# Physics 227H – First Hour Exam
Sunday, October 7, 2018

**Faraday**
**Michael**
Physics , Section 01
RUID: 139550004
**Code: 123**

Your name with **exam code**

**Your signature** ______________________________

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**4** There are 16 multiple-choice questions on the exam. For each question, mark only one answer on the answer sheet. There is no subtraction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess.

**5** Before starting the exam, make sure that your copy contains all 16 questions and the reference page at the end. Bring your exam to the proctor if this is not the case.

**6** At the end of the exam, hand in **only the cover sheet**. Retain the question sheets for future reference and study.

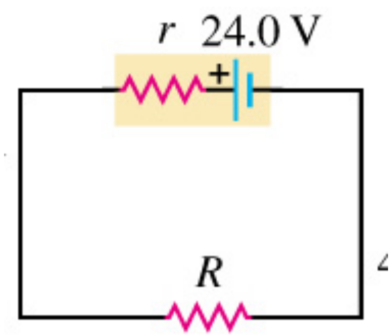
No marks except filled in answer circles below the line, please.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1: | A | B | C | D | E |
| 2: | A | B | C | D | E |
| 3: | A | B | C | D | E |
| 4: | A | B | C | D | E |
| 5: | A | B | C | D | E |
| 6: | A | B | C | D | E |
| 7: | A | B | C | D | E |
| 8: | A | B | C | D | E |
| 9: | A | B | C | D | E |
| 10: | A | B | C | D | E |
| 11: | A | B | C | D | E |
| 12: | A | B | C | D | E |
| 13: | A | B | C | D | E |
| 14: | A | B | C | D | E |
| 15: | A | B | C | D | E |
| 16: | A | B | C | D | E |

1. A potential difference of 4.0 V is applied between the ends of a wire, resulting in a current of 16 A. If the wire is 2.5 m in length and 0.60 mm in radius, then the resistivity of the material of which the wire is made is

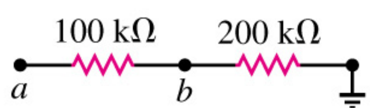
   a) $1.1 \times 10^{-7}\ \Omega m$  b) $2.8 \times 10^{-8}\ \Omega m$  c) $4.5 \times 10^{-7}\ \Omega m$
   d) $0.25\ \Omega$  e) $4.0\ \Omega$

2. Consider the circuit shown in the figure. The terminal voltage of the battery is 21.2 V and the resistor R is 5.30 Ω. What is the power dissipated in the resistor R?



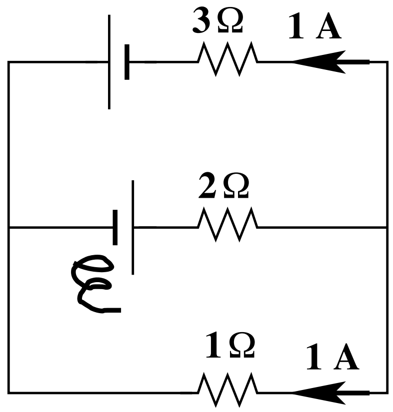

   a) 84.8 W
   b) 109 W
   c) 112 W
   d) 127 W
   e) 4.00 W

3. Point $a$ in the figure is maintained at a constant potential of 600 V above ground. When connected between point $b$ and ground, the reading of a voltmeter with resistance 200 kΩ is



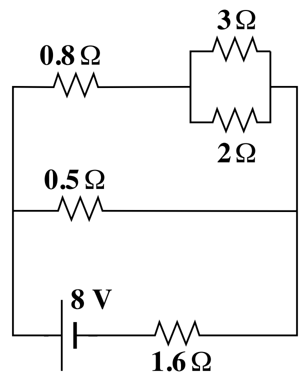

   a) 300 V
   b) 400 V
   c) 200 V
   d) 480 V
   e) 120 V

4. In the circuit shown, the emf $\mathcal{E}$ of the lower battery is




   a) 2 V
   b) 3 V
   c) 4 V
   d) 5 V
   e) 6 V

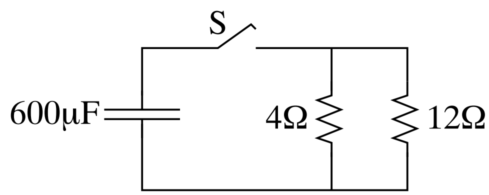
5. In the circuit, the current flowing through the 1.6 Ω resistance is




