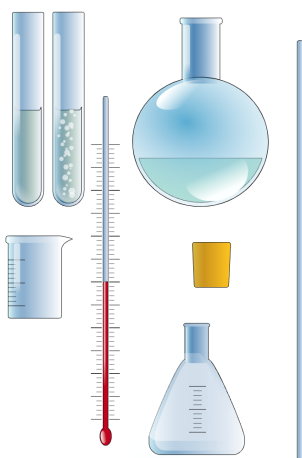




UNIVERSITY INTERSCHOLASTIC LEAGUE

Science

Invitational A • 2024



GENERAL DIRECTIONS:

- **DO NOT OPEN EXAM UNTIL TOLD TO DO SO.**
- Contestants may take up to two hours to complete the contest. 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. Write clearly and legibly!
- You may place as many notations as you desire anywhere on the test paper but not 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.
- The back two pages of this test include a copy of the periodic table of the elements, as well as listings of other scientific relationships. You may use this information during the contest and may detach the back page from the test if you wish.
- A simple scientific calculator is sufficient for the high school Science contest. **The UIL provides a list of approved calculators that meet the criteria for use in the Science contest. No other calculators are permitted during the contest.** The Science Contest Approved Calculator List is available in the current Science Contest Handbook and on the UIL website. Contest directors will perform a brief visual inspection to confirm that all contestants are using only approved calculators. Each contestant may use up to two approved calculators during the contest.

- B01. Where are proteins designated for export synthesized?
- A) smooth endoplasmic reticulum
 - B) rough endoplasmic reticulum
 - C) peroxisome
 - D) cytosolic ribosomes
 - E) lysosome
- B02. If P is purple and p is white, what percentage of the second filial generation would be white after crossing PP x pp?
- A) 0%
 - B) 25%
 - C) 50%
 - D) 75%
 - E) 100%
- B03. Bacterial genomes are typically arranged as
- A) multiple circular chromosomes.
 - B) one linear chromosome.
 - C) a mix of both linear and circular chromosomes within the same cell.
 - D) multiple linear chromosomes.
 - E) a single, circular chromosome.
- B04. *Enterobacteriaceae* are differentiated from non-*Enterobacteriaceae* by
- A) the presence of a thin layer of peptidoglycan in only the *Enterobacteriaceae*.
 - B) the presence of two membranes in the non-*Enterobacteriaceae*, the cytoplasmic membrane and the outer membrane.
 - C) *Enterobacteriaceae* typically lack an electron transport chain enzyme called cytochrome c oxidase.
 - D) the presence of lipopolysaccharide (LPS) in *Enterobacteriaceae* only.
 - E) *Enterobacteriaceae* are disease-causing in humans but the non-*Enterobacteriaceae* are not.
- B05. Carbon dioxide is first produced in _____ of aerobic respiration.
- A) glycolysis
 - B) the citric acid cycle
 - C) chemiosmosis.
 - D) pyruvate oxidation
 - E) electron transport chain
- B06. In October 2023, the Centers for Disease Control and Prevention issued a food safety warning for diced onions linked to
- A) *Salmonella*.
 - B) Hepatitis virus.
 - C) *Listeria*.
 - D) *Escherichia coli*.
 - E) Shiga-toxin producing *Escherichia coli*.
- B07. Epithelial cells are found in all of the following places except
- A) skin.
 - B) esophagus.
 - C) inside of the bladder wall.
 - D) the middle or distal end of a hair strand.
 - E) kidney tubules.
- B08. All of the following processes regulate gene expression except
- A) attenuation.
 - B) repressors binding to operators.
 - C) specific sigma factors binding to RNA polymerase in bacteria.
 - D) activators binding upstream of a promoter.
 - E) RNA polymerase binding to a start codon.

