Physics 161 - Final Exam
Prof. Chandra
December 20, 2019

PHYSICS 161, SECTION
RUID:
CODE: 289

Your name with exam code
Your signature

Turn off and put away cell phones now!

1. The exam will last from 8:00 AM to 11:00 AM.
2. Use a #2 pencil to make entries in the circles at the bottom of the cover sheet.
3. During the exam, you may use pencils, a calculator, and one handwritten 8.5 x 11 inch sheet with formulas and notes, without attachments.
4. There are 30 multiple-choice questions on the exam. For each question mark only one answer on the answer sheet. There is no deduction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess.
5. At the end of the exam, hand in only the cover sheet. Retain the question sheets for future reference and study.
6. When you are asked to open the exam, make sure that your copy contains all 30 questions. Raise your hand if this is not the case, and a proctor will help you. Also raise your hand during the exam if you have a question.

BATHROOM RULE: ONE PERSON AT A TIME

Good Luck!

No marks except filled in answer circles below the line, please.
1. In a typical ultrasound scan, the waves travel through body tissue with a speed of 1500 m/s. For a good detailed image, the wavelength should be no more than 1.0 mm. What frequency of sound is required for a good scan?
   a) 1,500,000 rads/sec
   b) 1,500,000 Hz
   c) 15,000,000 Hz
   d) 1,500,000 sec
   e) 1,500,000 rpm

2. The intensity level of sound is measured in
   a) Watts/meter
   b) Decibels
   c) Beats/sec
   d) Hertz
   e) Joule/meter²

3. Which of the following will increase the speed of sound in air?
   a) Decreasing the air temperature
   b) Increasing the frequency of the sound
   c) Increasing the air temperature
   d) Increasing the amplitude of the sound wave
   e) Reducing the pressure of the air

4. Suppose you are on a hot air balloon ride, carrying a buzzer that emits a sound of frequency \( f \). If you accidentally drop the buzzer over the side while the balloon is rising at constant speed, what can you conclude about the sound you hear as the buzzer falls towards the ground?
   a) The frequency and intensity increase
   b) The frequency decreases and the intensity increases
   c) The frequency decreases and the intensity decreases
   d) The frequency remains the same, but the intensity decreases
   e) The frequency increases and intensity decreases

5. A 100 W light bulb is accidentally left on for ten hours in a basement. If electricity costs $0.10/kWh, how much does this oversight cost?
   a) $0.01
   b) $10.00
   c) $100.00
   d) $0.10
   e) $1.00

6. Two cubical objects made from the same material have different masses (m and 3m) and different initial temperatures (20°C and 60°C) as shown. If the bodies are placed in thermal contact, the final temperature is most nearly
   a) 20 °C
   b) 30 °C
   c) 40 °C
   d) 47 °C
   e) 50 °C
13. Two similarly charged particles are approximately 50 fm apart. What happens?
   a) The particles repel each other due to the Coulomb effect
   b) The particles don’t move as the Coulomb effect balances out the nuclear force
   c) The particles move closer due to the vastly stronger nuclear force
   d) The particles attract each other due to the Coulomb effect
   e) This cannot be determined without more information such as particle mass and charge

14. Kirchhoff’s junction rule is equivalent to which of the following principles?
   a) Conservation of charge
   b) Conservation of energy
   c) Conservation of mass
   d) Conservation of momentum
   e) Conservation of force

15. Which statement below is correct about the currents in this circuit?
   a) $I_1 = 0.83 \, A$
   b) $I_1 = 0.30 \, A$
   c) $I_2 = 1.8 \, A$
   d) $I_3 = 2.5 \, A$
   e) $I_1 = 0.15 \, A$

16. Many medical devices, including the electro-cardiogram machine, contains resistors. From the diagram below, what is the resistance if the power produced by the resistor is 0.172 mW and each of the three battery’s voltages is 1.5 V?

   \[ R \]
   \[ \text{batteries} \]
   a) 13 Ω
   b) 118 Ω
   c) 13 kΩ
   d) 118 kΩ
   e) 26 kΩ

17. Astronauts on the space station in a circular orbit around Earth are weightless because
   a) the net force on them is zero
   b) space is a vacuum
   c) they are far from the Earth so gravity has a minimal effect
   d) they fall resulting in a circular orbit around Earth
   e) The gravitational and normal forces cancel out

18. A collection of four identical machines creates a decibel level of $\beta = 87.0 \, dB$ in a machine shop. What intensity level would be created by only one such machine?
   a) 83 dB
   b) 70 dB
   c) 71 dB
   d) 80 dB
   e) 81 dB
25. An ideal gas in a container moves from state 1 to state 2, as illustrated in the graphs below. What could be causing this change?
   a) The pressure is increasing.
   b) The gas temperature is increasing.
   c) The volume is decreasing.
   d) Gas is being removed from the container.
   e) Gas is being added to the container.

26. In 6 hours, 15 percent of a radioactive material decays. What is its half-life?
   a) 12.8 hours
   b) 25.6 hours
   c) 68.6 hours
   d) 60.0 hours
   e) 40.0 hours

27. In a nuclear decay reaction $^{95}_{36}Kr \rightarrow \frac{4}{2}X + e^- + \bar{\nu}$, the final nucleus has $(A, Z)$ equal to
   a) (95, 36)
   b) (94, 35)
   c) (91, 34)
   d) (96, 35)
   e) (95, 37)

28. Two blocks of masses 24 kg and 9 kg are connected together by a light string and rest on a frictionless level surface. Attached to the 9-kg mass is another light string, which a person uses to pull both blocks horizontally. If the two-block system accelerates at 0.6 m/s$^2$ what is the tension in the connecting string between the blocks?
   a) 19.8 N
   b) 9.0 N
   c) 14.4 N
   d) 5.4 N
   e) 40 N

29. A 80 kg man standing on frictionless ice throws a 1.00 kg mass at 21.0 m/s at an angle of elevation of 30.0°. What is the magnitude of the man's momentum immediately after throwing the mass?
   a) 42.0 kg·m/s
   b) 24.2 kg·m/s
   c) 18.2 kg·m/s
   d) 10.5 kg·m/s
   e) 0.227 kg·m/s

30. A ball is thrown vertically up and reaches a maximum height of 2.0 m. What is its speed as it passes the height of 1.0 m?
   a) 4.4 m/s
   b) 6.0 m/s
   c) 8.5 m/s
   d) 3.1 m/s
   e) 6.3 m/s