Physics 2145 Spring 2023 Final Exam (4 pages)

Name:__solution_____ May 12, 2023 Total Score:__120_____/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)__C___
2)__C___
3)__D___
4)__C___
5)__C___
6)__A___
7)__A___
8)__B___
9)__B___
10)_C____
11)_B____
12)_C____
13)_D____
14)_A____
15)_A____
16)_C____
17)_A____
18)_B____
19)_D____
20)_A____
21)_C____
22)_C____
23)_B____
24)_ABCD____

1. An electron is moving in a uniform electric field and slowing down. Its potential energy _____ and it moves towards _____ electric potential.

A) increases, higher B) decreases, higher
C) increases, lower D) decreases, lower

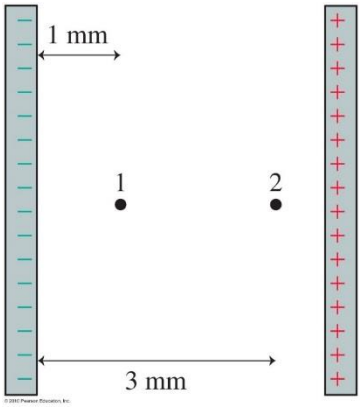
2. An object has been charged to +7.0 nC. A bead 3.0cm away from the object feels a repulsive electric force of 1.4×10^{-3}N. The charge on the bead is

A) − 2 nC B) + 6.7nC C) + 20nC D) − 670 nC

3. Which is **FALSE** for a conductor in electrostatic equilibrium?

A) The electric potential is constant on the surface of the conductor.
B) All excess charge is on the surface of the conductor.
C) The electric field is zero inside the conductor.
D) The electric field at the surface is tangential to the surface

4. The figure shows a parallel plate capacitor. Let V=0 be the electric potential at the negative plate. Which of the following is true about the of the electric potential V_1 and V_2 and the electric field strengths E_1 and E_2 at the two points, respectively?



A) $V_1 = V_2$ and $E_1 = E_2$ B) $V_1 = \frac{1}{3}V_2$ and $E_1 = \frac{1}{3}E_2$
C) $V_1 = \frac{1}{3}V_2$ and $E_1 = E_2$ D) $V_1 = V_2$ and $E_1 = \frac{1}{3}E_2$

5. The potential difference between two plates of a parallel plate capacitor equals 3,000 V. A **proton** is released from rest at the positive plate. The kinetic energy of the proton as it arrives at the negative plate equals

A) 4.8×10^{-16} eV B) 4,800 J C) 3keV D) 3kJ

6. The proton in problem 6 arrives at the negative plate with speed:

A) 7.6×10^{5}m/s B) 3.2×10^{7}m/s C) 1.1×10^{15}m/s D) 5.7×10^{11}m/s

7. A dipole is placed in a uniform electric field. The dipole moment is the vector which is pointing from the negative to the positive charge. Which of the following is true?

A) The dipole never experiences a net force.
B) The dipole never experiences a net torque.
C) The dipole only experiences a net torque if the dipole moment is parallel to the electric field.
D) The dipole experiences a net force if the dipole moment is perpendicular to the electric field.

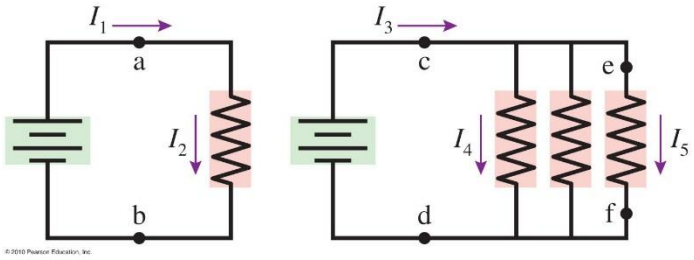
8. A parallel plate capacitor consists of two circular plates of radius 5 cm that are spaced 2mm apart with air between the plates. If the potential difference between the plates is 720 V, the charge store on each plate equals

A) 35pC B) 25 nC C) 3,600 C D) 25×10^{-7} C

9. If the potential difference across a capacitor in decreased by a factor of three, the capacitance
A) decreases by a factor of three B) remains unchanged
C) increases by a factor of three D) decreases by a factor of nine

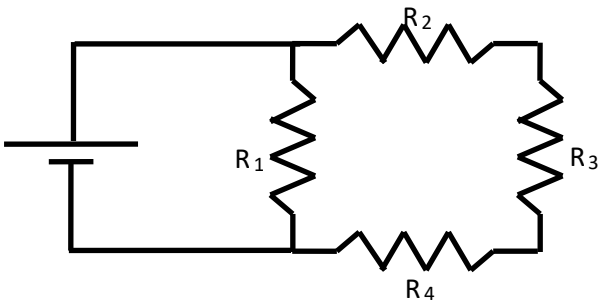
10. The potential difference across a length of wire is decreased. Which of the following does **not** decrease as well?
A) Electric field in the wire B) Power dissipated in the wire
C) Resistance of the wire D) Current through the wire

11. In the two circuits on the right, the batteries are identical and all resistors are identical. Which of the statements is **true**?
A) $I_1 > I_2$ B) $I_3 = 3\ I_1$
C) $I_3 = I_1$ D) $I_1 > I_4$



