

Name: _____



Cornell University Prison Education Program

Conceptual Physics Class 13 Questions May 4th, 2018

The following might be useful for today's class questions:

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 H Hydrogen 1.008	2 He Helium 4.003																
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.933	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 84.90
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanide Series	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [210]	86 Rn Radon [222]
87 Fr Francium [223]	88 Ra Radium [226]	89-103 Actinide Series	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [289]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium [278]	114 Fl Flerovium [289]	115 Uup Ununpentium [289]	116 Lv Livermorium [293]	117 Uus Ununseptium [294]	118 Uuo Ununoctium [294]
57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967			
89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]			

Alkali Metal

Alkaline Earth

Transition Metal

Basic Metal

Semimetal

Nonmetal

Halogen

Noble Gas

Lanthanide

Actinide

© 2014 Todd Helmenstine
sciencememes.org

Part 1: Probability

1. You have a jar with 73 red balls, and 27 blue balls. You randomly draw a ball from this jar. What is:
 - (a) The percent chance that you will draw a red ball?
 - (b) The percent chance that you will draw a blue ball?
 - (c) The probability that you will draw a red ball?
 - (d) The probability that you will draw a blue ball?
 - (e) The probability of drawing a red or blue ball?
2. Give an example of 2 statistically *independent* events.
3. Give an example of 2 statistically *dependent* events.
4. You toss a coin in the air 3 times. What is the probability that:
 - (a) It will land heads all 3 times?
 - (b) It will land heads twice (and only twice)?
 - (c) It will land heads 2 or 3 times?
 - (d) It will land tails 2 or 3 times?

5. You are tossing a fair coin, which has a $1/2$ probability of landing heads and a $1/2$ probability of landing tails. If you toss the coin in the air 300 times, how many times **on average** would you expect it to land:
- (a) Heads:

 - (b) Tails:
6. You are tossing a trick coin, which has a $2/3$ probability of landing heads, and a $1/3$ probability of landing tails. If you toss the coin 300 times, hoe many times **on average** would you expect it to land:
- (a) Heads:

 - (b) Tails:
7. Based on your answers to the two previous questions, how could you tell if a coin was fair (without any special equipment or knowledge of how coins can be biased)?
8. There are 52 cards in a deck. You are dealt 2 cards (without refilling the deck). What is the probability that you will have both the ace of spades and the ace of diamonds?
9. Why isn't it valid to define randomness by saying that randomness is when all outcomes are equally likely?

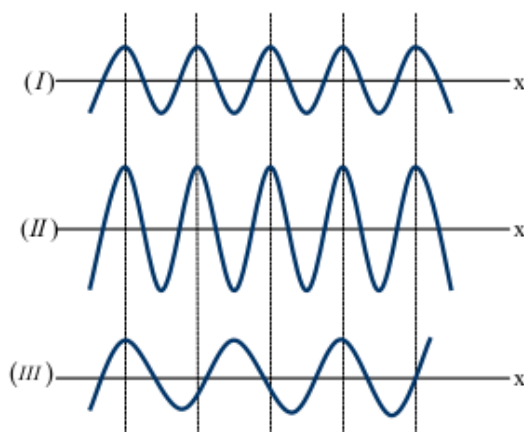
From *Light and Matter*, Chapter 33 Discussion Question B

10. Suppose you have two identical loaded four-sided dice, with $P(4) = 1/2$, and $P(1) = P(2) = P(3) = 1/6$.
- (a) If you rolled one die many times, what is the average value you would roll?
 - (b) If you rolled both dice there are 16 possible rolls you could get. What is the probability of each?
 - (c) If you add up the values of your two rolls, you could get between 2 and 8. What is the probability of each possible sum?
 - (d) What is the average sum you would get if you rolled both dice many times?
11. Does the number of radioactive nuclei in a sample decrease to exactly half its original value in one half-life? Explain in terms of the statistical nature of radioactive decay.
12. Describe the following kinds of radioactive decay;
- (a) Alpha decay:
 - (b) Beta decay:
 - (c) Gamma decay:

13. You have a block of radioactive material, and measure the number of initial decays to be 128 million. If it has a half-life of 4 hours, what do you expect its radioactivity level to be after:
- (a) 4 hours?
 - (b) 8 hours?
 - (c) 16 hours?
14. Does the number of radioactive nuclei in a sample decrease to exactly half its original value in one half-life? Explain in terms of the statistical nature of radioactive decay.
15. What distinguishes between:
- (a) Different kinds of elements?
 - (b) Different isotopes within an element?
16. Physicists thought for a long time that bismuth-209 was the heaviest stable isotope. (Very heavy elements decay by alpha emission because of the strong electrical repulsion of all their protons.) However, a 2003 paper by Marcillac et al. describes an experiment in which bismuth-209 lost its claim to fame it actually undergoes alpha decay with a half-life of 2×10^{19} years.
- (a) After the alpha particle is emitted (two protons and two neutrons), what is the isotope left over?
 - (b) Compare the half-life to the age of the universe, which is about 14 billion years.
17. What is the source of energy emitted in radioactive decay? (Hint: think about conservation laws from before)

Part 2: Quantum Mechanics

18. What is the Heisenberg uncertainty principle?
19. What is the concept of *wave-particle duality*?
20. How would the wavelength of an object change if:
- (a) Its mass increased?
 - (b) Its velocity decreased?
21. Three particles of equal mass are traveling in the same direction. The waves of the three particles are as shown.



- Rank the speeds of the particles (I), (II) and (III) by circling one of these four possibilities.
- A. $v_{II} > v_I > v_{III}$
 - B. $v_{II} > v_{III} > v_I$
 - C. $v_I = v_{II} > v_{III}$
 - D. $v_{II} > v_I = v_{III}$
22. According to the uncertainty principle, the more we know about an electron's position, the less we know about its
- A. speed.
 - B. momentum.
 - C. kinetic energy.
 - D. all of these.

23. A metal surface is struck with light of wavelength 400nm, releasing a stream of electrons. If the 400nm light is replaced by a 300nm light with the same number of photons incident on the metal per second, what will happen?
- A. More electrons are emitted in a given time interval
 - B. Fewer electrons are emitted in a given time interval
 - C. Emitted electrons are more energetic
 - D. Emitted electrons are less energetic
 - E. None of the above
24. A metal surface is struck with light of wavelength 400nm, releasing a stream of electrons. If the light intensity increases without changing the wavelength, what will happen?
- A. More electrons are emitted in a given time interval
 - B. Fewer electrons are emitted in a given time interval
 - C. Emitted electrons are more energetic
 - D. Emitted electrons are less energetic
 - E. None of the above
25. Why do we not notice quantum effects in our day-to-day lives?