

# d\_cp2.13

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Friday 9<sup>th</sup> November, 2018



Latex markup at

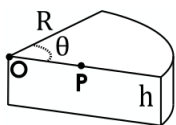
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# 1 Quiz

1. A square coil has sides that are  $L=0.25$  m long and is tightly wound with  $N=200$  turns of wire. The resistance of the coil is  $R=5\ \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt=0.04$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it? <sup>1</sup>
  - A. **1.000E-01 A**
  - B. 1.100E-01 A
  - C. 1.210E-01 A
  - D. 1.331E-01 A
  - E. 1.464E-01 A
2. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.5 m. The magnetic field is spatially uniform but decays in time according to  $(1.5)e^{-\alpha t}$  at time  $t = 0.05$  seconds, and  $\alpha = 5\text{s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $10\ \Omega$ ? <sup>2</sup>
  - A. 3.791E-01 A
  - B. 4.170E-01 A
  - C. **4.588E-01 A**
  - D. 5.046E-01 A
  - E. 5.551E-01 A
3. The current through the windings of a solenoid with  $n=2.000\text{E}+03$  turns per meter is changing at a rate  $dI/dt=3$  A/s. The solenoid is 50 cm long and has a cross-sectional diameter of 3 cm. A small coil consisting of  $N=20$  turns wrapped in a circle of diameter 1 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil? <sup>3</sup>
  - A. 9.788E-06 V
  - B. 1.077E-05 V
  - C. **1.184E-05 V**
  - D. 1.303E-05 V
  - E. 1.433E-05 V
4. Calculate the motional emf induced along a 20 km conductor moving at an orbital speed of 7.8 km/s perpendicular to Earth's  $5.000\text{E}-05$  Tesla magnetic field. <sup>4</sup>
  - A. 7.091E+03 V
  - B. **7.800E+03 V**
  - C. 8.580E+03 V
  - D. 9.438E+03 V
  - E. 1.038E+04 V



5. A cylinder of height 1.1 cm and radius 3.1 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 2.1 cm from point  $O$  and moves at a speed of 5.1 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ ).] <sup>5</sup>
  - A. **8.767E+00 cm<sup>3</sup>/s**

- B. 9.644E+00 cm<sup>3</sup>/s
- C. 1.061E+01 cm<sup>3</sup>/s
- D. 1.167E+01 cm<sup>3</sup>/s
- E. 1.284E+01 cm<sup>3</sup>/s**

6. A rectangular coil with an area of 0.5 m<sup>2</sup> and 10 turns is placed in a uniform magnetic field of 1.5 T. The coil is rotated about an axis that is perpendicular to this field. At time t=0 the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of 2.000E+03 s<sup>-1</sup>. What is the "magnitude" (absolute value) of the induced emf at t = 50 s?<sup>6</sup>

- A. 4.029E+02 V
- B. 4.432E+02 V
- C. 4.875E+02 V
- D. 5.362E+02 V**
- E. 5.899E+02 V

7. A spatially uniform magnetic points in the z-direction and oscillates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 1.5$  T and  $\omega = 2.000E+03$  s<sup>-1</sup>. Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.5 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.<sup>7</sup>

- A. 9.425E+03 V**
- B. 1.037E+04 V
- C. 1.140E+04 V
- D. 1.254E+04 V
- E. 1.380E+04 V

8. A long solenoid has a radius of 0.7 m and 50 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 3$  A and  $\alpha = 25$  s<sup>-1</sup>. What is the induced electric field at a distance 2.0 m from the axis at time t=0.04 s?<sup>8</sup>

- A. 2.124E-04 V/m**
- B. 2.336E-04 V/m
- C. 2.570E-04 V/m
- D. 2.827E-04 V/m
- E. 3.109E-04 V/m

9. A long solenoid has a radius of 0.7 m and 50 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 3$  A and  $\alpha = 25$  s<sup>-1</sup>. What is the induced electric field at a distance 0.15 m from the axis at time t=0.04 s?<sup>9</sup>

- A. 1.300E-04 V/m**
- B. 1.430E-04 V/m
- C. 1.573E-04 V/m
- D. 1.731E-04 V/m
- E. 1.904E-04 V/m