- B09. R is red and r is white but R exhibits incomplete dominance. Which of the following crosses would not yield any pink flowers?
- A) RR x rr
 - B) Rr x Rr
 - C) RR x Rr
 - D) RR x RR
 - E) All of the above crosses yield pink flowers.
- B10. Signaling through the use of acetylcholine occurs via the _____ system.
- A) nervous
 - B) endocrine
 - C) reproductive
 - D) digestive
 - E) respiratory
- B11. Organisms that are _____ are only found in one location, such as Puerto Rico or Galapagos.
- A) epidemic
 - B) introduced
 - C) pandemic
 - D) migratory
 - E) endemic
- B12. Transcription for almost all genes in the eukaryotic genome occurs
- A) in the cytosol.
 - B) in the nucleus.
 - C) within mitochondria.
 - D) on the rough endoplasmic reticulum.
 - E) on ribosomes.
- B13. Which of the following organic molecules functions in long-term energy storage?
- A) triglycerides
 - B) phospholipids
 - C) amino acids
 - D) nucleotides
 - E) monosaccharides
- B14. The type of fermentation that produces a mixture of ethanol, carbon dioxide, lactate, formate, succinate, hydrogen gas, and acetate is called
- A) alcohol fermentation.
 - B) homolactic acid fermentation.
 - C) heterolactic acid fermentation.
 - D) mixed acid fermentation.
 - E) 2,3-butanediol fermentation.
- B15. Which of the following is an acellular replication process?
- A) mitosis
 - B) meiosis
 - C) lysogeny
 - D) binary fission
 - E) All of the above are acellular processes.
- B16. If the frequency of the recessive allele is 0.931, what percent of the population is heterozygous?
- A) 0.48%
 - B) 6.9%
 - C) 12.8%
 - D) 86.7%
 - E) 96.5%
- B17. _____ isolation is to time as _____ is to location.
- A) Temporal; behavioral
 - B) Mechanical; ecological
 - C) Geographic; temporal
 - D) Behavioral; ecological
 - E) Temporal; geographic
- B18. Pine trees belong to Division (plant phylum) _____.
- A) Magnoliophyta
 - B) Ginkgophyta
 - C) Coniferophyta
 - D) Gnetophyta
 - E) Bryophyta

B19. Plants turning or moving towards a light source is called

- A) phototropism.
- B) gravitropism.
- C) photomorphogenesis.
- D) nutation.
- E) twining.

B20. Which statement is incorrect?

- A) The basic unit of life is the cell.
- B) Viruses are made of cells.
- C) All organisms have ribosomes.
- D) All organisms are made of cells.
- E) All cells come from pre-existing cells.

Chemistry

1A 1																	8A 18
1 H 1.01	2A 2											3A 13	4A 14	5A 15	6A 16	7A 17	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 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 47.87	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)

Water Data

$T_{mp} = 0^{\circ}\text{C}$
 $T_{bp} = 100^{\circ}\text{C}$
 $c_{ice} = 2.09 \text{ J/g}\cdot\text{K}$
 $c_{water} = 4.184 \text{ J/g}\cdot\text{K}$
 $c_{steam} = 2.03 \text{ J/g}\cdot\text{K}$
 $\Delta H_{fus} = 334 \text{ J/g}$
 $\Delta H_{vap} = 2260 \text{ J/g}$
 $K_f = 1.86 \text{ }^{\circ}\text{C}/m$
 $K_b = 0.512 \text{ }^{\circ}\text{C}/m$

Constants

$R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$
 $R = 8.314 \text{ J}/\text{mol}\cdot\text{K}$
 $R = 62.36 \text{ L}\cdot\text{torr}/\text{mol}\cdot\text{K}$
 $e = 1.602 \times 10^{-19} \text{ C}$
 $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
 $k = 1.38 \times 10^{-23} \text{ J/K}$
 $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$
 $c = 3.00 \times 10^8 \text{ m/s}$
 $R_H = 2.178 \times 10^{-18} \text{ J}$
 $m_e = 9.11 \times 10^{-31} \text{ kg}$
 $\mathcal{F} = 96,485 \text{ C}/\text{mol } e^{-}$
 $1 \text{ amp} = 1 \text{ C}/\text{sec}$
 $1 \text{ mol } e^{-} = 96,485 \text{ C}$

Conversion factors

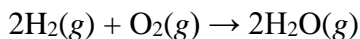
$1 \text{ L}\cdot\text{atm} = 101.325 \text{ J}$

C01. If $1/8$ of a mole of helium is added to a latex balloon at 25°C and 1.1 atm pressure, how many helium atoms are in the balloon?