   a) 1.0 A
   b) 2.0 A
   c) 2.5 A
   d) 4.0 A
   e) 6.0 A

6. The capacitor shown in the circuit always starts initially charged. In the version shown, the current in the circuit takes a certain amount of time to reach $\frac{1}{e}$ of it's initial value. Then the switch is opened, the 12Ω resistor is replaced by a 2.4Ω resistor, and the switch is closed again. The time it will take the current in the circuit to reach $\frac{1}{e}$ of it's initial value is:

a) halved
b) doubled
c) unchanged
d) tripled
e) 10 times greater

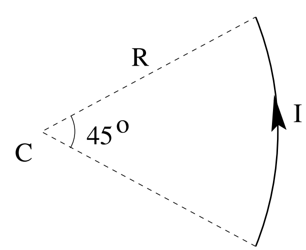



7. A proton moves at a constant speed in a circular orbit in a plane perpendicular to a uniform magnetic field. The period of its motion is
$2.6 \times 10^{-8}$ s. What is the magnitude of the magnetic field?

a) insufficient information
b) $3 \times 10^{-4}$ T
c) 6.28 T
d) 5 T
e) 2.4 T

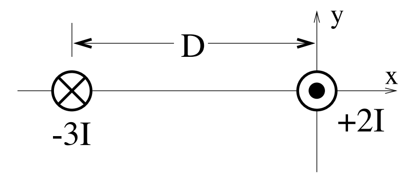
8. A segment of a wire is in the shape of an arc of a circle of radius R, and carries current I in the direction shown. The arc subtends a 45∘ angle. What is the contribution to the magnetic field at the center C by the current in this arc?

a) $\mu_0$ I/4R out of the paper
b) $\mu_0$ I/4R into the paper
c) $\mu_0$ I/2R into the paper
d) $\mu_0$ I/16R into the paper
e) $\mu_0$ I/16R out of the paper



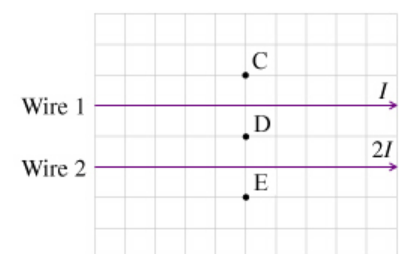

9. At $x = 0$, a long straight wire carries current $2I$ **out** of the plane of the paper. At $x = -D$, another long straight wire carries current $3I$ **into** the plane of the paper. What is the direction of the force on the wire at $x = -D$?

a) in the positive $x$-direction
b) in the negative $x$-direction
c) in the positive $y$-direction
d) in the negative $y$-direction
e) none of the other answers




10. In the figure you are given two wires. Wire 1 carries a current $I$ and wire 2 carries a current $2I$. Point C is located a distance $d$ above wire 1. Point D is located a distance $d$ below wire 1 and the same distance $d$ above wire 2. Point E is located a distance $d$ below wire 2. Rank the magnetic fields $B$ at points C, D, and E, where positive fields are out of the page and negative fields are into the page.

a) $B_C = B_E > B_D$
b) $B_C > B_D > B_E$
c) $B_C = B_D > B_E$
d) $B_D > B_E > B_C$
e) $B_E > B_D > B_C$



11. A long solenoid of 800 turns of wire is 30 cm in length. If it carries a current of 2.0 A, what is the magnetic field inside the solenoid at its center?

    a) About 2.0 mT
    b) About 6.7 mT
    c) About 3.4 mT
    d) About 1.7 mT
    e) About 1.0 mT

12. A cylindrical wire of cross sectional radius $R$ carries a total current $I$, which is *uniformly* distributed inside the wire. At a distance $r = 2R$ from the axis of the wire, the magnetic field strength is 6 T. At what distance $r$ **inside** the wire is the magnetic field strength equal to 4 T?

    a) $r = \frac{1}{4}R$
    b) $r = \frac{1}{3}R$
    c) $r = \frac{1}{2}R$
    d) $r = \frac{2}{3}R$
    e) There is *no* point inside the wire at which the field strength gets as large as 4 T.