## 2 Renditions

### 2.1

1. A square coil has sides that are  $L = 0.673$  m long and is tightly wound with  $N = 211$  turns of wire. The resistance of the coil is  $R = 5.31 \Omega$ . The coil is placed in a spacially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0454$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
  - A.  $6.753E-01$  A
  - B.  $7.428E-01$  A
  - C.  $8.171E-01$  A**
  - D.  $8.988E-01$  A
  - E.  $9.887E-01$  A
2. A square coil has sides that are  $L = 0.861$  m long and is tightly wound with  $N = 538$  turns of wire. The resistance of the coil is  $R = 9.04 \Omega$ . The coil is placed in a spacially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0433$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
  - A.  $1.737E+00$  A
  - B.  $1.910E+00$  A**
  - C.  $2.101E+00$  A
  - D.  $2.311E+00$  A
  - E.  $2.543E+00$  A
3. A square coil has sides that are  $L = 0.259$  m long and is tightly wound with  $N = 628$  turns of wire. The resistance of the coil is  $R = 6.51 \Omega$ . The coil is placed in a spacially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0372$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
  - A.  $1.809E-01$  A
  - B.  $1.989E-01$  A
  - C.  $2.188E-01$  A
  - D.  $2.407E-01$  A**
  - E.  $2.648E-01$  A
4. A square coil has sides that are  $L = 0.894$  m long and is tightly wound with  $N = 255$  turns of wire. The resistance of the coil is  $R = 8.83 \Omega$ . The coil is placed in a spacially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0682$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
  - A.  $1.301E+00$  A
  - B.  $1.431E+00$  A
  - C.  $1.574E+00$  A**
  - D.  $1.732E+00$  A
  - E.  $1.905E+00$  A
5. A square coil has sides that are  $L = 0.436$  m long and is tightly wound with  $N = 284$  turns of wire. The resistance of the coil is  $R = 6.89 \Omega$ . The coil is placed in a spacially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0733$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

- A. 5.743E-01 A**
- B. 6.318E-01 A
- C. 6.950E-01 A
- D. 7.645E-01 A
- E. 8.409E-01 A

6. A square coil has sides that are  $L = 0.561$  m long and is tightly wound with  $N = 930$  turns of wire. The resistance of the coil is  $R = 5.08 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0548$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

- A. 2.609E+00 A
- B. 2.870E+00 A
- C. 3.157E+00 A**
- D. 3.473E+00 A
- E. 3.820E+00 A

7. A square coil has sides that are  $L = 0.547$  m long and is tightly wound with  $N = 198$  turns of wire. The resistance of the coil is  $R = 4.62 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0768$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

- A. 8.953E-01 A
- B. 9.848E-01 A**
- C. 1.083E+00 A
- D. 1.192E+00 A
- E. 1.311E+00 A

8. A square coil has sides that are  $L = 0.245$  m long and is tightly wound with  $N = 925$  turns of wire. The resistance of the coil is  $R = 8.0 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0618$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

- A. 3.545E-01 A
- B. 3.899E-01 A
- C. 4.289E-01 A**
- D. 4.718E-01 A
- E. 5.190E-01 A

9. A square coil has sides that are  $L = 0.568$  m long and is tightly wound with  $N = 482$  turns of wire. The resistance of the coil is  $R = 8.78 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0544$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

