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

PHYSICS DEPARTMENT

PHY 2054 Final Exam December 7, 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"$=10^6$	$\mu_0 = 4\pi \times 10^{-7}$ T-m/A

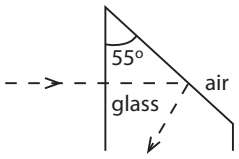
1. An object is placed 60 cm in front of a mirror, and the image is upright and $\frac{1}{4}$ the size of the object. What is the focal length of the mirror?

(1) -20 cm (2) -12 cm (3) 45 cm (4) -75 cm (5) some positive value not given

2. An object is 20 cm to the left of a lens of focal length +10 cm. A second lens, of focal length +12.5 cm, is 30 cm to the right of the first lens. The distance between the original object and the final image is:

(1) 0 (2) 50 cm (3) 100 cm (4) 28 cm (5) infinity

3. The illustration shows total internal reflection taking place in a piece of glass. The index of refraction of this glass:



(1) at least 1.22 (2) at most 1.74 (3) at least 1.74 (4) at most 1.22 (5) cannot be calculated from the given data

4. A person has his nearsightness corrected by lenses of -4.00 D. With his glasses, his near point is 37.5 cm. Without his glasses on, what is his near point? Assume the lenses are very close to the eyes.

(1) 15.0 cm (2) 20.0 cm (3) 13.0 cm (4) 45.0 cm (5) 24.0 cm

5. An astronomical telescope is made with lenses of focal length 80.0 cm and 4.00 cm. Two stars in the sky are separated by 0.080°. What angle of separation do they have when viewed in the telescope?

(1) 1.6° (2) 3.2° (3) 20° (4) 0.8° (5) 0.080°

6. One wire, lying on the x-axis, carries a current of 4.0 A in the positive x-direction. Another wire, lying on the y-axis, carries a current of 6 A in the positive y-direction. What is the magnitude of the magnetic field at (x, y) = (8.0 cm, 12.0 cm)?

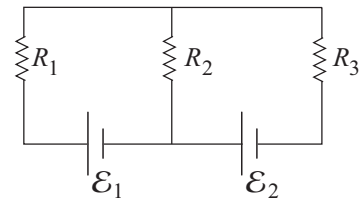
(1) 0.83×10^{-5} T (2) 1.5×10^{-5} T (3) 0.65×10^{-5} T (4) 2.2×10^{-5} T (5) 2.0×10^{-10} T

7. A singly charged ^{9}Be ion is accelerated from rest through a potential difference of 32000 V. The ion is then sent into a mass spectrometer where the radius of the path is 24 cm. What is the magnetic field in the spectrometer?

(1) 0.32 T (2) 0.16 T (3) 0.081 T (4) 0.0028 T (5) 0.58 T

8. If $R_1 = 6\Omega$, $R_2 = 8\Omega$, $R_3 = 2\Omega$, $\mathcal{E}_1 = 12$ V, and $\mathcal{E}_2 = 42$ V, what is the current in R_2?

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



9. A particle with a charge of 5.5×10^{-8}C is fixed at the origin. A particle with a charge of -2.3×10^{-8}C is moved from $x = 7.0$ cm on the x axis to $y = 8.6$ cm on the y axis. The change in potential energy of the two-particle system is:

(1) 3.0×10^{-5}J (2) -1.6×10^{-3}J (3) 1.6×10^{-3}J (4) -3.0×10^{-5}J (5) 0

10. A circular loop of wire with radius 10.0 cm and resistance 2.0Ω is in the plane of the page. It is sitting in a magnetic field directed into the page. The magnetic field strength varies in time at a rate of 40.0 T/s. Which of the following answers is a possibility for the current?

(1) 0.63 A, CCW (2) 0.63 A, CW (3) 20 A, CW (4) 0.2 A, CCW (5) 20 A, CCW

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

(1) $16R$ (2) $4R$ (3) $R/4$ (4) $R/16$ (5) none of these

12. 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]?

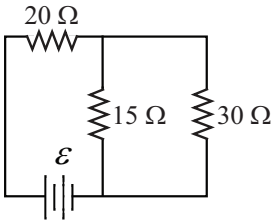
(1) 16.6 (2) 23.5 (3) 11.7 (4) 44.9 (5) 87.7

13. 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?

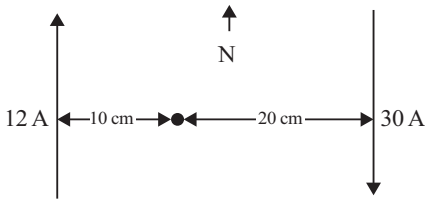
(1) $1.91kq^2/L^2$ (2) kq^2/L^2 (3) $2.50kq^2/L^2$ (4) $1.41kq^2/L^2$ (5) $3.00kq^2/L^2$

14. If $\mathcal{E} = 12$ V, at what rate is thermal energy generated in the 20-Ω resistor?

(1) 3.2 W
(2) 13 W
(3) 23 W
(4) 28 W
(5) 39 W



15. Two parallel wires run in a north-south direction. The eastern wire carries 30.0 A southward while the western wire carries 12.0 A northward. If the wires are separated by 30 cm, what is the magnitude of the magnetic field at a point between the wires at a distance of 10 cm from the western wire?



(1) 54μT (2) 12μT (3) 30μT (4) 6.0μT (5) 180μT

16. Four identical, thin, converging lenses have been stacked together to make one lens of focal length 20 cm. What is the focal length (in cm) of each of them?

(1) 80 (2) 60 (3) 40 (4) 20 (5) none of these

17. Wave 1 has amplitude of 9.0 units and wave 2 has amplitude 4.0 units. What is the ratio of their intensities, I_1/I_2?

(1) 5.1 (2) 20.0 (3) 2.3 (4) 1.5 (5) 1.3

18. A thin film of magnesium fluoride ($n = 1.38$) is applied to glass ($n = 1.50$) at a thickness of 100 nm. For what visible wavelength will this coating act as nonreflecting?

(1) 552 nm (2) 578 nm (3) 600 nm (4) 504 nm (5) 491 nm

19. What minimum thickness of oil ($n = 1.50$) on the surface of water ($n = 1.33$) would give constructive interference for 550 nm light with normal incidence?

(1) 92.0 nm (2) 80.0 nm (3) 78.0 nm (4) 183 nm (5) 275 nm

20. Light of a wavelength of 661.1 nm is received from a star that is emitting light of a wavelength of 659.6 nm. How fast is the star moving relative to the earth, and is it moving toward or away?

(1) 680 km/s, away (2) 580 km/s, away (3) 580 km/s, towards (4) 680 km/s, towards (5) none of these