

WLHS AP Physics Final Exam
May 25, 2023
No calculators or other electronic devices.

Exam, Form:

A

Name: _____

Student Number: _____

TA: _____

Date: _____

Short answer questions (12 pts): You will be graded on the clarity and correctness of your answer.

1. Grandma says that it is quicker to bake a potato if you put a nail in it. In fact, she is correct. Justify her baking technique in terms of one of the three processes of heat transfer.

2. You are stranded in the mountains in bitterly cold weather. You have a thin mylar (shiny metallic foil) blanket. When would you wrap yourself in the blanket: during the day or during the night? Explain your answer.

3. An overhead electrical power line carries a constant electric current due northward. You have a small circular loop of copper wire in your pocket. Can you generate an electrical current in the loop by simply moving it around under the power line? Explain. What physics law are you using?

4. When measuring the width of your hair in the laboratory, you used a red laser beam and observed the interference fringes on a sheet of paper behind the hair. If you used a blue laser beam instead, would the fringes become more or less widely spaced? Explain.
5. Sitting on the beach, wearing a pair of polaroid sunglasses, you notice little discomfort due to glare from the water on a bright sunny day. When you lie on your side, however, you notice the glare increase. Why?
6. A neutron is fired at a uranium-235 nucleus. The resulting fission of the uranium releases Barium-141, Krypton-92 and three neutrons. Write down this fission reaction formula.

Heat and Entropy (10 pts): A hot lead bullet (specific heat 0.1 joules/gram celsius) is submerged in a cool water bath (specific heat 4 joules/gram celsius). The mass of the bullet and the water are both 500 grams. During a short time interval, Δt , a small amount of heat, ΔQ , flows from the bullet into the water. During this short time interval,

7. Does the entropy of the bullet increase or decrease? Explain, using an appropriate mathematical formula if possible.

8. Does the entropy of the water increase or decrease?

9. Does the overall entropy of the bullet and the water increase or decrease? Explain.

10. Does the temperature of the water or the bullet change more during this time interval?

11. If the original temperature of the bullet was 200 degrees celsius, and the water was 20 degrees celsius, then what is the (approximate) final temperature of the water and bullet when they eventually come to thermal equilibrium?

Charged particle in an electric and magnetic field (8 pts): A special gun in the laboratory shoots a beam of positively charged particles ($q = 1 \times 10^{-18}$ coulombs) across a laboratory bench in the northward direction at a speed of 1×10^7 meters/second. After leaving the barrel, the beam proceeds through a region of space in which there is a uniform electric field pointing directly eastward. The electric field strength is 1000 volts per cm.

12. How much force does the electric field exert on the traveling particles? In which direction is this force acting? In other words, which way does the beam swerve?

13. In order to make the beam travel in a straight line (instead of a curved line) through the electric field, a magnetic field can be turned on. In which direction (north, south, east, west, up or down) must the magnetic field be directed? What must be the strength of the magnetic field so that the beam travel in a straight line?

14. If the electric field is turned off, which direction does the beam now swerve?

15. When the electric field is turned off, the radius of curvature is found to be 10 cm. What is the mass of the charged particle?

Electronic circuit (10 pts): Two resistors (1 ohm and 2 ohms) are placed in series. The series of resistors is then attached across the terminals of a 12 volt battery.

16. Make a sketch of this electronic circuit.

17. When the battery is turned on, how much electrical current is drawn from the battery?

18. What is the voltage at a point between the two resistors?

19. How much (heat) power is generated in 2 ohm resistor?

20. If a 3 ohm resistor is now attached in parallel to the series containing the 1 and 2 ohm resistors, would the current being drawn from the battery increase or decrease? What would be the new current drawn from the battery?