- A. 6.581E-01 A
- B. 7.239E-01 A
- C. 7.963E-01 A
- D. 8.759E-01 A
- E. 9.635E-01 A**

10. A square coil has sides that are  $L = 0.638$  m long and is tightly wound with  $N = 927$  turns of wire. The resistance of the coil is  $R = 8.34 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0718$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
- A.  $2.685E+00$  A
  - B.  $2.953E+00$  A
  - C.  $3.248E+00$  A**
  - D.  $3.573E+00$  A
  - E.  $3.931E+00$  A
11. A square coil has sides that are  $L = 0.219$  m long and is tightly wound with  $N = 508$  turns of wire. The resistance of the coil is  $R = 8.42 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0619$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
- A.  $1.791E-01$  A**
  - B.  $1.970E-01$  A
  - C.  $2.167E-01$  A
  - D.  $2.384E-01$  A
  - E.  $2.622E-01$  A
12. A square coil has sides that are  $L = 0.308$  m long and is tightly wound with  $N = 969$  turns of wire. The resistance of the coil is  $R = 8.64 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0498$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
- A.  $4.817E-01$  A
  - B.  $5.298E-01$  A**
  - C.  $5.828E-01$  A
  - D.  $6.411E-01$  A
  - E.  $7.052E-01$  A
13. A square coil has sides that are  $L = 0.738$  m long and is tightly wound with  $N = 717$  turns of wire. The resistance of the coil is  $R = 5.25 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0655$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
- A.  $3.660E+00$  A
  - B.  $4.027E+00$  A
  - C.  $4.429E+00$  A
  - D.  $4.872E+00$  A**
  - E.  $5.359E+00$  A
14. A square coil has sides that are  $L = 0.888$  m long and is tightly wound with  $N = 604$  turns of wire. The resistance of the coil is  $R = 4.31 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0441$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?
- A.  $3.661E+00$  A
  - B.  $4.028E+00$  A
  - C.  $4.430E+00$  A

**D. 4.873E+00 A**

E. 5.361E+00 A

15. A square coil has sides that are  $L = 0.325$  m long and is tightly wound with  $N = 697$  turns of wire. The resistance of the coil is  $R = 4.87 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0842$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

A. 1.157E+00 A

**B. 1.273E+00 A**

C. 1.400E+00 A

D. 1.540E+00 A

E. 1.694E+00 A

16. A square coil has sides that are  $L = 0.727$  m long and is tightly wound with  $N = 376$  turns of wire. The resistance of the coil is  $R = 5.59 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0485$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

A. 1.567E+00 A

**B. 1.724E+00 A**

C. 1.897E+00 A

D. 2.086E+00 A

E. 2.295E+00 A

17. A square coil has sides that are  $L = 0.465$  m long and is tightly wound with  $N = 954$  turns of wire. The resistance of the coil is  $R = 6.06 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0367$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

A. 1.136E+00 A

**B. 1.249E+00 A**

C. 1.374E+00 A

D. 1.512E+00 A

E. 1.663E+00 A

18. A square coil has sides that are  $L = 0.819$  m long and is tightly wound with  $N = 887$  turns of wire. The resistance of the coil is  $R = 5.69 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0618$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

A. 4.414E+00 A

B. 4.855E+00 A

C. 5.341E+00 A

D. 5.875E+00 A

**E. 6.462E+00 A**

19. A square coil has sides that are  $L = 0.458$  m long and is tightly wound with  $N = 742$  turns of wire. The resistance of the coil is  $R = 6.81 \Omega$ . The coil is placed in a spatially uniform magnetic field that is directed perpendicular to the face of the coil and whose magnitude is increasing at a rate  $dB/dt = 0.0559$  T/s. If  $R$  represents the only impedance of the coil, what is the magnitude of the current circulating through it?

- A. 1.056E+00 A
- B. 1.161E+00 A
- C. 1.278E+00 A**
- D. 1.405E+00 A
- E. 1.546E+00 A

## 2.2

1. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.72 m. The magnetic field is spatially uniform but decays in time according to  $(1.3)e^{-\alpha t}$  at time  $t = 0.039$  seconds, and  $\alpha = 9.5 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $18.0 \Omega$  ?
  - A. 7.013E-01 A
  - B. 7.714E-01 A**
  - C. 8.486E-01 A
  - D. 9.334E-01 A
  - E. 1.027E+00 A
2. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.76 m. The magnetic field is spatially uniform but decays in time according to  $(4.2)e^{-\alpha t}$  at time  $t = 0.058$  seconds, and  $\alpha = 8.8 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $86.0 \Omega$  ?
  - A. 4.681E-01 A**
  - B. 5.149E-01 A
  - C. 5.664E-01 A
  - D. 6.231E-01 A
  - E. 6.854E-01 A
3. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.28 m. The magnetic field is spatially uniform but decays in time according to  $(2.7)e^{-\alpha t}$  at time  $t = 0.035$  seconds, and  $\alpha = 6.6 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $76.0 \Omega$  ?
  - A. 3.131E-02 A
  - B. 3.444E-02 A
  - C. 3.788E-02 A
  - D. 4.167E-02 A
  - E. 4.584E-02 A**
4. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.98 m. The magnetic field is spatially uniform but decays in time according to  $(4.5)e^{-\alpha t}$  at time  $t = 0.045$  seconds, and  $\alpha = 8.6 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $7.5 \Omega$  ?
  - A. 7.221E+00 A
  - B. 7.943E+00 A
  - C. 8.738E+00 A
  - D. 9.611E+00 A
  - E. 1.057E+01 A**
5. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.53 m. The magnetic field is spatially uniform but decays in time according to  $(2.0)e^{-\alpha t}$  at time  $t = 0.077$  seconds, and  $\alpha = 7.5 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $67.0 \Omega$  ?