- A) 0.125 atoms
- B) 6.02×10^{23} atoms
- C) 7.53×10^{24} atoms
- D) 4.82×10^{24} atoms
- E) 7.53×10^{22} atoms

C02. For the gas phase reaction between H_2 and O_2 , which of the statements below is *not* true?



- A) Two molecules of hydrogen react with one molecule of oxygen to form two molecules of water.
- B) Two moles of hydrogen react with one mole of oxygen to form two moles of water.
- C) Two grams of hydrogen react with one gram of oxygen to form two grams of water.
- D) Two liters of hydrogen react with one liter of oxygen to form two liters of water vapor.
- E) Two hydrogen atoms combine with one oxygen atom to form each water molecule.

C03. How many electrons are there in a Se^{2-} ion?

- A) 2 B) 36 C) 34 D) 33 E) 32

C04. Which pair of elements below is most likely to form an ionic compound?

- A) magnesium and fluorine
- B) nitrogen and sulfur
- C) oxygen and chlorine
- D) sodium and aluminum
- E) None of these would form an ionic compound

C05. A SCUBA diver takes a 1.0 L balloon from the surface of the ocean to 33 feet underwater, where the pressure is 2.0 atm . What would the volume of the balloon be at 33 feet of depth?

- A) 2.0 L
- B) 1.0 L
- C) 0.5 L
- D) 3.33 L
- E) 0.33 L

C06. What type(s) of intermolecular forces would you expect to find in a sample of liquid chloroform, CHCl_3 ?

- A) dispersion forces only
- B) dipole-dipole and dispersion forces
- C) hydrogen bonding and dispersion forces
- D) hydrogen bonding, dipole-dipole, and dispersion forces
- E) dipole-dipole forces only

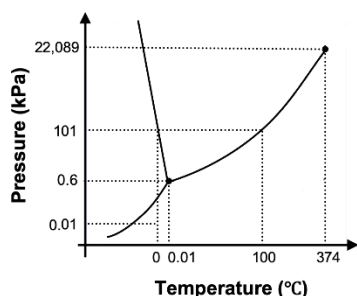
C07. Changes in the internal energy of a system are evident in the form of which two types of energy?

- A) heat and work
- B) heat and entropy
- C) work and entropy
- D) heat and enthalpy
- E) enthalpy and entropy

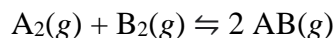
C08. A 100 gram sample of NaCl contains

- A) equal masses of sodium and chlorine
- B) 23 grams of sodium and 35.5 grams of chlorine
- C) about twice as many grams of chlorine as sodium
- D) about twice as many grams of sodium as chlorine
- E) None of the above answer choices is correct

- C09. This is a phase diagram for an unknown compound. What phase change(s) would the compound undergo if you took a sample at 0.01 kPa and 0°C and pressurized it to 22,089 kPa while keeping the temperature constant?



- A) The solid sample would melt to a liquid and then vaporize to a gas.
 B) The liquid sample would freeze to a solid.
 C) The solid sample would melt to a liquid.
 D) The gaseous sample would condense to a liquid then freeze to a solid.
 E) The gaseous sample would deposit as a solid and then melt to a liquid.
- C10. The following gas phase reaction has an equilibrium constant K_P of 16.0



In a system at equilibrium the partial pressures of A_2 and B_2 are 0.50 atm. What is the partial pressure of the AB gas?

