Chapters 27-28 Review Problems

Vocabulary Questions
1. In physics, what defines time?
2. How do you set up a reference frame?
3. True or false: The speed of light changes based on the speed the source is moving at?
4. What is a proper time interval?
5. True or false: If a 20 year old astronaut travels in a space ship at close to the speed of light for 10 years as measured on earth, the astronaut's true age would be older than 30.
6. True or false: distances traveled at extremely high speeds are seen by the traveler as shorter than they actually are.
7. According to the principle of relativity, under what conditions are all of the laws of physics valid?
8. True or false: the rule for determining relative velocities change when speeds approach c?
9. As a body approaches the speed of light, does it become more or less difficult to increase the velocity?
10. What did the scattering of the X-rays in Compton's experiment prove?
11. What did De Broglie discover about the nature of matter?
12. According to Heisenberg's uncertainty principle, what happens to the level of uncertainty in momentum as the electron wave packet gets smaller?
13. True or false: the photoelectric effect is when light incident on the surface of a metal causes protons to be released.
14. What is the name for the packets of energy that radiation is emitted in?
15. What happens when the frequency of a light incident on a metal falls below threshold frequency?
16. What is the minimum work that must be done to emit an electron?
17. You are most likely to liberate photo electrons from a metal when using light of a short or long wavelength?
18. True or false: With very accurate instruments it is possible to correctly measure an objects position and momentum simultaneously.
19. It is possible to "time travel" to the future by traveling at speeds near c. Is it possible to "time travel" to the past?
20. What are Einstein's postulates?

Problems:

Relate Directly to Chapters 27-28:

1. What is the energy of a photon in a 570 nm wavelength of light?
2. If the speed of an electron is 100 m/s, what is its de Broglie wavelength?
3. Calculate the momentum of a photon of light that has a frequency of 2.5 X 10^9 Hz.
4. The wavelength of visible light ranges from 400 nm to 700 nm. What is the corresponding range of photon energies?

5. Convert 12.3 X 10^37 eV.
6. If the frequency of a light is 5.90 X 10^7 Hz, what is the wavelength?
7. A light source emits photons, each of which has a momentum of 1.40 X 10^27 energy does each photon have?
8. Blue light of frequency 6.3 X 10^14 Hz falls on the surface of sodium, which has a work function of 2.27 eV. Find the maximum kinetic energy of emitted electrons.
9. If the work function of a metal is 6.00 X 10^14 and the kinetic energy of the average photoelectron emitted from the metal is 3.30 eV, what is the frequency of the light?
10. After being created in a high-energy particle accelerator, a pi meson at rest has an average lifetime of 2.60 X 10^-8 s. Traveling at a speed very close to the speed of light, a pi meson travels a distance of 120 m before decaying. How fast is it moving?

Integrate Material From Other Chapters:
1. Two race cars are traveling in the same direction, one in front of the other, 340 m apart, at a speed of 70.0 m/s. The driver of the car in front sounds his horn. How much time elapses before the other driver hears the horn?
2. How much would you age in traveling a distance of 5.00 light years from earth if you were able to travel at a speed of 0.990c?
3. **An X-ray photon that is Compton scattered from an electron at an angle of 180 imparts to the electron a speed of 1.00 X 10^7 m/s. Find the wavelength of the incident X rays.**
4. How many photons per second enter one eye if you look directly at a 100 W light bulb 2.00 m away? Assume a pupil diameter of 4.00 mm and a wavelength of 600 nm.
5. A certain spaceship travels so close to the speed of light that while 1.00 s elapses on the spaceship 1.00 y elapses in the earth's reference frame. Find the difference between the speed of light and the speed of the space craft, expressed as a fraction of c.

Answers:
1. The reading of clock nearby the event.
2. You must set up a system of synchronized clocks around the reference frame which are at rest relative to one another.
3. False

4. Time measured on a single, stationary clock.
5. False
6. True
7. In any inertial reference frame.
8. True.
9. More difficult.
10. The wave-particle duality of light
11. Electrons (therefore all matter) have wave properties.
12. Uncertainty increases.
13. False
14. Photons
15. No electrons are emitted from the metal.
16. The work function.
17. Short.
18. False.
19. No :(
20. 1)The principle of relativity: All laws of physics are valid in any inertial reference frame.

    2)Light always travels through a vacuum at a fixed speed c, relative to any inertial reference frame, independent of the motion of the light source.

1) 3.5 X 10^-19 J
2) 7.2 X 10^-6 m
3) 5.5 X 10 ^-33 m/s
4) 3.11 eV - 1.78 eV
5) 2.0 X 10^20 eV
6) 5.10 X 10^11
7) 2.63 eV
8) 0.34 eV
9) 1.40 X 10^15 Hz
10) 0.998 c

1) 0.83 s
2) 258 Days
3) 1.41 X 10^-10
4) 7.55 X 10^13
5) 5.00 C 10^-16 c

References:
Coletta, Vincent; Physics Fundamentals; Physics Curriculum & Instruction; © 2008

Williams, Jim; <u>Chapters 27-28</u> Test; 2011.