**A. 1.109E-01 A**

B. 1.220E-01 A

C. 1.342E-01 A

D. 1.476E-01 A

E. 1.624E-01 A

6. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.65 m. The magnetic field is spatially uniform but decays in time according to  $(5.7)e^{-\alpha t}$  at time  $t = 0.073$  seconds, and  $\alpha = 8.2\text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $51.0\ \Omega$  ?

A. 5.525E-01 A

B. 6.078E-01 A

**C. 6.685E-01 A**

D. 7.354E-01 A

E. 8.089E-01 A

7. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.77 m. The magnetic field is spatially uniform but decays in time according to  $(2.7)e^{-\alpha t}$  at time  $t = 0.035$  seconds, and  $\alpha = 5.5\text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $38.0\ \Omega$  ?

A. 4.511E-01 A

B. 4.962E-01 A

C. 5.459E-01 A

**D. 6.004E-01 A**

E. 6.605E-01 A

8. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.68 m. The magnetic field is spatially uniform but decays in time according to  $(2.6)e^{-\alpha t}$  at time  $t = 0.061$  seconds, and  $\alpha = 9.5\text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $13.0\ \Omega$  ?

A. 1.278E+00 A

B. 1.406E+00 A

**C. 1.546E+00 A**

D. 1.701E+00 A

E. 1.871E+00 A

9. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.42 m. The magnetic field is spatially uniform but decays in time according to  $(4.7)e^{-\alpha t}$  at time  $t = 0.033$  seconds, and  $\alpha = 5.7\text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $25.0\ \Omega$  ?

A. 3.697E-01 A

B. 4.066E-01 A

C. 4.473E-01 A

**D. 4.920E-01 A**

E. 5.412E-01 A

10. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.73 m. The magnetic field is spatially uniform but decays in time according to  $(1.2)e^{-\alpha t}$  at time  $t = 0.058$  seconds, and  $\alpha = 7.1\text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $54.0\ \Omega$  ?

**A. 1.750E-01 A**

- B. 1.925E-01 A
- C. 2.117E-01 A
- D. 2.329E-01 A
- E. 2.562E-01 A

11. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.97 m. The magnetic field is spatially uniform but decays in time according to  $(1.6)e^{-\alpha t}$  at time  $t = 0.035$  seconds, and  $\alpha = 7.5 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $97.0 \Omega$  ?

- A. 2.113E-01 A
- B. 2.324E-01 A
- C. 2.557E-01 A
- D. 2.813E-01 A**
- E. 3.094E-01 A

12. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.75 m. The magnetic field is spatially uniform but decays in time according to  $(5.2)e^{-\alpha t}$  at time  $t = 0.067$  seconds, and  $\alpha = 9.6 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $71.0 \Omega$  ?

- A. 5.937E-01 A
- B. 6.531E-01 A**
- C. 7.184E-01 A
- D. 7.902E-01 A
- E. 8.692E-01 A

13. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.73 m. The magnetic field is spatially uniform but decays in time according to  $(3.3)e^{-\alpha t}$  at time  $t = 0.062$  seconds, and  $\alpha = 8.1 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $53.0 \Omega$  ?

- A. 4.645E-01 A
- B. 5.110E-01 A**
- C. 5.621E-01 A
- D. 6.183E-01 A
- E. 6.801E-01 A

14. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.68 m. The magnetic field is spatially uniform but decays in time according to  $(1.8)e^{-\alpha t}$  at time  $t = 0.038$  seconds, and  $\alpha = 5.3 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $91.0 \Omega$  ?

