Instructor(s): *Z. Qiu*

PHYSICS DEPARTMENT

PHY2005, Spring, 2012 Final Exam, 4:05pm–6:00pm April 25, 2012

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

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

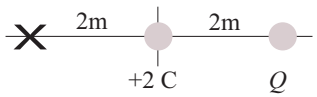
YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(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.

Physical Constants:

$g = 9.8$ m/s^2	$m_e = 9.11 \times 10^{-31}$ kg	$m_p = 1.67 \times 10^{27}$ kg
$e = 1.6 \times 10^{-19}$ C	constant k in Coulomb's Law: $k = 8.99 \times 10^9$ Nm^2/C^2	
$\mu_o = 4\pi \times 10^{-7}$ N/A^2	$\varepsilon_o = 8.85 \times 10^{-12}$ C^2/Nm^2	$h = 6.63 \times 10^{-34}$J·s

1. A charge of +3 C is at the origin. When charge Q is placed at 2 m along the positive x axis, the electric field at 2 m along the negative x axis becomes zero. What is the value of Q?

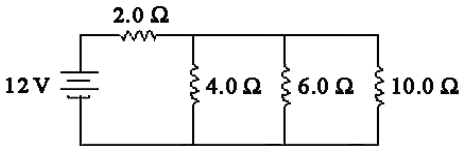


(1) −12 C (2) −9 C (3) −15 C (4) −6 C (5) +9 C

2. Two capacitors with capacitances of 2.0 and 4.0μF, respectively, are connected in series. The system is connected to a 30-V battery. What charge accumulates on the 2.0-μF capacitor?

(1) 40μC (2) 60μC (3) 50μC (4) 30μC (5) 20μC

3. Three resistors connected in parallel have individual values of 4.0, 6.0 and 10.0Ω, respectively. If this combination is connected in series with a 12-V battery and a 2.0-Ω resistor, what is the current in the 4.0-Ω resistor?



(1) 1.48 A (2) 1.15 A (3) 2.21 A (4) 0.69 A (5) 0.85 A

4. Two long parallel wires 40 cm apart carry currents of 5.0 A and 8.0 A in the same direction. Is there any point between the two wires where the magnetic field is zero?

(1) yes, 15.4 cm from the 5-A wire
(2) yes, 24 cm from the 5-A wire
(3) yes, midway between the wires
(4) no
(5) yes, 8.6 cm from the 5-A wire

5. A planar loop consisting of four turns of wire, each of which encloses 200 cm^2, is oriented perpendicularly to a magnetic field that increases uniformly in magnitude from 10 mT to 25 mT in a time of 5.0 ms. What is the resulting induced current in the coil if the resistance of the coil is 8.0Ω?

(1) 30 mA (2) 11 mA (3) 0.18 mA (4) 52 mA (5) 7.6 mA

6. Two converging thin lenses with focal lengths 15.0 cm and 10.0 cm are aligned on a common axis, running left to right, the 15-cm lens being on the left. A distance of 50.0 cm separates the lenses. An object is located at a distance of 60.0 cm to the left of the 15-cm lens. Where will the final image appear as measured from the 10-cm lens?

(1) +15 cm (2) −15 cm (3) −30 cm (4) +35 cm (5) +60 cm

7. A Young's double slit has a slit separation of 2.50×10^{-5}m on which a monochromatic light beam is directed. The resultant bright fringes on a screen 1.00 m from the double slit are separated by 2.30×10^{-2}m. What is the wavelength of this beam? (1 nm = 10^{-9}m)

(1) 575 nm (2) 454 nm (3) 373 nm (4) 667 nm (5) 292 nm

8. A puddle of water ($n = 1.33$) is covered with a very thin layer of oil ($n = 1.20$). How thick is the oil in the region that strongly reflects light with a wavelength of 550 nm?

