Physics 6b
Winter 2015 Final
Campagnari Section
Test Form D

- Fill out name and perm number on the scantron.
- <u>Do not forget to bubble in the "Test Form" (A, B, C, or, D).</u>
- At the end, only turn in the scantron. Keep questions/cheat sheets, etc.
- Keep a record of your answers to double-check the scantron results. (Solutions will be provided).
- No penalty for wrong answers.

$g = 9.8 \text{ m/sec}^2$
$\mu_0 = 4\pi \ 10^{-7} \text{ Tm/A}$
$k = 1/4\pi\varepsilon_\circ = 9 \ 10^9 \text{ Nm}^2/\text{C}^2$
$e = 1.6 \ 10^{-19} \text{ C}$

# <u>Do not turn this page until you have been instructed to do so</u>

1) A capacitor C is connected in series with a resistor R across a battery and an open switch. If a second capacitor of capacitance $2C$ is connected in parallel to the first, the time constant of the new RC circuit will be
    A) twice as large as before.
    B) three times a large as before.
    C) one–half as large as before.
    D) the same as before.
    E) one–fourth as large as before.

2) Two strings both vibrate at exactly 819 Hz. The tension in one of them is then increased slightly. As a result, six beats per second are heard when both strings vibrate. What is the new frequency of the string that was tightened?
    A) 825 Hz   B) 822 Hz   C) 813 Hz   D) 816 Hz

3) A 200–W light bulb is connected across 110 V. What current will flow through this bulb?
   A) 0.36 A   B) 0.90 A   C) 0.60 A   D) 0 A   E) 1.8 A

4) Four charged particles (two having a charge $+Q$ and two having a charge $-Q$) are arranged in the xy–plane, as shown in the figure. These particles are all equidistant from the origin. The electric potential (relative to infinity) at point P on the z–axis due to these particles, is
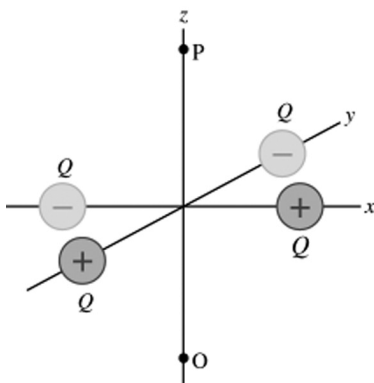
    A) zero.
    B) negative.
    C) positive.
    D) impossible to determine based on the information given.

5) Water flows through a pipe. The diameter of the pipe at point B is larger than at point A. Where is the speed of the water greater?
    A) point A
    B) point B
    C) same at both A and B
    D) Cannot be determined from the information given.

6) A person stands between two speakers driven by the same source. Each speaker produces a tone with a frequency of 200 Hz on a day when the speed of sound is 330 m/s. The person is 1.65 m from one speaker and 4.95 m from the other. What type of interference does the person perceive?
    A) constructive   B) destructive
    C) both constructive and destructive   D) neither constructive nor destructive

7) When a current of 2.0 A flows in the 100–turn primary of an ideal transformer, this causes 14 A to flow in the secondary. How many turns are in the secondary?

    A) 114   B) 14   C) 700   D) 356   E) 4

8) The wire in the figure carries a current I that is increasing with time at a constant rate. The wire and the three loops are all in the same plane. What is true about the currents induced in each of the three loops shown?
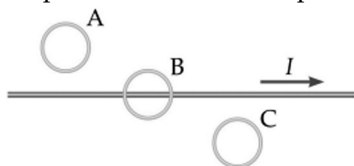
    A) Loop A has clockwise current, loop B has no induced current, and loop C has counterclockwise current.
    B) The currents are clockwise in all three loops.
    C) The currents are counterclockwise in all three loops.
    D) Loop A has counterclockwise current, loop B has no induced current, and loop C has clockwise current.
    E) No current is induced in any loop.

9) Electrical and gravitational forces follow similar equations with one main difference:
    A) Gravitational forces obey the inverse square law and electrical forces do not.
    B) Electrical forces attract and gravitational forces repel.
    C) Electrical forces obey the inverse square law and gravitational forces do not.
    D) Electrical forces repel and gravitational forces attract.
    E) Gravitational forces are always attractive but electrical forces can be attractive or repulsive.