- A. 1.245E-01 A**
- B. 1.370E-01 A
- C. 1.507E-01 A
- D. 1.657E-01 A
- E. 1.823E-01 A

15. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.92 m. The magnetic field is spatially uniform but decays in time according to  $(2.8)e^{-\alpha t}$  at time  $t = 0.032$  seconds, and  $\alpha = 6.6 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $88.0 \Omega$  ?

- A. 3.397E-01 A
- B. 3.736E-01 A

- C. 4.110E-01 A
- D. 4.521E-01 A**
- E. 4.973E-01 A

16. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.48 m. The magnetic field is spatially uniform but decays in time according to  $(3.8)e^{-\alpha t}$  at time  $t = 0.036$  seconds, and  $\alpha = 9.3 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $68.0 \Omega$  ?

- A. 2.022E-01 A
- B. 2.224E-01 A
- C. 2.447E-01 A
- D. 2.691E-01 A**
- E. 2.961E-01 A

17. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.59 m. The magnetic field is spatially uniform but decays in time according to  $(2.6)e^{-\alpha t}$  at time  $t = 0.051$  seconds, and  $\alpha = 9.1 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $63.0 \Omega$  ?

- A. 1.940E-01 A
- B. 2.134E-01 A
- C. 2.347E-01 A
- D. 2.582E-01 A**
- E. 2.840E-01 A

18. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.4 m. The magnetic field is spatially uniform but decays in time according to  $(2.3)e^{-\alpha t}$  at time  $t = 0.051$  seconds, and  $\alpha = 4.1 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $1.7 \Omega$  ?

- A. 1.545E+00 A
- B. 1.700E+00 A
- C. 1.870E+00 A
- D. 2.057E+00 A
- E. 2.262E+00 A**

19. A time dependent magnetic field is directed perpendicular to the plane of a circular coil with a radius of 0.38 m. The magnetic field is spatially uniform but decays in time according to  $(1.5)e^{-\alpha t}$  at time  $t = 0.032$  seconds, and  $\alpha = 4.4 \text{ s}^{-1}$ . What is the current in the coil if the impedance of the coil is  $7.6 \Omega$  ?

- A. 2.571E-01 A
- B. 2.828E-01 A
- C. 3.111E-01 A
- D. 3.422E-01 A**
- E. 3.764E-01 A

### 2.3

1. The current through the windings of a solenoid with  $n = 2.120\text{E}+03$  turns per meter is changing at a rate  $dI/dt = 4 \text{ A/s}$ . The solenoid is 94 cm long and has a cross-sectional diameter of 2.56 cm. A small coil consisting of  $N = 30$  turns wrapped in a circle of diameter 1.15 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

- A.  $3.019\text{E-}05\text{ V}$   
**B.  $3.321\text{E-}05\text{ V}$**   
C.  $3.653\text{E-}05\text{ V}$   
D.  $4.018\text{E-}05\text{ V}$   
E.  $4.420\text{E-}05\text{ V}$
2. The current through the windings of a solenoid with  $n= 2.460\text{E+}03$  turns per meter is changing at a rate  $dI/dt=7\text{ A/s}$ . The solenoid is 87 cm long and has a cross-sectional diameter of 3.32 cm. A small coil consisting of  $N=38$  turns wrapped in a circle of diameter 1.29 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $7.340\text{E-}05\text{ V}$   
B.  $8.075\text{E-}05\text{ V}$   
C.  $8.882\text{E-}05\text{ V}$   
D.  $9.770\text{E-}05\text{ V}$   
**E.  $1.075\text{E-}04\text{ V}$**
3. The current through the windings of a solenoid with  $n= 2.100\text{E+}03$  turns per meter is changing at a rate  $dI/dt=7\text{ A/s}$ . The solenoid is 91 cm long and has a cross-sectional diameter of 3.24 cm. A small coil consisting of  $N=22$  turns wrapped in a circle of diameter 1.22 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $3.245\text{E-}05\text{ V}$   
B.  $3.569\text{E-}05\text{ V}$   
C.  $3.926\text{E-}05\text{ V}$   
D.  $4.319\text{E-}05\text{ V}$   
**E.  $4.751\text{E-}05\text{ V}$**
4. The current through the windings of a solenoid with  $n= 2.220\text{E+}03$  turns per meter is changing at a rate  $dI/dt=10\text{ A/s}$ . The solenoid is 70 cm long and has a cross-sectional diameter of 2.73 cm. A small coil consisting of  $N=28$  turns wrapped in a circle of diameter 1.45 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $1.066\text{E-}04\text{ V}$   
B.  $1.173\text{E-}04\text{ V}$   
**C.  $1.290\text{E-}04\text{ V}$**   
D.  $1.419\text{E-}04\text{ V}$   
E.  $1.561\text{E-}04\text{ V}$
5. The current through the windings of a solenoid with  $n= 2.840\text{E+}03$  turns per meter is changing at a rate  $dI/dt=19\text{ A/s}$ . The solenoid is 65 cm long and has a cross-sectional diameter of 2.18 cm. A small coil consisting of  $N=25$  turns wrapped in a circle of diameter 1.35 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $2.206\text{E-}04\text{ V}$   
**B.  $2.426\text{E-}04\text{ V}$**   
C.  $2.669\text{E-}04\text{ V}$

