Here are some of the qualitative questions on material for Hour Exam 3. You should be able to explain each answer not just choose the correct response.

26-1: You and your friend are playing catch in a train moving at 60 mph in an eastward direction. Your friend is at the front of the car and throws you the ball at 3 mph (according to him). What velocity does the ball have when you catch it, according to you?
   A) 3 mph eastward
   B) 3 mph westward
   C) 57 mph eastward
   D) 57 mph westward
   E) 60 mph eastward

26-2: Which of the systems below are not inertial reference frames?
   A) a person standing still
   B) an airplane in mid-flight
   C) a merry-go-round rotating at a constant rate
   D) all of the above are IRFs
   E) none of the above are IRFs

26-3: Which of these quantities change when you change your reference frame?
   A) position
   B) velocity
   C) acceleration
   D) all of the above
   E) only 1) and 2)

26-4: You are in a spaceship with no windows, radios or other means to check outside. How would you determine if the spaceship is at rest or moving at constant velocity?
   A) by determining the apparent velocity of light in the spaceship
   B) by checking your precision watch. If it’s running slow, then the ship is moving.
   C) by measuring lengths of objects in the spaceship. If they are shorter, then the ship is moving.
   D) You should give up because you’ve taken on a impossible task.

26-5: You are in the Enterprise traveling at half the speed of light \( (v = 0.5 \, c) \), heading toward a Borg spaceship. You fire your phasers and you see the light waves leaving your ship at the speed of light \( c = 3 \times 10^8 \, \text{m/s} \) toward the Borg. With what speed do the Borg see the phaser blasts approaching their ship?
   A) 0.5 \( c \)
   B) \( c \)
   C) 1.5 \( c \)
   D) more than 2 \( c \)
   E) none of the above
26-6: Your roommate tells you that she has conducted an experiment under water and found some high-energy particles to move faster than light. She asks for your opinion. Based on your excellent preparation you received in your PHYS 2 course, what do you tell her?
   A) That is impossible.
   B) That is quite possible.
   C) You have no clue.
   D) You don’t care.

26-7: A boxcar moves right at a very high speed. A green flash of light moves from left to right, and a blue flash from right to left. For someone with sophisticated measuring equipment in the boxcar, which flash takes longer to go from one end to the other?
   A) the blue ball  B) the green ball  C) both the same

26-8: A boxcar moves right at a very high speed. A green flash of light moves from left to right, and a blue flash from right to left. According to an observer on the ground, which flash takes longer to go from one end to the other?
   A) the blue ball  B) the green ball  C) both the same

A spacecraft has a length of 100 m, when parked on Earth. It is now moving toward a tunnel with a speed of 0.8 c (g =1.66). The lady living near the tunnel can control doors that open and shut at each end of the tunnel, which is 65 m long. The doors are open as the spaceship approaches, but in the very moment that she sees the back of the spaceship in the tunnel, she closes both doors and then immediately opens them again.

26-9  What happens according to the lady living near the tunnel:
   A) no door hit the spaceship because for her the doors weren’t closed simultaneously
   B) no door hit the spacecraft because length contraction makes the spaceship only 60 m long
   C) no door hits the spaceship because length contraction has made the tunnel 109 m long
   D) a door hits the spaceship

26-10: What happens according to the Captain of the Spaceship?  (choose from above)

26-11: A spaceship in the shape of a sphere moves past an observer on Earth at a speed of 0.9 c. What shape should the observer on earth see as the spaceship moves by?
   A) Unchanged
   B) Cigar-like
   C) Pancake-like

27-1: A metal surface with a work function of $W_0 = \frac{hc}{550 \text{ nm}}$ is struck with blue light and electrons are released. If the blue light is replaced by red light of the same intensity, what is the result?
   A) emitted electrons are more energetic
   B) emitted electrons are less energetic
   C) more electrons are emitted in a given time interval
D) fewer electrons are emitted in a given time interval
E) no electrons are emitted

27-2: A metal surface is struck with light of $\lambda = 400$ nm, releasing a stream of electrons. If the 400 nm light is replaced by $\lambda = 300$ nm light of the same intensity, what is the result?
   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

27-3: The speed of proton A is larger than the speed of proton B. Which one has the longer wavelength?
   A) proton A
   B) proton B
   C) both the same
   D) neither has a wavelength

27-4: An electron and a proton have the same speed. Which has the longer wavelength?
   A) electron
   B) proton
   C) both the same
   D) neither has a wavelength

27-5: An electron and a proton are accelerated through the same voltage. Which has the longer wavelength?
   A) electron
   B) proton
   C) both the same
   D) neither has a wavelength

30-1 There are 82 protons in a lead nucleus. Why doesn’t the lead nucleus burst apart?
   A) Coulomb repulsive force doesn’t act inside the nucleus
   B) gravity overpowers the Coulomb repulsive force inside the nucleus
   C) the negatively charged neutrons balance the positively charged protons
   D) protons lose their positive charge inside the nucleus
   E) none of the above

30-2 What weighs more, an electron plus a proton, or a hydrogen atom?
   A) electron plus proton
   B) hydrogen atom
   C) both the same
30-3 What is the total energy (or mass) of the hydrogen atom in its ground state?
   A) 13.6 eV
   B) $m_p c^2 + m_e c^2 + 13.6 \text{ eV}$
   C) $m_p c^2 + m_e c^2$
   D) $m_p c^2 + m_e c^2 - 13.6 \text{ eV}$

30-4 What element results when $^{14}\text{C}$ undergoes beta decay?
   A) $^{15}\text{C}$
   B) $^{15}\text{N}$
   C) $^{14}\text{C}$
   D) $^{14}\text{N}$
   E) $^{15}\text{O}$

30-5 You have 16 kg of a radioactive sample with a certain half-life of 30 years. How much is left after 90 years?
   A) 8 kg
   B) 4 kg
   C) 2 kg
   D) 1 kg
   E) nothing

Ans: 26-1 B; 26-2 C; 26-3 E; 26-4 D; 26-5 B; 26-6 B; 26-7 C; 26-8 B; 26-9 B ; 26-10 A; 26-11 C ; 27-1 E; 27-2 C; 27-3 B; 27-4 A; 27-5 A; 30-1 E; 30-2 A; 30-3 D; 30-4 D; 30-5 C;