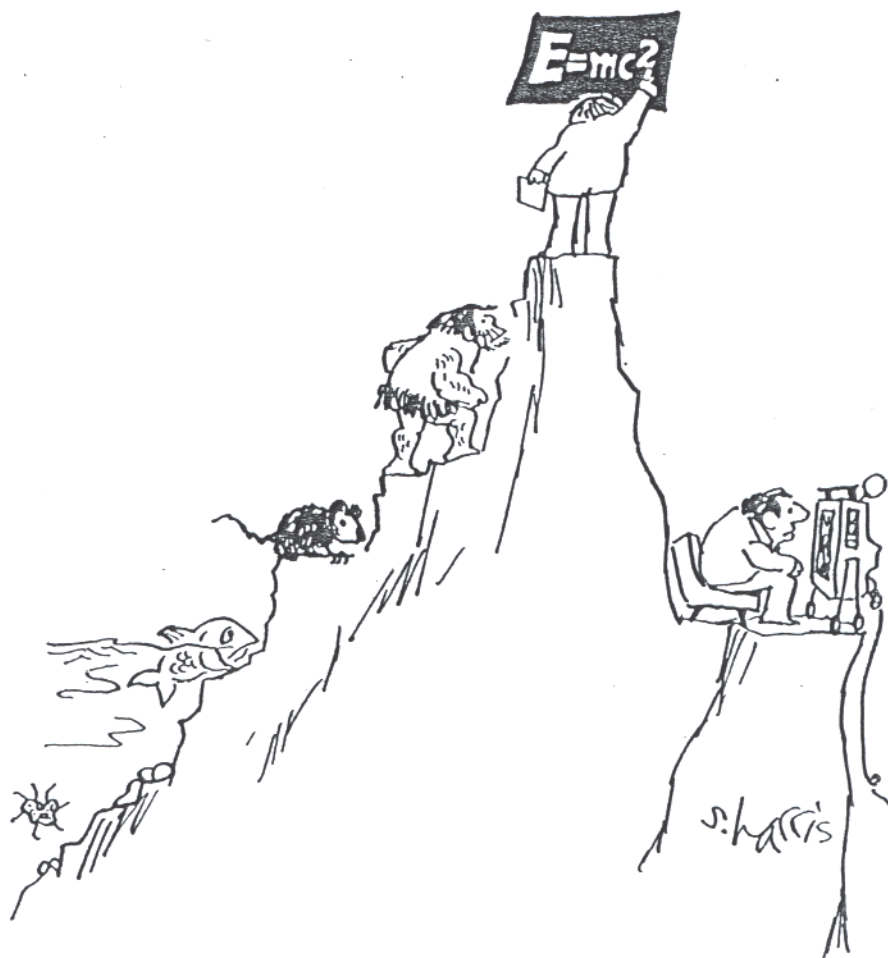


Name _____

Physics 100 Midterm II (practice)

[speed = $\frac{\text{distance}}{\text{time}}$; time = $\frac{\text{distance}}{\text{speed}}$; distance = speed \times time]
[Work = $F \cdot d_{\parallel}$; $K.E. = \frac{1}{2}mv^2$; grav. $P.E. = mgh$; momentum = $m\vec{v}$]
[$F_{\text{grav}} = G \frac{m_1 m_2}{d^2}$, $G = 6.7 \times 10^{-11} \frac{Nm^2}{kg^2}$; $g = G \frac{M_{\text{Earth}}}{R_{\text{Earth}}^2} = 10 \frac{m}{s^2}$]
[$F_{\text{elec}} = k \frac{q_1 q_2}{d^2}$, $k = 9 \times 10^9 \frac{Nm^2}{coul^2}$; $F_{\text{mag}} = \kappa \frac{I_1 I_2 \ell}{d}$, $\kappa = 2 \times 10^{-7} \frac{N}{A^2}$]
[current = $\frac{\text{coulombs}}{\text{elapsed time}} = \frac{\text{voltage}}{\text{resistance}}$; power = current \times voltage]
[wave speed = frequency \times wavelength; wavelength = $\frac{\text{wave speed}}{\text{frequency}}$]
[c = speed of light in vacuum = $3 \times 10^8 m/s$; $E = mc^2$; $\gamma = \frac{1}{\sqrt{1-v^2/c^2}}$]

Answer all 20 Questions.