D.  $2.936\text{E-}04\text{ V}$

E.  $3.230\text{E-}04\text{ V}$

6. The current through the windings of a solenoid with  $n = 2.040\text{E}+03$  turns per meter is changing at a rate  $dI/dt = 19\text{ A/s}$ . The solenoid is 76 cm long and has a cross-sectional diameter of 3.23 cm. A small coil consisting of  $N = 25$  turns wrapped in a circle of diameter 1.67 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

A.  $2.204\text{E-}04\text{ V}$

B.  $2.425\text{E-}04\text{ V}$

**C.  $2.667\text{E-}04\text{ V}$**

D.  $2.934\text{E-}04\text{ V}$

E.  $3.227\text{E-}04\text{ V}$

7. The current through the windings of a solenoid with  $n = 2.970\text{E}+03$  turns per meter is changing at a rate  $dI/dt = 15\text{ A/s}$ . The solenoid is 89 cm long and has a cross-sectional diameter of 3.48 cm. A small coil consisting of  $N = 28$  turns wrapped in a circle of diameter 1.5 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

A.  $2.081\text{E-}04\text{ V}$

B.  $2.289\text{E-}04\text{ V}$

C.  $2.518\text{E-}04\text{ V}$

**D.  $2.770\text{E-}04\text{ V}$**

E.  $3.047\text{E-}04\text{ V}$

8. The current through the windings of a solenoid with  $n = 1.820\text{E}+03$  turns per meter is changing at a rate  $dI/dt = 7\text{ A/s}$ . The solenoid is 78 cm long and has a cross-sectional diameter of 3.26 cm. A small coil consisting of  $N = 35$  turns wrapped in a circle of diameter 1.68 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

**A.  $1.242\text{E-}04\text{ V}$**

B.  $1.366\text{E-}04\text{ V}$

C.  $1.503\text{E-}04\text{ V}$

D.  $1.653\text{E-}04\text{ V}$

E.  $1.819\text{E-}04\text{ V}$

9. The current through the windings of a solenoid with  $n = 2.210\text{E}+03$  turns per meter is changing at a rate  $dI/dt = 18\text{ A/s}$ . The solenoid is 65 cm long and has a cross-sectional diameter of 2.2 cm. A small coil consisting of  $N = 36$  turns wrapped in a circle of diameter 1.29 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