- A) 1.0 atm
 B) 2.0 atm
 C) 0.50 atm
 D) 4.0 atm
 E) 0.25 atm
- C11. What is the pH of a 3.46×10^{-4} M solution of HCl?
- A) 3.46
 B) 3.25
 C) 3.75
 D) 3.60
 E) 3.33

- C12. The K_{sp} for $Ni(OH)_2$ is 2.8×10^{-16} . What is the concentration of Ni^{2+} in a saturated solution of $Ni(OH)_2$?

- A) 1.7×10^{-8} M
 B) 1.2×10^{-8} M
 C) 1.6×10^{-6} M
 D) 4.2×10^{-6} M
 E) 6.3×10^{-6} M

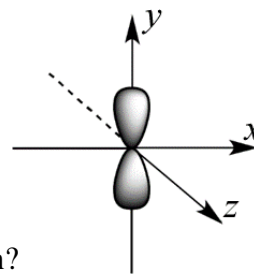
- C13. Which of the equations below represents an oxidation half-reaction?

- A) $H_2(g) + 2O_2(g) \rightarrow 2H_2O(g)$
 B) $2H^+(aq) + 2e^- \rightarrow H_2(g)$
 C) $O_3(aq) + 2H^+(aq) + 2e^- \rightleftharpoons O_2(g) + H_2O(l)$
 D) $2H_2O(g) \rightarrow H_2(g) + 2O_2(g)$
 E) $H_2(g) \rightarrow 2H^+(aq) + 2e^-$

- C14. If a reaction rate is second order with respect to reactant A and you triple the concentration of A, how much faster will the reaction go?

- A) Twice as fast
 B) Four times faster
 C) Six times faster
 D) Nine times faster
 E) Eighteen times faster

- C15. An electron is in an orbital with this shape. Which set of quantum numbers below could be a valid set for this electron?



- A) $n = 1$ $\ell = 0$ $m_\ell = 0$ $m_s = +1/2$
 B) $n = 2$ $\ell = 0$ $m_\ell = -1$ $m_s = -1/2$
 C) $n = 2$ $\ell = 0$ $m_\ell = 0$ $m_s = +1/2$
 D) $n = 3$ $\ell = 1$ $m_\ell = -1$ $m_s = +1/2$
 E) $n = 3$ $\ell = 1$ $m_\ell = 2$ $m_s = -1/2$

C16. What is the energy of a photon of visible light that has a wavelength of 610 nm?

- A) 3.04×10^{-22} J
- B) 3.26×10^{-19} J
- C) 4.51×10^{-20} J
- D) 9.92×10^{-18} J
- E) 7.58×10^{-19} J

C17. How many fluorine atoms are in a 10.0 L sample of fluorine gas at STP?

- A) 2.69×10^{23} F atoms
- B) 3.47×10^{23} F atoms
- C) 4.91×10^{23} F atoms
- D) 5.38×10^{23} F atoms
- E) 6.73×10^{23} F atoms

C18. The compressibility factor Z for one mole of gas is calculated as

$$Z = \frac{PV}{RT}$$

Which of the following statements about compressibility factor is true?

- A) As you decrease the pressure of an ideal gas, Z increases
- B) As you increase the pressure of an ideal gas, Z increases
- C) As you increase the temperature of an ideal gas, Z increases
- D) As you decrease the volume of an ideal gas, Z increases
- E) Z for an ideal gas is always equal to 1

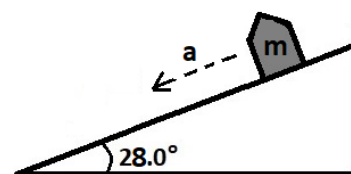
C19. What is the limiting reactant in a chemical reaction?

- A) The reactant that slows down the reaction rate.
- B) The reactant that is the most expensive or the most difficult to obtain.
- C) The reactant that runs out first, causing the reaction to stop.
- D) A reactant that is in the solid or liquid phase.
- E) The reactant that you have the most of, which limits how small of a reaction vessel you can use for the reaction.

C20. What is the percent yield of nickel(II) sulfide if the actual yield is 345.7 grams and the theoretical yield is 360.5 grams?