(1) 229 nm (2) 207 nm (3) 388 nm (4) 520 nm (5) 607 nm

9. If a proton with mass 1.67×10^{-27}kg moves in an accelerator such that its total energy is four times its rest energy, what is its speed? ($c = 3.00 \times 10^{8}$m/s)

(1) 2.90×10^{8}m/s (2) 2.81×10^{8}m/s (3) 2.62×10^{8}m/s (4) 2.30×10^{8}m/s (5) none of the others

10. What is the wavelength of the line in the Balmer series of hydrogen that is comprised of transitions from the $n = 5$ to the $n = 2$ level? ($R = 1.097 \times 10^{7}\text{m}^{-1}$ and 1 nm = 10^{-9}m)

(1) 434 nm (2) 486 nm (3) 523 nm (4) 630 nm (5) 775 nm

11. In the year 2112 an astronaut wears an antique, but accurate, "quartz" wristwatch on a journey at a speed of 2.5×10^{8} m/s. According to mission control in Houston, the trip lasts 12 hours. How long was the trip as measured on the watch? (in hr)

(1) 6.6 (2) 5.7 (3) 21.7 (4) 16.1 (5) 2.5

12. A 0.80-m-long metal rod has a radius of 2.0 cm and a resistance of $3.2 \times 10^{-5}\Omega$. What is the resistivity of the metal?

(1) $5.0 \times 10^{-8}\Omega$·m (2) $1.6 \times 10^{-8}\Omega$·m (3) $16 \times 10^{-8}\Omega$·m (4) $160 \times 10^{-8}\Omega$·m (5) $50 \times 10^{-8}\Omega$·m

13. A muon has rest energy 105 MeV. What is its kinetic energy when its speed is 0.95c? (in MeV)

(1) 231 (2) 37 (3) 741 (4) 151 (5) 64

14. What is the speed of an electron that has the same wavelength as a 3.26 eV photon? (in m/s)

(1) 1.9×10^{3} (2) 2.5×10^{5} (3) 2.1×10^{4} (4) 2.7×10^{6} (5) 2.8×10^{8}

15. A uniform electric field, with a magnitude of 900 N/C, is directed parallel to the positive x-axis. If an electron is released from rest at x = 2.0 m, what is its speed as the electron reaches $x = 0$? (in m/s)

(1) 2.51×10^{7} (2) 0.69×10^{7} (3) 1.56×10^{7} (4) 4.18×10^{6} (5) 3.75×10^{6}

16. Two small identical metal spheres carry charges of $-2.0\ \mu$C and $3.2\ \mu$C and are 5.0 m apart. Now the spheres are touched together and again separated to 5.0 m. What force does one exert on the other? (in N)

(1) 1.30×10^{-4} (2) 3.15×10^{-3} (3) 8.79×10^{-3} (4) 2.03×10^{-4} (5) 6.38×10^{-3}

17. A proton is released such that it has an initial speed of 5.0×10^5m/s from left to right across the page. A magnetic field of 2.8 T is present at an angle of 40° to the horizontal direction (or positive x axis). What is the magnitude of the force experienced by the proton? ($q_p = 1.6 \times 10^{-19}$C)

(1) 14.4×10^{-14} N (2) 7.9×10^{-13} N (3) 19.2×10^{-15} N (4) 22.5×10^{3} N (5) 7.2×10^{-14} N

18. A square coil, enclosing an area with sides 8.0 cm long, is wrapped with 5000 turns of wire. A uniform magnetic field perpendicular to its plane is turned on and increases to 1.50 T during an interval of 3.0 s. What average voltage is induced in the coil?

(1) 16.0 V (2) 8.0 V (3) 32.0 V (4) 40.0 V (5) 12.0 V

19. An object is held at a distance of 24 cm from a convex mirror creating an image that is 1/4 the object size. What is the focal length of the mirror?

(1) −8.0 cm (2) −6.0 cm (3) −9.0 cm (4) −12 cm (5) 15 cm

20. An oil film floats on a water surface. The indices of refraction for water and oil, respectively, are 1.333 and 1.176. If a ray of light is incident on the air-to-oil surface at an angle of 49.0°with the normal, what is the incident angle at the oil-to-water surface?

(1) 39.9° (2) 28.4° (3) 35.3° (4) 48.0° (5) 45.7°