

Examination 1
Time: 75 minutes

Name: _____

Physics 222

UIN: _____

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All problems count 5 points

Part 1. In these multiple choice problems circle the correct answer; do not need to show your work.

1. Conservation laws of which quantities are universal?
 - a. energy, mass, linear momentum, number of atoms and nucleons
 - b. charge, mass, angular momentum
 - c. energy, linear momentum, angular momentum, mass
 - d. energy, charge, linear momentum, angular momentum

2. A small sphere of initial volume V is filled with n moles of helium at initial pressure and temperature P and T . Which of the following statements are true?
 - a. The volume decreases to $V/2$, and the pressure increases to $4P$ when the temperature is $T/2$.
 - b. $n/2$ moles of gas are removed, the volume is decreased to $V/2$, and the pressure decreases to $P/4$ with a drop in temperature of $T/2$.
 - c. n moles of gas are added, the total sample is heated to $2T$, and the pressure drops to $P/2$ when the volume increase to $8V$.
 - d. The amount of gas is doubled to $2n$, the pressure is doubled to $2P$, and the volume is doubled to $2V$, with a corresponding temperature drop to $T/2$.

3. Will a meter stick manufactured on earth work correctly on a spaceship moving with a speed of $0.8c$?
 - a. No, it will be contracted.
 - b. Yes, it will not change its length.
 - c. No, it will be longer.
 - d. Yes, time dilation will balance length contraction.

4. Strong interaction is one type of fundamental forces in nature that are relevant to the
 - a. interaction of electrons and protons
 - b. interaction of protons and neutrons in nuclei
 - c. interaction of photons
 - d. gravitational interaction

5. Which of the following statements about the Michelson-Morley experiment is correct?
- The interferometer measured large effects from the ether, showing that the velocity of light changes depending on motion with respect to the ether.
 - Changing the angle of the interferometer produced different results.
 - They found that the interference effects of the ether were not dependent on the direction of motion of the interferometer.
6. The relativistic factor γ provides that
- an object of length L measured in a frame at rest is measured to be γL when that object is moving with respect to the rest frame.
 - if two frames are aligned at $t = t' = 0$ but the 'primed' frame moves at some constant velocity, an interval of time t in the rest frame will be measured as a time γt in the moving frame.
 - increased velocities decrease the value of γ .
 - a particle moving faster than the speed of light gives a real relativistic factor.

Part 2. Workout problems: circle the correct answer

Suppose the astronauts traveled from the earth to a far planet and back the total distance of 2 light years, and the trip took 5 years as measured on earth. Assuming (incorrectly) that they moved with a constant velocity.

Hint: 1 light year is the distance that light travels in 1 year.

7. What was their speed as a fraction of speed of light (factor β)?
- 0.1
 - 0.2
 - 0.3
 - 0.4
 - 0.5
8. What was the relativistic factor γ ?
- 0.15
 - 0.8
 - 1.09
 - 1.25
 - 1.50
9. What was the proper time for the trip?
- 2.02y
 - 3.01y
 - 4.72y
 - 5.00y
 - 4.58y

10. What was the time difference for the trip between the clocks on earth and their clocks?
- 0.10y
 - 0.32y
 - 0.42y
 - 0.83y
 - 1.1y
11. A group of scientists decide to repeat the muon decay experiment. They measure 2500 muons on top of a mountain, which is 3000m above sea level. The half-time of muon decay is 1.52×10^{-6} s and muons travel vertically down at a speed of 0.98c. Find the number of muons expected at sea level.
- 991
 - 1982
 - 2022
 - 511
 - 1230
12. What is the total energy of a proton having a momentum of 40 GeV/c?
- 40.511 GeV
 - 40.938 GeV
 - 40.011 GeV
 - 39.071 GeV
13. The kinetic energy of a proton is equal to (2/3) of its rest energy. What is the speed of a proton as a fraction of c?
- 0.8
 - 0.9
 - 1.0
 - 1.2
 - 0.7
14. (b) What is the momentum of the proton (expressed in MeV/c)?
- 168.0
 - 368.5
 - 976.3
 - 1251
 - 1453.1
15. A particle having a speed of 0.88 c has a momentum of 10^{-16} kg m/s. What is its mass?
- 1.80×10^{-25} kg
 - 1.65×10^{-24} kg
 - 3.6×10^{-26} kg
 - 3.6×10^{-27} kg
 - 1.8×10^{-26} kg

16. A particle initially has a speed of $0.5c$. At what speed does its moment increase by 10%?
- a. $0.756c$
 - b. $0.635c$
 - c. $0.536c$
 - d. $0.504c$
17. A spacecraft traveling out of the solar system at a speed of $0.84c$ sends back information at a rate of 700Hz . At what rate do we receive the information?
- a. 103 Hz
 - b. 206 Hz
 - c. 309 Hz
 - d. 407 Hz
 - e. 813 Hz

Consider an electron traveling at the speed of $0.1c$ and calculate.

18. The momentum p
- a. $501\text{ keV}/c$
 - b. $305\text{ keV}/c$
 - c. $123\text{ keV}/c$
 - d. $25.6\text{ keV}/c$
 - e. $51.4\text{ keV}/c$
19. The kinetic energy K
- a. 105 keV
 - b. 2.57 keV
 - c. 5.20 keV
 - d. 20.5 keV
 - e. 8.71 keV
20. The total energy E
- a. 716 keV
 - b. 514 keV
 - c. 839 keV
 - d. 315 keV
 - e. 911 keV