PHYS2002 – Spring 2007
Practice Final Exam

Name:_____

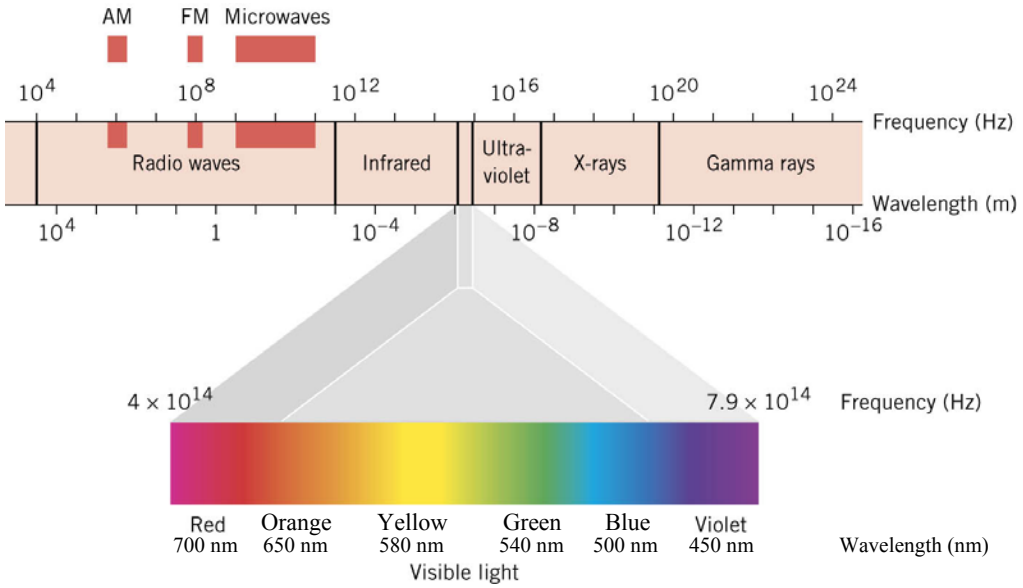
Fundamental Constants

Quantity	Symbol	Value*
Avogadro's number	N_A	$6.022\,141\,99 \times 10^{23}\ \text{mol}^{-1}$
Boltzmann's constant	k	$1.380\,6503 \times 10^{-23}\ \text{J/K}$
Electron charge magnitude	e	$1.602\,176\,462 \times 10^{-19}\ \text{C}$
Permeability of free space	μ_0	$4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A}$
Permittivity of free space	ϵ_0	$8.854\,187\,817 \times 10^{-12}\ \text{C}^2/(\text{N}\cdot\text{m}^2)$
Planck's constant	h	$6.626\,068\,76 \times 10^{-34}\ \text{J}\cdot\text{s}$
Mass of electron	m_e	$9.109\,381\,88 \times 10^{-31}\ \text{kg}$
Mass of neutron	m_n	$1.674\,927\,16 \times 10^{-27}\ \text{kg}$
Mass of proton	m_p	$1.672\,621\,58 \times 10^{-27}\ \text{kg}$
Speed of light in vacuum	c	$2.997\,924\,58 \times 10^{8}\ \text{m/s}$
Universal gravitational constant	G	$6.673 \times 10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2$
Universal gas constant	R	$8.314\,472\ \text{J/(mol}\cdot\text{K)}$

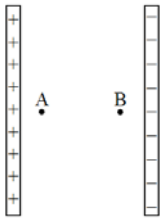
* 1998 CODATA recommended values.

Coulomb constant, $k = \dfrac{1}{4\pi\varepsilon_o} 8.99 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2$

Electron charge = -1.602×10^{-19} C
Proton charge = $+1.602 \times 10^{-19}$ C
Neutron charge = 0



1. A positively-charged particle is held at point A between two parallel metal plates. The plate on the left has a net positive charge $+q$ and the plate on the right has a net negative charge $-q$. The particle is then moved to point B. How does the electric potential energy at point A compare with that at point B?



a) $EPE_A > EPE_B$
b) $EPE_A = EPE_B$
c) $EPE_A < EPE_B$
d) $EPE_A > EPE_B$ or $EPE_A < EPE_B$ depending on the actual distances from the points to the plates.