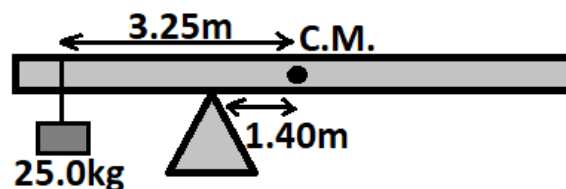
- A) 95.89%
- B) 96.33%
- C) 97.95%
- D) 94.42%
- E) 91.11%

- P01. According to Guillen, Isaac Newton did not publish his ideas concerning light until after one his rivals had died in 1704. Who was this rival?
 A) Nicolaus Copernicus
 B) Michael Faraday
 C) Robert Hooke
 D) Wilhelm Leibniz
 E) Thomas Young
- P02. According to Guillen, Isaac Newton was cheered on by Edmund Halley. Halley was overjoyed about Newton's equation of gravity because it helped make sense of...
 A) The retrograde motion of planets
 B) The orbits of the moons of Jupiter
 C) The behavior of comets
 D) The motion of the Moon
 E) The motions within star clusters
- P03. According to Guillen, one particular application of Newton's Laws is impossible to compute exactly. The best one can do is approximate an answer. What is this complicated problem?
 A) The centrifugal force problem
 B) The light spectrum problem
 C) The retrograde motion problem
 D) The escape velocity problem
 E) The three-body problem
- P04. Only one moon in our solar system has a thick atmosphere. It is also the only nitrogen-rich dense atmosphere found anywhere in the solar system. Which moon does this describe?
 A) Titan
 B) Io
 C) Triton
 D) Earth's Moon
 E) Europa
- P05. A domestic cat is chased across a yard by a domestic dog. You observe that the cat crosses the entire 18.0m length of the yard in a time of 4.50 seconds. How fast was the cat running in miles per hour?
 A) 1.79 mph
 B) 4.00 mph
 C) 6.40 mph
 D) 8.95 mph
 E) 14.4 mph
- P06. A domestic cat, starting from rest, accelerates at 3.50m/s^2 . The cat reaches its final speed after travelling a distance of 2.60m. What is the final speed of the cat?
 A) 4.27 m/s
 B) 4.86 m/s
 C) 9.10 m/s
 D) 11.8 m/s
 E) 18.2 m/s
- P07. A bag of cat food slides without friction down an inclined plane (as shown). The angle of the incline is 28.0° and the mass of the bag of food is 3.30kg. What is the acceleration of the bag of cat food down the incline?
 A) 8.65 m/s^2
 B) 4.60 m/s^2
 C) 2.97 m/s^2
 D) 2.62 m/s^2
 E) 1.39 m/s^2



- P08. A cat toy with a mass of 220g slides across a horizontal floor. The coefficient of friction between the cat toy and the floor is 0.320. The toy slides a distance of 4.50m before coming to rest. How much work was done on the toy by the force of friction?
 A) 9.70 J
 B) 5.31 J
 C) 3.10 J
 D) 2.16 J
 E) 0.690 J

- P09. A metal beam is arranged horizontally with a fulcrum (pivot point) located 1.40m to the left of the center of mass of the beam. A 25.0kg mass is attached to the beam at a location that is 3.25m to the left of the center of mass (as shown). The system is perfectly balanced. What is the mass of the metal beam?
 A) 10.8 kg
 B) 14.2 kg
 C) 33.0 kg
 D) 43.9 kg
 E) 58.0 kg



P10. You create a pendulum by tying a 150.0g mass to a long string. You attach the string to a branch on a tree and start the pendulum swinging. You observe that ten complete oscillations of the pendulum take 28.0seconds. What is the length of the pendulum?

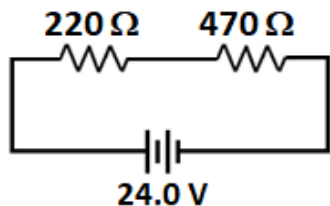
- A) 6.54 m
- B) 5.29 m
- C) 4.11 m
- D) 2.38 m
- E) 1.95 m

P11. A cube of steel, 8.00cm on a side, is heated to 750.0°C. At this temperature, the steel glows a bright red color. If the emissivity of the steel is 0.750, then how much power is emitted by the heated cube as electromagnetic radiation?

