}{d_i}$

$d_i = 58.7$ cm

P17. $E = \frac{\left(6.626x10^{-34}\right)\left(3x10^{8}\right)}{622x10^{-9}}$

$E = 3.1958x10^{-19}\left(\frac{1}{1.602x10^{-19}}\right)$

$E = 1.99$ eV

$$g = \frac{Gm}{r^2}$$

P19. $g' = \frac{G(6m)}{(3r)^2}$

$g' = \frac{2}{3}(9.8)$

$g' = 6.53$ m/s^2

$$I = \frac{V}{R}e^{\frac{-t}{RC}}$$

$$\tau = RC$$

P20. $\tau = 36(.12) = 4.32$

$I = \frac{12}{36}e^{\frac{-1.6}{4.32}}$

$I = .230$ A