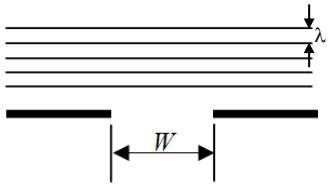
2. Complete the following sentence: When a *negatively*-charged particle is released from rest in a region that has a magnetic field directed due east, the particle will

a) remain at rest.
b) be accelerated due east.
c) be accelerated due west.
d) be accelerated upward.
e) be accelerated downward.

3. An object is placed in front of a concave spherical mirror. Which of the following statements concerning the resulting image is false?

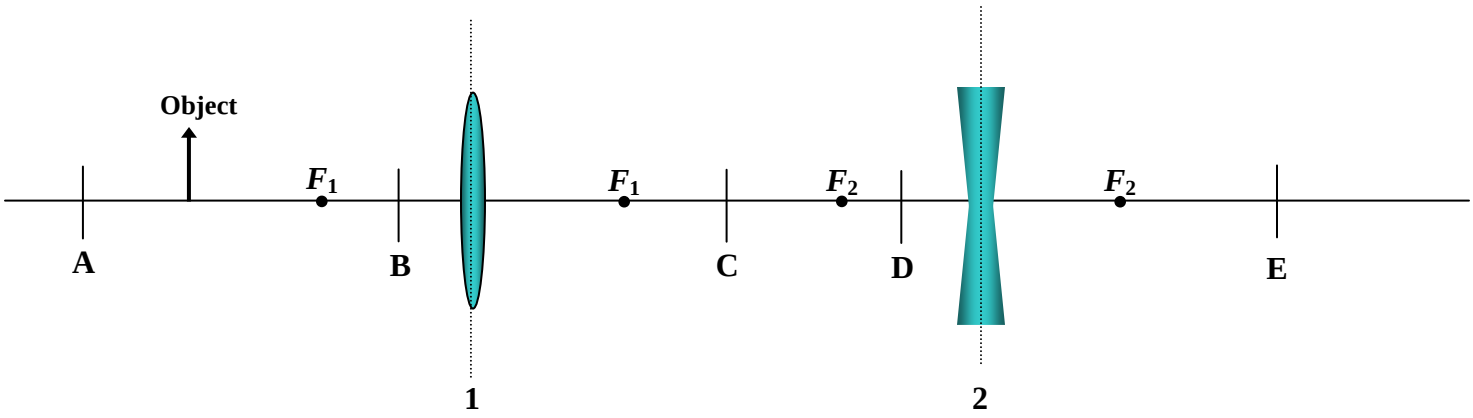
a) It is possible to place the object at a location that will result in an upright image.
b) It is possible to place the object at a location that will result in an inverted image.
c) It is possible to place the object at a location that will result in a virtual image.
d) An object that is placed more than two times the focal length from the mirror will produce an inverted, reduced image.
e) An object that is placed at a distance less than the focal length from the mirror will produce a real image.

4. Water waves of wavelength λ are approaching an opening of width W as shown. For which of the following parameter choices will the greatest diffraction of the waves occur?



a) large wavelength, large width
b) small wavelength, large width
c) large wavelength, small width
d) small wavelength, small width
e) diffraction will never be observed

5. An object is located to the left of a compound lens system consisting of a converging and diverging lens. The focal lengths of the two lenses are shown. Where will the final image of the object, as denoted by the letters, be located?



6. What was Werner Heisenberg uncertain about?

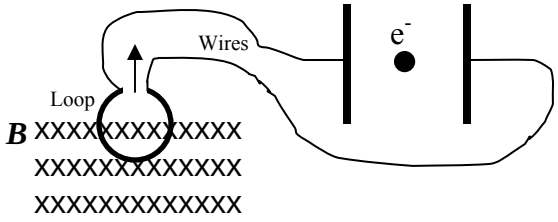
a) He was uncertain that one could ever measure any parameter precisely.
b) He was uncertain as to the applicability of quantum mechanics in understanding atoms.
c) He was uncertain as to whether particles could have wave-like characteristics.
d) He wasn't uncertain. He just said that if a photon collides with an electron at rest, some of the photon's energy will be transferred to the electron.
e) He wasn't uncertain. He just said that if you know the position of a moving particle very precisely, then the particle's momentum cannot be known very precisely, and vice versa.

