Exam 2

Physics 1320, March 28, 2022

The exam consists of 20 questions. Two are bonus, so you will be scored out of 18, so it is possible to get a score of 20/18=111%

The exam is closed-book and closed-notes. You may use your own calculator, but you may not store formula on your calculator.

Useful Information

mass of proton: $1.67 \times 10^{-27} kg$
mass of electron: $9.1 \times 10^{-31} kg$
$\epsilon_0 = 8.85 \times 10^{-12} C^2/Nm^2$
$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 Nm^2/C^2$
proton's charge: $e = 1.6 \times 10^{-19} C$
electon's charge: $-e$
The prefix n means "nano" and stands for 10^{-9}.
The prefix μ means "micro" and stands for 10^{-6}.
$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enclosed}}{\epsilon_0}$

1)

What is the magnitude of the repulsive force between two ions, one having a charge of 2e, and the other having a charge of e, if they are separated from one another by a distance of 2 nm?

(1) 0.7E-10 N

(2) 1.2E-10 N

(3) 2.1E-10 N

(4) 3.4E-10N

Answer: 2

2)

What is the change in electrical potential energy when an electron and proton initially separated from one another by 2.11E-10 meters move to a final separation of 4.76E-10 meters? (Note: 1 eV = 1.6x10-19 J)

(1) 3.78 eV

(2) 5.22 eV

(3) 5.89 eV

(4) 6.80 eV

Answer: 1

3)

A charge of 1 nC is transferred to neutral metal sphere having a radius 25 cm. What is the strength of the electric field at a point outside the sphere, just above the surface of the sphere?

(1) 900N/C.

(2) 400 N/C.

(3) 225 N/C.

(4) 144 N/C.

Answer: 4

4)

Consider two concentric spherical shells, an inner shell with radius 10 cm, and an outer shell with radius 20 cm.The inner shell has a negative uniform surface charge density -1.00 nC/m^2. The outer shell has a positive uniform surface charge density 1.00 nC/m^2. What is the electric field at a point between both shells, at a radial distance 15 cm from their common center?

(1) 54.2 N/C

(2) -54.2 N/C

(3) 50.3 N/C
(4) -50.3 N/C

Answer: 4

5)

When a charge of 8.5E-6 Coulombs is transferred to the surface of the spherical globe of a Van de Graaff generator, the electric field at the surface reaches the breakdown threshold for dry air of of 3E6 N/C . What is the radius of the globe?
(1) 18 cm

(2) 16 cm

(3) 14 cm

(4) 12 cm

Answer: 2

6)

If the potential drop is 12 volts across a resistor carrying a current of 4 amps, what is the resistance?

(1) 7.2

(2) 6.0

(3) 3.0

(4) 1.8

Answer: 3

7)

An infinite uniformly- charged sheet has a surface charge density of 1 $\mu C / m^2$. A point-charge of -1 μC is attracted to the sheet. If the perpendicular distance between the sheet and the point charge is 1 meter, what is the force of attraction between the point-charge and the sheet?

(1) 0.018 N

(2) 0.014 N

(3) 0.011 N

(4) 0.056 N

Answer: 4

8)

A parallel plate capacitor consists of two closely-spaced parallel plates in vacuum that are uniformly charged to a charge of 1 μC ; one is positive and other other is negative. The potential difference between the plates is 5 Volts. If the gap between the plates is 40 μm what is the plate area?

(1) 0.55 m^2
(2) 0.90 m^2
(3) 1.52 m^2
(4) 2.20 m^2

Answer: 2

9)

The capacitance of the globe of the Van de Graaff generator at Regener Hall is measured to be 5E-12 F. If the minimum work to charge the globe is 1.8 Joules, how much charge is stored on the globe?