10) For a proton moving in the direction of the electric field
    A) its potential energy increases and its electric potential increases.
    B) its potential energy increases and its electric potential decreases.
    C) its potential energy decreases and its electric potential increases.
    D) its potential energy decreases and its electric potential decreases.
    E) both its potential energy and it electric potential remain constant.

11) A flat circular loop of radius 0.10 m is rotating in a uniform magnetic field of 0.20 T. Find the magnetic flux through the loop when the plane of the loop and the magnetic field vector are parallel.

    A) $0 \text{ T} \cdot \text{m}^2$ B) $6.3 \times 10^{-3} \text{ T} \cdot \text{m}^2$ C) $5.5 \times 10^{-3} \text{ T} \cdot \text{m}^2$ D) $3.1 \times 10^{-3} \text{ T} \cdot \text{m}^2$

12) A coil lies flat on a level tabletop in a region where the magnetic field vector points straight up. The magnetic field suddenly grows stronger. When viewed from above, what is the direction of the induced current in this coil as the field increases?
    A) counterclockwise
    B) clockwise
    C) clockwise initially, then counterclockwise before stopping
    D) There is no induced current in this coil.

13) A charged particle that is moving in a static uniform magnetic field
    A) may experience a magnetic force, but its speed will not change.
    B) will always experience a magnetic force, regardless of its direction of motion.
    C) may experience a magnetic force, but its direction of motion will not change.
    D) may experience a magnetic force which will cause its speed to change.
    E) None of the above statements are true.

14) When the current through a resistor is increased by a factor of 4, the power dissipated by it
    A) increases by a factor of 16.
    B) decreases by a factor of 4.
    C) decreases by a factor of 16.
    D) increases by a factor of 4.
    E) remain unchanged.

15) A 100–kg person sits on a 5–kg bicycle. The weight is borne equally by the two wheels of the bicycle. The tires are inflated to a gauge pressure of 8.0×10^5 Pa and are 2.0 cm wide. What length of each tire is in contact with the ground?
    A) 1.6 cm   B) 2.4 cm   C) 6.4 cm   D) 3.2 cm   E) 1.8 cm

16) A 5.0 μC charge is placed at the 0 cm mark of a meter stick and a –4.0 μC charge is placed at the 50 cm mark. At what point on a line joining the two charges is the electric field zero?
    A) 1.4 m from the 0 cm mark
    B) 2.9 m from the 0 cm mark
    C) 2.5 m from the 0 cm mark
    D) 4.7 m from the 0 cm mark
    E) 3.3 m from the 0 cm mark

17) If the ac peak current through a 100 ohm resistor is 1.7 A, the average power dissipated by the resistance is
    A) 85 W.   B) 289 W.   C) 170 W.   D) 145 W.   E) 220 W.

18) A simple harmonic oscillator is undergoing oscillations with an amplitude A. How far is it from its equilibrium position when the kinetic and potential energies are equal?
    A) A B) $A/2$ C) $A/\sqrt{3}$ D) $A/\sqrt{2}$ E) $A/3$

19) If you were to cut a small permanent bar magnet in half,
    A) neither piece would be magnetic.
    B) one piece would be a magnetic north pole and the other piece would be a south pole.
    C) each piece would in itself be a smaller bar magnet with both north and south poles.
    D) None of these statements is true.

20) The reason that you do not observe a Doppler shift when you listen to the car radio while driving is that
    A) there is a Doppler shift but we don't notice it.
    B) the speed of the car is too fast compared to the speed of sound.
    C) the source and observer are moving at the same speed.
    D) the air inside the car is moving at the same speed as the car.
   E) the speed of the car is too slow compared to the speed of sound.

21) A capacitor consists of a set of two parallel plates of area A separated by a distance d. This capacitor is connected to a battery and charged until its plates carry charges $+Q$ and $-Q$. If the separation between the plates is doubled, the electrical energy stored in the capacitor will
 A) not change.
 B) double.
 C) be cut in fourth.
 D) quadruple.
 E) be cut in half.

