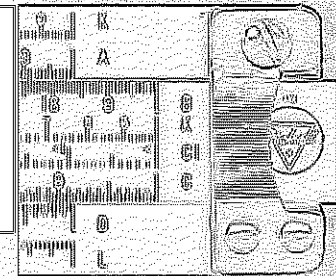
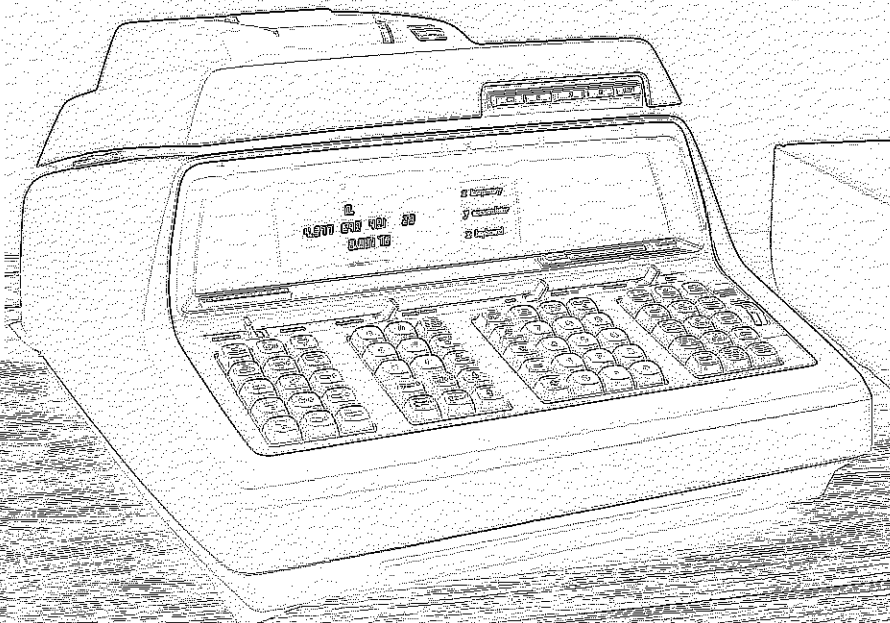
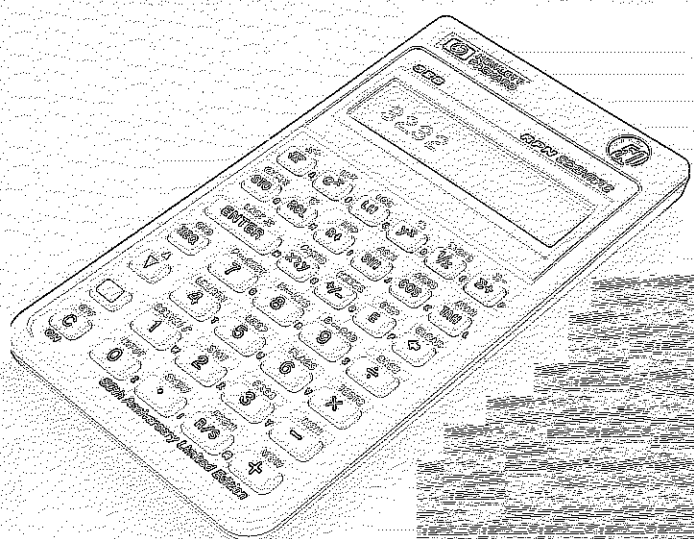
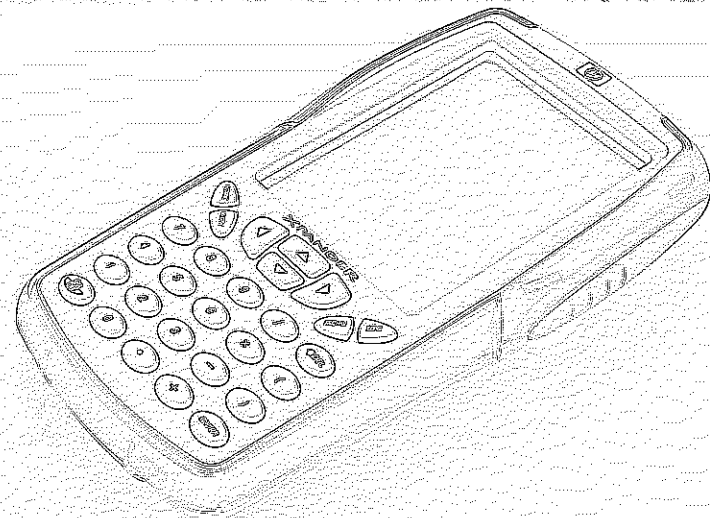
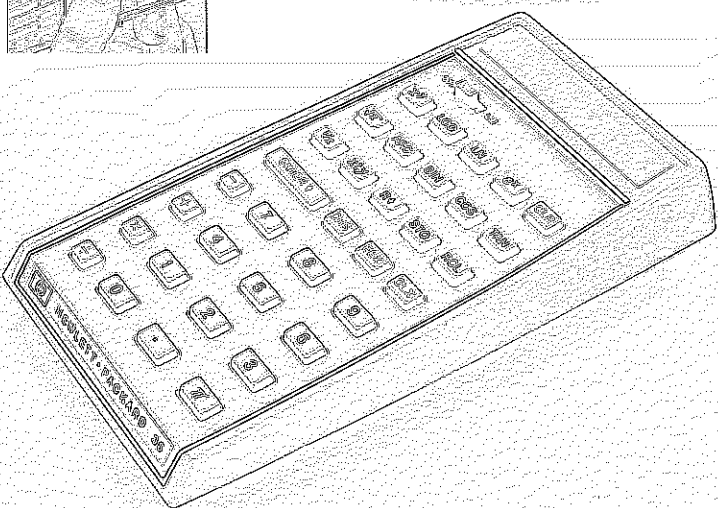