1. Maxwell's theory indicated that light is a wave:
 - a) of mutually perpendicular \vec{E} - and \vec{B} -fields.
 - b) that is totally unrelated to radio waves.
 - c) that is sometimes only \vec{E} -fields and other times only \vec{B} -fields.
 - d) all of the above.

2. Which of the following statements is true?
 - a) \vec{E} -fields are produced by electric currents.
 - b) Changing \vec{E} -fields produce \vec{B} -fields.
 - c) Changing \vec{B} -fields do not produce \vec{E} -fields.
 - d) \vec{E} -field lines never end.
 - e) \vec{B} -field lines start on + charges and end on - charges.

3. Which of the following statements is not true?
 - a) Electrical forces can be attractive and repulsive.
 - b) The electrical force between two charges separated by a distance d is proportional to $1/d^2$.
 - c) In atoms, the electrical force keeps electrons in orbit around the positively charged nucleus.
 - d) The electrical forces between the electrons and the nucleus of an atom are much bigger than the gravitational force.
 - e) The gravitational forces between the electrons and the nucleus of an atom are much bigger than the electrical force.

4. The microwaves in an ordinary microwave oven have a wavelength in empty space $\lambda = 0.02$ m. What is their frequency?
 - a) 6×10^{-10} Hz.
 - b) 6.7×10^{-11} Hz.
 - c) 1.5×10^{10} Hz.
 - d) 6×10^{10} Hz.
 - e) 1.5×10^6 Hz.

5. Light from lasers shines through narrow slits and produce the intensity patterns as shown in the figures. What are the slit arrangements for the two cases?

- a) upper: single slit; lower: double slit
- b) upper: single slit; lower: single slit
- c) upper: double slit; lower: single slit
- d) upper: double slit; lower: single slit

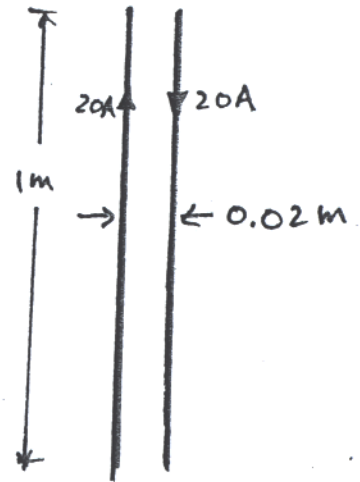


6. The speed of light is related to which of the following?

- a) The ratio of the strengths of the electric and gravitational forces.
- b) The ratio of the strengths of the magnetic and gravitational forces.
- c) The ratio of the strengths of the electric and magnetic forces.
- d) None of the above.

7. Two 1-m long parallel wires are separated by a distance of 0.02m and each carry a current of 20A in *opposite* directions. The force between the wires is

- a) 4×10^{-9} N.
- b) 8×10^{-7} N.
- c) 2×10^{-5} N.
- d) 4×10^{-3} N.
- e) 2×10^{-1} N.



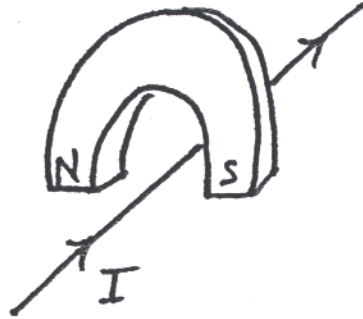
8. The forces on the two wires in the previous question

- a) pushes the wires apart.
- b) pulls the wires together.
- c) pulls the left wire out of the page.
- d) pushes the left wire into the page.

9. Two positive 20 Coulomb electric charges are separated by a distance of 0.02m. The force between the charges is
- 9×10^9 N.
 - 9×10^{11} N.
 - 4.5×10^{15} N.
 - 9×10^{15} N.
 - 1.8×10^{16} N.

10. A wire carrying an electric current is placed near a magnet as shown. The force that the magnet exerts on the wire is

- upward.
- downward.
- to the right.
- to the left.

