- 48. The first postulate of special relativity
 - says that there is no absolute reference frame. a.
 - b. is a reaffirmation of the Galilean principle of relativity.
 - states that the laws of physics are the same in all inertial reference systems. c.
 - d. applies also to the implication of Maxwell's equations that the speed of light in vacuum is constant.



All of these statements are true.

- 49. A rocket is 8 m long when measured at rest. What is its length as measured by an observer who sees the rocket ship moving past at 99.9% of the speed of light? The relativistic adjustment factor, $\gamma = 1/(1-v^2/c^2)^{1/2}$, for 0.999c is 22.4. contracked L'= \$/22.4= 0.36m = L/Y
 - a. 179.2 m b. 37.9 m
 - c. 22.4 m
 - d. 1.7 m



e. None of the above is within 10% of the correct answer.

- 50. An electron is being accelerated by a constant force to nearly the speed of light. Which of the following is NOT true?
 - a. Its kinetic energy increases steadily.
 - b. Its momentum increases at a constant rate.
 - It can approach but not exceed the speed of light. c. mess constant
 - Its total energy continually increases. Its rest energy increases steadily. PALSE

All of the above are trues



51. A train is traveling along a straight, horizontal track at a constant speed of 0.9c. A warning light on the ground flashes once each second. An observer in the train measures the time between flashes to be, most nearly.

| | , | |
|-------------|-----------|--|
| a. | 0.1 s | n = 1 = 2.3 |
| b. | 0.9 s | V1-(0.9)2 |
| c. | 1.0 s | |
| d. | 1.11 s | Dilated $\Delta t' = \gamma \Delta t = (2.3)(1)$ |
| e. | 1.67 s | Pluis do 1 |
| (f.) | 2.3 s | |
| ¥g. | None of t | he above is within 10% of the correct answer. |

- 52. If the speed, v, of a particle of rest mass m increases from 0.999999c to 0.9999999c, {so that v/c increases from $(1 - 10^{-5})$ to $(1 - 10^{-7})$, by what factor does its total energy increase, most nearly?
- $E^{ivr} = \gamma mc^{2} \qquad \frac{\gamma_{f}}{\Gamma_{f}} = \sqrt{\frac{2 \cdot (1 v_{i/c})}{\sqrt{2(1 v_{f/vc})}}} = \int_{10^{-5^{-1}}}^{10^{-5^{-1}}} 10.$ Fince $1 v_{i/c^{2}} = (1 + v/c)(1 v/c) \approx 2(1 v/c)$ when $v/c \approx 1$ a. $(1+10^{-7})$ b. $(1+10^{-6})$ c. $(1+10^{-5})$ d. 3.3 4.67 10 None of the above is within 10% of the correct answer. 53. The law of definite proportions states that _____ have definite _____ ratios of their constituent elements. a. compounds ... mass b. compounds ... volume X ... only if faieras! c. mixtures ... mass X } Does not apply to Minkings
 - None of the above, the law of definite proportions is about volumes, not masses. \boldsymbol{X} e.

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54. Two gases are kept at the same temperature. If the molecules of gas A have 4 times the mass of those of gas B, what is the ratio of the average kinetic energy of the A molecules to that of the B molecules?

a. 4 b. 1/4 ~

- 55. Which of the following is NOT assumed in our model of the ideal gas? The gas particles
 - rebound elastically when they collide with the container wall. a.
 - b. have no internal structure.
 - c. are indestructible.
 - d. do not interact except when they collide.
 - All of the above properties are assumed for our ideal gas.
 - None of the above statements is true of our ideal gas.
- 56. The pressure that a molecular gas exerts on the walls of its container increases with
 - a. the average magnitude of the momentum of the molecules.
 - b. the speed with which the molecules travel to their next collision with the wall.
 - c. the density of gas molecules .
 - d. the average kinetic energy of the gas molecules.
 - e. All of the above statements are true. YES
 - None of the above answers is correct. \mathbf{x}
- 57. The two fixed points used to define the modern Celsius temperature scale are those of
 - a. boiling water and a mixture of ice and salt.
 - b. the human body temperature and a mixture of ice and salt.
 - the human body temperature and freezing water. c.
 - d. boiling water and freezing water.
 - None of the above
- 58. Which of the following doubles with a doubling of the Celsius temperature of an ideal gas?
 - average momentum a.
 - b. average speed
 - c. average kinetic energy
 - product of pressure and volume d.

None of the above e.,

NONE: (Ary KE doubles unter doubleng of KELVIN temperature)

- 59. The pressure in a container filled with gas increases when it is heated because
 - the walls do work on the gas. X Not unless they more! a.