(1) 2.4E-6 C

(2) 3.0E-6 C

(3) 4.2E-6 C

(4) 5.8E-6 C

Answer: 3

10)

Four capacitors are connected together in the manner shown in the figure below. The capacitance of each capacitor is indicated in micro farads. What is the equivalent capacitance between terminals A and B?
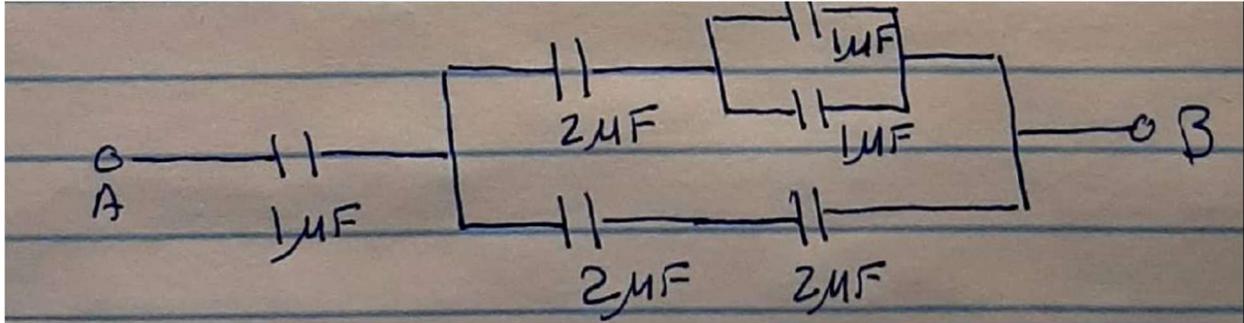
(1) 0.66 micro farads

(2) 0.84 micro farads

(3) 1.50 micro farads

(4) 2.30 micro farads

Answer: 1

11)

A capacitor with capacitance of 15.0 pF has a dielectric spacer with a dielectric constant of 8.0. What would be the capacitance if instead the dielectric constant were 3.0?

(1) 2.4 pF

(2) 4.5 pF

(3) 5.6 pF

(4) 9.1 pF

Answer: 3

12)

The following statements concern a metal in equilibrium. Which of the following is false?

(1) The electric field at the surface of a metal in equilibrium must be directed normal to the surface.

(2) In equilibrium, all points on a metal are at the same potential.

(3) Charges placed on a metal will distribute in a manner that minimizes the (free) energy.

(4) In equilibrium, the electrical currents in a metal form circulating flow patterns.

Answer: 4

13)

Initially, the 2 microfarad capacitor has a charge of Q=5 microcoulombs, and the 3 microfarad capacitor is uncharged. How much charge q2 will move from the 2 microfarad capacitor to the 3 microfarad capacitor when the switch is closed?
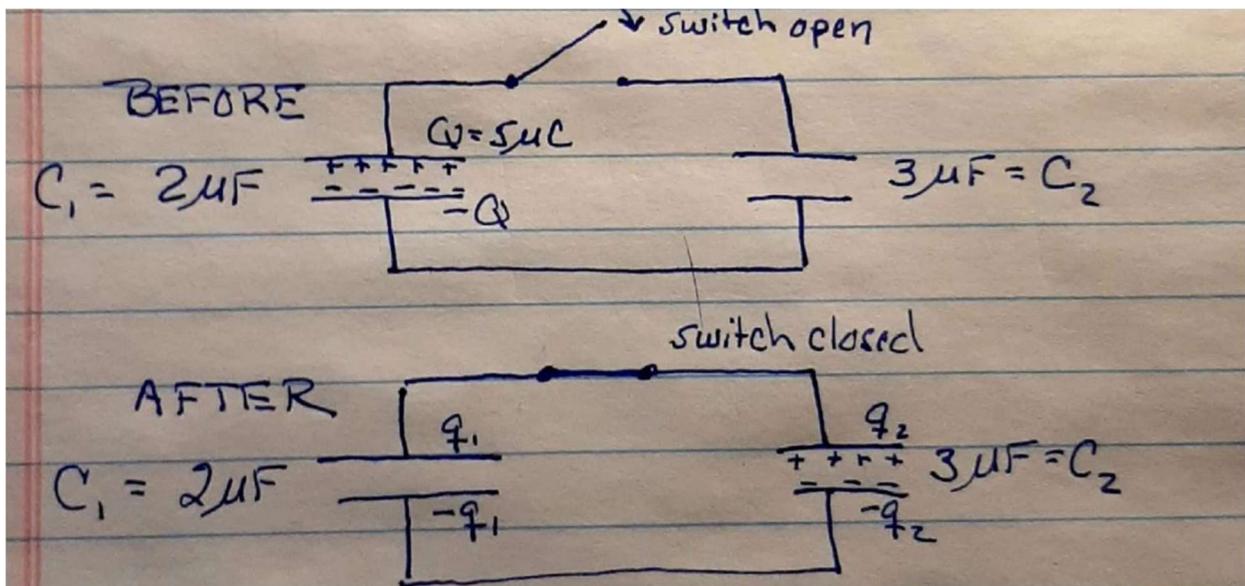
(1) 1 micro coulombs