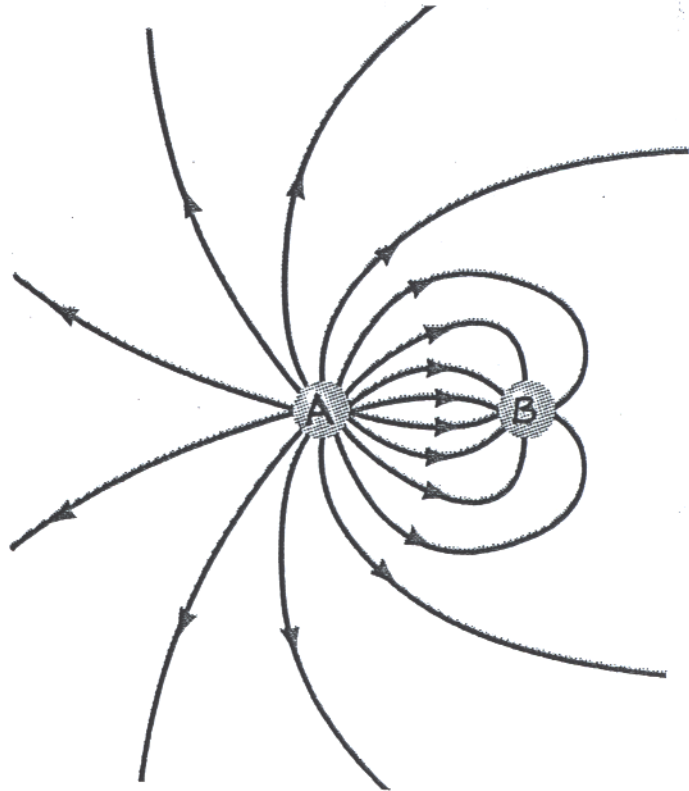


11. Two charges (indicated by A and B) produce an \vec{E} -field as shown. Which one of the following statements about the signs of A and B is true?

- A is positive, B is negative.
- A is negative, B is positive.
- Both A and B are positive.
- Both A and B are negative.

12. For charges A and B in the previous question: Which of the following statements about the magnitudes of the charges A and B is true?

- A is bigger than B.
- A is smaller than B.
- A and B are the same.
- Not enough information to tell.



13. Lenz' law states that the magnetic field created by an induced electric current
- a) is always zero.
 - b) is directed so as to increase the influence that produced it.
 - c) is always the same no matter how it is produced.
 - d) is directed so as to oppose the influence that produced it.
14. Suppose that an astronaut travels to the star α -centauri, which is 4.3 cyr (light years) from the Earth, on a rocket ship at a speed of $v = 0.9c$ (i.e. 90% of the speed of light. Her twin brother remains at home, studying physics at the UH, (For $v = 0.9c$, $\gamma = 2.3$) According to *her* clock on *her rocket ship*, how long does it take her to get to α -centauri?
- a) 4.3 yrs.
 - b) 3.9 yrs.
 - c) 4.8 yrs.
 - d) 1.7 yrs.
 - e) 2.1 yrs.
15. In reference to the woman-twin's trip in the previous problem: If, when measured when it is at rest, the rocket ship is 100 m long, how does it appear to the two twins during the trip?
- a) she: 100 m; he: 43.5 m.
 - b) she: 43.5 m; he: 100 m.
 - c) she: 43.5 m; he: 43.5 m.
 - d) she: 100 m; he: 100 m.
 - e) she: 100 m; he: 230 m.
16. Still in reference to the woman-twin's trip of question 14: After she reaches α -centauri, the space-travelling twin immediately turns around and returns to Earth at the same speed. When she returns she finds that
- a) she and her twin brother have aged by the same amount.
 - b) she has aged less than her brother.
 - c) she has aged more than her brother.
 - d) she is younger than when she started on her trip.

17. According to Einstein, the speed of light in empty space is 3×10^8 m/s:
- a) only in the restframe of the luminiferous Aether.
 - b) to all observers regardless of their state of motion.
 - c) only to observers that are at rest relative to the light source.
 - d) at only one time of the year; other times it is different.
18. The Sun's total power output is 4×10^{26} Watts (Joules/sec). How much of the Sun's mass is converted to energy each second?
- a) 3.6×10^{42} kg.
 - b) 4.4×10^9 kg.
 - c) 1.3×10^{18} kg.
 - d) 1.4×10^{12} kg.
19. When Isaac Newton wrote down his laws of motion, he implicitly assumed that they worked equally well in every direction. What conservation law does this imply?
- a) Conservation of momentum.
 - b) Conservation of angular momentum.
 - c) Conservation of energy.
 - d) Conservation of electric charge.
20. The temperature *absolute zero* (-273°C or -460°F) is the lowest temperature possible. What happens at absolute zero that makes this the lowest possible temperature?
- a) The speed of light becomes very slow.
 - b) The energy of the random thermal atomic motions disappears.
 - c) Water starts to freeze.
 - d) Electrons stop orbiting atoms.