Physics 1308 Exam 1 Summer 2015

E1-01 1. A neutral metal ball is suspended by a string. A positively charged insulating rod is placed near the ball, which is observed to be attracted to the rod. This is because:

A) the ball becomes positively charged by induction

B) the ball becomes negatively charged by induction

C) the number of electrons in the ball is more than the number in the rod

D) the string is not a perfect insulator

E) there is a rearrangement of the electrons in the ball

Ans: E

Difficulty: E

Section: 21-1

Learning Objective 21.1.0

E1-02 3. The charge on a glass rod which has been rubbed with silk is called positive:

A) by arbitrary convention

B) so that the proton charge will be positive

C) to conform to the conventions adopted for G and m in Newton's law of gravitation

D) because like charges repel

E) because glass is an insulator

Ans: A

Difficulty: E

Section: 21-1

Learning Objective 21.1.1

E1-03 5. An electrical insulator is a material:

A) containing no electrons

B) through which electrons do not flow easily

C) which has more electrons than protons on its surface

D) cannot be a pure chemical element

E) must be a crystal

Ans: B

Difficulty: E

Section: 21-1

Learning Objective 21.1.2

E1-04 18. A small object has charge Q. Charge q is removed from it and placed on a second small object. The two objects are placed 1 m apart. For the force that each object exerts on the other to be a maximum, q should be:

A) $2Q$

B) Q

C) $Q/2$

D) $Q/4$

E) 0

Ans: C

Difficulty: M

Section: 21-1

Learning Objective 21.1.9

E1-05 20. Two particles, X and Y, are 4 m apart. X has a charge of 2*Q* and Y has a charge of *Q*. The force of X on Y:

A) has twice the magnitude of the force of Y on X

B) has half the magnitude of the force of Y on X

C) has four times the magnitude of the force of Y on X

D) has one-fourth the magnitude of the force of Y on X

E) has the same magnitude as the force of Y on X

Ans: E

Difficulty: E

Section: 21-1

Learning Objective 21.1.9

E1-06 24. In the Rutherford model of the hydrogen atom, a proton (mass *M*, charge *Q*) is the nucleus and an electron (mass *m*, charge *q*) moves around the proton in a circle of radius *r*. Let *k* denote the Coulomb force constant ($1/4\pi\varepsilon_0$) and *G* the universal gravitational constant. The ratio of the electrostatic force to the gravitational force between electron and proton is:

A) $kQq/GMmr^2$

B) GQq/kMm

C) kMm/GQq

D) GMm/kQq

E) kQq/GMm

Ans: E

Difficulty: M

Section: 21-1

Learning Objective 21.1.9

E1-07 25. A particle with a charge of 5×10^{-6} C and a mass of 20 g moves uniformly with a speed of 7 m/s in a circular orbit around a stationary particle with a charge of -5×10^{-6} C. The radius of the orbit is:

A) 0 m

B) 0.23 m

C) 0.62 m

D) 1.6 m

E) 4.4 m

Ans: B

Difficulty: M

Section: 21-1

Learning Objective 21.1.9

E1-08 1. The units of the electric field are:
A) $N \cdot C^2$
B) C/N
C) N
D) N/C
E) C/m^2

Ans: D
Difficulty: E
Section: 22-1
Learning Objective 22.1.0

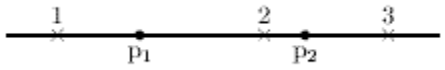
E1-09 5. Experimenter A uses a test charge q_0 and experimenter B uses a test charge $2q_0$ to measure an electric field produced by stationary charges. A finds a field that is:
A) the same as the field found by B
B) greater than the field found by B
C) less than the field found by B
D) either greater or less than the field found by B, depending on the masses of the test charges
E) either greater or less than the field found by B, depending on the accelerations of the test charges

Ans: A
Difficulty: E
Section: 22-1
Learning Objective 22.1.3

E1-10 7. Two thin spherical shells, one with radius *R* and the other with radius 2*R*, surround an isolated charge point particle. The ratio of the number of field lines through the larger sphere to the number through the smaller is:
A) 1
B) 2
C) 4
D) 1/2
E) 1/4

Ans: A
Difficulty: E
Section: 22-1
Learning Objective 22.1.4

E1-11 12. Two protons (p_1 and p_2) are on the *x* axis, as shown below. The directions of the electric field at points 1, 2, and 3 respectively, are:



A) →, ←, →
B) ←, →, ←
C) ←, →, →
D) ←, ←, ←
E) ←, ←, →

Ans: E
Difficulty: M
Section: 22-2
Learning Objective 22.2.2

E1-12 16. An isolated charged point particle produces an electric field with magnitude E at a point 2 m away. At a point 1 m from the particle the magnitude of the field is:
A) E
B) $2E$
C) $4E$
D) $E/2$
E) $E/4$

Ans: C
Difficulty: M
Section: 22-2
Learning Objective 22.2.3

E!-13 26. An electric dipole consists of a particle with a charge of $+6 \times 10^{-6}$ C at the origin and a particle with a charge of -6×10^{-6} C on the x axis at $x = 3 \times 10^{-3}$ m. The direction of the electric field due to the dipole at points on the x axis is:
A) in the positive x direction
B) in the negative x direction
C) in the positive y direction
D) in the negative y direction
E) in the positive x direction between the charges and in the negative x direction elsewhere

Ans: E
Difficulty: E
Section: 22-3
Learning Objective 22.3.2

E1-14 39. The electric field due to a uniform distribution of charge on a spherical shell is zero:
A) everywhere
B) nowhere
C) only at the center of the shell
D) only inside the shell
E) only outside the shell

Ans: D
Difficulty: E
Section: 22-6
Learning Objective 22.6.1

E1-15 3. The area vector for a flat surface:
A) is parallel to the surface and has a magnitude equal to the length of a side of the surface.
B) is perpendicular to the surface and has a magnitude equal to the length of a side of the surface.
C) is parallel to the surface and has a magnitude equal to the area of the surface.
D) is perpendicular to the surface and has a magnitude equal to the area of the surface.
E) none of the above.

Ans: D
Difficulty: E
Section: 23-1
Learning Objective 23.1.3

E!-16 5. When a piece of paper is held with one face perpendicular to a uniform electric field the flux through it is 25 $N \cdot m^2/C$. When the paper is turned 25° with respect to the field the flux through it is:
A) 0 $N \cdot m^2/C$
B) 11 $N \cdot m^2/C$
C) 12 $N \cdot m^2/C$
D) 23 $N \cdot m^2/C$
E) 25 $N \cdot m^2/C$

Ans: D
Difficulty: E
Section: 23-1
Learning Objective 23.1.5

E1-17 8. Which statement is correct?
A) The flux through a closed surface is always positive.
B) The flux through a closed surface is always negative.
C) The sign of the flux through a closed surface depends on an arbitrary choice of sign for the surface vector.
D) Inward flux through a closed surface is negative and outward flux is positive.
E) Inward flux through a closed surface is positive and outward flux is negative.

Ans: D
Difficulty: E
Section: 23-1
Learning Objective 23.1.6

E1-18 12. A point particle with charge q is placed inside a cube but not at its center. The electric flux through any one side of the cube:

A) is zero
B) is q/ε_0
C) is $q/4\varepsilon_0$
D) is $q/6\varepsilon_0$
E) cannot be computed using Gauss' law

Ans: E
Difficulty: E
Section: 23-2
Learning Objective 23.2.1

E1-19 14. A point particle with charge q is at the center of a Gaussian surface in the form of a cube. The electric flux through any one face of the cube is:

A) q/ε_0
B) $q/4\pi\varepsilon_0$
C) $q/4\varepsilon_0$
D) $q/6\varepsilon_0$
E) $q/16\varepsilon_0$

Ans: D
Difficulty: M
Section: 23-2
Learning Objective 23.2.1

E1-20 22. Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2. A particle with charge q is placed at the center of the cavity. The magnitude of the electric field at a point in the cavity, a distance r from the center, is:

A) $\frac{Q}{4\pi\varepsilon_0 R_1^2}$
B) $\frac{Q}{4\pi\varepsilon_0 (R_1^2 - r^2)}$
C) $q/4\pi\varepsilon_0 r^2$
D) $(q + Q)/4\pi\varepsilon_0 r^2$
E) $\frac{(q+Q)}{4\pi\varepsilon_0 (R_1^2 - r^2)}$

Ans: C
Difficulty: E
Section: 23-3
Learning Objective 23.3.0

E1-21 25. A particle with charge $+Q$ is placed outside a large neutral conducting sheet. At any point in the interior of the sheet the electric field produced by charges on the surface is directed:
A) toward the surface
B) away from the surface
C) toward Q
D) away from Q
E) none of the above

