Instructor(s): *Profs. P. Kumar, Z. Qiu*

PHYSICS DEPARTMENT

PHY 2054 Exam 1 September 26, 2013

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

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

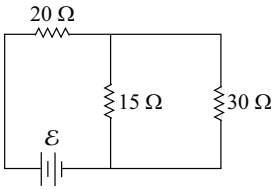
YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(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 <u>blue</u> or <u>black</u> ink**. Do not make any stray marks or some answers may be counted as incorrect.
(5) Hand in the answer sheet separately.

Useful Constants:

$k = 9 \times 10^9 \mathrm{Nm}^2/C^2$			$\epsilon_0 = 8.85 \times 10^{-12} \mathrm{C}^2/(\mathrm{Nm}^2)$	
electron charge $= -1.6 \times 10^{-19}$C			electron mass $= 9.11 \times 10^{-31}$kg	
V=volt	N=newton	J=joule	m="milli"$=10^{-3}$	C=coulomb
k="kilo"$=10^3$	"pico"$=10^{-12}$	n="nano"$=10^{-9}$	proton charge $= +e$	proton mass $= 1.67 \times 10^{-27}$ kg
μ="micro"$=10^{-6}$		$g = 9.8$ m/s^2		M="mega"$=10^6$

1. If $\mathcal{E} = 18.0$ V, what is the current in the 15-Ω resistor?



(1) 0.40 A
(2) 0.60 A
(3) 0.20 A
(4) 0.52 A
(5) 1.00 A

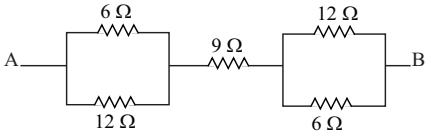
2. A 12.0 V battery is placed across a 4.00 Ω resistor. If the current through the resistor is 2.80 A, what is the terminal voltage of the battery?

(1) 11.2 V (2) 12.8 V (3) 11.6 V (4) 12.0 V (5) 9.6 V

3. Four 12 Ω resistors are connected together. Which of the following resistances cannot be formed using all 4 resistors?

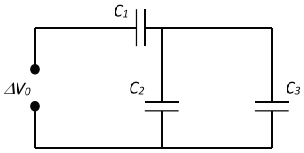
(1) 60Ω (2) 9.0Ω (3) 12Ω (4) 48Ω (5) 20Ω

4. What is the resistance of the combination of resistors?



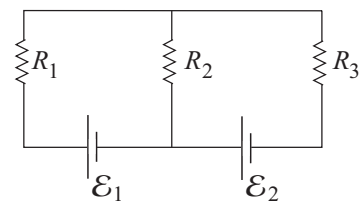
(1) 17Ω (2) 25Ω (3) 8.0Ω (4) 34Ω (5) 4.0Ω

5. If $C_1 = 25\mu$F, $C_2 = 20\mu$F, $C_3 = 10\mu$F, and $\Delta V_0 = 42$ V, determine the energy stored by C_2.



(1) 3.6 mJ (2) 1.3 mJ (3) 1.6 mJ (4) 2.9 mJ (5) 2.2 mJ

6. If $R_1 = 6\Omega$, $R_2 = 8\Omega$, $R_3 = 2\Omega$, $\mathcal{E}_1 = 8$ V, and $\mathcal{E}_2 = 28$ V, what is the current in R_2?



(1) 2 A
(2) 4 A
(3) 6 A
(4) 8 A
(5) 10 A

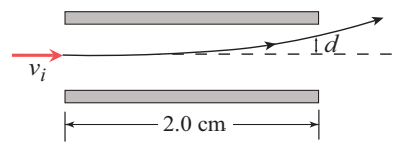
7. If a 2.0 pF capacitor has a voltage of 20 mV, how many more electrons are on the negative plate than on the positive plate?

(1) 0.5×10^6 (2) 2.5×10^5 (3) 4.0×10^{14} (4) 2.0×10^3 (5) none, the electrons are in equal numbers on the plates.

8. If protons are accelerated from rest in a Van de Graff accelerator through a potential difference of 1.00 MV, what is their resulting speed?

(1) 1.38×10^7 m/s (2) 6.25×10^7 m/s (3) 9.79×10^6 m/s (4) 3.67×10^8 m/s (5) 6.92×10^6 m/s

9. A horizontal beam of electrons initially moving at 3.9×10^7m/s is deflected vertically up by the vertical electric field between oppositely charged parallel plates. The magnitude of the field is 2.30×10^4 N/C. What is the vertical deflection d of the positrons as they leave the plates?



(1) 0.531 mm (2) 1.5 mm (3) 3.5 mm (4) 6.3 mm (5) 0.153 mm

10. A copper wire of length l and radius r has resistance R. The wire is pulled hard so that its length is tripled, although its density remains unchanged. What is its resistance now?