22) Two people are talking at a distance of 3.0 m from where you are and you measure the sound intensity as 1.1 $\times 10^{-7}$ W/m^2. Another student is 4.0 m away from the talkers. What sound intensity does the other student measure?
 A) 6.2×10^{-8} W/m^2
 B) 8.3×10^{-8} W/m^2
 C) 1.5×10^{-7} W/m^2
 D) 2.5×10^{-8} W/m^2
 E) 7.8×10^{-7} W/m^2

23) When unequal resistors are connected in parallel in a circuit,
 A) the potential drop is always the same across each resistor.
 B) the power generated in each resistor is the same.
 C) the same current always runs through each resistor.
 D) the largest resistance has the largest current through it.

24) A bar magnet is oriented above a copper ring, as shown in the figure. If the magnet is pulled upward, what is the direction of the current induced in the ring, as viewed from above?

 A) There is no current in the ring.
 B) counterclockwise
 C) clockwise

25) Which one of the following is a correct statement for a number of resistors connected in series or parallel?
 A) The voltage is different across resistors connected in a parallel circuit.
 B) The flow of current is different through resistors connected in a series circuit.
 C) The total resistance in a series circuit decreases as more resistors are added.
 D) The total resistance in a parallel circuit decreases as more resistors are added.
 E) None of the above statements is correct.

26) The primary coil of a transformer has 100 turns and its secondary coil has 400 turns. If the ac voltage applied to the primary coil is 120 V, what voltage is present in its secondary coil?
 A) 400 V   B) 100 V   C) 70 V   D) 30 V   E) 480 V

27) The magnitude of a magnetic field a distance 3.0 μm from a wire is 20.0×10^{-4} T. How much current is flowing through the wire? Assume the wire is the only contributor to the magnetic field.

   A) 19 mA   B) 188 mA   C) 30 mA   D) 377 mA

28)
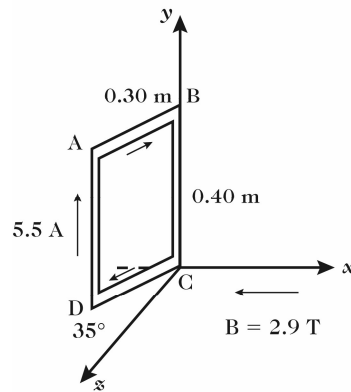
A rigid rectangular loop, which measures 0.30 m by 0.40 m, carries a current of 5.5 A, as shown. A uniform external magnetic field of magnitude 2.9 T in the negative x–direction is present. Segment CD is in the x–z plane and forms a 35° angle with the z–axis, as shown. An external torque applied to the loop keeps it in static equilibrium. The magnitude of the external torque is closest to:

    A) 0.73 N • m   B) 1.4 N • m   C) 1.1 N • m   D) 1.3 N • m   E) 1.6 N • m

29) A negative charge is moved from point A to point B along an equipotential surface. Which of the following statements is true for this case?

    A) Work is both required and performed in moving the negative charge from point A to point B.

    B) No work is required to move the negative charge from point A to point B.

    C) The negative charge performs work in moving from point A to point B.

    D) Work is required to move the negative charge from point A to point B.

30) A 2.0 kg block on a frictionless table is connected to two springs with spring constants k_1 and k_2 whose opposite ends are fixed to walls, as show in the figure. What is the oscillation angular frequency if $k_1 = 7.6$ N/m and $k_2 = 5.0$ N/m?
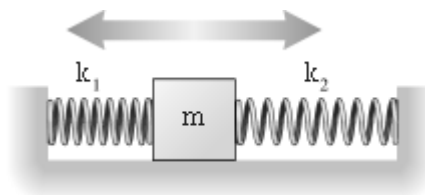

    A) 0.56 rad/s   B) 0.40 rad/s   C) 2.5 rad/s   D) 3.5 rad/s

31) As shown in the figure, two parallel wires carry a current I in opposite directions, and this current is decreasing. A rectangular loop is centered between the wires. The direction of the induced current through the resistor R is
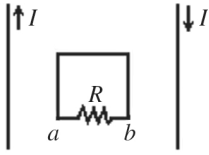
   A) from b to a.   B) from a to b.   C) No current is induced.