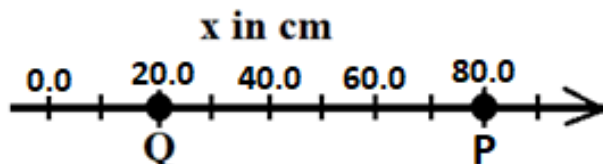
- A) 296 W
- B) 517 W
- C) 1080 W
- D) 1780 W
- E) 2380 W

P12. For the circuit shown, determine the voltage drop across the 470Ω resistor.

- A) 24.0 V
- B) 16.3 V
- C) 11.2 V
- D) 7.65 V
- E) 3.48 V

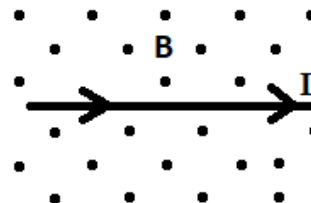


P13. A charge, Q , with a magnitude of 250.0nC, is located on a line at the 20.0cm mark, as shown. What is the magnitude of the electric field at the point P, located on the line at the 80.0cm mark, due to the presence of the charge Q ?



- A) 2250 N/C
- B) 2810 N/C
- C) 3510 N/C
- D) 3750 N/C
- E) 6240 N/C

P14. A 24.0cm length of wire carries a current of 14.0A in the positive x-direction (to the right, as shown). A magnetic field with a strength of 650mT is directed in the positive z-direction (out of the page). What is the magnitude and direction of the force acting on the current-carrying wire due to the magnetic field?



- A) 2.18 N up (positive y-direction)
- B) 2.18 N down (negative y-direction)
- C) 5.76 N down (negative y-direction)
- D) 9.10 N up (positive y-direction)
- E) 9.10 N down (negative y-direction)

P15. A laser beam, which is naturally vertically polarized, has an intensity of 500W/m². The beam is sent through a polarizer whose axis is oriented at 32.0° with respect to vertical. What is the intensity of the laser beam after passing through the polarizer?

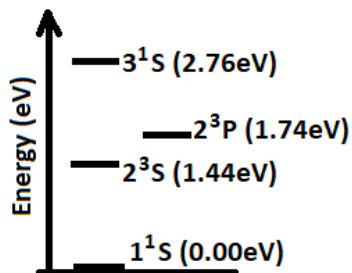
- A) 500 W/m²
- B) 420 W/m²
- C) 360 W/m²
- D) 260 W/m²
- E) 140 W/m²

P16. A butterfly sits 29.0cm to the left of a diverging lens. The lens has a focal length of -18.0cm. What is the magnification of the image of the butterfly formed by the lens?

- A) 2.64
- B) 1.64
- C) 0.617
- D) 0.383
- E) 0.234

P17. The energy level diagram for a newly discovered element is shown below. Atoms of this element produce a strong spectral line at a wavelength of 713nm. Which transition on the energy level diagram is responsible for producing this strong spectral line?

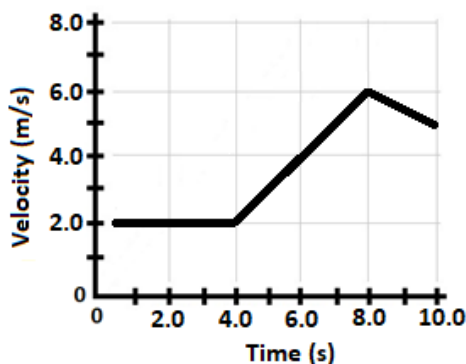
- A) $3^1S \rightarrow 2^3S$
- B) $3^1S \rightarrow 2^3P$
- C) $2^3P \rightarrow 2^3S$
- D) $2^3P \rightarrow 1^1S$
- E) $2^3S \rightarrow 1^1S$



P18. Positronium is the bound state of an electron and its antiparticle, a positron. It exists for only a brief time, after which the electron and positron annihilate one another, producing a pair of gamma rays. Which of the fundamental forces is responsible for the existence and decay of positronium?