(2) 2 micro coulomb

(3) 3 micro coulombs

(4) 4 micro coulombs

(5) 5 micro coulombs

Answer: 3

14)

At the origin (x,y)=(0,0) an electric field has magnitude of 10 N/C, and is directed along the positive x axis ($\hat{i}$). An ion has a charge of -2e. What is the force exerted by the field on the ion if it is placed at the origin?

(1) 10 N $\hat{i}$

(2) -1.6E-18 N $\hat{i}$

(3) -1.0 N $\hat{i}$

(4) 3.2E-18 N $\hat{i}$

(5) -3.2E-18 N $\hat{i}$

Answer: 5

15)

A parallel plate capacitor consists of two square sheets of aluminum foil with dimensions 10 cm by 10 cm, separated from one another by a sheet of wax paper having a thickness of 30 microns. The dielectric constant is 3.7. What is the capacitance?

(1) 6 nF
(2) 11 nF

(3) 15 nF

(4) 19 nF

Answer: 2

16)

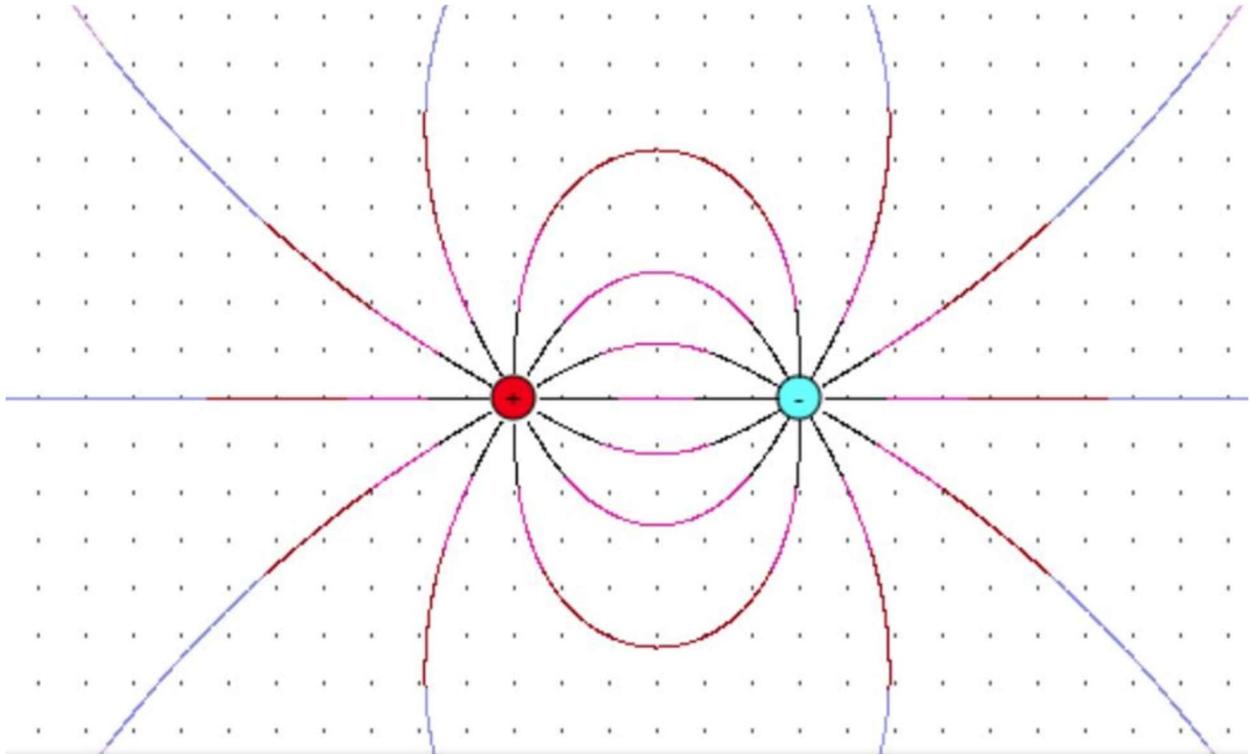What is the current through a light bulb that emits 60 W radiation when placed in series with a 100 V voltage source?

