Instructor(s): *Reitze/Kumar*

PHYSICS DEPARTMENT

PHY 2054 Exam 1 February 16, 2011

Name (print, last first): _____ Signature: _____

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink**. Do not make any stray marks or some answers may be counted as incorrect.
(5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

Useful Constants:

$k_e = 8.99 \times 10^9 \mathrm{Nm}^2/C^2$		$\epsilon_0 = 8.85 \times 10^{-12} \mathrm{C}^2/(\mathrm{Nm}^2)$		V=volt	N=newton
electron charge $= -1.6 \times 10^{-19}$C		electron mass $= 9.11 \times 10^{-31}$kg		J=joule	m=Meter
"milli"$=10^{-3}$	"micro"$=10^{-6}$	n="nano"$=10^{-9}$	"pico"$=10^{-12}$	C=coulomb	$g = 9.8$ m/s^2

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1. If the electric field has a magnitude of 4 N/C at a distance of 1 meter from an isolated point charge, at what distance (in m) is the magnitude of the electric field equal to 0.5 N/C?

(1) 2.83 (2) 0.82 (3) 0.63 (4) 0.58 (5) 1.58

2. If the electric field has a magnitude of 4 N/C at a distance of 1 meter from an isolated point charge, at what distance (in m) is the magnitude of the electric field equal to 6 N/C?

(1) 0.82 (2) 2.83 (3) 0.63 (4) 0.58 (5) 1.58

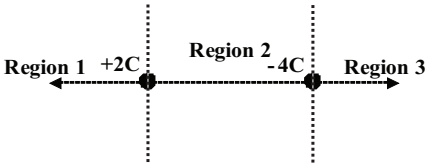
3. If the electric field has a magnitude of 4 N/C at a distance of 1 meter from an isolated point charge, at what distance (in m) is the magnitude of the electric field equal to 10 N/C?

(1) 0.63 (2) 0.82 (3) 2.83 (4) 0.58 (5) 1.58

4. An electron traveling north enters a region where the electric field is uniform and points north. The electron will then:

(1) slow down (2) speed up (3) veer east (4) veer west (5) continue with the same speed in the same direction

5. Two charged particles are arranged as shown in the figure with the +2C charge on the left and the −4C charge on the right. In which region could a third particle, with charge +1C, be placed so that the net electrostatic force on it is zero?



(1) Region 1 only (2) Region 1 and 2 only (3) Region 3 only (4) Region 1 and 3 only (5) Region 2 only

6. A 1 gram particle with a charge of 1 milliC starts from rest in a uniform electric field. If the particle moves 5 m in 2 seconds, what is the magnitude of the electric field (in N/C)?

(1) 2.5 (2) 15 (3) 25 (4) 5 (5) 10

7. A 1 gram particle with a charge of 1 milliC starts from rest in a uniform electric field. If the particle moves 30 m in 2 seconds, what is the magnitude of the electric field (in N/C)?

(1) 15 (2) 2.5 (3) 25 (4) 5 (5) 10

8. A 1 gram particle with a charge of 1 milliC starts from rest in a uniform electric field. If the particle moves 50 m in 2 seconds, what is the magnitude of the electric field (in N/C)?

(1) 25 (2) 15 (3) 2.5 (4) 5 (5) 10

9. Two point particles, one with charge $+8.0 \times 10^{-9}$C and the other with charge -2.0×10^{-9}C, are separated by 4 m. What is the magnitude of the electric field (in N/C) midway between them?

(1) 22.48 (2) 13.49 (3) 9.99 (4) 5.99 (5) 5.62

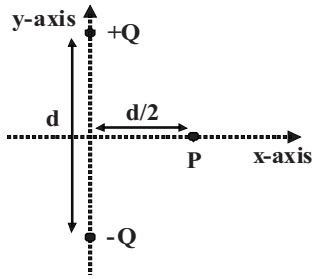
10. Two point particles, one with charge $+8.0 \times 10^{-9}$C C and the other with charge -2.0×10^{-9}C, are separated by 6 m. What is the magnitude of the electric field (in N/C) midway between them?

(1) 9.99 (2) 22.48 (3) 13.49 (4) 5.99 (5) 5.62

11. Two point particles, one with charge $+8.0 \times 10^{-9}$C and the other with charge -2.0×10^{-9}C, are separated by 8 m. What is the magnitude of the electric field (in N/C) midway between them?

(1) 5.62 (2) 3.37 (3) 13.49 (4) 9.99 (5) 5.99

12. Two equal and opposite point charges $+Q$ and $-Q$ are located on the y-axis at $y = d/2$ and $y = -d/2$ as shown in the figure. What is the magnitude of the electric field at the point P on the x-axis a distance $x = d/2$ from the origin? Note $k_e = 1/(4\pi\epsilon_0)$.

