PHYSICS 116 PRACTICE EXAM 3B

Seat No_____

Last Name (Print): _____ First Name (Print): _____

Honor Pledge: *All work presented here is my own.*

Signature: _____ Student ID: _____

READ THIS ENTIRE PAGE NOW
Do <u>not</u> open the exam until told to do so.
You will have <u>110 minutes</u> to complete the examination.

<u>NO</u> CELL PHONES, TEXT MSG, etc. ALLOWED AT ANY TIME.

Before the exam begins:

- Print and sign your name, and write your student ID number in the spaces above.

During the exam

- When the exam begins, print your name and student ID number on the top of each page. Do this first when you are told to open your exam.
- If you are confused about a question, raise your hand and ask for an explanation.
- If you cannot do one part of a problem, move on to the next part.
- This is a closed book examination. All equations and constants are provided.
- You may use a calculator, but not a computer, or other internet connected devices (smart-phones, iPads, etc.).

For multiple-choice questions:

- Clearly circle your answer choice. Make no stray marks. If you must erase, erase completely.

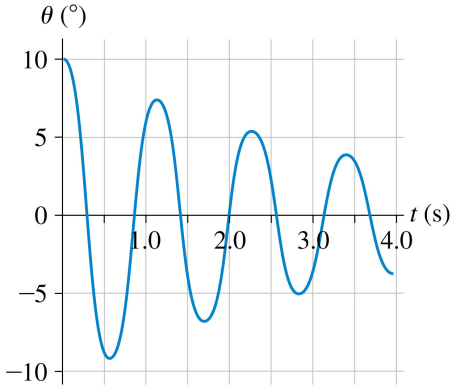
End of exam:

- Out of respect to other students, please remain seated for the last 20 minutes of the exam. At the end of the exam, please remain seated until all exams have been collected

Name: _____ **Student ID** _____ **Score** _____
last *first*

Answer Questions 1 through 16 on your scantron form. Fill in the bubble(s) corresponding to the correct answer fully and erase marks of unwanted choices. Only one choice is correct. Please write your name on ALL the paper you use.

1. [5 pts] The graph at right shows the angular oscillation of a damped pendulum with time. Estimate the time constant for this damped oscillation.
   a. 0.3 s
   b. 1.2 s
   c. 2.5 s
   d. 3.6 s
   e. 4.3 s



2. [5 pts] When the standing wave pattern in a pipe is NANA, the pipe has which of the following set of properties? (N stands for node, A for antinode.)
   a. It is open at both ends.
   b. It is closed at both ends.
   c. It is open at one end and closed at the other end.
   d. Any of the above could be true.

3. [5 pts] Unpolarized light of intensity $2.0 \times 10^{-2}\mathrm{W/m^2}$ is incident on a polarizer sheet whose axis is aligned vertically, then light passes through an analyzer (a second polarizer sheet) whose axis makes an angle of 25° above the horizontal. What's the intensity that passes through the combination?
   a. $0.42 \times 10^{-2}\mathrm{W/m^2}$
   b. $0.36 \times 10^{-2}\mathrm{W/m^2}$
   c. $1.6 \times 10^{-2}\mathrm{W/m^2}$
   d. $0.82 \times 10^{-2}\mathrm{W/m^2}$
   e. $0.18 \times 10^{-2}\mathrm{W/m^2}$

4. [5 pts] A ray of light is incident on the mid-point of a glass prism surface at an angle of 25.0° with the normal. For the glass, n = 1.55, and the prism apex angle is 30.0°. What is the angle of refraction as the ray enters the air on the far side of the prism?
   a. 14.1°
   b. 22.3°
   c. 28.4°
   d. 46.0°