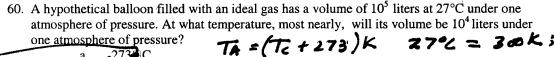
 - b. the average momentum of a gas particle increases. No $\langle \vec{p} \rangle = 0 \cdots drem't$ charge c. the number of gas particles increases. No: heat dres not change No ℓ particles d. the volume of the gas decreases als
 - d. the volume of the gas decreases. NO.



The average momentum change in a collision with the wall increases. None of the above.

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 $V_i = CT_i = 70 = \frac{T_i}{T_f} = T_f = \frac{300}{10} = 30k$ $V_F = 7F_F = \frac{300}{10} = 30k$





RRON

e. f. None of the above is within 10% of the correct answer.

61. You exert a force of 3 N on the head of a thumbtack to place it on a board. The tip of the thumbtack has an area less than 10^{-2} mm.². The pressure on the board at the tip must be greater than: $P = \frac{F}{A} > \frac{3N}{m^{-2} \cdot 10^{-6} m^2} = 3 \times 10^{6} \frac{N}{m^2}$

(Recall 1 Pa = $1N/m^2$.) $3 \times 10^{2} Pa$ a.

c. d.

 $3 \times 10^{3} Pa$ b. 3 X 10⁴Pa c. 3 X 10⁵ Pa d.

-273 C

-243 -203

- 3 X 10⁷ Pa
 - 3 X 10⁸ Pa
 - None of the above is within 10% of the minimal pressure
- 62. In radiative heat transfer, thermal energy is transported by
 - the movement of a fluid. X a.
 - the collisions of particles.
 - electromagnetic fields.
 - the propagation of sound waves.
 - physical vibrations of the intervening medium.
- 63. Joule's experiments with hanging weights turning paddle wheels in water
 - showed that heat was not a fluid. No: Rum Foll Mond that.
 - showed that 4.2 joules of work are equivalent to 1 calorie of heat.

 - c. were used to define the calorie. No: WATER'S Spechie Last define colore d. showed that heat could be converted 100% to mechanical energy NO: V. sleks 2nd Law
 - e. None of the above.
- 64. The first law of thermodynamics
 - a. is a restatement of the law of conservation of energy.
 - b. allows that work can be completely converted into internal energy.
 - c. treats heat as another form of energy.
 - guarantees that the work extracted by a cyclic heat engine can never exceed the heat inserted. d.

NÒ

- All of the above statements are true of the first law. **(**e.)
- 65. Which of the following statements about a cup of water and a gallon of water at the same temperature is correct?
 - a. They will transfer the same heat energy to a third object at lower temperature.
 - b. They have the same internal energies.
 - c. The average molecular speed in the gallon is less than that in the cup *NO*
 - The average molecular speed in the cup of water is less that that in the gallon. No d.

None of the above. (e.

Page 13 of 26 Fall 2005 Final Exam EwerCom 66. Aluminum and air have almost the same specific heats. Therefore, 100 calories of the will raise the 1 liter of Aluminum. (Assume T = 2000 and P = 1 atm.) temperature of 1 liter of air _ , because 18. of air has MUCH LESS MASS then much more than a.) slightly more than Б. 12 d Al. c. about the same as d. slightly less than much less than e. a. that the energy of an isolated system is conserved. X Inter Sugs that b. that the entropy of the earth can never decrease. X IF heat is hearing at S decreases c. that it is impossible to reach the absolute over the second s 67. The second law of thermodynamics says that it is impossible to reach the absolute zero of temperature. 3 - 3

- d. that it is impossible to build a heat engine that does more mechanical work than the thermal energy it consumes. 10th Law
- e. that two objects which are both in thermal equilibrium with the same third object are also in thermal equilibrium with one another. Other
- f. . None of the above.
- 68. It is impossible to run an ocean liner by taking in seawater at the bow of the ship, extracting internal energy from the water, and dropping ice cubes off the stern because this process violates the _____ law of thermodynamics.

 - c second, because none of the heat as haded is exhausted d. third to the furroundings. None of the above. In fact, the U.S. navy is developing just such a propulsion process. f.
- 69. What restrictions does the first law of thermodynamics place on building a perpetual motion machine?
 - It does not place any restriction on the possibility. The a.
 - Some heat energy must be exhausted and wasted in No/this is 2nd Law b.
 - c. Thermal energy cannot be completely converted to mechanical energy
 - The machine must have a very long cyclical period. ILCOLOMAT: No K. d.
 - The losses due to friction can not exceed hc (= Planck's constant times the speed of e.
 - light) in any cycle. X Nowsense

None of the above restrictions is imposed by the first law. f.