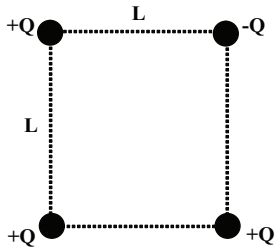


(1) $2.83k_eQ/d^2$
(2) $1.41k_eQ/d^2$
(3) $0.71k_eQ/d^2$
(4) $5.6k_eQ/d^2$
(5) $4k_eQ/d^2$

13. In the previous problem, what is the direction of the electric field at the point P on the x-axis a distance $x = d/2$ from the origin?

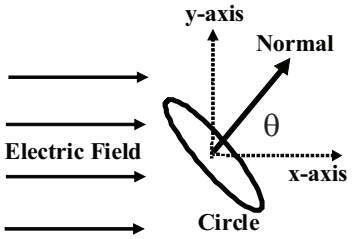
(1) negative y-direction
(2) positive y-direction
(3) positive x-direction
(4) negative x-direction
(5) 45° up from the positive x-axis

14. Four point charges form a square with sides of length L as shown in the figure. Three of the charges have charge $+Q$ and one has charge $-Q$. What is the amount of work that must be done (*against the electric force*) to bring in another $+Q$ charge from infinity and place it at the center of the square?



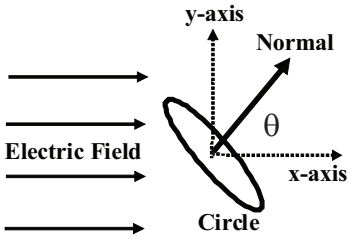
(1) $2.83k_eQ^2/L$
(2) $4.24k_eQ^2/L$
(3) $-2.83k_eQ^2/L$
(4) $-4.24k_eQ^2/L$
(5) $1.41k_eQ^2/L$

15. A uniform electric field of intensity 0.2 N/C is pointing along the x-axis. If the electric flux through a circular plane with radius $R = 2$ m is 2 Nm^2/C, what angle θ (in degrees) does the normal of the circle make with the x-axis if the normal lies in the xy-plane as shown in the figure?



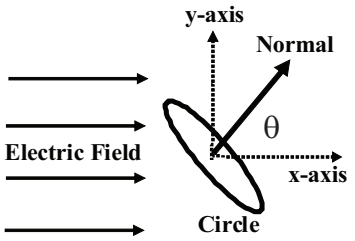
(1) 37.3
(2) 58.0
(3) 74.6
(4) 45.0
(5) 80.8

16. A uniform electric field of intensity 0.3 N/C is pointing along the x-axis. If the electric flux through a circular plane with radius $R = 2$ m is 2 Nm^2/C, what angle θ (in degrees) does the normal of the circle make with the x-axis if the normal lies in the xy-plane as shown in the figure?



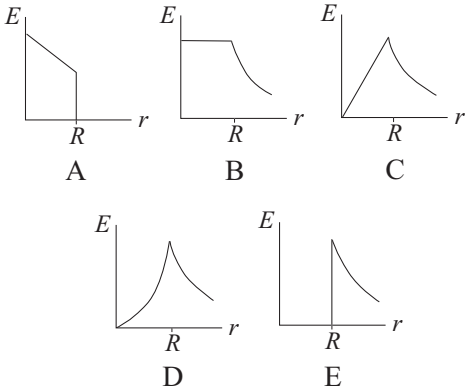
(1) 58.0
(2) 37.3
(3) 74.6
(4) 45.0
(5) 80.8

17. A uniform electric field of intensity 0.6 N/C is pointing along the x-axis. If the electric flux through a circular plane with radius $R = 2$ m is 2 Nm^2/C, what angle θ (in degrees) does the normal of the circle make with the x-axis if the normal lies in the xy-plane as shown in the figure?



(1) 74.6
(2) 37.3
(3) 58.0
(4) 45.0
(5) 80.8

18. Which of the graphs in the figure represents the magnitude of the electric field as a function of the distance from the center of a solid charged conducting sphere of radius R?



(1) E
(2) A
(3) B
(4) C
(5) D

19. Which of the following is equivalent to 1 Joule of energy?

(1) $1C^2/F$ (2) $1F^2/C$ (3) $1V^2/F$ (4) $1V/C^2$ (5) $1C/V^2$

20. When two capacitors are connected in parallel, their equivalent capacitance is 9μF. When the same two capacitors are connected in series their equivalent capacitance is 2μF. What is the capacitance (in μF) of the smaller of the two capacitors?