**A.  $2.352\text{E-}04\text{ V}$**

B.  $2.587\text{E-}04\text{ V}$

C.  $2.846\text{E-}04\text{ V}$

D.  $3.131\text{E-}04\text{ V}$

E.  $3.444\text{E-}04\text{ V}$

10. The current through the windings of a solenoid with  $n = 2.760 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 8$  A/s. The solenoid is 74 cm long and has a cross-sectional diameter of 2.57 cm. A small coil consisting of  $N = 32$  turns wrapped in a circle of diameter 1.49 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $1.407 \times 10^{-4}$  V
  - B.  $1.548 \times 10^{-4}$  V**
  - C.  $1.703 \times 10^{-4}$  V
  - D.  $1.873 \times 10^{-4}$  V
  - E.  $2.061 \times 10^{-4}$  V
11. The current through the windings of a solenoid with  $n = 2.060 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 12$  A/s. The solenoid is 68 cm long and has a cross-sectional diameter of 2.96 cm. A small coil consisting of  $N = 29$  turns wrapped in a circle of diameter 1.74 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $1.463 \times 10^{-4}$  V
  - B.  $1.609 \times 10^{-4}$  V
  - C.  $1.770 \times 10^{-4}$  V
  - D.  $1.947 \times 10^{-4}$  V
  - E.  $2.142 \times 10^{-4}$  V**
12. The current through the windings of a solenoid with  $n = 1.830 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 14$  A/s. The solenoid is 87 cm long and has a cross-sectional diameter of 2.5 cm. A small coil consisting of  $N = 30$  turns wrapped in a circle of diameter 1.34 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $1.126 \times 10^{-4}$  V
  - B.  $1.238 \times 10^{-4}$  V
  - C.  $1.362 \times 10^{-4}$  V**
  - D.  $1.498 \times 10^{-4}$  V
  - E.  $1.648 \times 10^{-4}$  V
13. The current through the windings of a solenoid with  $n = 2.260 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 12$  A/s. The solenoid is 62 cm long and has a cross-sectional diameter of 3.37 cm. A small coil consisting of  $N = 23$  turns wrapped in a circle of diameter 1.7 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?
- A.  $1.215 \times 10^{-4}$  V
  - B.  $1.337 \times 10^{-4}$  V
  - C.  $1.470 \times 10^{-4}$  V
  - D.  $1.617 \times 10^{-4}$  V
  - E.  $1.779 \times 10^{-4}$  V**
14. The current through the windings of a solenoid with  $n = 2.500 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 4$  A/s. The solenoid is 96 cm long and has a cross-sectional diameter of 2.39 cm. A small coil consisting of  $N = 22$  turns wrapped in a circle of diameter 1.44 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

- A. 3.721E-05 V
- B. 4.093E-05 V
- C. 4.502E-05 V**
- D. 4.953E-05 V
- E. 5.448E-05 V

15. The current through the windings of a solenoid with  $n = 2.590 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 11$  A/s. The solenoid is 95 cm long and has a cross-sectional diameter of 2.29 cm. A small coil consisting of  $N = 25$  turns wrapped in a circle of diameter 1.15 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

- A. 6.985E-05 V
- B. 7.683E-05 V
- C. 8.452E-05 V
- D. 9.297E-05 V**
- E. 1.023E-04 V

16. The current through the windings of a solenoid with  $n = 2.960 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 10$  A/s. The solenoid is 85 cm long and has a cross-sectional diameter of 3.12 cm. A small coil consisting of  $N = 32$  turns wrapped in a circle of diameter 1.44 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

- A. 1.602E-04 V
- B. 1.762E-04 V
- C. 1.939E-04 V**
- D. 2.132E-04 V
- E. 2.346E-04 V

17. The current through the windings of a solenoid with  $n = 1.850 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 17$  A/s. The solenoid is 98 cm long and has a cross-sectional diameter of 3.38 cm. A small coil consisting of  $N = 23$  turns wrapped in a circle of diameter 1.72 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

- A. 1.587E-04 V
- B. 1.745E-04 V
- C. 1.920E-04 V
- D. 2.112E-04 V**
- E. 2.323E-04 V

18. The current through the windings of a solenoid with  $n = 2.980 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 9$  A/s. The solenoid is 88 cm long and has a cross-sectional diameter of 2.69 cm. A small coil consisting of  $N = 28$  turns wrapped in a circle of diameter 1.64 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

- A. 1.498E-04 V
- B. 1.647E-04 V
- C. 1.812E-04 V

**D. 1.993E-04 V**

E. 2.193E-04 V

19. The current through the windings of a solenoid with  $n = 2.400 \times 10^3$  turns per meter is changing at a rate  $dI/dt = 3$  A/s. The solenoid is 93 cm long and has a cross-sectional diameter of 2.13 cm. A small coil consisting of  $N = 30$  turns wrapped in a circle of diameter 1.35 cm is placed in the middle of the solenoid such that the plane of the coil is perpendicular to the central axis of the solenoid. Assume that the infinite-solenoid approximation is valid inside the small coil. What is the emf induced in the coil?