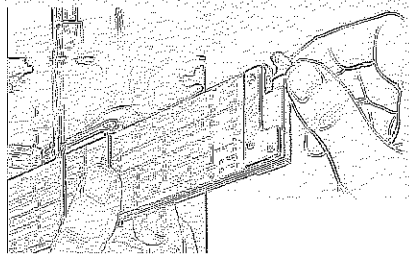
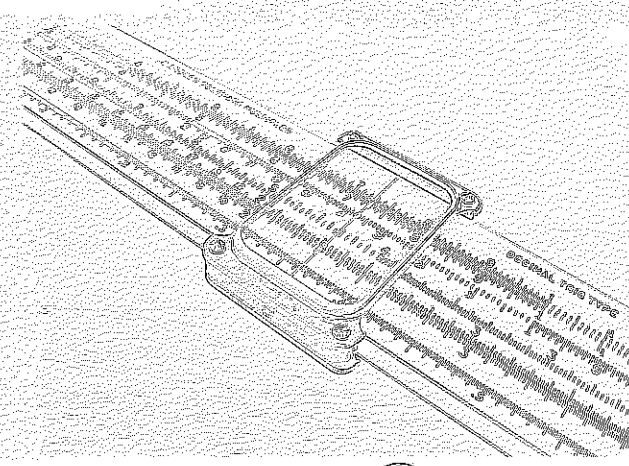
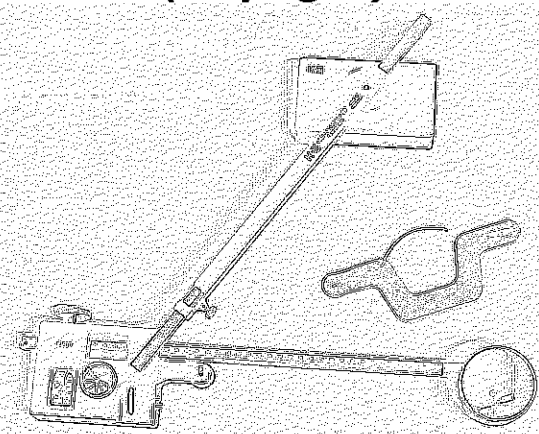
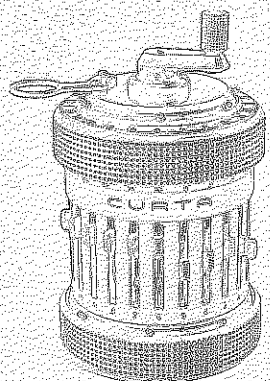