32) A circular conducting loop with a radius of 1.00 m and a small gap filled with a 10.0 Ω resistor is oriented in the xy–plane. If a magnetic field of 2.0 T, making an angle of 30° with the z–axis, increases to 9.0 T, in 2.0 s, what is the magnitude of the current that will be caused to flow in the conductor?
   A) 0.95 A   B) 0.24 A   C) 0.55 A   D) 0.095 A

33) Four waves are described by the following expressions, where distances are measured in meters and times in seconds.
    I $y = 0.12 \cos(3x - 21t)$
   II $y = 0.15 \sin(6x + 42t)$
  III $y = 0.13 \cos(6x + 21t)$
  IV $y = -0.23 \sin(3x - 42t)$
Which of these waves have the same speed?
   A) III and IV   B) I and II   C) II and IV   D) II and III   E) I and III

34) An electron enters a magnetic field of 0.75 T with a velocity perpendicular to the direction of the field. At what frequency does the electron traverse a circular path? (The mass of an electron is 9.1×10^{-31} kg, and the charge of an electron is 1.6×10^{-19} C.)
   A) 2.1×10^{10} Hz   B) 2.1×10^{14} Hz   C) 4.8×10^{-7} Hz   D) 4.8×10^{-11} Hz

35) Three identical capacitors are connected in parallel to a potential source (battery). If a charge of Q flows into this combination, how much charge does each capacitor carry?
   A) $3Q$ B) $Q/3$ C) Q D) $Q/9$

36) When you are scuba diving, the pressure on your face plate
   A) is independent of both depth and orientation.
   B) depends only on your depth, and not on how you are oriented.
   C) will be greatest when you are facing downward.
   D) will be greatest when you are facing upward.

FIGURE 19–2
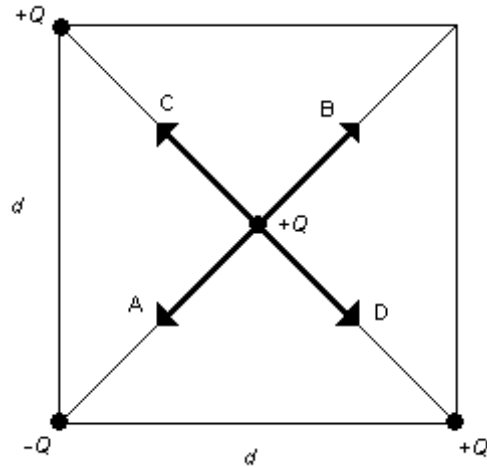
37) Four point charges of equal magnitudes but with varying signs are arranged on three of the corners and at the center of the square of side d as shown in **Figure 19–2**. Which of the arrows shown represents the net force acting on the center charge?
   A) A
   B) B
   C) C
   D) D
   E) none of the above

38) If the total energy of a harmonic oscillator is reduced by 1/3, what is the change in the amplitude of the oscillations?

   A) 3   B) $\sqrt{1/3}$ C) 1/3   D) $\sqrt{3}$

39) Crests of an ocean wave pass a pier every 12.0 s. If the waves are moving at 5.6 m/s, what is the wavelength of the ocean waves?
   A) 34 m   B) 67 m   C) 77 m   D) 57 m

40) An electron is initially at rest. It is accelerated through a potential difference of 400 V. What is the kinetic energy of this electron? The magnitude of the electron charge is e=1.6 x 10^{-19} C.
   A) 6.4×10^{-17} J   B) 400 J   C) 800 J   D) 0 J   E) 6400 J

