Instructor(s): Professor Meisel

PHYSICS DEPARTMENT

PHY 2020 Mid-term Exam 3 22 Nov 2005; 8:20 – 10:10 pm, NPB 1001

Name (print, last first): ________________________________ Signature: ________________________________

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(1) Code your test number on your answer scansheet (use lines 76–80 for the 5-digit number). Code your name and UFID on your answer sheet. Do not insert a hyphen or space into your UFID.

(2) Blacken the circle of your intended answer completely, using a #2 pencil or black pen. Do not make any stray marks, or your sheet may not scan correctly.

(3) Print your name on this exam paper and sign it after reading the “Honor Code” statement.

(4) Do all scratch work on this exam and on the scratch paper provided. When you finish, place your scratch paper inside this exam paper and return all the materials to the Proctor. No credit will be given unless the scan sheet, exam paper, and scratch paper are all returned.

(5) Write your test number onto your formula sheet and take it home. It is your record of taking this exam.

(6) For each problem, choose the answer that is closest to exact. (We suggest you work all problems to at least three significant figures.) Assume that given angles are exact.

(7) You may have only the following items on your desk:
   • Calculator (graphing calculator is OK);
   • Four sheets of approved notes (8.5 inch × 11 inch); No other aids are allowed or required;
   • Scratch paper (as provided by proctors);
   • Pen/pencil & eraser;
   • UF Gator-one ID card.

Other than your calculator and your wristwatch, you may not have any other electronic devices in your sight (no cell phones, PDAs, pagers, iPods, etc.)

(8) All of the problems will be graded and will be tabulated to generate a final score. Therefore, you should submit work for all of the problems.

(9) All work must be shown to receive full credit. Work must be clear and unambiguous. Be sure that you hand your completed work to the Proctor.

(10) Each problem is worth 5 points.

(11) Following the UF Honor Code, your work on this examination must reflect your own independent effort, and you must not have given, nor received, any unauthorized help or assistance.

On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” If true, please initial here: ______

DO NOT OPEN EXAM UNTIL INSTRUCTED
1. In order to receive credit for this problem, you must correctly code ("bubble") both your 8-digit UFID and your 5-digit test number onto your scan sheet and also select the correct response below. Check right now that both numbers are correctly bubbled. Code your UFID as if it were an ordinary 8-digit number and do not insert a blank space or hyphen in the middle.

   (1) I have correctly bubbled my UFID and test number.
   (2) I don’t think this is important.
   (3) I bubbled the wrong test number.
   (4) I don’t have time to check.
   (5) I bubbled the wrong UFID.

2. If natural gas gives off 1031 BTU/ft$^3$ when burned, how much natural gas will be needed to heat a house that requires $4.2 \times 10^7$ kcal for the entire winter? Assume that an additional 30 percent of the heat is lost to the local environment (i.e. not the house). You may wish to know that $1 \text{ BTU} = 0.252 \text{ kcal}$ and $1 \text{ ft}^3 = 0.0283 \text{ m}^3$.

   (1) $2.1 \times 10^5 \text{ ft}^3$
   (2) $5.3 \times 10^5 \text{ ft}^3$
   (3) $4.1 \times 10^4 \text{ ft}^3$
   (4) $1.6 \times 10^4 \text{ ft}^3$
   (5) $7.8 \times 10^3 \text{ ft}^3$

3. A heat engine utilizes a heat source at 550°C and has an ideal efficiency of 30 percent. To increase the efficiency to 35 percent, what must be the temperature of the heat source?

   (1) None of these values are correct.
   (2) 555°C
   (3) 687°C
   (4) 585°C
   (5) 960°C

4. Your cellular phone receives and transmits at a frequency near 1 GHz. These signals travel close to the speed of light. What are the wavelengths of these signals?

   (1) 0.3 m
   (2) 3.3 m
   (3) 300 m
   (4) 3.3 mm
   (5) 3.3 μm

5. An unfingered violin string vibrates at 294 Hz. If the string is now fingered one-third of the way from the tuning end, what is the new frequency of the vibrating part?

   (1) 411 Hz
   (2) 294 Hz
   (3) 196 Hz
   (4) 882
   (5) Not enough information is given to answer this question.

6. Particles of charge $+86 \mu\text{C}$ (left), $-48 \mu\text{C}$ (center), and $+90 \mu\text{C}$ (right) are placed on a line, and their orientation with respect to one another is given by the left, center, right designations. The center charge is 1.0 m from the other two charges. What is the net force experienced by the charge on the right?