Texas Competitive Mathematics
Web - <http://www.texasmath.org>
Fax - (866) 606-3535
E-Mail - webmaster@texasmath.org



2008 UIL Science District 1 Test
(12 pages)



UIL

SCIENCE

DISTRICT 1 • 2008



GENERAL DIRECTIONS:

- DO NOT OPEN EXAM UNTIL TOLD TO DO SO.
- Ninety minutes should be ample time to complete this contest, but since it is not a race, contestants may take up to two hours. If you are in the process of actually writing an answer when the signal to stop is given, you may finish writing that answer.
- Papers may not be turned in until 30 minutes have elapsed. If you finish the test in less than 30 minutes, remain at your seat and retain your paper until told to do otherwise. You may use this time to check your answers.
- All answers must be written on the answer sheet provided. Indicate your answers in the appropriate blanks provided on the answer sheet.
- You may place as many notations as you desire anywhere on the test paper except on the answer sheet, which is reserved for answers only.
- You may use additional scratch paper provided by the contest director.
- All questions have ONE and only ONE correct (BEST) answer. There is a penalty for all incorrect answers.
- If a question is omitted, no points are given or subtracted.
- On the back of this page is printed a copy of the periodic table of the elements. You may wish to refer to this table in answering the questions, and if needed, you may use the atomic weights and atomic numbers from the table. Other scientific relationships are listed also.
- Silent hand-held calculators that do not need external wall plugs may be used. Graphing calculators that do not have built-in or stored functionality that provides additional scientific information are allowed. Small hand-held computers are not permitted. Calculators that accept memory cards or memory sticks are not permitted. Each contestant may bring one spare calculator. All memory must be cleared.
- Answers within 5% of the exact answer will be considered correct.

SCORING:

All questions will receive 6 points if answered correctly; no points will be given or subtracted if unanswered; 2 points will be deducted for an incorrect answer.

UNIVERSITY INTERSCHOLASTIC LEAGUE

Making a World of Difference

Periodic Table of the Elements

1A	1																	8A
	H																	2
	1.008																	He
	3	4											5	6	7	8	9	10
	Li	Be											B	C	N	O	F	Ne
	6.941	9.012											10.81	12.01	14.01	16.00	19.00	20.18
	11	12											13	14	15	16	17	18
	Na	Mg											Al	Si	P	S	Cl	Ar
	23.00	24.31											26.98	28.09	30.97	32.06	35.45	39.95
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
	39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.70	63.55	65.38	69.72	72.59	74.92	78.96	79.90	83.80
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
	85.47	87.62	88.91	91.22	92.91	95.94	(98)	101.1	102.9	106.4	107.9	112.4	114.8	118.7	121.8	127.6	126.9	131.3
	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
	132.9	137.3	138.9	178.5	180.9	183.9	186.2	190.2	192.2	195.1	197.0	200.6	204.4	207.2	209.0	(209)	(210)	(222)
	87	88	89	104	105	106	107			109								
	Fr	Ra	Ac	Rf	Ha	Unh	Uns			Uue								
	(223)	226.0	227.0	(261)	(262)	(263)	(262)			(267)								

	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Lanthanides	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	140.1	140.9	144.2	(145)	150.4	152.0	157.3	158.9	162.5	164.9	167.3	168.9	173.0	175.0
Actinides	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	232.0	231.0	238.0	237.0	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(260)

See Reverse Page for Other Useful Information

OTHER USEFUL INFORMATION

Avogadro's Number, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Absolute zero = 0 K = -273.15°C

Atmospheric pressure, 1 atm = $1.013 \times 10^5 \text{ N/m}^2 = 101.3 \text{ kPa} = 760.0 \text{ Torr} = 760.0 \text{ mmHg}$

Standard temperature and pressure (STP) is 0°C and 1 atm

Gram molecular volume at STP = 22.4 L

Mechanical equivalence of heat, 1 kcal = 1 Cal = 1,000 cal = 4,186 J

Gas constant, $R = 1.987 \text{ cal/mol}\cdot\text{K} = 0.08206 \text{ atm}\cdot\text{L/mol}\cdot\text{K} = 8.314 \text{ J/mol}\cdot\text{K}$

Dulong and Petit's constant = 6.0 amu \cdot cal/gram \cdot K

Faraday's constant, 1 F = 96,485 C/mol

Acceleration of gravity at Earth's surface, $g = 9.80 \text{ m/s}^2$

Gravitational constant, $G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$

Horsepower, 1 hp = 746 W = 550 ft \cdot lbs/s

Boltzmann's constant, $k_B = 1.38 \times 10^{-23} \text{ J/K}$

Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\cdot\text{K}^4$

Elementary charge, $e = 1.602 \times 10^{-19} \text{ C}$

Coulomb's law constant, $k = 1/4\pi\epsilon_0 = 8.988 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$

Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$

Permeability of free space, $\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$

Electron volt, 1 eV = $1.602 \times 10^{-19} \text{ J}$

Vacuum speed of light, $c = 3.00 \times 10^8 \text{ m/s}$

Planck's constant, $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s} = 4.136 \times 10^{-15} \text{ eV}\cdot\text{s}$

Planck's reduced constant, $\hbar = h/2\pi = 1.054 \times 10^{-34} \text{ J}\cdot\text{s} = 6.582 \times 10^{-16} \text{ eV}\cdot\text{s}$

Atomic mass unit, 1 amu = 1 u = $1.66 \times 10^{-27} \text{ kg} = 931.5 \text{ MeV}/c^2$