7. Which one of the following statements concerning the strong nuclear force is false?

a) The strong nuclear force only acts over distances that are around 10^{-15} m and is zero for longer distances.
b) The strong nuclear force is one of only three fundamental forces that have been discovered.
c) The strong nuclear force plays an important role in the stability of a nucleus.
d) Because of the limitations of the strong nuclear force, there is a limit to the number of nucleons that can form a stable nucleus.
e) The strong nuclear force is stronger between two neutrons than it is between two protons or between a neutron and a proton.

8. A conducting loop of wire is sliding upward out of a region of space where a uniform magnetic field exists everywhere into the page. A set of electrical wires connects the conducting loop to a parallel plate capacitor. An electron, initially at rest, sits in the middle of the capacitor between the plates. What happens when the loop starts to slide out of the field?

a) Nothing happens.
b) The electron moves left.
c) The electron moves right.
d) The electron moves up.
e) The electron moves down.

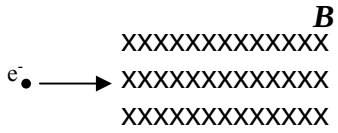


9. Electromotive force has the following units:

a) V
b) N
c) V·N
d) N·V/C
e) dyne-cm/erg

10. An electron is moving toward a region of space where a uniform magnetic field exists everywhere into the page. What happens when the electron enters the field?

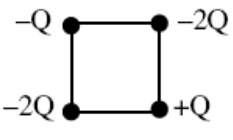
a) Nothing. It travels straight thru.
b) It moves cw in a circular trajectory.
c) It moves ccw in a circular trajectory.
d) It feels a force directed out of the page.
e) It feels a force directed into the page.

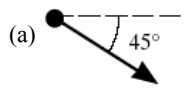


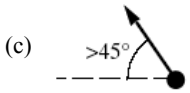
11. A −4.0-μC charge is located 0.30 m to the left of a +6.0-μC charge. What is the magnitude and direction of the electrostatic force on the positive charge?

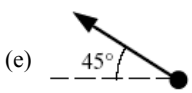
(a) 2.4 N, to the right
(b) 2.4 N, to the left
(c) 4.8 N, to the right
(d) 4.8 N, to the left
(e) 7.2 N, to the right

12. Four point charges are held fixed at the corners of a square as shown in the figure. Which of the five arrows shown below most accurately shows the direction of the net force on the charge –Q due to the presence of the three other charges?

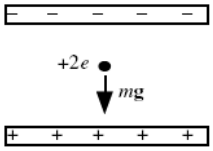






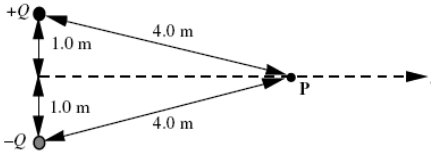


13. A helium nucleus is located between the plates of a parallel-plate capacitor as shown. The nucleus has a charge of +2e and a mass of 6.6×10^{-27} kg. What is the magnitude of the electric field such that the electric force exactly balances the weight of the helium nucleus so that it remains stationary?



(a) 4.0×10^{-7} N/C
(b) 6.6×10^{-26} N/C
(c) 2.0×10^{-7} N/C
(d) 5.0×10^{-3} N/C
(e) 1.4×10^{8} N/C

14. Two charges of opposite sign and equal magnitude $Q = 2.0$ C are held 2.0 m apart as shown in the figure. What is the electric potential at point P?



(a) 2.2×10^{9} V/m
(b) 5.6×10^{8} V/m
(c) 4.4×10^{8} V/m
(d) 2.8×10^{8} V/m
(e) 0 V/m

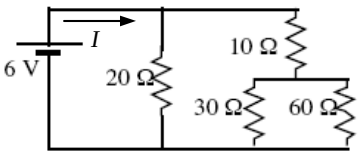
15. A potential difference of 120 V is established between two parallel metal plates. The magnitude of the charge on each plate is 0.020 C. What is the capacitance of this capacitor?

(a) 167 μC
(b) 24 μC
(c) 7.2 μC
(d) 0.12 C
(e) 2.4 C

16. The resistivity of a silver wire is 1.59×10^{-8} Ω • m. The radius of the wire is 5.04×10^{-4} m. If the length of the wire is 3.00 m, what is the resistance of the wire?