   (1) None of the choices listed are correct.
   (2) 34.8 N and toward the right
   (3) 38.9 N and toward the left
   (4) 4.1 N and toward the right
   (5) zero

7. How much heat is produced by a 1 kW iron in 15 minutes?

   (1) 0.9 MJ
   (2) 15 kJ
   (3) 1 kW
   (4) 15 kW
   (5) 0.25 kW

8. An ordinary flashlight uses two 1.5 V batteries. What is the voltage applied to the bulb?

   (1) 3.0 V
   (2) 1.5 V
   (3) 0.3 V
   (4) 0.5 V
   (5) 1.0 V
9. Consider two charges to be located on a line. A charge of \(-2Q\) is located at the origin \(x = 0\). A charge of \(Q\) is located at \(x = 1\) m. What is the electric field at a point \(P\) located at \(x = 2\) m? The magnitude in units of \(\text{m}^{-2}\) is listed first, and then the direction is given.

(1) 0.5 kQ, +x direction
(2) kQ, - x direction
(3) 2 kQ, + x direction
(4) 0.5 kQ, - x direction
(5) kQ, + x direction

10. What was the average speed of the Tsunami of December 2004?

(1) 330 miles per hour  (2) 100 miles per hour  (3) 75 miles per hour  (4) 1,000 miles per hour  (5) 40 miles per hour

11. Professor Meisel performed or attempted several demonstrations of mechanical resonance. Which of the choices listed was NOT performed in class to demonstrate this phenomenon?

(1) blowing a whistle
(2) mass oscillating on the end of a spring
(3) punching bag mass oscillating on a rope
(4) reciprocating “flappers” of different lengths
(5) shaking his hanging car keys back and forth

12. From a reference book, you are able to find the specific heats of ice (0.55 kcal/(kg K)), liquid water (1.00 kcal/(kg K)), and steam (0.48 kcal/(kg K)). In addition, you find that the latent heat of vaporization at the steam point at 1 bar is 538 kcal/kg and the latent heat of fusion at the melting point at 1 bar is 80 kcal/kg. So, suppose you purchased 100 kg of ice which was at a temperature of \(-5^\circ\text{C}\). How much heat would be needed to melt all of the ice and to bring the resulting liquid water to ambient temperature of \(25^\circ\text{C}\)?

(1) 10775 kcal  (2) \(2.75 \times 10^2\) kcal  (3) \(8.0 \times 10^3\) kcal  (4) \(2.5 \times 10^3\) kcal  (5) Not enough information given to answer.

13. A fisherman notices that wave crests pass the bow of his anchored boat every 2.0 s. He measures the distance between two crests to be 5.0 m. How fast are the waves traveling?

(1) 2.5 m/s  (2) 2.0 m/s  (3) 1.5 m/s  (4) 10 m/s  (5) 3.0 m/s

14. A diver produces a sound by striking the hull of her ship beneath the waterline and hears the echo of the wave reflected from the bottom 1.5 s later. How deep is the ocean at this point and what kind of waves are being heard? The speed of sound in water is approximately 1440 m/s.

(1) 1080 m and longitudinal
(2) 1080 m and transverse
(3) 540 m and longitudinal
(4) 540 m and transverse
(5) None of the possible choices are correct.

15. Consider the circuit in Figure “Circuit 1”. What is the total current delivered by the battery?

(1) 0.9 A  (2) 5 A  (3) 0.2 A  (4) 0.3 A  (5) 0.6 A

16. (CONTINUATION) What is the voltage drop across the 25 Ω resistor?

(1) 15 V  (2) 24 V  (3) 9 V  (4) 0 V  (5) 12 V
17. A music concert is measured to produce sound at the level of 120 dB. The rush-hour traffic at the corner of 13th and University is measured to produce sound at a level of 70 dB. The intensity of the sound from the music concert is \( \frac{120}{70} = \frac{12}{7} \) times greater than the intensity of the sound from the traffic. What is the intensity?

(1) 10^5 (2) 50 (3) 10^4 (4) 190 (5) The correct value is not listed as an option.

18. Imagine that you connect three 2 Ω resistors so that all three are NEITHER in parallel NOR in series. Find the effective resistance of the two possible configurations.

(1) 1.3 Ω and 3.0 Ω
(2) 1.0 Ω and 6.0 Ω
(3) 0.7 Ω and 6.0 Ω
(4) 1.0 Ω and 3.0 Ω
(5) Not enough information is given to answer this question.

19. A car moving at 15 m/s with its horn sounding at a frequency of 600 Hz is heard by the driver of this car. The truck moving at 20 m/s. What is the apparent frequency of the horn as heard by the driver of the truck? (For this problem, consider the speed of sound to be 340 m/s.)

(1) 591 Hz (2) 600 Hz (3) 582 Hz (4) 618 Hz (5) 609 Hz

20. On the page where the figures are located, you will find a boxed region entitled “Sketch of My Refrigerator”. For 5 points, please provide a sketch of the major components of your refrigerator, as discussed in class and in the textbook, and bubble the correct response on your answer sheet.

(1) I have made a sketch of the major components of a standard household refrigerator.
(2) I have skipped this question.
(3) I cannot sketch.
(4) I am cold, does that count?
(5) I will think about this question over the T-Day break.
Circuit 1

Sketch of My Refrigerator
THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 16