(1) $9R$ (2) $3R$ (3) $R/3$ (4) $R/9$ (5) none of these

11. A capacitor is attached across a battery and charged. Then the battery is removed leaving the capacitor charged. The positive lead of the capacitor is then connected to one lead of a previously uncharged identical capacitor, and then the other lead of the charged capacitor is connected to the other lead of the second capacitor. How does the energy E_o stored in the originally charged capacitor compare to the energy E_f stored in the connected capacitors?

(1) $E_o = 2E_f$ (2) $E_o < E_f$ (3) $E_o = E_f$ (4) $E_o = 4E_f$ (5) none of these

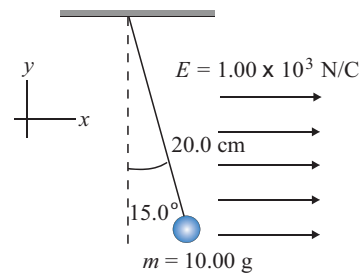
12. Two small, positively charged spheres have a combined charge of 50 μC. If each sphere is repelled from the other by an electrostatic force of 1N when the spheres are 2.0 m apart, what is the charge (in μC) on the sphere with the smallest charge?

(1) 11.6 (2) 1.2 (3) 25 (4) 19.8 (5) none of these

13. Two charges, $q_1 = -1$ C and $q_2 = -4$ C, are placed along the x-axis a distance L apart with charge q_1 at the origin and q_2 at $x = L$. A third charge, $q_3 = +4/9$ C, is also placed along the x-axis such that there is no net Coulomb force on any of the charges. What is the position of this charge along the x axis in units of L, *i.e.,* what is x/L?

(1) $\frac{1}{3}$ (2) $\frac{1}{2}$ (3) 1 (4) 2 (5) 3

14. A small 10 g plastic ball is suspended by a 20 cm long string in a uniform electric field. If the ball makes an angle 15° with the vertical, what is the net charge on the ball?



(1) 26.8μC
(2) 5.26μC
(3) 50μC
(4) 13.4μC
(5) 10.5μC

15. Three protons, placed on the vertices of an equilateral triangle of 1 mm edges, are released simultaneously with zero initial velocities. When the protons are very far apart, what is their speed [in m/s]?

(1) 16.6 (2) 23.5 (3) 11.7 (4) 44.9 (5) 87.7

16. Three protons, placed on the vertices of an equilateral triangle of 0.5 mm edges, are released simultaneously with zero initial velocities. When the protons are very far apart, what is their speed [in m/s]?

(1) 23.5 (2) 16.6 (3) 11.7 (4) 44.9 (5) 87.7

17. Three protons, placed on the vertices of an equilateral triangle of 2 mm edges, are released simultaneously with zero initial velocities. When the protons are very far apart, what is their speed [in m/s]?

(1) 11.7 (2) 16.6 (3) 23.5 (4) 44.9 (5) 87.7

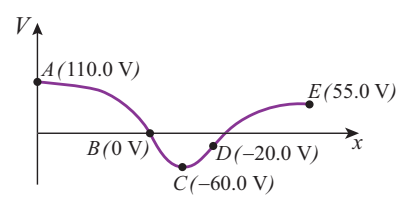
18. Two identical small insulated conducting spheres, whose centers are 18.9 cm apart, carry charges $Q_1 = -100\mu$C and $Q_2 = -200\mu$C, respectively. The spheres are kept insulated, but you bring them into mutual contact and then you put them back into their original positions. How much does the potential energy (in J) between the 2 spheres change from the initial to the final configuration?

(1) 119 (2) 96 (3) 81 (4) -119 (5) -96

19. Four charges of magnitude q are placed at the corners of a square with sides of length L. What is the magnitude of the force acting on any of the charges?

(1) $1.91kq^2/L^2$ (2) kq^2/L^2 (3) $2.50kq^2/L^2$ (4) $1.41kq^2/L^2$ (5) $3.00kq^2/L^2$

20. A proton starts at point E moving left. How much kinetic energy (in Joules) must it have in order to reach point A?

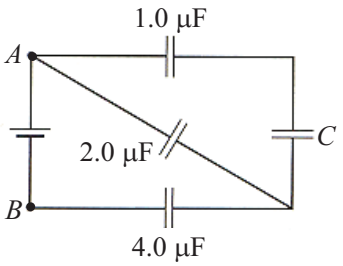


(1) 8.8×10^{-18}
(2) 1.84×10^{-17}
(3) 2.56×10^{-17}
(4) 0
(5) 7.2×10^{-18}

21. Refer to the figure in the problem above but consider an electron, also moving to the left at position E. How much kinetic energy (in Joules) does it need to get to A?

(1) 1.84×10^{-17} (2) 7.2×10^{-18} (3) 2.56×10^{-17} (4) 0 (5) 8.8×10^{-17}

22. The capacitance across A and B is 1.563μF. What is the capacitance C in μF?



(1) 1.3
(2) 3.4
(3) 10.5
(4) 56
(5) none of these

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 21 FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE

TYPE 1
Q# S 15
Q# S 16
Q# S 17