Electron rest mass, $m_e = 9.11 \times 10^{-31} \text{ kg} = 0.000549 \text{ u} = 0.511 \text{ MeV}/c^2$

Proton Mass = $1.6726 \times 10^{-27} \text{ kg} = 1.00728 \text{ u} = 938.3 \text{ MeV}/c^2$

Neutron Mass = $1.6749 \times 10^{-27} \text{ kg} = 1.008665 \text{ u} = 939.6 \text{ MeV}/c^2$

Some standard values for water:

Mass density, $\rho = 1.00 \text{ g/cm}^3 = 1,000 \text{ kg/m}^3$

Heat capacity or Specific heat, $c = 1.00 \text{ cal/gram}\cdot\text{C}^\circ = 1.00 \text{ kcal/kg}\cdot\text{C}^\circ = 4186 \text{ J/kg}\cdot\text{C}^\circ$

Latent heats, $L_f = 79.7 \text{ kcal/kg} = 3.33 \times 10^5 \text{ J/kg}$ & $L_v = 539 \text{ kcal/kg} = 22.6 \times 10^5 \text{ J/kg}$

Index of refraction, $n = 1.33$

Biology Questions (1 – 20)

1. Which of the following is the organelle that pinches off portions of its membrane to form vesicles used for storage or transport?
 - A) mitochondrion
 - B) chloroplast
 - C) nucleolus
 - D) lysosome
 - E) Golgi body

2. The carbon source for organisms that get their energy directly from photosynthesis is ____ .
 - A) oxygen
 - B) carbon dioxide
 - C) water
 - D) glucose
 - E) glycerol

3. The distribution of cytoplasm to daughter cells occurs during ____ .
 - A) conjugation
 - B) mitosis
 - C) meiosis
 - D) cytokinesis
 - E) interphase

4. If R is dominant to r , the offspring of the cross of RR with rr will ____ .
 - A) be homozygous
 - B) display the same phenotype as the RR parent
 - C) display the same phenotype as the rr parent
 - D) have the same genotype as the RR parent
 - E) have the same genotype as the rr parent

5. Rosalind Franklin used which technique to determine many of the physical characteristics of DNA?
 - A) transformation
 - B) transmission electron microscopy
 - C) density-gradient centrifugation
 - D) x-ray diffraction
 - E) DNA sequencing

6. Which of the following is true of viruses?
 - A) They are able to move by themselves.
 - B) They are able to reproduce by themselves.
 - C) They are structurally organized.
 - D) They contain no instructions to make more of themselves.
 - E) They are active outside of host cells.

7. Which of the following structures can be found inside bacterial cells, and contains DNA, but is found outside of the chromosome?
 - A) plasmid
 - B) endoplasmic reticulum
 - C) mitochondrion
 - D) viroid
 - E) spore

8. Saprobies are ____ .
 - A) metabolic byproducts
 - B) parasites of plants
 - C) an evolutionary dead end
 - D) heterotrophic plankton
 - E) organisms that feed on dead material

9. Which of the following is NOT a monocot?
 - A) iris
 - B) maple
 - C) wheat
 - D) grass
 - E) corn

10. Which of the following plant cells are alive at maturity?
 - A) sieve tube members
 - B) cork
 - C) sclereids
 - D) vessel members
 - E) tracheids

11. Plant stamens contain ____ .
 - A) petals
 - B) sepals
 - C) anthers
 - D) ovules
 - E) stigmas

12. Which of the following types of tissue is blood?
- A) epithelial
 - B) connective
 - C) muscular
 - D) nervous
 - E) epithelial and connective
13. Which of the following organisms has a hydrostatic skeleton with a soft body wall?
- A) earthworm
 - B) spider
 - C) sponge
 - D) crab
 - E) vertebrate
14. Which of the following is the correct direction an impulse follows within a single neuron?
- A) dendrite → axon → cell body
 - B) axon → dendrite → cell body
 - C) dendrite → cell body → axon
 - D) cell body → dendrite → axon
 - E) cell body → axon → dendrite
15. The pituitary gland is controlled by the ____.
- A) pons
 - B) corpus callosum
 - C) medulla oblongata
 - D) thalamus
 - E) hypothalamus
16. Ruminant animals need special enzymes to digest ____.
- A) proteins
 - B) starch
 - C) cellulose
 - D) lignin
 - E) fatty acids
17. Which of the following is NOT true of asexual reproduction?
- A) It is more suitable for reproduction in organisms in stable environments.
 - B) It results in offspring that are identical to each other.
 - C) It promotes genetic variation in each successive generation.
 - D) Budding is one type of asexual reproduction.
 - E) The offspring are genetically identical to the parents.
18. The distribution of different organisms over the surface of the earth ____.
- A) offers evidence of evolution
 - B) provides evidence for a single center of evolution
 - C) appears to be simply a matter of chance
 - D) is not affected by physical features
 - E) is primarily the result of human activities
19. The early atmosphere of earth ____.
- A) was essentially the same as occurs now
 - B) was changed drastically by the liberation of oxygen following the evolution of photosynthesis
 - C) was characterized by high concentrations of oxygen and ozone
 - D) was characterized by high concentrations of inert gases before the evolution of living organisms
 - E) was produced by the release of carbon dioxide by heterotrophic bacteria
20. Which of the following is NOT a density-dependent growth-limiting factor?
- A) predation
 - B) drought
 - C) parasitism
 - D) competition
 - E) pathogens