(a) 0.0598 Ω
(b) 47.0 μΩ
(c) 9.46 μΩ
(d) 0.167 Ω
(e) 1.88 Ω

17. What is the current *I* in the following circuit?



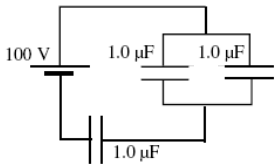
(a) 0.12 A
(b) 0.05 A
(c) 0.21 A
(d) 1.2 A
(e) 0.5 A

18. Which one of the following statements is true concerning capacitors of *unequal capacitance* connected in series?

(a) Each capacitor holds a different amount of charge.
(b) The equivalent capacitance of the circuit is the sum of the individual capacitances.
(c) The total voltage supplied by the battery is the sum of the voltages across each capacitor.
(d) The total positive charge in the circuit is the sum of the positive charges on each capacitor.
(e) The total voltage supplied by the battery is equal to the average voltage across all the capacitors.

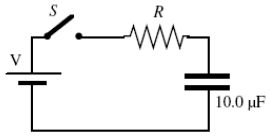
19. What is the equivalent capacitance of the combination of capacitors shown in the circuit?

(a) 0.37 μF (b) 3.3 μF (c) 4.6 μF
(d) 0.67 μF (e) 2.1 μF



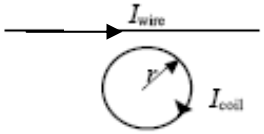
20. The figure shows a simple RC circuit consisting of a battery in series with a 10.0-μF capacitor and a resistor. Initially, the switch S is open and the capacitor is uncharged. Two seconds after the switch is closed, the capacitor holds 30% of its equilibrium charge value. What is the value of R?

a) 0.7 Ω c) 166 kΩ e) None of these.
b) 561 kΩ d) 6 kΩ



21. The radius of a single coil of wire is $r = 0.22$ m. A current $I_{coil} = 200$ A flows clockwise in the coil, as shown. A long, straight wire carrying a current $I_{wire} = 310$ A toward the right is located 0.05 m from the edge of the coil. What is the value of the magnetic field at the center of the coil? (1 Tesla = 10,000 gauss)

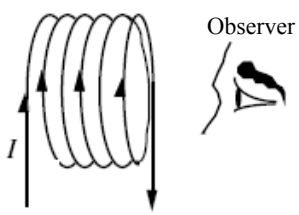
(a) 4 gauss (b) 8 gauss (c) 0 gauss (d) 16 gauss
(e) None of these.

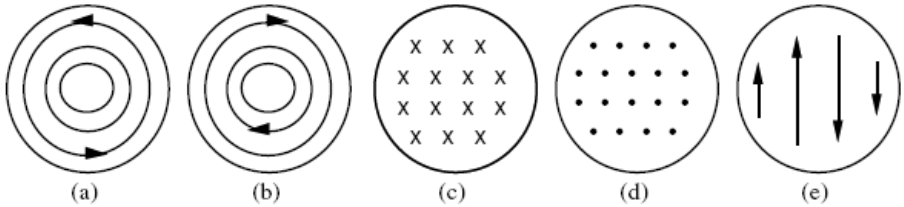


22. A long, straight wire carries a 6.0-A current that is directed in the positive *x* direction. When a uniform magnetic field is applied perpendicular to a 3.0-m segment of the wire, the magnetic force on the segment is 0.36 N, directed in the negative *y* direction, as shown. What are the magnitude and direction of the magnetic field?

(a) 0.020 T, out of the paper (d) 0.060 T, into the paper
(b) 0.020 T, into the paper (e) 0.65 T, out of the paper
(c) 0.060 T, out of the paper

23. A long wire that carries a current *I* is bent into five loops as shown in the figure. If the observer could "see" the magnetic field *inside* this arrangement of loops, how would it appear?





24. Socola is standing 1.0 m in front of a mirror. A virtual image is formed 10.0 m behind the mirror. What is the radius of curvature of the mirror?

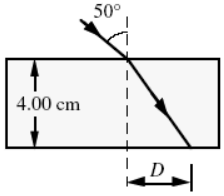
(a) 0.56 m (b) 1.1 m (c) 2.2 m (d) 4.4 m (e) 10 m

25. An object is placed 30.0 cm from a convex spherical mirror with radius of curvature 40.0 cm. Which one of the following phrases best describes the image?