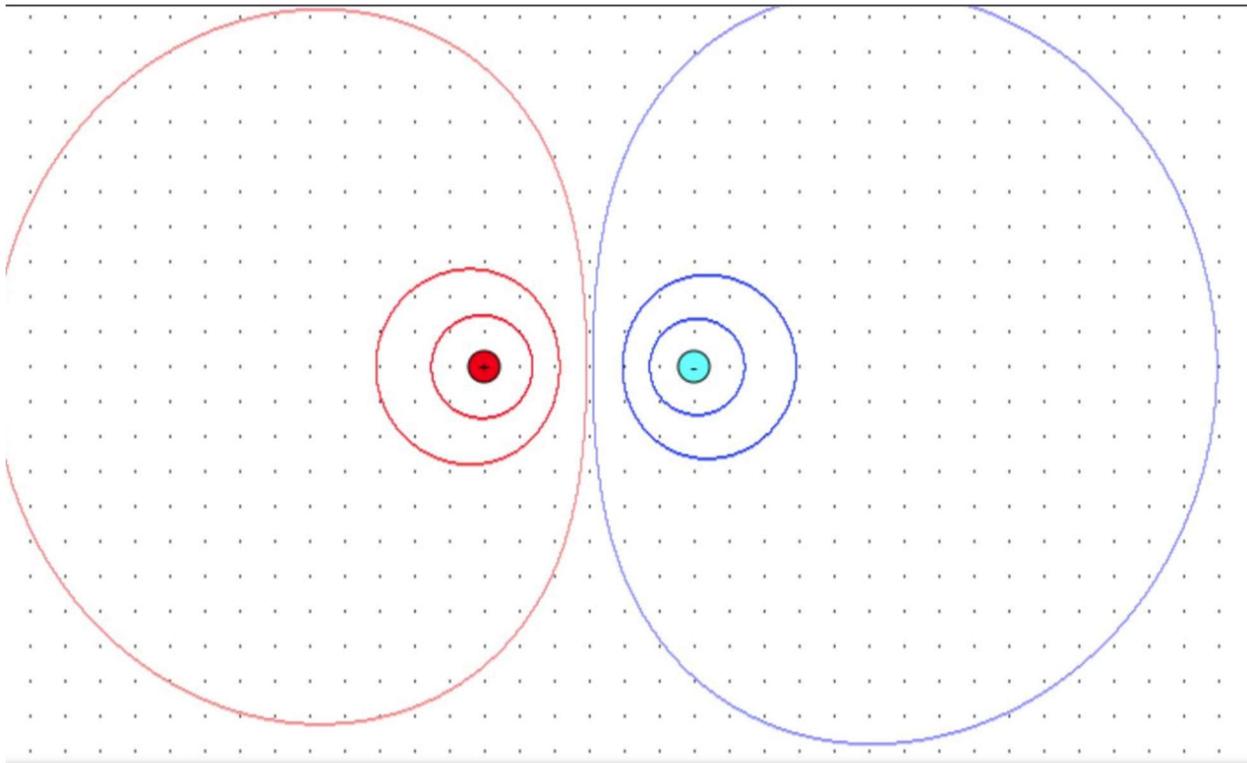(1) 0.60 A
(2) 0.45 A

(3) 0.30 A.

(4) 0.15 A

Answer: 1

17)

One of the two graphs below is a sketch of the electric field lines of a dipole. The other is a sketch of the corresponding equipotentials. Which of the two, Graph A or Graph B, shows the equipotentials?

Graph A

Graph B

(1) Graph A
(2) Graph B

Answer: 2

18)

What are the units of capacitance?

(1) Coulombs per volt
(2) Volts per meter.

(3) Coulombs per newton.

(4) Joules per coulomb.

Answer: 1

19)

What are the units of power?

(1) Coulombs/volt
(2) Volts/meter.

(3) Volt-Ampere.

(4) Coulombs/second

Answer: 3

Question 20:

20)

What is the total charge that can be delivered by a battery that is rated at 500 mAh?

(1) 600 Coulombs
(2) 900 Coulombs .
(3) 1800 Coulombs
(4) 2400 Coulombs

Answer: 3