12. A copper wire (resistivity of copper is $1.7\times10^{-8}\ \Omega$m) is 30 cm long and has a circular cross section with a diameter 1mm. The resistance of the wire is
A) $3.2\times10^{-6}\Omega$ B) $1.6\times10^{-3}\Omega$ C) $6.5\times10^{-3}\Omega$ D) $6.5\times10^{-1}\Omega$

13. For the resistor circuit shown, $R_1 = 3\Omega$, $R_2 = 1\Omega$, $R_3 = 2\Omega$, and $R_4 = 3\Omega$. The equivalent resistance of the circuit equals:
A) 9Ω B) 6Ω C) 3Ω D) 2Ω

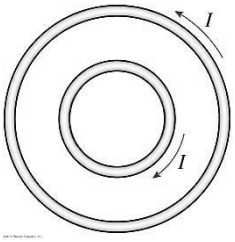


14. For the circuit shown: If the battery provides a voltage of 36 V, the current through resistor R_1 equals_____ and the power dissipated in resistor R_1 equals_____
A) 12A, 432W B) 8A, 192W C) 18A, 648 W D) 36A, 1.3kW

15. Two identical capacitors are connected in series. They are then reconnected in parallel. The capacitance of the series combination is_____ the capacitance of the parallel combination.
A) less than B) more than C) equal to D) half

16. The time constant of an RC circuit is the time it takes for the current to…
A) fully charge the capacitor. B) reach its maximum value.
C) decrease to 37% of its initial value. D) drop to zero.

17. One current **loop** is placed inside another current loop with twice the radius. Each loop carries the same current, but in opposite directions, as shown in the figure: the current in the big loop is counter-clockwise, the current in the small loop is clockwise. The magnetic field at the center is
A) into the page B) zero C) out of the page D) clockwise

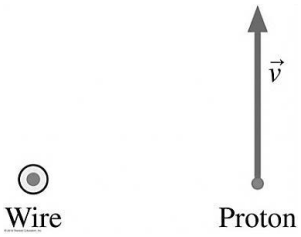


18. A solenoid with radius *R* carries a current *I*. The magnetic field at a point inside the solenoid, a perpendicular distance *r* from the solenoid axis, depends on

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

19. In the figure, a proton is moving with speed *v* close to a wire which is carrying a current directed out of the page. The force on the proton is

A) to the right B) to the left C) into the page D) zero



20. Two parallel wires, each of length 50 cm and carrying a current of 4 A in opposite directions, are 1.0cm apart. The force of wire 1 on wire 2 is

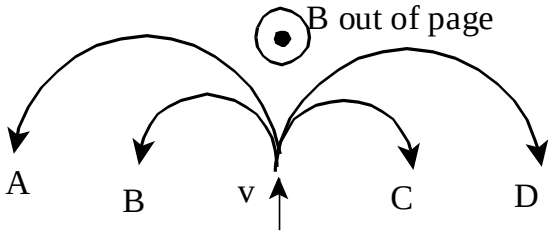
A) 1.6×10^{-4} N, repulsive B) 1.6 N, repulsive

C) 6.4×10^{-8} N, attractive D) 1.6×10^{-4} N, attractive

21. Four particles moving at constant speed *v* are entering a region of a constant magnetic field which points out of the page. Their masses and charges are, respectively: (M, +Q), (M, -Q), (2M, +Q), and (2M, -Q).

Which is the trajectory that belongs to the particle with mass M and positive charge?

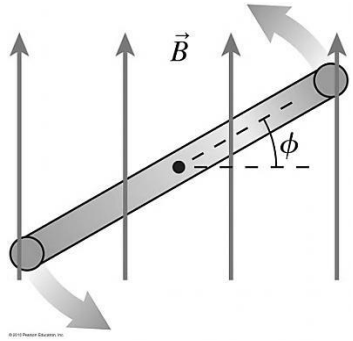
A) A B) B C) C D) D



22. A circular current loop rotates about an axle through its center. The figure shows a side view. The loop is in an external magnetic field that points towards the top of the page. At angle Φ =90º, the magnetic flux is _____ and the torque is _____.

A) maximum, maximum. B) maximum, zero.

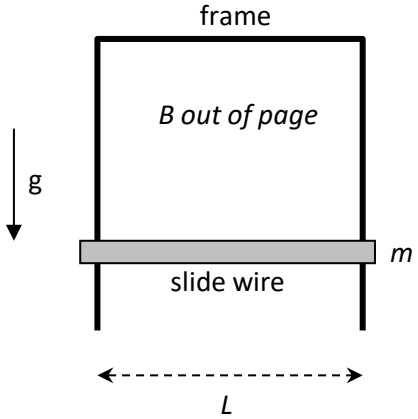
C) zero, maximum. D) zero, zero.



23. A horizontal slide wire of mass *m*=100g, length *L*=50cm and resistance *R*=2Ω is sliding downward in a vertical conducting frame of negligible resistance. The entire apparatus is in an external uniform magnetic field ***B***=0.4T directed out of the page. At the instant the wire has speed 2m/s, the induced current is

A) 0.02A counter- clockwise B) 0.2 A clockwise

C) 0.01 A counter -clockwise D) 0.1 A clockwise



24. It has been suggested that, in keeping with tradition, the last question of the Final exam should be a freebie. Do you agree?

A) Yes!!! B) No, I want more.

C) Yes. I believe in fairness D) What do you mean – is the test over already?