13. The plane of a circular, single-turn coil of radius 10 cm is perpendicular to a uniform magnetic field. The field is increased at a constant rate from 0.15 T to 0.65 T in 0.01 seconds. What is the magnitude of the emf induced in the coil?

    a) About 5.2 V
    b) About 9.1 V
    c) About 0.3 V
    d) About 1.6 V
    e) About 0.9 V

14. A cylindrical region of radius R = 3.0 cm contains a uniform magnetic field parallel to its axis. The field is zero outside the cylinder. If the field is changing at the rate 0.60 T/s, the electric field induced at a point $2R$ from the cylinder axis is:

    a) 0
    b) 0.0045 V/m
    c) 0.0090 V/m
    d) 0.018 v/m
    e) none of these

# REFERENCE PAGE: Useful Information

c = speed of light = $3.00 \times 10^8$ m/s
$q_e = -e$ = charge on an electron = -$1.602 \times 10^{-19}$ Coulombs
$q_p = +e$ = charge on a proton = $+1.602 \times 10^{-19}$ Coulombs
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$k = 9 \times 10^9$ N m$^2$/C$^2$
$\epsilon_0 = 8.85 \times 10^{-12}$ C$^2$/(Nm$^2$)
$g = 9.80$ m/s$^2$
1 $eV = 1.602 \times 10^{-19}$ J
1 mC = $10^{-3}$ C    1 $\mu$C = $10^{-6}$ C
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a) 0
b) none of these
c) 0.0045 V/m
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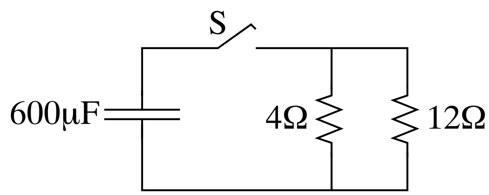
2. The capacitor shown in the circuit always starts initially charged. In the version shown, the current in the circuit takes a certain amount of time to reach $\frac{1}{e}$ of it's initial value. Then the switch is opened, the $12\Omega$ resistor is replaced by a $2.4\Omega$ resistor, and the switch is closed again. The time it will take the current in the circuit to reach $\frac{1}{e}$ of it's initial value is:

a) doubled
b) halved
c) 10 times greater
d) tripled
e) unchanged

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c) $\mu_0$ I/4R into the paper
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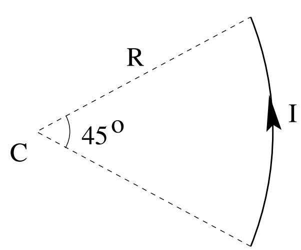


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a) $2.8 \times 10^{-8}\ \Omega m$ b) $0.25\ \Omega$ c) $1.1 \times 10^{-7}\ \Omega m$
d) $4.5 \times 10^{-7}\ \Omega m$ e) $4.0\ \Omega$

5. In the circuit, the current flowing through the $1.6\ \Omega$ resistance is

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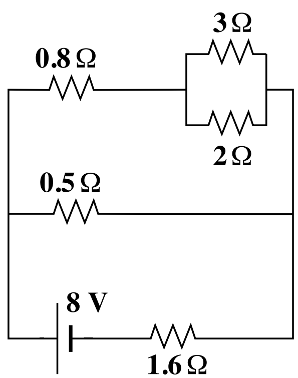
b) 2.5 A
c) 1.0 A
d) 2.0 A
e) 4.0 A

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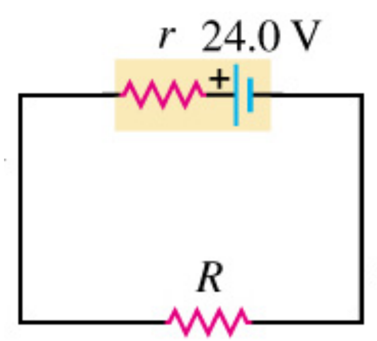

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a) 6.28 T
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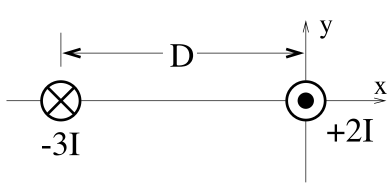
c) 2.4 T
d) 5 T
e) $3 \times 10^{-4}$ T