Chemistry Questions (21 – 40)

21. What is the oxidation number assigned to the phosphorus atom in sodium phosphate?
- A) 0
B) -3
C) +7
D) +5
E) +1
22. Write the balanced molecular equation for the reaction of an aqueous solution of calcium hydroxide with nitric acid. What is the sum of the coefficients in the balanced equation?
- A) eight
B) four
C) five
D) six
E) three
23. The number of valence electrons in one tin atom is ____.
- A) 0
B) 4
C) 2
D) 14
E) 8
24. The atomic number of an element gives the number of ____ and the number of ____ in the atom while the mass number gives the total number of ____ and ____.
- A) protons, electrons; neutrons, protons
B) neutrons, protons; neutrons, electrons
C) neutrons, electrons; neutrons, protons
D) protons, electrons; neutrons, electrons
E) neutrons, electrons; protons, electrons
25. _____ equals Planck's constant times the frequency of the electromagnetic radiation.
- A) Velocity
B) Wavelength
C) Intensity
D) Quantum
E) Energy
26. When $n = 4$, $l = 2$ and $m_l = -1$, what atomic orbital type is this?
- A) 4d
B) 2p
C) 2d
D) 4p
E) 5d
27. Which of the following properties is generally NOT associated with ionic bonding?
- A) aqueous solutions conduct electricity
B) high melting and boiling points
C) all of the other choices are properties of ionically bonded substances
D) crystalline solid
E) soluble in nonpolar solvents
28. Which one of the following molecules has only 120° bond angles?
- A) PF_3
B) NF_3
C) SF_6
D) BF_3
E) PF_5
29. 15.0 mL of a 0.250 M H_2SO_4 solution exactly neutralizes 20.0 mL of an NaOH solution. What is the molarity of the NaOH solution?
- A) 0.667 M
B) 0.375 M
C) 0.188 M
D) 0.0938 M
E) 0.250 M
30. The heat capacity of some molecule X(liq) is 10 cal/K-mole, its heat of vaporization is 5000 cal/mole and its boiling point is 75°C . For the conversion of one mole of X(g) at 75°C to one mole of X(liq) at 60°C , ____.
- A) 5150 cal of heat are absorbed by X
B) 5150 cal of heat are released by X
C) 4850 cal of heat are absorbed by X
D) 150 cal of heat are released by X
E) 4850 cal of heat are released by X

