Your code is: AABDJE

Put your name here:

Keep this exam **CLOSED** until advised by the instructor.

Fill out the bubble sheet: last name, first initial, student number, section number and **code**.

60 minute long closed book exam.

A two-sided 8.5 by 11 handwritten help sheet is allowed.

When done, hand in your **bubble sheet** and your **exam**.

Possibly useful constants:

- $k_e = 8.99 \times 10^9$ Nm^2/C^2
- $\epsilon_0 = 8.85 \times 10^{-12}$ As/(Vm)
- $\mu_0 = 4\pi \times 10^{-7}$ Vs/(Am)
- c = 3.00×10^8 m/s
- e = 1.60×10^{-19} C
- $m_e = 9.11 \times 10^{-31}$ kg
- $m_e c^2 = 0.511$ MeV
- h = 6.63×10^{-34} Js
- h = 4.14×10^{-15} eVs
- hc = 1240 eVnm
- $\sigma = 5.67 \times 10^{-8}$ W/(m^{2}K^4)
- Wien's constant = 2.898×10^{-3} Km
- $R_H = 1.097 \times 10^7$ 1/m
- $E_0 = 13.6$ eV
- $a_0 = 0.529$ Angstrom
- 1 eV = 1.60×10^{-19} J
- 1 AMU (1 u) = 931.494 MeV/c^2 = 1.67×10^{-27}kg
- $\times$ Field directly into page.
- $\bullet$ Field directly out of page

Name:

$\boxed{\textit{12 pt}}$ Select True or False for the following questions about radioactive decay.

▷ In alpha decay, a neutron is emitted.
1. **A**◯ True **B**◯ False

▷ In gamma decay, a positron is emitted.
2. **A**◯ True **B**◯ False

▷ In beta decay, an electron or a positron is emitted.
3. **A**◯ True **B**◯ False

$\boxed{\textit{6 pt}}$ A projectile is observed during a very short time of $1.1 \cdot 10^{-24}$ s? What is its minimum energy uncertainty in nJ?

4.A◯ 1.01×10^{-2} **B**◯ 1.26×10^{-2} **C**◯ 1.57×10^{-2}
D◯ 1.96×10^{-2} **E**◯ 2.45×10^{-2} **F**◯ 3.07×10^{-2}
G◯ 3.83×10^{-2} **H**◯ 4.79×10^{-2}

$\boxed{\textit{7 pt}}$ If the binding energy per nucleon of a fictitious nucleus with Z = N = 90 is 7.4 MeV, what is its mass in u?
The mass of a proton is 1.007276 u.
The mass of a nuetron is 1.008665 u.

5.A◯ 171.00 **B**◯ 173.70 **C**◯ 176.40
D◯ 180.00 **E**◯ 181.43 **F**◯ 182.86
G◯ 186.52 **H**◯ 192.12

$\boxed{\textit{12 pt}}$ Select True or False for the following statements.

▷ The speed of electromagnetic waves in vacuum is not proportional to their wavelength.
6. **A**◯ True **B**◯ False

▷ Sunlight perpendicularly strikes two surfaces of equal area. One surface is a perfect absorber and the other surface is a perfect reflector. The force exerted by the sunlight on the absorbing surface is twice the size of the force exerted by the sunlight on the reflecting surface.
7. **A**◯ True **B**◯ False

▷ A wire carries a steady current $i=I_0$. There is no electromagnetic radiation from the wire.
8. **A**◯ True **B**◯ False

$\boxed{\textit{7 pt}}$ What is the wavelength of radiation emitted when an electron goes from the n = 6 to the n = 5 level of the Bohr hydrogen atom? Give your answer in nm.

9.A◯ 7459.89 **B**◯ 9324.87 **C**◯ 11656.08
D◯ 14570.10 **E**◯ 18212.63 **F**◯ 22765.79
G◯ 28457.23 **H**◯ 35571.54

$\boxed{\textit{7 pt}}$ The age of a piece of wood from an archeological site is to be determined using the Carbon-14 method. The activity of the sample is measured to be 0.432 times the Carbon-14 activity of living plants. What is the age of the sample in years? (The half-life of the Carbon-14 isotope is 5730 years.)

10.A◯ 4.26×10^3 **B**◯ 4.81×10^3 **C**◯ 5.43×10^3
D◯ 6.14×10^3 **E**◯ 6.94×10^3 **F**◯ 7.84×10^3
G◯ 8.86×10^3 **H**◯ 1.00×10^4

$\boxed{\textit{12 pt}}$ Select True or False for each of the following statements.