(1) 3 (2) 1 (3) 2 (4) 4 (5) 6

21. If both the plate area and the plate separation of a parallel-plate capacitor are doubled, the capacitance is:

(1) unchanged (2) doubled (3) halved (4) tripled (5) quadrupled

22. A battery with an internal resistance of 0.5Ω is connected to a 10Ω resistor. If the voltage across the battery (the terminal voltage) is 20 Volts, what is the EMF of the battery (in Volts)?

(1) 21 (2) 22 (3) 19 (4) 23 (5) 20

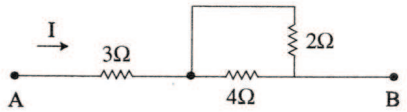
23. A battery with an internal resistance of 1.0Ω is connected to a 10Ω resistor. If the voltage across the battery (the terminal voltage) is 20 Volts, what is the EMF of the battery (in Volts)?

(1) 22 (2) 21 (3) 19 (4) 23 (5) 20

24. A battery with an internal resistance of 1.5Ω is connected to a 10Ω resistor. If the voltage across the battery (the terminal voltage) is 20 Volts, what is the EMF of the battery (in Volts)?

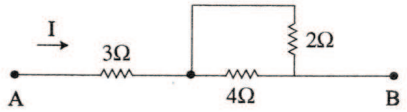
(1) 23 (2) 21 (3) 22 (4) 19 (5) 20

25. The potential difference between point A and B shown in the figure is 5 V. How much power (in W) is dissipated in the 4Ω resistor?



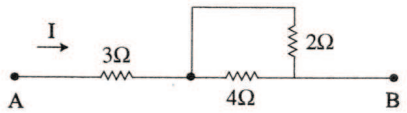
(1) 0.6 (2) 1.2 (3) 3.1 (4) 10.2 (5) 0.2

26. The potential difference between point A and B shown in the figure is 10 V. How much power (in W) is dissipated in the 4Ω resistor?



(1) 2.4 (2) 0.8 (3) 5.7 (4) 12.1 (5) 16.5

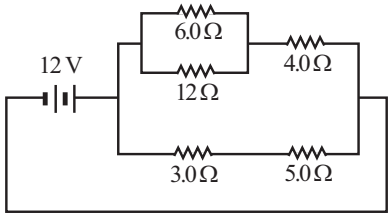
27. The potential difference between point A and B shown in the figure is 20 V. How much power (in W) is dissipated in the 4Ω resistor?



(1) 9.5 (2) 2.6 (3) 7.8 (4) 14.7 (5) 12.6

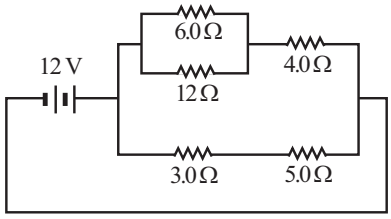
28. What is the current in the 5.0Ω resistor in the circuit shown in the figure?

(1) 1.5 A
(2) 0.42 A
(3) 0.67 A
(4) 2.4 A
(5) 3.0 A

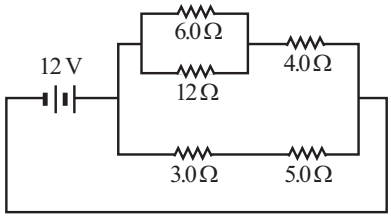


29. What is the current in the 3.0Ω resistor in the circuit shown in the figure?

(1) 1.5 A
(2) 0.42 A
(3) 0.67 A
(4) 2.4 A
(5) 3.0 A

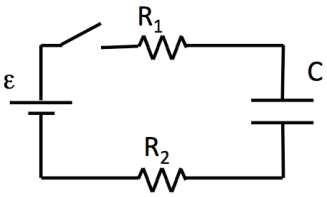


30. What is the current in the 4.0Ω resistor in the circuit shown in the figure?



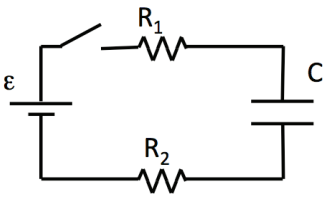
(1) 1.5 A
(2) 0.42 A
(3) 0.67 A
(4) 2.4 A
(5) 3.0 A

31. If the switch is closed at $t = 0$, how much charge is on the capacitor C (in μC) at $t = 10$ ms? Assume that $\epsilon = 10$ V, $R_1 = 100\Omega$, $R_2 = 500\Omega$, and $C = 10\mu$F.



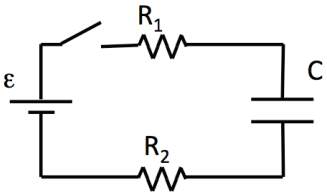
(1) 81.1
(2) 19.0
(3) 121.7
(4) 24.3
(5) 3.3

32. If the switch is closed at $t = 0$, how much charge is on the capacitor C (in μC) at $t = 10$ ms? Assume that $\epsilon = 15$ V, $R_1 = 100\Omega$, $R_2 = 500\Omega$, and $C = 10\mu$F.