31. To prepare a solution that is 0.25 M NaOH starting with 100 mL of 0.15 M NaOH, _____.
- add 0.01 mole NaOH(s)
 - add 4.0 g NaOH(s)
 - evaporate water from the 0.15 M solution until there is 50 mL of solution left
 - add 50 mL of water
 - all the answers are correct
32. In a system at equilibrium at constant temperature and pressure, ΔH is necessarily equal to _____.
- $P \Delta V$
 - ΔE
 - ΔG
 - 0
 - $T \Delta S$
33. A reaction mechanism will usually be _____.
- proven experimentally to be the only possible mechanism
 - obvious from a consideration of the balanced chemical equation
 - difficult to verify experimentally
 - the only possible explanation for the reaction
 - described by at most two steps
34. In which of the following cases will the least time be required to arrive at equilibrium?
- K_c is a very small number.
 - Cannot tell since the time to arrive at equilibrium does not depend on K_c .
 - K_c is about 1.
 - Cannot tell without knowing the value of K_c .
 - K_c is a very large number.
35. Calculate the pH of a solution prepared by adding 80.0 mL of 0.100 M NaOH solution to 100 mL of 0.100 M HNO_3 solution.
- 2.24
 - 2.08
 - 2.16
 - 2.02
 - 1.95
36. The value of K_{sp} for copper(I) iodide is 1.0×10^{-12} . What is the solubility for copper(I) iodide in grams per liter?
- 1.0×10^{-12}
 - 9.0×10^{-6}
 - 1.9×10^{-4}
 - 1.0×10^{-6}
 - 1.0×10^{-4}
37. The half-reaction that occurs at the cathode during the electrolysis of molten sodium bromide is _____.
- $2 \text{Br}^- \rightarrow \text{Br}_2 + 2 e^-$
 - $2 \text{H}_2\text{O} + 2 e^- \rightarrow 2 \text{OH}^- + \text{H}_2$
 - $\text{Br}_2 + 2 e^- \rightarrow 2 \text{Br}^-$
 - $\text{Na} \rightarrow \text{Na}^+ + e^-$
 - $\text{Na}^+ + e^- \rightarrow \text{Na}$
38. For the reaction $? \text{ZnO} + ? \text{HCl} \rightarrow ? \text{ZnCl}_2 + ? \text{H}_2\text{O}$, a maximum of _____ grams of ZnCl_2 could be formed from 3.259 grams of ZnO and 6.281 grams of HCl.
- 5.46 g
 - 12.0 g
 - 7.64 g
 - 3.82 g
 - 2.18 g
39. What is the volume occupied by 4.906 g of gaseous H_2S at 94.3°C and 1451 torr?
- 2.27 L
 - 1.59 L
 - 0.91 L
 - 3.18 L
 - 5.00 L
40. An aqueous solution is 40.0% silver nitrate by mass. The density of this solution is 1.48 grams/mL. Calculate the molality of silver nitrate in this solution.
- 8.62 m
 - 1.57 m
 - 3.92 m
 - 7.06 m
 - 2.74 m

Physics Questions (41 – 60)

41. Jupiter is an average distance of 7.78×10^8 km from the sun. Given that the Earth is 1.50×10^8 km from the Sun on average, estimate the length of the year on Jupiter.
- A) 0.0856 yr
 B) 0.334 yr
 C) 3.00 yr
 D) 5.19 yr
 E) 11.8 yr
42. A 5.00 kg ball, moving to the right with a velocity of 2.50 m/s on a frictionless table, has a head-on elastic collision with a 7.50 kg ball that is also initially traveling to the right at 1.00 m/s. After the collision what are the final velocities of the balls?
- A) 0.700 m/s to the left & 2.20 m/s to the left
 B) 0.500 m/s to the left & 1.00 m/s to the right
 C) 0.500 m/s to the right & 1.00 m/s to the left
 D) 0.700 m/s to the right & 2.20 m/s to the right
 E) 1.48 m/s to the right & 2.98 m/s to the right
43. At a given location the Earth's magnetic field points vertically downward and has a magnitude of $50.0 \mu\text{T}$. An electron is moving horizontally toward the west at this location with a speed of 5.25×10^6 m/s. What is the magnitude of the magnetic force that the Earth's magnetic field exerts on the electron?
- A) 0.00 N
 B) 4.21×10^{-17} N
 C) 4.21×10^{-11} N
 D) 2.63×10^2 N
 E) 2.63×10^8 N
44. How many microseconds are in a femtosecond?
- A) 10^{-9}
 B) 10^{-6}
 C) 10^3
 D) 10^6
 E) 10^9
45. Three capacitors, $C_1 = 2.00 \mu\text{F}$, $C_2 = 5.00 \mu\text{F}$ and $C_3 = 10.0 \mu\text{F}$, are connected in series across a 40.0 V power supply. What is the voltage across the $5.00 \mu\text{F}$ capacitor?
- A) 0.00 V
 B) 5.00 V
 C) 10.0 V
 D) 25.0 V
 E) 40.0 V
46. What is the smallest number of whole logs (with density 660 kg/m^3 , diameter 30 cm and length 3.00 m) that are needed to build a raft that will carry four people who have an average mass of 75.0 kg safely across a river?
- A) 1
 B) 2
 C) 3
 D) 4
 E) 5
47. A homerun just clears the top of a sign that is 20.0 m high and 125 m away from home plate. If the baseball was hit at a height of 1.20 m above the ground and at 55.0° above the horizontal, then neglecting air resistance what was the initial speed of the ball?
- A) 6.69 m/s
 B) 13.4 m/s
 C) 19.1 m/s
 D) 36.1 m/s
 E) 38.2 m/s
48. An electron, passing close to a target nucleus, slows and radiates away some of its energy. What is this process called?
- A) blackbody radiation
 B) bremsstrahlung
 C) Compton effect
 D) photoelectric effect
 E) stimulated emission