Ans: C
Difficulty: M
Section: 23-3
Learning Objective 23.3.3

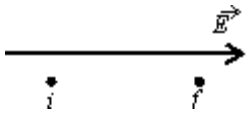
E1-22 1. An electron volt is:
A) the force acting on an electron in a field of 1 N/C
B) the force required to move an electron 1 meter
C) the energy gained by an electron in moving through a potential difference of 1 volt
D) the energy needed to move an electron through 1 meter in any electric field
E) the work done when 1 coulomb of charge is moved through a potential difference of 1 volt

Ans: C
Difficulty: E
Section: 24-1
Learning Objective 24.1.0

E1-23 3. The fact that we can define electric potential energy means that:
A) the electric force is nonconservative
B) the electric force is conservative
C) the work done on a charged particle depends on the path it takes
D) there is a point where the electric potential energy is exactly zero
E) it takes work for the electric force to move from some point a to some other point b and back again

Ans: B
Difficulty: E
Section: 24-1
Learning Objective 24.1.1

E1-24 7. An electron moves from point *i* to point *f*, in the direction of a uniform electric field. During this motion:



A) the work done by the field is positive and the potential energy of the electron-field system increases
B) the work done by the field is negative and the potential energy of the electron-field system increases
C) the work done by the field is positive and the potential energy of the electron-field system decreases
D) the work done by the field is negative and the potential energy of the electron-field system decreases
E) the work done by the field is positive and the potential energy of the electron-field system does not change

Ans: B
Difficulty: E
Section: 24-1
Learning Objective 24.1.5

E1-25 10. During a lightning discharge, 30 C of charge move through a potential difference of 1.0×10^8 V in 2.0×10^{-2} s. The energy released by this lightning bolt is:
A) 1.5×10^{11} J
B) 3.0×10^9 J
C) 6.0×10^7 J
D) 3.3×10^6 J
E) 1500 J

Ans: B
Difficulty: E
Section: 24-1
Learning Objective 24.1.5

E1-26 18. If the electric field is in the positive x direction and has a magnitude given by $E = Cx^2$, where C is a constant, then the electric potential is given by $V =$
A) $2Cx$
B) $-2Cx$
C) $Cx^3/3$
D) $-Cx^3/3$
E) $-3Cx^3$

Ans: D
Difficulty: M
Section: 24-2
Learning Objective 24.2.2

E1-27 27. The equipotential surfaces associated with a charged point particle are:
A) radially outward from the particle
B) vertical planes
C) horizontal planes
D) concentric spheres centered at the particle
E) concentric cylinders with the particle on the axis

Ans: D
Difficulty: E
Section: 24-3
Learning Objective 24.3.5

E1-28 32. A wire carrying a charge density of λ C/m is bent into a circle of radius r. What is the electric potential at the center of the circle?
A) $\lambda/4\pi\varepsilon_0 r$
B) $\lambda/4\pi\varepsilon_0$
C) $\lambda/4\varepsilon_0$
D) $\lambda/2\varepsilon_0$
E) λ/ε_0

Ans: D
Difficulty: M
Section: 24-5
Learning Objective 24.5.1

E1-29 1. The units of capacitance are equivalent to:
A) J/C
B) V/C
C) J^2/C
D) C/J
E) C^2/J

Ans: E
Difficulty: E
Section: 25-1
Learning Objective 25.1.0

E1-30 6. If the charge on a parallel-plate capacitor is doubled:
A) the capacitance is halved
B) the capacitance is doubled
C) the electric field is halved
D) the electric field is doubled
E) the surface charge density is not changed on either plate

Ans: D
Difficulty: E
Section: 25-2
Learning Objective 25.2.0

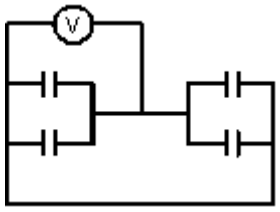
E1-31 12. If the plate area of an isolated charged parallel-plate capacitor is doubled:
A) the electric field is doubled
B) the potential difference is halved
C) the charge on each plate is halved
D) the surface charge density on each plate is doubled
E) none of the above

Ans: B
Difficulty: M
Section: 25-2
Learning Objective 25.2.2

E1-32 14. Pulling the plates of an isolated charged capacitor apart:
A) increases the capacitance
B) increases the potential difference
C) does not affect the potential difference
D) decreases the potential difference
E) does not affect the capacitance

Ans: B
Difficulty: M
Section: 25-2
Learning Objective 25.2.2

E1-33 22. Each of the four capacitors shown is 500 μF. The voltmeter reads 1000V. The magnitude of the charge on each capacitor plate is:



A) 0.2 C
B) 0.5 C
C) 20 C
D) 50 C
E) none of these

Ans: B
Difficulty: M
Section: 25-3
Learning Objective 25.3.2

E1-34 32. Two identical capacitors are connected in series and two, each identical to the first, are connected in parallel. The equivalent capacitance of the series connection is _____ the equivalent capacitance of parallel connection.
A) twice
B) four times
C) half
D) one fourth
E) the same as

Ans: D
Difficulty: M
Section: 25-3
Learning Objective 25.3.6

E1-35 43. A 20-μF capacitor is charged to 200 V. Its stored energy is:
A) 4000 J
B) 4 J
C) 0.4 J
D) 0.1 J
E) 0.004 J

Ans: C
Difficulty: M
Section: 25-4
Learning Objective 25.4.2

E1-36 4. Current is a measure of:
A) force that moves a charge past a point
B) resistance to the movement of a charge past a point
C) energy used to move a charge past a point
D) amount of charge that moves past a point per unit time
E) speed with which a charge moves past a point

Ans: D
Difficulty: E
Section: 26-1
Learning Objective 26.1.1

E1-37 6. A 10-ohm resistor has a constant current. If 1200 C of charge flow through it in 4 minutes what is the value of the current?
A) 3.0 A
B) 5.0 A
C) 20 A
D) 120 A
E) 300 A

Ans: B
Difficulty: M
Section: 26-1
Learning Objective 26.1.1

E1-38 10. Conduction electrons move to the right in a certain wire. This indicates that:
A) the current density and electric field both point right
B) the current density and electric field both point left
C) the current density points right and the electric field points left
D) the current density points left and the electric field points right
E) the current density points left but the direction of the electric field is unknown

Ans: B
Difficulty: E
Section: 26-2
Learning Objective 26.2.1

E1-39 13. A wire with a length of 150 m and a radius of 0.15 mm carries a current with a uniform current density of 2.8×10^7 A/m^2. The current is:
A) 0.63 A
B) 2.0 A
C) 5.9 A
D) 300 A
E) 26000 A

Ans: B
Difficulty: M
Section: 26-2
Learning Objective 26.2.4

E1-40 17. Copper contains 8.4×10^{28} free electrons per cubic meter. A copper wire of cross-sectional area 7.4×10^{-7} m^2 carries a current of 1 A. The electron drift speed is approximately:
A) 3×10^8 m/s
B) 10^3 m/s
C) 1 m/s
D) 10^{-4} m/s
E) 10^{-23} m/s

Ans: D
Difficulty: M
Section: 26-2
Learning Objective 26.2.9

E1-41 21. A wire has an electric field of 6.2 V/m and carries a current density of 2.4×10^8 A/m^2. What is its resistivity?
A) 6.7×10^{-10} Ω·m
B) 1.5×10^{-8} Ω·m
C) 2.6×10^{-8} Ω·m
D) 3.9×10^{7} Ω·m
E) 1.5×10^{9} Ω·m

Ans: C
Difficulty: E
Section: 26-3
Learning Objective 26.3.3

E1-42 27. Two conductors are made of the same material and have the same length. Conductor A is a solid wire of diameter 1 m. Conductor B is a hollow tube of inside diameter 1 m and outside diameter 2 m. The ratio of their resistance, R_A/R_B, is:
A) 1
B) $\sqrt{2}$
C) 2
D) 3
E) 4

Ans: D
Difficulty: M
Section: 26-3
Learning Objective 26.3.6

E1-43 50. It is better to send 10,000 kW of electric power long distances at 10,000 V rather than at 220 V because:
A) there is less heating in the transmission wires
B) the resistance of the wires is less at high voltages
C) more current is transmitted at high voltages
D) the insulation is more effective at high voltages
E) the *iR* drop along the wires is greater at high voltage

Ans: A
Difficulty: M
Section: 26-5
Learning Objective 26.5.3

E1-44 1. "The sum of the emf's and potential differences around a closed loop equals zero" is a consequence of:
A) Newton's third law
B) Ohm's law
C) Newton's second law
D) conservation of energy
E) conservation of charge

Ans: D
Difficulty: E
Section: 27-1
Learning Objective 27.1.0

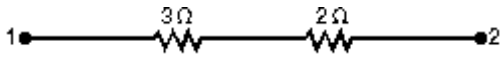
E1-45 4. A battery with an emf of 12 V and an internal resistance of 1 Ω is used to charge a battery with an emf of 10 V and an internal resistance of 1 Ω. The current in the circuit is:
A) 1 A
B) 2 A
C) 4 A
D) 11 A
E) 22 A