(a) virtual and located at infinity
(b) real and located 12 cm from the mirror
(c) real and located 17 cm from the mirror
(d) virtual and located 12 cm from the mirror
(e) virtual and located 17 cm from the mirror

26. A ray of light passes from air into a block of glass with a refractive index of 1.50 as shown in the figure. What is the value of the distance *D*?

(a) 1.42 cm (d) 2.14 cm
(b) 1.66 cm (e) 2.38 cm
(c) 1.90 cm



27. Unpolarized light with an intensity of 7.5 W/m^2 passes thru a polarizer whose transmission axis is set at 60^o with respect to the vertical. What is the intensity of the light leaving the polarizer?

a) 7.5 W/m^2 b) 3.75 W/m^2 c) 1.88 W/m^2 d) 0 W/m^2 e) None of these.

28. An object is placed 4.0 cm from a thin converging lens with a focal length of 12 cm. Which one of the following statements is true concerning the image?

(a) The image is virtual and 6.0 cm from the lens.
(b) The image is virtual and 12 cm from the lens.
(c) The image is real and 3.0 cm from the lens.
(d) The image is real and 6.0 cm from the lens.
(e) The image is real and 12 cm from the lens.

29. A diverging lens has a focal length of –10 cm. An object is placed 25 cm from the lens. What is the distance *between the object and the image*?

(a) 7 cm (b) 10 cm (c) 18 cm (d) 32 cm (e) 35 cm

30. A double slit with a slit separation distance of 2.00×10^{-5} m is illuminated by light of wavelength 560 nm. If the distance from the slits to the screen is 6.00 m, what is the separation between the central bright fringe and the third dark fringe?

(a) 0.421 m (b) 0.224 m (c) 0.168 m (d) 0.084 m (e) 0.070 m

31. Photons of what minimum frequency are required to remove electrons from gold?
Note: *The work function for gold is 4.8 eV.*

(a) 7.3×10^{14} Hz (b) 1.2×10^{15} Hz (c) 3.8×10^{17} Hz (d) 6.5×10^{15} Hz
(e) 4.6×10^{14} Hz

32. What is the de Broglie wavelength of The Hubble Space Telescope? It has an orbital speed of 7.56×10^{3} m/s and a mass of 11,600 kg.

(a) 8.77×10^{7} m (c) 6.63×10^{-34} m (e) 7.56×10^{-42} m
(b) 5.81×10^{-26} m (d) 3.78×10^{-40} m

33. Why was it necessary for Bohr to require that electrons remain in *stationary orbits*?

(a) An electron must travel in a circular path.
(b) It was required by the Heisenberg uncertainty principle.
(c) No two electrons can be in the same region in the atom.
(d) It was required by the Pauli exclusion principle.
(e) Classical physics predicts that the electron should spiral into the nucleus.

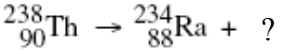
34. What is the binding energy per nucleon of ${}^{202}_{80}\mathrm{Hg}$ that has an atomic mass of 201.970617 u? **Note**: Use the following atomic masses in your calculation: Hydrogen atomic mass = 1.007 825 u and neutron mass = 1.008 665 u.

(a) 8.647 MeV (b) 11.47 MeV (c) 9.151 MeV (d) 7.897 MeV (e) 8.361 MeV

35. The half-life of a particular isotope of iodine is 8.0 days. How much of a 10.0-g sample of this isotope will remain after 30 days?

(a) 0.37 g (b) 0.45 g (c) 0.60 g (d) 0.74 g (e) 1.25 g

36. What would correctly complete the following decay process?



a) Gamma Ray b) Alpha particle
c) Beta^{-} ray d) Beta^{+} Ray e) None of these.

Answers

1. A
2. A
3. E
4. C
5. D
6. E
7. E
8. B
9. A
10. B
11. B
12. E
13. C
14. E
15. A
16. A
17. E
18. C
19. D
20. B
21. B
22. A
23. C
24. C
25. D
26. E
27. B
28. A
29. C
30. A
31. B
32. E
33. E
34. D
35. D
36. B