Your code is: ACGFGE

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:

9 pt
A telescope consists of a mirror with radius of curvature 19 m and an eyepiece of focal length 26 cm. Approximately what is the magnitude of its magnification?

1. **A**◯ 17.38 **B**◯ 25.20 **C**◯ 36.54
D◯ 52.98 **E**◯ 76.82 **F**◯ 111.39
G◯ 161.52 **H**◯ 234.20

9 pt The near point of an eye is 140 cm. A corrective lens is to be used to allow this eye to focus clearly on objects 19 cm in front of it. What should be the focal length of this lens (in cm)?

2. **A**◯ 18.8 **B**◯ 22.0 **C**◯ 25.7 **D**◯ 30.1
E◯ 35.2 **F**◯ 41.2 **G**◯ 48.2 **H**◯ 56.4

A parallel plate capacitor with plate separation d is connected to a battery. The capacitor is fully charged to Q Coulombs and a voltage of V. (C is the capacitance.) Answer the following questions regarding the capacitor charged by a battery. For each statement below, select True or False.

3 pt

▷ With the capacitor connected to the battery, inserting a dielectric between the plates of the capacitor will increase C.
3. **A**◯ True **B**◯ False

3 pt

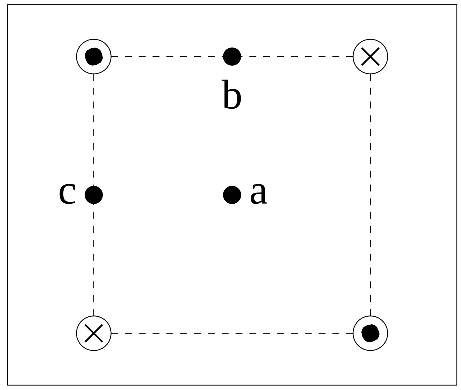
▷ After being disconnected from the battery, decreasing d increases V.
4. **A**◯ True **B**◯ False

3 pt

▷ With the capacitor connected to the battery, inserting a dielectric between the plates of the capacitor will decrease Q.
5. **A**◯ True **B**◯ False

Name:

Four electric currents, equal in magnitude are arranged at the corners of a square as shown in the figure.



Two currents go into the page, and two are pointing out of the page. Point **a** is at the center of the square, and points **b** and **c** are in the middle of two of the sides.

3 pt What is the direction of the magnetic field at point **a**?

6. **A**◯ To the left.
B◯ To the right.
C◯ Up (to the top of the page).
D◯ The magnetic field is zero at this point.
E◯ Down (to the bottom of the page).

3 pt What is the direction of the magnetic field at point **b**?

7. **A**◯ To the right.
B◯ The magnetic field is zero at this point.
C◯ To the left.
D◯ Up (to the top of the page).
E◯ Down (to the bottom of the page).

3 pt What is the direction of the magnetic field at point **c**?

8. **A**◯ Up (to the top of the page).
B◯ The magnetic field is zero at this point.
C◯ Down (to the bottom of the page).
D◯ To the right.
E◯ To the left.

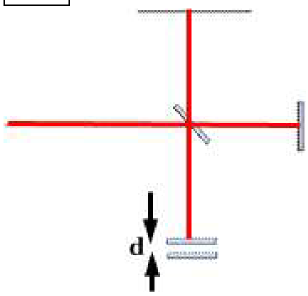
9 pt Select True or False for the following statements about diffraction of light on a diffraction grating.

▷ If the distance between the screen and the grating is doubled, then the distance between the bright fringes also doubles.
9. **A**◯ True **B**◯ False

▷ If the wavelength of the light is increased, then the distance between the bright fringes decreases.
10. **A**◯ True **B**◯ False

▷ If the line density of the grating is halved, then the distance between the bright fringes also halves.
11. **A**◯ True **B**◯ False

9 pt



The wavelength of a monochromatic source is measured with a Michelson interferometer. When the movable mirror moves d = 0.12 mm, 486 fringes move by the screen. What is the wavelength of the light in nm?

12. **A**◯ 494 **B**◯ 617 **C**◯ 772 **D**◯ 965 **E**◯ 1206 **F**◯ 1507 **G**◯ 1884 **H**◯ 2355

10 pt Some possible trasitions of the hydrogen atom are listed below:

A: $n_i = 4$, $n_f = 7$
B: $n_i = 3$, $n_f = 5$
C: $n_i = 3$, $n_f = 6$
D: $n_i = 2$, $n_f = 5$
E: $n_i = 6$, $n_f = 3$
F: $n_i = 5$, $n_f = 3$
G: $n_i = 5$, $n_f = 2$
H: $n_i = 7$, $n_f = 4$

where n_i and n_f are the initial and the final principal quantum numbers respectively.

▷ For which transition will the atom gain the most energy?

13. **A**◯ A **B**◯ B **C**◯ C **D**◯ D **E**◯ E **F**◯ F **G**◯ G **H**◯ H

▷ Which transition will emit light with the shortest wavelength?

14. **A**◯ A **B**◯ B **C**◯ C **D**◯ D **E**◯ E **F**◯ F **G**◯ G **H**◯ H

6 pt

▷ The work function of a surface determines the minimum ______________ of light which will cause electrons to be emitted.

15. **A**◯ wavelength **B**◯ frequency **C**◯ intensity

▷ If two sources emit the same number of photons per second, one near the red end of the spectrum will emit ______________ one near the blue end.

16. **A**◯ less energy than
B◯ more energy than
C◯ the same amount of energy as

9 pt A projectile is observed during a very short time of $1.9 \cdot 10^{-23}$ s? What is its minimum energy uncertainty in nJ?

17. **A**◯ 2.37×10^{-3} **B**◯ 2.78×10^{-3} **C**◯ 3.25×10^{-3} **D**◯ 3.80×10^{-3} **E**◯ 4.44×10^{-3} **F**◯ 5.20×10^{-3} **G**◯ 6.08×10^{-3} **H**◯ 7.12×10^{-3}

Select the correct statement about α-radiation.

4 pt

18. **A**◯ In α-radiation the emitted particle is a ^{4}He nucleus.
B◯ In α-radiation the emitted particle is a neutron.
C◯ In α-radiation the emitted particle is an electron.
D◯ In α-radiation the emitted particle is a high-energy photon.
E◯ In α-radiation the emitted particle is a positron.

4 pt

Select the correct statement about β-radiation.

19. **A**◯ In β-radiation the emitted particle is a neutron.
B◯ In β-radiation the emitted particle is a ^{4}He nucleus.
C◯ In β-radiation the emitted particle is a high-energy photon.
D◯ In β-radiation the emitted particle is an electron or a positron.

4 pt

Select the correct statement about γ-radiation.

20. **A**◯ In γ-radiation the emitted particle is a neutron.
B◯ In γ-radiation the emitted particle is a ^{4}He nucleus.
C◯ In γ-radiation the emitted particle is a high-energy photon.
D◯ In γ-radiation the emitted particle is an electron.
E◯ In γ-radiation the emitted particle is a positron.

9 pt The ratio of ^{14}C to ^{12}C in living organisms is 1.3×10^{-12}. The fossilized remains of an organism are discovered and the ratio of ^{14}C to ^{12}C in the fossil is measured to be 3.6×10^{-13}. How long ago, in years was the organism alive? (The half life of ^{14}C is 5,730 years.)

21. **A**◯ 2402 **B**◯ 3482 **C**◯ 5050 **D**◯ 7322 **E**◯ 10617 **F**◯ 15394 **G**◯ 22322 **H**◯ 32367