Physics 2145 Spring 2022 Final Exam (4 pages)

Name:_____ May 9, 2022 Total Score:_____/120

Write clearly in the space provided on this Answer Sheet the letter which you believe to be the best answer to each question found on the following pages. Only answers on this page will be graded.

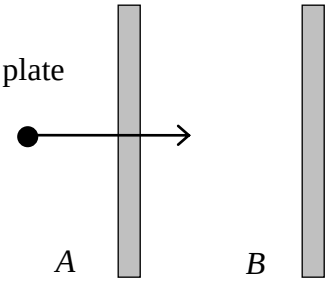
Each question is worth 5 points.

1)_____	9)_____	17)_____
2)_____	10)_____	18)_____
3)_____	11)_____	19)_____
4)_____	12)_____	20)_____
5)_____	13)_____	21)_____
6)_____	14)_____	22)_____
7)_____	15)_____	23)_____
8)_____	16)_____	24)_____

1. Which is true for a conductor in electrostatic equilibrium?
A) The electric potential varies across the surface of the conductor.
B) All excess charge is at the center of the conductor.
C) The electric field is zero inside the conductor.
D) The electric field at the surface is tangential to the surface

2. What charge magnitude creates a 1.8N/C electric field at a point 2m away?
A) 0.4nC B) 0.8 nC C) 3.6 nC D) 0.8 C

3. An electron travels through a small hole in plate A and then towards plate B. A uniform electric field between the plates **slows** the electron without deflecting it. What is the direction of the electric field?
A) up B) down C) right D) left



4. As the electron in question 1 goes from plate A to plate B, its potential energy _____ and it moves towards _____ electric potential.
A) increases, higher B) decreases, higher
C) increases, lower D) decreases, lower

5. The potential difference between two plates of a parallel plate capacitor equals 1,000 V. A **proton** is released from rest at the positive plate. The proton's speed as it arrives at the negative plate equals:
A) 4.4×10^{5}m/s B) 1.9×10^{11}m/s C) 1.9×10^{7}m/s D) 2.2×10^{5}m/s

6. The proton in problem 5 arrives at the negative plate with a kinetic energy of
A) 1 keV B) 1,000 J C) 1.6×10^{-16} eV D) 1,600 J

7. A parallel plate capacitor consists of two square plates of side length 8cm that are spaced 2mm apart with Teflon (κ=2.0) between the plates. What potential difference between the plates do you need for this capacitor to store a charge of 1.4 nC on each plate?
A) 2.5V B) 24.7 V C) 5.6×10^{-11}V D) 59.4 V

8. A fully charged parallel-plate capacitor is disconnected from the battery. The plates are then moved further apart. Which of these quantities **decreases**?
A) charge B) capacitance
C) potential difference D) Electric field

9. The potential difference across a length of wire is increased. Which of the following does **not** increase as well?
A) Electric field in the wire B) Power dissipated in the wire
C) Resistance of the wire D) Current through the wire

10. Current flows through a resistor which consists of a series combination of two segments of equal lengths and equal radii. Their resistivities differ, with $\rho_1=3\rho_2$. If I_1 is the current flowing in segment 1, how big is the current flowing in segment 2, I_2?

A) $I_2=\frac{1}{3}I_1$ B) $I_2=I_1$

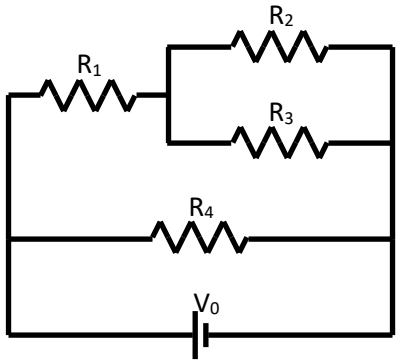
C) $I_2=3I_1$ D) $I_2=9I_1$

11. A nichrome wire (resistivity $1.5\times10^{-6}\,\Omega$m) is 30 cm long and has a circular cross section with a diameter 1.0mm. The resistance of the wire is

A) 0.57 Ω B) 2.8×10^{-4} Ω C) 0.14 Ω D) 57Ω

12. For the resistor circuit shown $R_1 = 2\Omega$, $R_2 = 4\Omega$, $R_3 = 4\Omega$, and $R_4 = 6\Omega$. The equivalent resistance of the circuit equals:

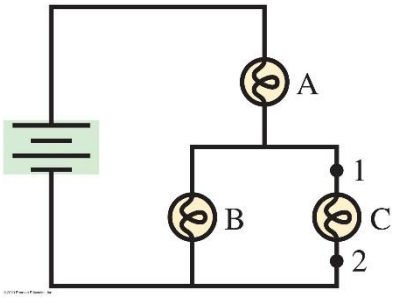
A) 2.4Ω B) 3.5Ω C) 3.75Ω D) 16Ω



13. For the circuit shown: if the battery provides a voltage of 24 V, the current through resistor R_4 equals _____ and the power dissipated in resistor R_4 equals