FIGURE 21–3
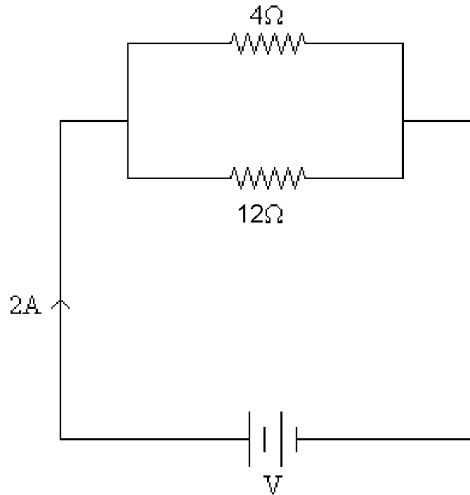
41) A 4–Ω resistor is connected in parallel with a 12–Ω resistor and this combination is connected to a DC power supply with voltage V as shown in **Figure 21–3**. If the total current in this circuit is 2 A, what is the value of voltage V?
   A) 2 V
   B) 3 V
   C) 1.5 V
   D) 6 V
   E) None of the other answers is correct.

42) In simple harmonic motion, the speed is greatest at that point in the cycle when
   A) the displacement is a maximum.
   B) the potential energy is a maximum.
   C) the kinetic energy is a minimum.
   D) the magnitude of the acceleration is a minimum.
   E) the magnitude of the acceleration is a maximum.

43) A cubical box 25.00 cm on each side is immersed in a fluid. The pressure at the top surface of the box is 109.4 kPa and the pressure on the bottom surface is 112 kPa. What is the density of the fluid?
   A) 1000 kg/m^3
   B) 1060 kg/m^3
   C) 1030 kg/m^3
   D) 1120 kg/m^3
   E) 1090 kg/m^3

FIGURE 19–12
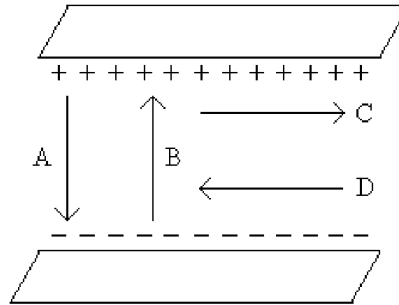
44) Which of the arrows shown in **Figure 19–12** represents the correct direction of the electric field between the two metal plates?
   A) A
   B) B
   C) C
   D) D
   E) none of the above

FIGURE 15–3
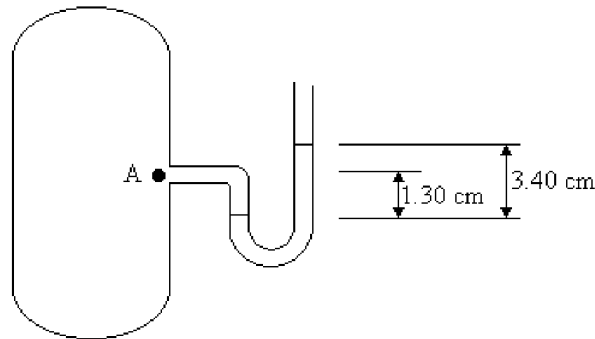
45) The U–tube shown in **Figure 15–3** contains mercury with a density of $13{,}600$ kg/m^3. It is open on one end and the other end is connected to a boiler, which contains water at high pressure. The water from the boiler pushes directly on the mercury column. What is the gauge pressure at point A in the boiler? The density of water is $1{,}000$ kg/m^3.
   A) 4.54 kPa   B) 449 Pa   C) 128 Pa   D) 441 Pa   E) 4.41 kPa

46) The zirconium nucleus contains 40 protons, and an electron is 1.0 nm from the nucleus. What is the electric force on the electron due to the nucleus? ($e = 1.60 \times 10^{-19}$ C, $k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N $\cdot$ m^2/C^2)
   A) 1000 C   B) 9.2 nN   C) 6.8 nN   D) 2.9 nN   E) 3.7 nN

1) B
2) A
3) E
4) A
5) A
6) A
7) B
8) A
9) E
10) D
11) A
12) B
13) A
14) A
15) D
16) D
17) D
18) D
19) C
20) C
21) B
22) A
23) A
24) B
25) D
26) E
27) C
28) C
29) B
30) C
31) A
32) A
33) B
34) A
35) B
36) B
37) A
38) B
39) B
40) A
41) D
42) D
43) B
44) A
45) E
46) B