8. A cylindrical wire of cross sectional radius $R$ carries a total current $I$, which is *uniformly* distributed inside the wire. At a distance $r = 2R$ from the axis of the wire, the magnetic field strength is 6 T. At what distance $r$ **inside** the wire is the magnetic field strength equal to 4 T?

a) $r = \frac{1}{2}R$
b) There is *no* point inside the wire at which the field strength gets as large as 4 T.
c) $r = \frac{1}{3}R$
d) $r = \frac{1}{4}R$
e) $r = \frac{2}{3}R$

9. At $x = 0$, a long straight wire carries current $2I$ **out** of the plane of the paper. At $x = -D$, another long straight wire carries current $3I$ **into** the plane of the paper. What is the direction of the force on the wire at $x = -D$?

a) in the negative $y$-direction
b) none of the other answers
c) in the negative $x$-direction
d) in the positive $y$-direction
e) in the positive $x$-direction

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a) About 9.1 V
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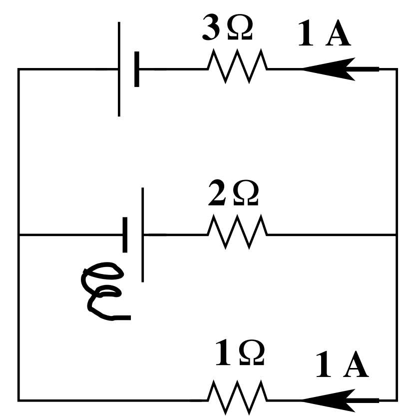
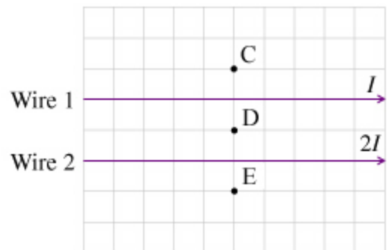
c) About 5.2 V
d) About 1.6 V
e) About 0.9 V

11. In the circuit shown, the emf $\mathcal{E}$ of the lower battery is




a) 3 V
b) 6 V
c) 4 V
d) 2 V
e) 5 V

12. In the figure you are given two wires. Wire 1 carries a current $I$ and wire 2 carries a current $2I$. Point C is located a distance $d$ above wire 1. Point D is located a distance $d$ below wire 1 and the same distance $d$ above wire 2. Point E is located a distance $d$ below wire 2. Rank the magnetic fields $B$ at points C, D, and E, where positive fields are out of the page and negative fields are into the page.

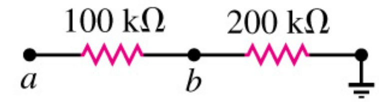



a) $B_C = B_E > B_D$
b) $B_D > B_E > B_C$
c) $B_C = B_D > B_E$
d) $B_C > B_D > B_E$
e) $B_E > B_D > B_C$

13. A long solenoid of 800 turns of wire is 30 cm in length. If it carries a current of 2.0 A, what is the magnetic field inside the solenoid at its center?

a) About 3.4 mT
b) About 2.0 mT
c) About 6.7 mT
d) About 1.0 mT
e) About 1.7 mT

14. Point $a$ in the figure is maintained at a constant potential of 600 V above ground. When connected between point $b$ and ground, the reading of a voltmeter with resistance 200 kΩ is




a) 120 V
b) 200 V
c) 400 V
d) 480 V
e) 300 V

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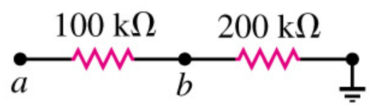
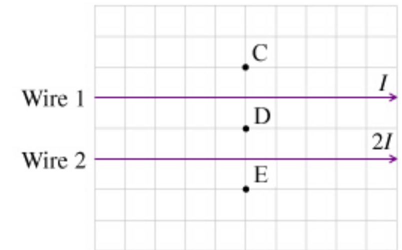
   a) 0.0045 V/m
   b) none of these
   c) 0.018 v/m
   d) 0.0090 V/m
   e) 0

2. Point $a$ in the figure is maintained at a constant potential of 600 V above ground. When connected between point $b$ and ground, the reading of a voltmeter with resistance 200 kΩ is