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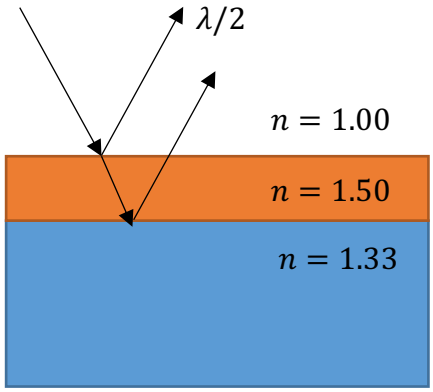
5. [5 pts] A researcher measures the thickness of a layer of benzene ($n = 1.50$) floating on water ($n = 1.33$) by shining monochromatic light onto the film and varying the wavelength of the light. She determines the thickness to be 120 nm. What is the largest wavelength (measured in vacuum) that is reflected most strongly from the film?
    a. 90 nm
    b. 320 nm
    c. 370 nm
    d. 640 nm
    e. 720 nm



6. A container of water ($n = 1.333$) has a flat layer of ice on top ($n = 1.309$) of it. If a beam of light originates from the water, what's the minimum angle of incidence on the ater-ice-interface would no light penetrate through the ice?
    a. 89.53°
    b. 79.11°
    c. 41.17°
    d. 37.03°
    e. The situation described is not possible.

7. [5 pts] A candle with a height of 20 cm is 50 cm from a concave mirror with a focal length of 30 cm. Determine the height and orientation of the image of the candle.
    a. 30 cm and inverted
    b. 0.38 cm and upright
    c. 0.38 cm and inverted
    d. 7.5 cm and upright
    e. 7.5 cm and inverted

8. [5 pts] Light with a frequency of 5.3×10^{14}Hz illuminates one narrow slit with a width of 1.7×10^{-6}m. How many bright fringes are produced?
    a. None.
    b. 3
    c. 4
    d. 5
    e. 6

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Use the following situation to answer the next two questions
Alicia wears corrective lenses with a refractive power of –1.5.

9. [5 pts] Based on the refractive power of her lenses, which of the following problems can you conclude that her eyes may have?
    a. The ability of her eyes' ciliary muscle to shorten their lens' focal length is impaired.
    b. Her eyeballs are too short; her eyes' lenses are too close to her retina.
    c. Her eyeballs are too long; her eyes' lenses are too far from her retina.
    d. She does not have enough rods or cones in her retina.
    e. More than one of the choices above could be her problem.

10. [5 pts] If an object is placed 2.5 m from her corrective lenses, where from the lens does the image form? Can this image be projected on a screen?
    a. 0.27 m, No
    b. 0.27 m, Yes
    c. 0.53 m, No
    d. 0.53 m, Yes
    e. 0.91 m, Yes

11. [5 pts] A person has a near point of 1.5 m. What refractive power lenses would he need to focus on a newspaper held at a comfortable distance of 0.25 m?
    a. -3.3D
    b. -0.30D
    c. 0.21D
    d. 0.30D
    e. 3.3D

Use the following scenario for the following two questions.
The work function of the metal in a photoelectric effect apparatus is 3.7×10^{-19}J. Monochromatic light with a frequency of 1.1×10^{15}Hz illuminates the cathode metal surface, causing electrons to be emitted.

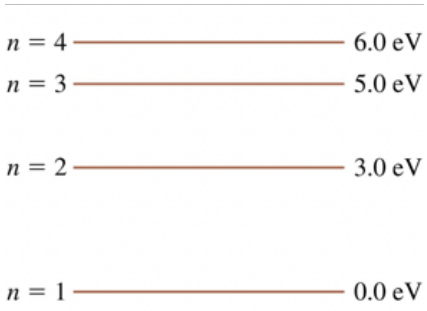
12. [5 pts] What is the minimum wavelength of the ejected electrons? The mass of an electron is 9.1×10^{-31}kg. Hint: the kinetic energy of a particle, K, can be expressed in terms of its momentum, p, as $K = \frac{p^2}{2m}$, where m is the mass of the particle.
    a. Not applicable as electrons do not have wavelength.
    b. 5.8×10^{-10}m
    c. 8.2×10^{-10}m
    d. 1.2×10^{-10}m
    e. 2.7×10^{-10}m

13. [5 pts] If the intensity of the light hitting the cathode surface remains the same, but the frequency of the light shining on the cathode is increased, what will happen to the number and the maximum kinetic energy of ejected electrons?

a. Less electrons would be ejected, and the maximum kinetic energy of the ejected electrons would increase.
b. Less electrons would be ejected, and the maximum kinetic energy of the ejected electrons would decrease.
c. More electrons would be ejected, and the maximum kinetic energy of the ejected electrons would increase.
d. More electrons would be ejected, and the maximum kinetic energy of the ejected electrons would decrease.
e. Fewer electrons would be ejected with the same maximum kinetic energy.