- 70. What restrictions does the second law of thermodynamics place on building a perpetual motion machine?
 - The work extracted must be less than the heat input. thee. a. 11
 - Some heat energy must be exhausted and wasted b.
 - Thermal energy cannot be completely converted to mechanical energy. TRUE c.
 - Its efficiency must not exceed the Carnot efficiency. d.
 - All of the above restrictions are imposed by the second law.
 - None of the above answers is true and correct.
- 71. Consider a certain person's human body to be a heat engine with an efficiency of only 20%. This means that
 - IRPELEVANT only 20% of the food he eats is digested. a. ? NON (OKE
 - b. 80% of the energy he obtains from food is destroyed.
 - he should spend 80% of each day lying quietly. X IRCELEVANT
 - only 20% of the energy he extracts from food can be used to do physical work. None of the above: no quantitative thermodynamic efficiency can be assigned to a human body.

- 72. A heat engine takes in 800 J of energy at 1200 K and exhausts 600 J at 400 K. What is the theoretical maximum (i.e., Carnot) efficiency of this engine? Mc = 1- Te/TH = 1 - 400/1200 = 0.67
 - a. 25% b. 33.3% 50%
 - 66.7% 75%
- Ever Gower:

None of the above is within 10% of the correct answer.

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73. An engine exhausts 1200 J of energy for every 3600 J of energy it takes in. What is its efficiency?

- 0.67

- a. 25 % b. 33 % c. 50 %
- d) 67 %
- 75%
- None of the above is within 10% of the correct answer.
- 74. A heat engine takes in energy at a rate of 1600 W at 1000 K and exhausts heat at a rate of 1200 W at 400 K. What is the actual efficiency of this engine?

= 25%

- 25% a. 🕽 6. 40%
 - 50% c.
 - d. 60%
 - e. 75%
 - f. None of the above is within 10% of the correct answer.

75. What is the probability of rolling a total of 10 with two dice?

- 10: (5+5) 3 possibilities out of 6×6=36 6+4 3/36= Probability of 10 a. 1/36 3/36 b. c. 5/36 d. 6/36 e. 10/36
 - f. None of the above.
- 76. A ringing bell is inserted into a large glass of water. The bell and the water are initially at the same temperature and are insulated from their surroundings. Eventually the bell stops vibrating and the comes to rest. Which of the following statements is FALSE?
 - The mechanical energy of the bell has been completely converted into internal energy a. T of the combined system.
 - b. The final temperature of the combined system is lower than the initial temperature.
 - The entropy of the combined system has increased. \mathbf{T}
 - d. The water has been warmed in the process
 - e. The bell performed work on the water.

None of the statements is false.

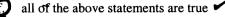
Delite LASTan swet 77 Which of the following statements conflicts with the second law of thermodynamics?

- a. Heat naturally flows from hot objects to cold objects.
- **b.** No engine can transform all of its heat input into mechanical work.
- c. The entropy of an isolated system can never decrease.
- d. Perpetual motion machines are not possible.

e. No engine can be less efficient than the Carnot engine with the same maximum and " WHONG: Contot if tess > more minimum temperatures

- Every heat engine must exhaust heat. f.
- None of the above contradicts the second law. g.

- 78. A hot piece of metal is dropped into an insulated container of cold water. After the system has reach its equilibrium temperature, the
 - entropy of the metal has decreased. a.
 - b. entropy of the water has increased.
 - c. net change in the entropy of the system is positive.
 - d. entropy of the system has increased.
 - heat energy has been transferred from metal to water



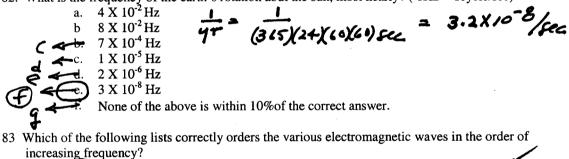
- None of the above statements is true. g.
- 79. Which of the following sets of parameters all affect the period of a pendulum? (M = Mass, L = Length, and g = acceleration due to gravity)

T= 2T) 1/9

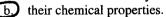
- a. (M, L and g)
- b. (M and L)
- (M and g) c
- (L and g)
- (L only)
- f. None of the above.
- 81. The fundamental wavelength for standing waves on a rope fixed at both ends is length of the rope.



- h/2= L => la= 2/
 - four times a. b. two times
 - the same as
 - d. one-half
 - e. one-fourth
 - None of the above f.
- 82. What is the frequency of the earth's rotation abut the sun, most nearly? (1Hz = 1cycle/sec)



- a. radio waves<microwaves<infra-red light<violet light<X-rays<gamma rays microwayes<radio waves<red light<ultraviolet light<X-rays<gamma rays 🖈 c 📣 infrared lightered light<violet light<ultraviolet light<mic waves<X-rays. 🗡 da gamma ravs<X-rays<ultray net light<microwaves<radio waves X e. Ultraviolet light<infrated light<gamma rays<X-rays<microwaves.
 - None of the above orderings is completely correct. f. [–]
- 84. The periodic table arranges the elements from right to left in order of increasing atomic mass and in columns corresponding to
 - the order in which they were discovered. a.