▷ In the quantum mechanical hydrogen atom, electrons in the n=2 orbit all have the same angular momentum.
11. **A**◯ True **B**◯ False

▷ The work function of a surface determines the minimum intensity of light which will cause electrons to be emitted.
12. **A**◯ True **B**◯ False

▷ If the temperature (in K) of a black-body increases by a factor of two, then the emitted power increases by a factor of two.
13. **A**◯ True **B**◯ False

$\boxed{\textit{12 pt}}$ For each statement below, select True or False.

▷ When a diffraction grating is illuminated by white light, the first order maximum for yellow light is farther away from the central maximum than the first order maximum for blue light.
14. **A**◯ True **B**◯ False

▷ Red light strikes two narrow slits and an inteference pattern is observed on a screen. As the distance separating the two narrow slits is decreased, the interference pattern observed on the screen will get wider.
15. **A**◯ True **B**◯ False

▷ As the wavelength of light hitting a single slit is increased, the diffraction pattern observed on a screen will get wider.
16. **A**◯ True **B**◯ False

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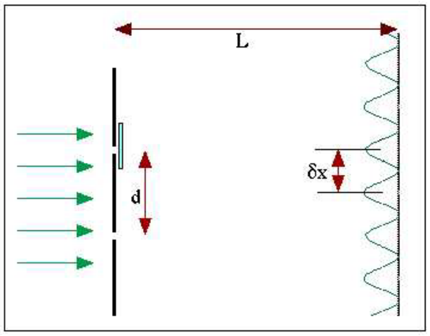
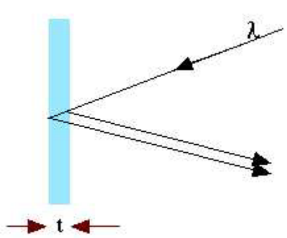
6 pt



A pair of slits separated by 1.2 mm, are illuminated with monochromatic light of wavelength 680 nm. The light falls on a screen 2.5 m away producing an interference pattern. A piece of glass with index of refraction n = 1.59 is placed at one slit. Placing the piece of glass in front of the slit causes the maxima to shift 0.27δx, where δx is the distance between adjacent maxima. What is the thickness of the glass in μm?

17.A◯ 0.142 **B**◯ 0.166 **C**◯ 0.194 **D**◯ 0.227
E◯ 0.266 **F**◯ 0.311 **G**◯ 0.364 **H**◯ 0.426



7 pt

A soap film with air on both sides is made with material of index of refraction n = 1.46. It is illuminated by white light. If the reflected light is maximum at λ = 570 nm, what is t, the minimum thickness (in nm) the film could have had?

18.A◯ 52.1 **B**◯ 60.9 **C**◯ 71.3 **D**◯ 83.4
E◯ 97.6 **F**◯ 114.2 **G**◯ 133.6 **H**◯ 156.3

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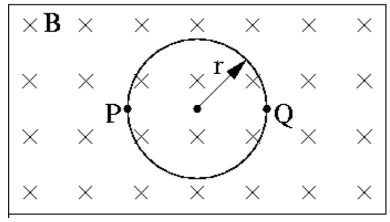
6 pt A flexible loop has a radius of 0.59 m and it is inside a constant magnetic field of 0.6 T. The resistance of the loop is 3.78 Ω. The loop is grasped at points P and Q and stretched until its area is zero. It takes 0.123 seconds to close the loop.



What is the average induced current (in amps) in the loop during the stretching process?

19.A◯ 1.41 **B**◯ 1.59 **C**◯ 1.80 **D**◯ 2.04
E◯ 2.30 **F**◯ 2.60 **G**◯ 2.94 **H**◯ 3.32

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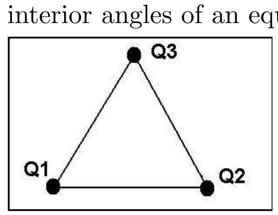
6 pt The figure shows three charges Q1, Q2 and Q3 fixed in place at the corners of an equilateral triangle. The length of each side of the triangle is 14.5 cm. Recall that all of the interior angles of an equilateral triangle are 60 °.



For Q1 = 17.80 μC, Q2 = -17.80 μC, and Q3 = 8.40 μC find the net electrostatic force acting on charge Q3.
(in `N`*)*

20.A◯ 5.01×10^1 **B**◯ 5.66×10^1 **C**◯ 6.40×10^1
D◯ 7.23×10^1 **E**◯ 8.17×10^1 **F**◯ 9.24×10^1
G◯ 1.04×10^2 **H**◯ 1.18×10^2