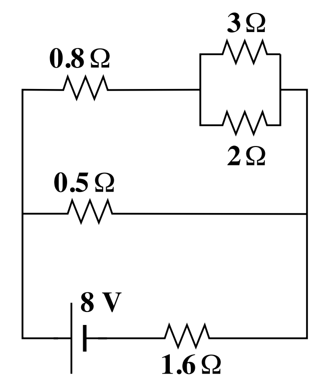

   a) 200 V
   b) 480 V
   c) 120 V
   d) 400 V
   e) 300 V

3. In the figure you are given two wires. Wire 1 carries a current $I$ and wire 2 carries a current $2I$. Point C is located a distance $d$ above wire 1. Point D is located a distance $d$ below wire 1 and the same distance $d$ above wire 2. Point E is located a distance $d$ below wire 2. Rank the magnetic fields $B$ at points C, D, and E, where positive fields are out of the page and negative fields are into the page.




   a) $B_D > B_E > B_C$
   b) $B_C > B_D > B_E$
   c) $B_E > B_D > B_C$
   d) $B_C = B_D > B_E$
   e) $B_C = B_E > B_D$

4. In the circuit, the current flowing through the 1.6 Ω resistance is




   a) 2.5 A
   b) 6.0 A
   c) 2.0 A
   d) 4.0 A
   e) 1.0 A

5. A cylindrical wire of cross sectional radius $R$ carries a total current $I$, which is *uniformly* distributed inside the wire. At a distance $r = 2R$ from the axis of the wire, the magnetic field strength is 6 T. At what distance $r$ **inside** the wire is the magnetic field strength equal to 4 T?

a) $r = \frac{1}{4}R$
b) $r = \frac{1}{2}R$
c) $r = \frac{2}{3}R$
d) $r = \frac{1}{3}R$
e) There is *no* point inside the wire at which the field strength gets as large as 4 T.

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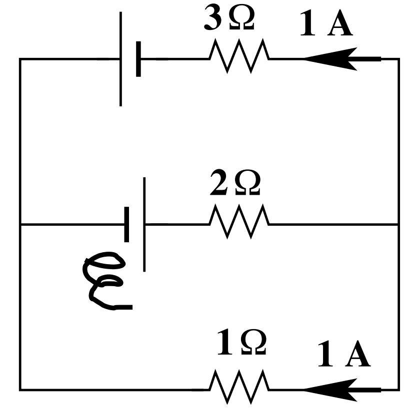
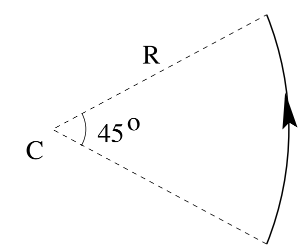
7. In the circuit shown, the emf $\mathcal{E}$ of the lower battery is




a) 5 V
b) 6 V
c) 4 V
d) 3 V
e) 2 V

8. A segment of a wire is in the shape of an arc of a circle of radius R, and carries current I in the direction shown. The arc subtends a 45o angle. What is the contribution to the magnetic field at the center C by the current in this arc?




a) $\mu_0$ I/16R out of the paper
b) $\mu_0$ I/4R out of the paper
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d) $\mu_0$ I/4R into the paper
e) $\mu_0$ I/16R into the paper

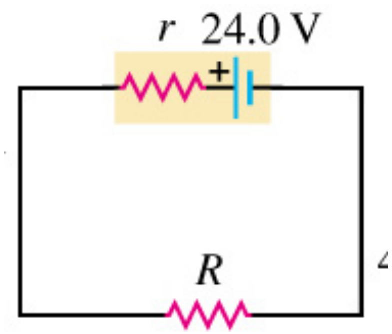
9. A potential difference of 4.0 V is applied between the ends of a wire, resulting in a current of 16 A. If the wire is 2.5 m in length and 0.60 mm in radius, then the resistivity of the material of which the wire is made is

a) $4.5 \times 10^{-7}\ \Omega m$ b) $2.8 \times 10^{-8}\ \Omega m$ c) $1.1 \times 10^{-7}\ \Omega m$
d) $4.0\ \Omega$ e) $0.25\ \Omega$