49. A 200 kg crate slides 5.0 m down a 15° incline and is prevented from accelerating by a worker pushing on it. The worker pushes with a constant force that is parallel to the incline and opposite to the direction of the motion of the crate. If the coefficient of kinetic friction is 0.25 between the crate and the incline, then calculate the amount of work done by the worker on the crate.
- A) -170 J
 B) -34 J
 C) 0.0 J
 D) 34 J
 E) 170 J
50. An underwater scuba diver (in water with an index of refraction of 1.33) sees the Sun at an apparent angle of 48.0° from the vertical. What is the actual direction (measured from the vertical) to the Sun?
- A) 8.74°
 B) 34.0°
 C) 42.0°
 D) 56.0°
 E) 81.3°
51. Assuming that the Earth orbits the Sun in a circular path with radius 1.50×10^8 km, what is the average velocity of the Earth after it completes one quarter of a revolution about the Sun? Neglect any contribution from the rotation of the Earth about its own axis.
- A) 0.00 m/s
 B) 7.47×10^3 m/s
 C) 2.69×10^4 m/s
 D) 2.99×10^4 m/s
 E) 5.38×10^4 m/s
52. An astronomical telescope has an angular magnification of $-132 \times$. Its objective lens has a refractive power of 1.50 diopters. What is the refractive power of its eyepiece?
- A) 68.0 D
 B) 88.0 D
 C) 108 D
 D) 198 D
 E) 268 D
53. A block slides up a rough incline and then returns to the exact same spot where it initially left. What takes the largest amount of time?
- A) Traveling up the incline.
 B) Turning around at the top of the motion.
 C) Traveling down the incline.
 D) Traveling in either direction is the same.
 E) Can't tell from the given information.
54. Copper has a breaking stress of about 3.0×10^8 N/m². What is the maximum load that can be hung from a copper wire with a diameter of 0.45 mm?
- A) 0.072 kg
 B) 4.9 kg
 C) 20 kg
 D) 48 kg
 E) 200 kg
55. In a Young's double slit experiment, the third order bright fringe is located at an angle of 2.5° . The slit separation is 3.5×10^{-5} m. What is the wavelength of the light?
- A) 380 nm
 B) 510 nm
 C) 760 nm
 D) 5200 nm
 E) 7000 nm
56. For his Nobel Prize in 1921, Einstein was cited "for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect." Who else was cited for their work on the photoelectric effect?
- A) Compton
 B) Millikan
 C) Planck
 D) Rutherford
 E) Thompson

57. Two point charges, with magnitudes $+4.50 \mu\text{C}$ and $-7.50 \mu\text{C}$, are separated by 75.0 cm . What is the electric potential at the point midway between them?
- A) $-7.20 \times 10^4 \text{ V}$
 - B) $-3.60 \times 10^4 \text{ V}$
 - C) $-7.20 \times 10^2 \text{ V}$
 - D) $+2.88 \times 10^3 \text{ V}$
 - E) $+2.88 \times 10^5 \text{ V}$
58. Which of the fundamental forces in nature is the weakest?
- A) All are the same
 - B) Electromagnetic force
 - C) Gravitational force
 - D) Nuclear strong force
 - E) Nuclear weak force
59. A fan runs on low speed at 200 rpm for 20.0 minutes before being turned on high speed at 350 rpm for the next 40.0 minutes . What is the average angular velocity of the fan during the hour interval?
- A) 275 rpm
 - B) 300 rpm
 - C) 450 rpm
 - D) 550 rpm
 - E) 900 rpm
60. The intensity of sunlight reaching the top of the Earth's atmosphere is about 1390 W/m^2 . Given that the distance between the Sun and the Earth is $1.50 \times 10^8 \text{ km}$ and the distance between the Sun and Mars is $2.28 \times 10^8 \text{ km}$, what is the intensity of the sunlight at the surface of Mars?
- A) 602 W/m^2
 - B) 914 W/m^2
 - C) 2110 W/m^2
 - D) 3210 W/m^2
 - E) This problem can't be solved with the given data.

UIL HIGH SCHOOL SCIENCE CONTEST
ANSWER KEY

DISTRICT 1 • 2008

- | | | | | | |
|-----|---|-----|---|-----|---|
| 1. | E | 21. | D | 41. | E |
| 2. | B | 22. | D | 42. | D |
| 3. | D | 23. | B | 43. | B |
| 4. | B | 24. | A | 44. | A |
| 5. | D | 25. | E | 45. | C |
| 6. | C | 26. | A | 46. | E |
| 7. | A | 27. | E | 47. | E |
| 8. | E | 28. | D | 48. | B |
| 9. | B | 29. | B | 49. | A |
| 10. | A | 30. | B | 50. | E |
| 11. | C | 31. | A | 51. | C |
| 12. | B | 32. | E | 52. | D |
| 13. | A | 33. | C | 53. | C |
| 14. | C | 34. | B | 54. | B |
| 15. | E | 35. | E | 55. | B |
| 16. | C | 36. | C | 56. | B |
| 17. | C | 37. | E | 57. | A |
| 18. | A | 38. | A | 58. | C |
| 19. | B | 39. | A | 59. | B |
| 20. | B | 40. | C | 60. | A |