Ans: A
Difficulty: M
Section: 27-1
Learning Objective 27.1.4

E1-46 10. Four 20-Ω resistors are connected in series and the combination is connected to a 20-V emf device. The current in any one of the resistors is:
A) 0.25 A
B) 1.0 A
C) 4.0 A
D) 5.0 A
E) 100 A

Ans: A
Difficulty: M
Section: 27-1
Learning Objective 27.1.8

E1-47 14. In the diagram, the current in the 3-Ω resistor is 4 A. The potential difference between points 1 and 2 is:



A) 0.75 V
B) 0.8 V
C) 1.25 V
D) 12 V
E) 20 V

Ans: E
Difficulty: M
Section: 27-1
Learning Objective 27.1.9

E1-48 19. The emf of a battery is equal to its terminal potential difference:
A) under all conditions
B) only when the battery is being charged
C) only when a large current is in the battery
D) only when there is no current in the battery
E) under no conditions

Ans: D
Difficulty: E
Section: 27-1
Learning Objective 27.1.11

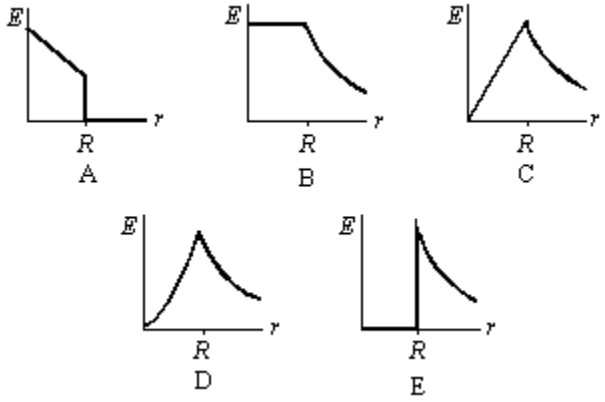
E1-49 26. "The sum of the currents into a junction equals the sum of the currents out of the junction" is a consequence of:
A) Newton's third law
B) Ohm's law
C) Newton's second law
D) conservation of energy
E) conservation of charge

Ans: E
Difficulty: E
Section: 27-2
Learning Objective 27.2.0

E1-50 35. In an antique automobile, a 6-V battery supplies a total of 48 W to two identical headlights in parallel. The resistance of each bulb is:
A) 0.75 Ω
B) 1.5 Ω
C) 3 Ω
D) 4 Ω
E) 8 Ω

Ans: B
Difficulty: M
Section: 27-2
Learning Objective 27.2.4

E1-B1 39. A solid insulating sphere of radius *R* contains a positive charge that is distributed with a volume charge density that does not depend on angle but does increase linearly with distance from the sphere center. Which of the graphs below correctly gives the magnitude *E* of the electric field as a function of the distance *r* from the center of the sphere?



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

Ans: D
Difficulty: M
Section: 23-6
Learning Objective 23.6.1

E1-B2 23. Positive charge is distributed uniformly throughout a non-conducting sphere. The highest electric potential occurs:
A) at the center
B) at the surface
C) halfway between the center and surface
D) just outside the surface
E) far from the sphere

Ans: A
Difficulty: M
Section: 24-3
Learning Objective 24.3.3

E1-B3 50. A parallel-plate capacitor has a plate area of 0.30 m^2 and a plate separation of 0.10 mm. If the charge on each plate has a magnitude of 5.0×10^{-6} C, what is the energy density in its electric field?
A) 0.16 J/m^3
B) 3.5 J/m^3
C) 7.8 J/m^3
D) 16 J/m^3
E) 24 J/m^3

Ans: D
Difficulty: M
Section: 25-4
Learning Objective 25.4.3

E1-B4 47. A certain resistor dissipates 0.5 W when connected to a 3 V potential difference. When connected to a 1 V potential difference, this resistor will dissipate:
A) 0.056 W
B) 0.167 W
C) 0.50 W
D) 1.5 W
E) none of these

Ans: A
Difficulty: M
Section: 26-5
Learning Objective 26.5.3

E1-B5 56. A certain galvanometer has a resistance of 100 Ω and requires 1 mA for full scale deflection. To make this into a voltmeter reading 1 V full scale, connect a resistance of:

A) 1000 Ω in parallel
B) 900 Ω in series
C) 1000 Ω in series
D) 10 Ω in parallel
E) 0.1 Ω in series

Ans: B
Difficulty: M
Section: 27-3
Learning Objective 27.3.1