10. A proton moves at a constant speed in a circular orbit in a plane perpendicular to a uniform magnetic field. The period of its motion is
$2.6 \times 10^{-8}$ s. What is the magnitude of the magnetic field?

a) 5 T
b) 6.28 T
c) $3 \times 10^{-4}$ T
d) 2.4 T
e) insufficient information

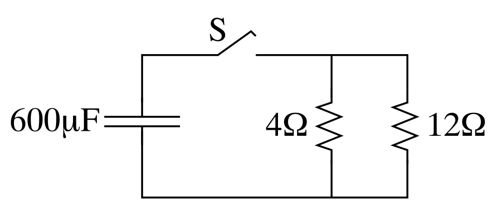
11. Consider the circuit shown in the figure. The terminal voltage of the battery is 21.2 V and the resistor R is 5.30 Ω. What is the power dissipated in the resistor R?




a) 127 W
b) 109 W
c) 84.8 W
d) 4.00 W
e) 112 W

12. The capacitor shown in the circuit always starts initially charged. In the version shown, the current in the circuit takes a certain amount of time to reach $\frac{1}{e}$ of it's initial value. Then the switch is opened, the 12Ω resistor is replaced by a 2.4Ω resistor, and the switch is closed again. The time it will take the current in the circuit to reach $\frac{1}{e}$ of it's initial value is:

a) unchanged
b) doubled
c) tripled
d) 10 times greater
e) halved

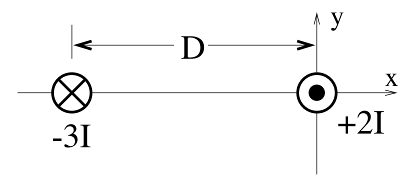



13. The plane of a circular, single-turn coil of radius 10 cm is perpendicular to a uniform magnetic field. The field is increased at a constant rate from 0.15 T to 0.65 T in 0.01 seconds. What is the magnitude of the emf induced in the coil?

a) About 9.1 V
b) About 1.6 V
c) About 0.9 V
d) About 0.3 V
e) About 5.2 V

14. At $x = 0$, a long straight wire carries current $2I$ **out** of the plane of the paper. At $x = -D$, another long straight wire carries current $3I$ **into** the plane of the paper. What is the direction of the force on the wire at $x = -D$?

a) in the negative $x$-direction
b) none of the other answers
c) in the negative $y$-direction
d) in the positive $x$-direction
e) in the positive $y$-direction



# REFERENCE PAGE:
# Useful Information

c = speed of light = $3.00 \times 10^8$ m/s
$q_e = -e$ = charge on an electron = -1.602 $\times 10^{-19}$ Coulombs
$q_p = +e$ = charge on a proton = +1.602 $\times 10^{-19}$ Coulombs
$m_e$ = electron mass = $9.11 \times 10^{-31}$ kg
$m_p$ = proton mass = $1.67 \times 10^{-27}$ kg
$k = 9 \times 10^9$ N m$^2$/C$^2$
$\epsilon_0 = 8.85 \times 10^{-12}$ C$^2$/(Nm$^2$)
$g = 9.80$ m/s$^2$
1 $eV = 1.602 \times 10^{-19}$ J
1 mC = $10^{-3}$ C    1 $\mu$C = $10^{-6}$ C
1 nC = $10^{-9}$ C    1 pC = $10^{-12}$ C

# Physics 227H – First Hour Exam
Sunday, October 7, 2018

**Faraday**
**Michael**
Physics , Section 01
RUID: 139550004
**Code: 123**

Your name with **exam code**

**Your signature** ______________________________

## Turn off and put away cell phones now!

**1** The exam will last from 8:10 to 9:30 PM.

Use a # 2 pencil to make entries in the circles at the bottom of the cover sheet.

**2** Make sure your name and RU ID are correct on the cover page. **CAREFULLY detach the cover sheet (with your name, ID and the answer circles.**

**3** During the exam, you may use pencils and a calculator. and **ONE SINGLE-SIDED** $8\frac{1}{2}'' \times 11''$ sheet of paper with equations and notes.

**4** There are 16 multiple-choice questions on the exam. For each question, mark only one answer on the answer sheet. There is no subtraction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess.