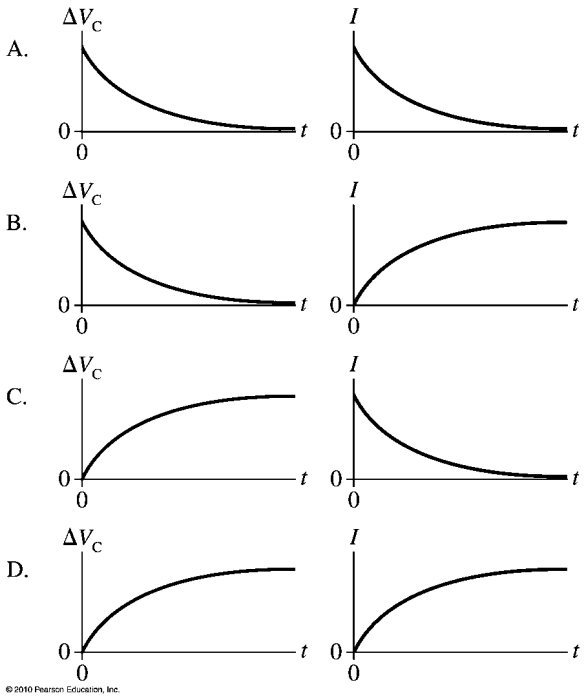
A) 10A, 360W B) 4A, 96 W C) 10A, 600W D) 4A, 540 W

14. The three bulbs in the circuit below are identical. Which of the following is true?



A) $V_A=V_B$
B) $I_A=I_B$
C) $V_A<V_B$
D) $V_A>V_B$

15. A capacitor is **charged** through a resistor. Which of the graphs at the right represent best the capacitor voltage and the current?



16. A capacitor is discharged through a resistor. After 30 ms, the current has fallen to one third of its initial value. The circuit's time constant is approximately

A) 2ms B) 27ms C) 33ms D) 5s

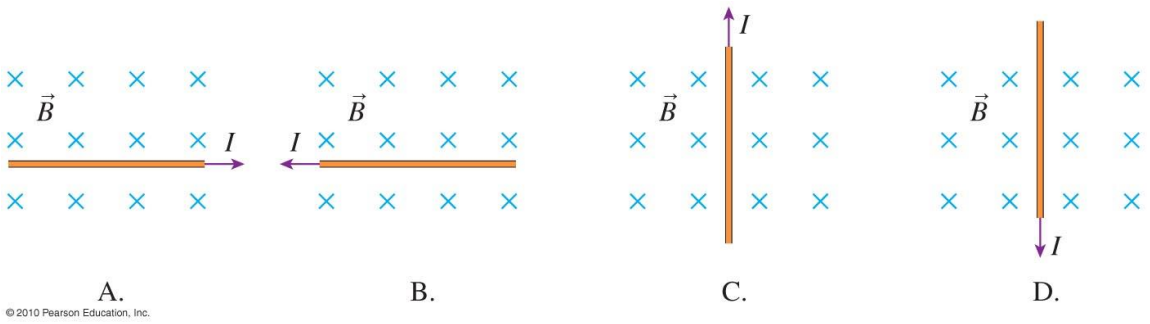
17. A solenoid of radius R carries a current I. The magnetic field at a point inside the solenoid, a perpendicular distance x from the solenoid axis, depends on

A) I, R, and x B) I, but not R or x C) R and x, but not I D) I and R, but not x

18. A long straight wire carries a current of 5A.What is the magnetic field a distance 5mm from the wire?

A) 2×10^{-7} T B) 2×10^{-4} T C) 6.3×10^{-4} T D) 6.3×10^{-7} T

19. Four wires carry current in the directions as shown. A uniform magnetic field is directed into the paper as shown. Which wire experiences a force to the right?

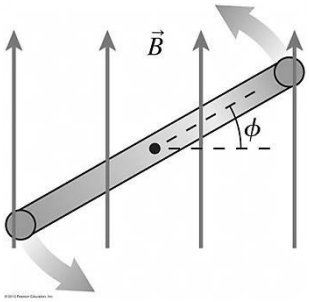


A) A B) B C) C D) D

20. An electron with speed of $v = 1.2 \times 10^{7}$ m/s moving to the left enters a region of uniform magnetic field B1 = 3 T directed out of the page. The radius of the electron's orbit is

A) 2.3×10^{-5} m B) 2.3×10^{2} m C) 8×10^{-4}m D) 6.9 ×10-5m

21. A circular current loop rotates about an axle through its center. The figure shows a side view. The loop is in a constant external magnetic field that points towards the top of the page. Which of the following is **false**?

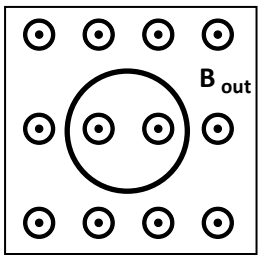


A) At angle Φ =0 the magnetic flux is zero and the torque is maximum.
B) At angle Φ =0 the magnetic flux is maximum and the torque is zero.
C) At angle Φ =90º the magnetic flux is zero and the torque is maximum.
D) The net force on the current loop is zero for any angle Φ

22. Two parallel wires, each of length 40 cm and carrying a current of 5 A in the same direction, are 0.5cm apart. The force of wire 1 on wire 2 is

A) 4×10^{-4} N, attractive B) 0.4 N, attractive
C) 4×10^{-3} N, repulsive D) 4×10^{-4} N, repulsive

23. A circular loop of 10cm diameter with a resistance of 0.1Ω is in a magnetic field that points out of the page, as shown in the figure. The induced current is counterclockwise and has a magnitude of 40mA. Which of the following is true about the magnetic field?



A) B is decreasing at 0.5 T/s B) B is increasing at 0.125 T/s
C) B is decreasing at 2 T/s D) B is increasing at 500 T/s

24. If you looked at the old Final, you saw that there was a free question at the end. Did you expect you would get one too?

A) no B) yes C) expect-no, but I hoped D) Is this the free question?