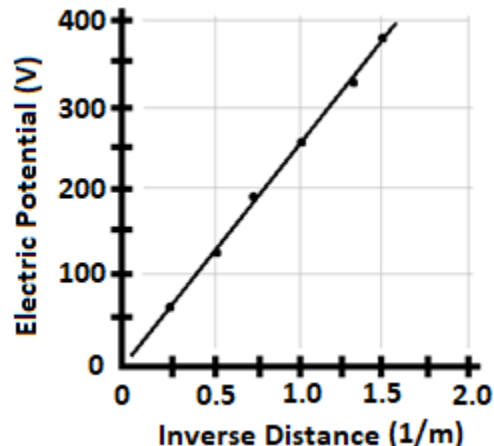
- A) The Electromagnetic Force
- B) The Gravitational Force
- C) The Strong Force
- D) The Higgs Force
- E) The Weak Force

P19. A large bird flies in a straight line for ten seconds. Shown below is a plot of the velocity of the bird (v) as a function of time (t) for those ten seconds. What is the instantaneous acceleration of the bird at $t = 5.0$ seconds?



- A) 3.0 m/s^2
- B) 1.0 m/s^2
- C) 0.75 m/s^2
- D) 0.60 m/s^2
- E) 0.50 m/s^2

P20. Shown below is a plot of the electric potential (V) produced by a point charge as a function of the inverse of the distance ($\frac{1}{r}$) from the point charge. Based on these data, determine the magnitude of the point charge (Q).



- A) 28 nC
- B) 40 nC
- C) 140 nC
- D) 250 nC
- E) 360 nC

Physics

Useful Constants

quantity	symbol	value
Free-fall acceleration	g	9.80 m/s^2
Permittivity of Free Space	ϵ_0	$8.854 \times 10^{-12} \text{ C}^2/\text{Nm}^2$
Permeability of Free Space	μ_0	$4\pi \times 10^{-7} \text{ Tm/A}$
Coulomb constant	k	$8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$
Speed of light in a vacuum	c	$3.00 \times 10^8 \text{ m/s}$
Fundamental charge	e	$1.602 \times 10^{-19} \text{ C}$
Planck's constant	h	$6.626 \times 10^{-34} \text{ Js}$
Electron mass	m_e	$9.11 \times 10^{-31} \text{ kg}$
Proton mass	m_p	$1.67265 \times 10^{-27} \text{ kg}$ 1.007276 amu
Neutron mass	m_n	$1.67495 \times 10^{-27} \text{ kg}$ 1.008665 amu
Atomic Mass Unit	amu	$1.66 \times 10^{-27} \text{ kg}$ $931.5 \text{ MeV}/c^2$
Gravitational constant	G	$6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$
Stefan-Boltzmann constant	σ	$5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$
Universal gas constant	R	$8.314 \text{ J/mol} \cdot \text{K}$ $0.082057 \text{ L} \cdot \text{atm/mol} \cdot \text{K}$
Boltzmann's constant	k_B	$1.38 \times 10^{-23} \text{ J/K}$
Speed of Sound (at 20°C)	v	343 m/s
Avogadro's number	N_A	$6.022 \times 10^{23} \text{ atoms/mol}$
Electron Volts	eV	$1.602 \times 10^{-19} \text{ J/eV}$
Distance Conversion	miles \rightarrow meters	$1.00 \text{ mile} = 1609 \text{ meters}$
Rydberg Constant	R_∞	$1.097 \times 10^7 \text{ m}^{-1}$
Standard Atmospheric Pressure	1 atm	$1.013 \times 10^5 \text{ Pa}$
Density of Pure Water	ρ_{water}	1000.0 kg/m^3