PHYSICS KEY for Science Contest • District 1 • 2008

41. (E) $T^2 \propto r^3$, $T = (7.78/1.5)^{(3/2)}(1 \text{ yr}) = 11.8 \text{ yr}$
42. (D) With: $\mathbf{p}_1 + \mathbf{p}_2 = \mathbf{p}'_1 + \mathbf{p}'_2$ & $v_1 - v_2 = v'_2 - v'_1$: $5(2.5) + 7.5(1) = 5 v'_1 + 7.5 v'_2$ & $2.5 - 1 = v'_2 - v'_1$
to get: $v'_1 = +0.7 \text{ m/s}$ & $v'_2 = +2.2 \text{ m/s}$
43. (B) $F = qvB \sin\theta = (1.60 \times 10^{-19})(5.25 \times 10^6)(50 \times 10^{-6}) = 4.21 \times 10^{-17} \text{ N}$
44. (A) $(1 \times 10^{-15}) / (1 \times 10^{-6}) = 10^{-9}$
45. (C) $C_{\text{eq}} = 5/4 \mu\text{F}$, $Q_{\text{tot}} = C_{\text{eq}}V = (5/4)40 = 50 \mu\text{C}$, $V = Q/C = 50 \mu\text{C} / 5 \mu\text{F} = 10 \text{ V}$
46. (E) The buoyant force must balance out both the weight of the wood and the weight of the people, so:
logs = $[4(75)] / \{(1000 - 660)[\pi(0.15)^2(3)]\} = 4.16$ or 5 logs
47. (E) The time is $t = 125 / (v_0 \cos 55^\circ)$ and plug into $20 = 1.2 + (v_0 \sin 55^\circ)t - 1/2 g t^2$ to get $v_0 = 38.17 \text{ m/s}$
48. (B) Bremsstrahlung or braking radiation is EM radiation produced by the deceleration of a charged particle.
49. (A) From Newton's 2nd law the applied force is:
 $F_A = F_{G\parallel} - F_{\text{frk}} = 200(9.8)[\sin 15^\circ - 0.25 \cos 15^\circ] = 33.98 \text{ N}$ & the work done is:
 $W_A = F_A d \cos\theta = (33.98)(5) \cos 180^\circ = -170 \text{ J}$
50. (E) By Snell's law: $\theta = \sin^{-1}(1.33 \sin(48^\circ) / 1.00) = 81.3^\circ$
51. (C) avg. vel. = displacement/time = $(\sqrt{2})R / (T/4) = (\sqrt{2})1.5 \times 10^{11} / (3.156 \times 10^7 / 4) = 2.69 \times 10^4 \text{ m/s}$
52. (D) $M = -f_o / f_e = -P_e / P_o$, thus: $P_e = -(-132)1.5 = 198 \text{ D}$
53. (C) Since the same distance is traveled and the magnitude of the acceleration when the block goes up the incline is greater than when it comes down, it will take longer to come back down the incline.
54. (B) stress = F/A , thus: $F = (3 \times 10^8)[\pi(0.225 \times 10^{-3})^2] = 47.7 \text{ N}$ or equivalently $47.7/g = 4.9 \text{ kg}$
55. (B) $\lambda = d \sin\theta / m = 3.5 \times 10^{-5} \sin 2.5^\circ / 3 = 509 \text{ nm}$
56. (B) For Millikan's 1923 Nobel prize he was cited "for his work on the elementary charge of electricity and on the photoelectric effect."
57. (A) $V = (9 \times 10^9)(4.5 \times 10^{-6}) / (0.375) + (9 \times 10^9)(-7.5 \times 10^{-6}) / (0.375) = -72,000 \text{ V}$
58. (C) The gravitational force is the weakest of the fundamental forces in nature, yet it is the force that determines the structure and formation of not just galaxies but the entire universe.
59. (B) total # rev. = $(200)(20) + (350)(40) = 18000 \text{ rev.}$ thus, avg ang. vel. = $18000/60 = 300 \text{ rpm}$
60. (A) Since $S = P / (4\pi r^2)$, then $S_M = (r_E / r_M)^2 S_E = (1.5/2.28)^2 1390 = 602 \text{ W/m}^2$