14. [5 pts] A beam of electrons, a beam of protons, and a beam of oxygen atoms each pass at the same speed through a very narrow slit. Which will produce the widest diffraction central maximum?
    a. The beam of electrons.
    b. The beam of protons.
    c. The beam of oxygen atoms.
    d. All three patterns will be the same.
    e. None of the beams actually produce diffraction patterns.

Use the following scenario for the following three questions. Consider a type of atoms with energy levels as shown at right.



15. [5 pts] What is the longest wavelength of light in the absorption spectrum of a gas of these atoms?
    a. 2.1×10^{-7}m
    b. 2.5×10^{-7}m
    c. 4.1×10^{-7}m
    d. 6.2×10^{-7}m
    e. 2.1×10^{-6}m

16. [5 pts] A beam of electrons with 5.8 eV kinetic energy collides with a gas of these atoms in the ground state. What is the largest energy of photons in the emission spectrum?
    a. 2.0 eV
    b. 3.0 eV
    c. 5.0 eV
    d. 5.8 eV
    e. 6.0 eV

17. [5 pts] The emission spectrum of a gas shows 15 lines. What is the minimum number of energy levels required to produce these 15 lines?
    a. 4
    b. 5

c. 6
d. 10
e. 15

Use the following scenario for the following three questions.
Consider an isotope of radon, $^{222}_{86}$Rn, which alpha-decays with a half-life of 3.8 days.

18. [5 pts] Compare the binding energy per nucleon of $^{222}_{86}$Rn and that of the decay products. Which is larger?
    a. The binding energy per nucleon of $^{222}_{86}$Rn is larger.
    b. The binding energy per nucleon of the decay products is larger.
    c. The binding energy per nucleon is the same for $^{222}_{86}$Rn and its decay products.
    d. The answer depends on which daughter isotope is produced in the decay.

19. [5 pts] How many neutrons are there in the nucleus of the daughter isotope?
    a. 84
    b. 134
    c. 136
    d. 137
    e. 218

20. [5 pts] Suppose that you initially had a sample of 4.0 g of $^{222}_{86}$Rn gas. What is the mass of the remaining $^{222}_{86}$Rn gas after 4.5 days?
    a. 0.44g
    b. 0.74g
    c. 1.8g
    d. 2.0g
    e. 3.4 g

21. [5 pts] A pure sample of ^{226}Ra contains 2.0×10^{14} atoms of the isotope. If the half-life of ^{226}Ra = 1.6×10^{3} years, what is the decay rate of this sample?
    a. 2.7×10^{-12} Ci
    b. 3.4×10^{-10} Ci
    c. 7.4×10^{-8} Ci
    d. 9.6×10^{-6} Ci

22. [5 pts] The Paschen series of hydrogen corresponds to electron transitions from higher levels to $n = 3$. What is the shortest wavelength in that series?
    a. 820 nm
    b. 365 nm
    c. 1 094 nm

d. 313 nm

23. [5 pts] 1.2 Gy of gamma radiation are directed into 0.25 kg tumor. How much energy does the tumor absorb?
    a. 0.20J
    b. 0.30J
    c. 3.3J
    d. 4.8J
    e. 6.0 J

24. [5 pts] The person exposed to waste from a nuclear accident absorbs 0.30 J of energy from beta-decays of ^{90}Sr in their skeleton in 30 days. If the person's mass is 65 kg, and the skeleton forms 17% of the person's body mass, what dose equivalent in Sv will be received by the person's skeleton in the 30 days? The RBE of beta particles is 1.
    a. 0.0046 Sv
    b. 0.027 Sv
    c. 0.14 Sv
    d. 0.81 Sv
    e. 1.8 Sv