(1) 121.7
(2) 81.1
(3) 19.0
(4) 24.3
(5) 3.3

33. If the switch is closed at $t = 0$, how much charge is on the capacitor C (in μC) at $t = 10$ ms? Assume that $\epsilon = 3$ V, $R_1 = 100\Omega$, $R_2 = 500\Omega$, and $C = 10\mu$F.



(1) 24.3
(2) 121.7
(3) 81.1
(4) 19.0
(5) 3.3

34. A copper cable with resistivity $\rho = 1.7 \times 10^{-8}\Omega/\text{m}$ is designed to carry a current of 200 Amps with a power loss of 2.0 W per meter. What is the required radius of this cable (in cm)?

(1) 1.04 (2) 2.08 (3) 3.12 (4) 1.56 (5) 0.66

35. A copper cable with resistivity $\rho = 1.7 \times 10^{-8}\Omega/\text{m}$ is designed to carry a current of 400 Amps with a power loss of 2.0 W per meter. What is the required radius of this cable (in cm)?

(1) 2.08 (2) 1.04 (3) 3.12 (4) 1.56 (5) 0.66

36. A copper cable with resistivity $\rho = 1.7 \times 10^{-8}\Omega/\text{m}$ is designed to carry a current of 600 Amps with a power loss of 2.0 W per meter. What is the required radius of this cable (in cm)?

(1) 3.12 (2) 1.04 (3) 2.08 (4) 1.56 (5) 0.66

37. Suppose the electric company charges 10 cents per kW·h. How much does it cost to use a 125 W lamp 4 hours a day for 30 days?

(1) \$1.50 (2) \$2.25 (3) \$3.00 (4) \$1.88 (5) \$3.38

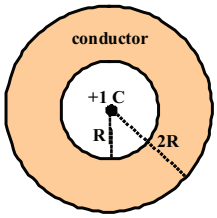
38. Suppose the electric company charges 10 cents per kW·h. How much does it cost to use a 125 W lamp 6 hours a day for 30 days?

(1) \$2.25 (2) \$1.50 (3) \$3.00 (4) \$1.88 (5) \$3.38

39. Suppose the electric company charges 10 cents per kW·h. How much does it cost to use a 125 W lamp 8 hours a day for 30 days?

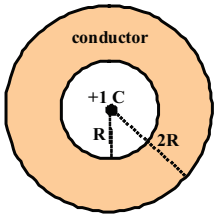
(1) \$3.00 (2) \$1.50 (3) \$2.25 (4) \$1.88 (5) \$3.38

40. A solid conducting shell with inner radius R and outer radius 2R has a a net charge of +2 C placed on it. If a +1 C point charge is placed at the center as shown in the figure, how much charge is located on the outer surface (radius 2R) of the conductor?



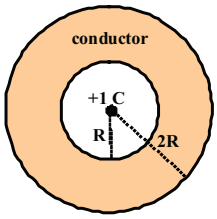
(1) +3 C (2) −1 C (3) zero (4) +2 C (5) +1 C

41. A solid conducting shell with inner radius R and outer radius 2R has a a net charge of +1 C placed on it. If a +1 C point charge is placed at the center as shown in the figure, how much charge is located on the outer surface (radius 2R) of the conductor?



(1) +2 C (2) +3 C (3) −1 C (4) zero (5) +1 C

42. A solid conducting shell with inner radius R and outer radius 2R has a a net charge of +3 C placed on it. If a +1 C point charge is placed at the center as shown in the figure, how much charge is located on the outer surface (radius 2R) of the conductor?



(1) +4 C (2) −1 C (3) zero (4) +2 C (5) +1 C

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 13 FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE

TYPE 1
Q# S 1
Q# S 2
Q# S 3
TYPE 2
Q# S 6
Q# S 7
Q# S 8
TYPE 3
Q# S 9
Q# S 10
Q# S 11
TYPE 4
Q# S 15
Q# S 16
Q# S 17
TYPE 5
Q# S 22

 77777

Q# S 23
Q# S 24
TYPE 6
Q# S 25
Q# S 26
Q# S 27
TYPE 7
Q# S 28
Q# S 29
Q# S 30
TYPE 8
Q# S 31
Q# S 32
Q# S 33
TYPE 9
Q# S 34
Q# S 35
Q# S 36
TYPE 10
Q# S 37
Q# S 38
Q# S 39
TYPE 11
Q# S 40
Q# S 41
Q# S 42