**5** Before starting the exam, make sure that your copy contains all 16 questions and the reference page at the end. Bring your exam to the proctor if this is not the case.

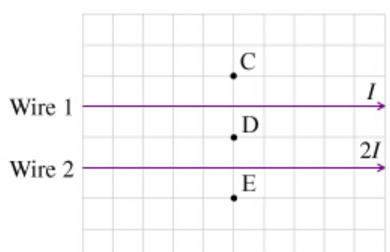
**6** At the end of the exam, hand in **only the cover sheet**. Retain the question sheets for future reference and study.

No marks except filled in answer circles below the line, please.

1. A proton moves at a constant speed in a circular orbit in a plane perpendicular to a uniform magnetic field. The period of its motion is
$2.6 \times 10^{-8}$ s. What is the magnitude of the magnetic field?
   a) 6.28 T
   b) 5 T
   c) $3 \times 10^{-4}$ T
   d) 2.4 T
   e) insufficient information

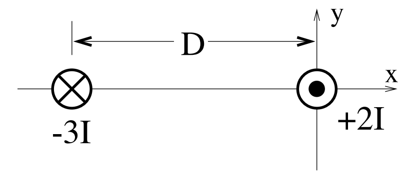
2. A long solenoid of 800 turns of wire is 30 cm in length. If it carries a current of 2.0 A, what is the magnetic field inside the solenoid at its center?
   a) About 3.4 mT
   b) About 1.7 mT
   c) About 1.0 mT
   d) About 6.7 mT
   e) About 2.0 mT

3. In the figure you are given two wires. Wire 1 carries a current $I$ and wire 2 carries a current $2I$. Point C is located a distance $d$ above wire 1. Point D is located a distance $d$ below wire 1 and the same distance $d$ above wire 2. Point E is located a distance $d$ below wire 2. Rank the magnetic fields $B$ at points C, D, and E, where positive fields are out of the page and negative fields are into the page.



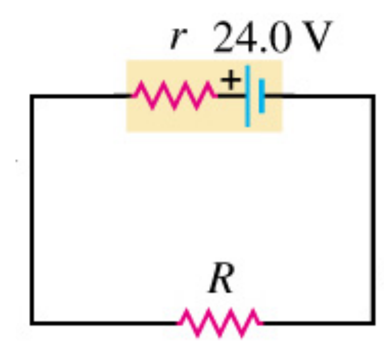

   a) $B_D > B_E > B_C$
   b) $B_C > B_D > B_E$
   c) $B_E > B_D > B_C$
   d) $B_C = B_E > B_D$
   e) $B_C = B_D > B_E$

4. At $x = 0$, a long straight wire carries current $2I$ **out** of the plane of the paper. At $x = -D$, another long straight wire carries current $3I$ **into** the plane of the paper. What is the direction of the force on the wire at $x = -D$?
   a) in the negative $y$-direction
   b) in the negative $x$-direction
   c) in the positive $y$-direction
   d) none of the other answers
   e) in the positive $x$-direction



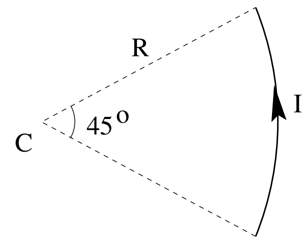

5. A cylindrical region of radius R = 3.0 cm contains a uniform magnetic field parallel to its axis. The field is zero outside the cylinder. If the field is changing at the rate 0.60 T/s, the electric field induced at a point $2R$ from the cylinder axis is:
   a) 0.0090 V/m
   b) none of these
   c) 0.0045 V/m
   d) 0
   e) 0.018 v/m

6. Consider the circuit shown in the figure. The terminal voltage of the battery is 21.2 V and the resistor R is 5.30 Ω. What is the power dissipated in the resistor R?
   a) 109 W
   b) 127 W
   c) 84.8 W
   d) 112 W
   e) 4.00 W



7. A segment of a wire is in the shape of an arc of a circle of radius R, and carries current I in the direction shown. The arc subtends a 45o angle. What is the contribution to the magnetic field at the center C by the current in this arc?