- c. their relative abundances.
- d. alphabetical order.
- e. None of the above.

85. Which is a correct observation of what happened in our cathode ray tube demonstrations?

- The end of the glass tube opposite the cathode glowed. a.
- A metal cross cast a shadow. b.
- c. The particles were seen only when an accelerating voltage is applied **V**
- The stream of particles is deflected by an magnetic field. d.
- e All of the above.

None of the the above happened during our demonstration.

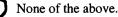
86. Thomson's plum pudding model of the atom was abandoned because...

- of the cathode ray studies which discovered electrons. a.
- of the large (compared with the H+ ion) charge to mass ratio of the electron. b.
- the electron charge was shown to be quantized in integer units of the smallest c. charge.
- the atom had to be neutrally charged electrically.



RUTHER FORD'S EXPERIMENT alpha particles sometimes back scattered.

- All of the above were reasons for abandoning the Thomson model.
- 87. When light is incident on a metallic surface, the emitted electrons
 - a. are called photons.
 - have arbitrarily high energies X b.
 - c. have a maximum energy that depends on the intensity of the light. X TRUE iff in
 - d. Are referred to as cathode rays.
 - All of the above

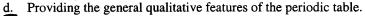


- 88. Rutherford's model predicted that atoms should be unstable (bedause the electrons should spiral into the nucleus) in very short time periods. What caused this instability in Rutherford's model?
 - The positive charge in the nucleus was too strong for the electrons to remain in distant a. 'NOT TRUE : Cf. Planots orbits.
 - The attractive force between the positive nucleus and the negative electrons would pull b. Not TRUCE: CF Plant them together.
 - An accelerating, such as one in uniform circular motion, charge must radiate energy. C.,
 - đ. Circular orbits are unstable for an attractive inverse square force.
 - e. All of the above.
 - f. None of the above.
- 89 .A clean surface of potassium metal will emit electrons when exposed to blue light. If the intensity of the blue light is increased, the ______ of the ejected electrons will also increase.
 - No! MAY En marcaker a frequency. maximum kinetic energy
 - number 🖌 🖌
 - c. average speed NO! d. average kinetic energy Ma!
 - All of the above quantities increase with intensity. e.
 - f. None of the above completions yields a true statement.
- 90. Which of the following is NOT a feature of the Bohr model of the atom?
 - an quantized electron angular momentum a.
 - electrons in planetary-like orbits b.
 - quantized energy levels c.
 - d. accelerating electrons that do not radiate "
 - photons emitted when electrons jump from one orbit to another. e.
 - All of the above are features of the Bohr model.
 - None of the features (a) through (e) is a feature of the Bohr model.
 - f. g.

d.

ł1

- 91. Which of the following is NOT considered to be a success of Bohr's theory of the atom?
 - Obtaining the numerical values for the spectral lines in hydrogen. a.
 - Explaining why there the same line frequencies occur in emission spectra as in b. Success absorption spectra.
 - c. Explaining why the frequency distributions in emission spectra are discrete rather than continuous. Success





All of the above are considered successes of the Bohr theory.

- None of the items (a) through (d) is considered to be a success of the Bohr model.
- 92. A clean surface of metal will emit electrons when exposed to light. If the color of the light is changed from red to blue without changing the intensity, the _____ of the ejected electrons will also increase.
 - mass a.
 - b. number
 - Maximum kinetic energy, Fince blue has higher frequency then red light. (c. charge
 - All of the quantities listed above will increase with the color change. e.
 - None of the quantities (a) through (d)above will increase with the change in color. e
- 93. Bohr gave the following argument why the electron in the hydrogen atom existing only in certain discrete energy levels
 - a. This agrees with Newtonian mechanics.
 - b. This agrees with Maxwell's equations.
 - This was implied by the Rutherford atom c.
 - All of the above were cited. d.



e. None of the above, Bohr simply postulated it, offering no supporting rationale, except that it explained the Hydrogen spectra.

- 94. Two hydrogen atoms have electrons in the n = 3 energy level. One of the electrons jumps to the n = 2 level, while the other jumps to the n = 1 level. Which property is the same for the two photons that are emitted?
 - velocity a.)

all photons have some velocity = c

- b. frequency X
- c. energy X
- d. color 🗙
- e. wave length 🗡
- All of the above properties are the same for the two photons. f.
- None of the properties (a) through (e) above is the same for the two photons..