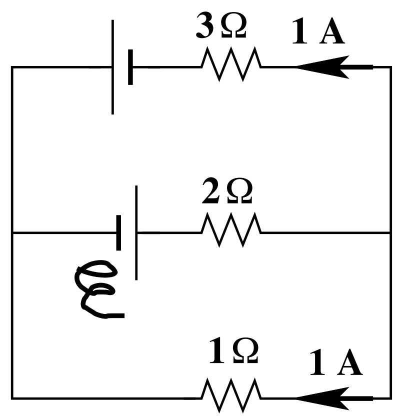
a) $\mu_0$ I/16R out of the paper
b) $\mu_0$ I/16R into the paper
c) $\mu_0$ I/2R into the paper
d) $\mu_0$ I/4R out of the paper
e) $\mu_0$ I/4R into the paper




8. A potential difference of 4.0 V is applied between the ends of a wire, resulting in a current of 16 A. If the wire is 2.5 m in length and 0.60 mm in radius, then the resistivity of the material of which the wire is made is

a) $2.8 \times 10^{-8}\ \Omega m$ b) 4.0 Ω c) $4.5 \times 10^{-7}\ \Omega m$
d) 0.25 Ω e) $1.1 \times 10^{-7}\ \Omega m$

9. In the circuit shown, the emf $\mathcal{E}$ of the lower battery is

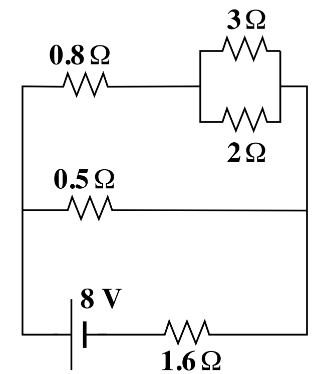



a) 2 V
b) 6 V
c) 5 V
d) 4 V
e) 3 V

10. The plane of a circular, single-turn coil of radius 10 cm is perpendicular to a uniform magnetic field. The field is increased at a constant rate from 0.15 T to 0.65 T in 0.01 seconds. What is the magnitude of the emf induced in the coil?

a) About 1.6 V
b) About 5.2 V
c) About 0.9 V
d) About 0.3 V
e) About 9.1 V

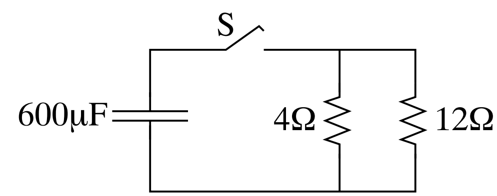
11. In the circuit, the current flowing through the 1.6 Ω resistance is




a) 4.0 A
b) 2.0 A
c) 6.0 A
d) 1.0 A
e) 2.5 A

12. The capacitor shown in the circuit always starts initially charged. In the version shown, the current in the circuit takes a certain amount of time to reach $\frac{1}{e}$ of it's initial value. Then the switch is opened, the 12Ω resistor is replaced by a 2.4Ω resistor, and the switch is closed again. The time it will take the current in the circuit to reach $\frac{1}{e}$ of it's initial value is:

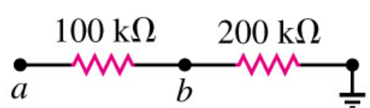
a) halved
b) 10 times greater
c) unchanged
d) tripled
e) doubled



13. A cylindrical wire of cross sectional radius $R$ carries a total current $I$, which is *uniformly* distributed inside the wire. At a distance $r = 2R$ from the axis of the wire, the magnetic field strength is 6 T. At what distance $r$ **inside** the wire is the magnetic field strength equal to 4 T?

a) $r = \frac{1}{4}R$
b) $r = \frac{1}{3}R$
c) There is *no* point inside the wire at which the field strength gets as large as 4 T.
d) $r = \frac{1}{2}R$
e) $r = \frac{2}{3}R$

14. Point $a$ in the figure is maintained at a constant potential of 600 V above ground. When connected between point $b$ and ground, the reading of a voltmeter with resistance 200 kΩ is




a) 480 V
b) 300 V
c) 400 V
d) 200 V
e) 120 V

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$q_p = +e$ = charge on a proton = $+1.602 \times 10^{-19}$ Coulombs
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1 $eV = 1.602 \times 10^{-19}$ J
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1 nC = $10^{-9}$ C    1 pC = $10^{-12}$ C