**A. 3.885E-05 V**

B. 4.274E-05 V

C. 4.701E-05 V

D. 5.171E-05 V

E. 5.688E-05 V

## 2.4

1. Calculate the motional emf induced along a 40.1 km conductor moving at an orbital speed of 7.85 km/s perpendicular to Earth's  $5.160 \times 10^{-5}$  Tesla magnetic field.

A.  $1.477 \times 10^4$  V

**B.  $1.624 \times 10^4$  V**

C.  $1.787 \times 10^4$  V

D.  $1.965 \times 10^4$  V

E.  $2.162 \times 10^4$  V

2. Calculate the motional emf induced along a 24.9 km conductor moving at an orbital speed of 7.82 km/s perpendicular to Earth's  $5.040 \times 10^{-5}$  Tesla magnetic field.

A.  $8.111 \times 10^3$  V

B.  $8.922 \times 10^3$  V

**C.  $9.814 \times 10^3$  V**

D.  $1.080 \times 10^4$  V

E.  $1.187 \times 10^4$  V

3. Calculate the motional emf induced along a 27.5 km conductor moving at an orbital speed of 7.86 km/s perpendicular to Earth's  $4.520 \times 10^{-5}$  Tesla magnetic field.

A.  $8.074 \times 10^3$  V

B.  $8.882 \times 10^3$  V

**C.  $9.770 \times 10^3$  V**

D.  $1.075 \times 10^4$  V

E.  $1.182 \times 10^4$  V

4. Calculate the motional emf induced along a 42.1 km conductor moving at an orbital speed of 7.77 km/s perpendicular to Earth's  $4.730 \times 10^{-5}$  Tesla magnetic field.

A.  $1.279 \times 10^4$  V

B.  $1.407 \times 10^4$  V

**C.  $1.547 \times 10^4$  V**

D.  $1.702 \times 10^4$  V



- E.  $1.872\text{E}+04\text{ V}$
5. Calculate the motional emf induced along a 11.9 km conductor moving at an orbital speed of 7.8 km/s perpendicular to Earth's  $4.870\text{E}-05$  Tesla magnetic field.
- A.  $3.736\text{E}+03\text{ V}$   
B.  $4.109\text{E}+03\text{ V}$   
**C.  $4.520\text{E}+03\text{ V}$**   
D.  $4.972\text{E}+03\text{ V}$   
E.  $5.470\text{E}+03\text{ V}$
6. Calculate the motional emf induced along a 24.7 km conductor moving at an orbital speed of 7.77 km/s perpendicular to Earth's  $5.410\text{E}-05$  Tesla magnetic field.
- A.  $7.801\text{E}+03\text{ V}$   
B.  $8.581\text{E}+03\text{ V}$   
C.  $9.439\text{E}+03\text{ V}$   
**D.  $1.038\text{E}+04\text{ V}$**   
E.  $1.142\text{E}+04\text{ V}$
7. Calculate the motional emf induced along a 37.9 km conductor moving at an orbital speed of 7.84 km/s perpendicular to Earth's  $5.410\text{E}-05$  Tesla magnetic field.
- A.  $1.208\text{E}+04\text{ V}$   
B.  $1.329\text{E}+04\text{ V}$   
C.  $1.461\text{E}+04\text{ V}$   
**D.  $1.608\text{E}+04\text{ V}$**   
E.  $1.768\text{E}+04\text{ V}$
8. Calculate the motional emf induced along a 50.7 km conductor moving at an orbital speed of 7.88 km/s perpendicular to Earth's  $4.930\text{E}-05$  Tesla magnetic field.
- A.  $1.791\text{E}+04\text{ V}$   
**B.  $1.970\text{E}+04\text{ V}$**   
C.  $2.167\text{E}+04\text{ V}$   
D.  $2.383\text{E}+04\text{ V}$   
E.  $2.622\text{E}+04\text{ V}$
9. Calculate the motional emf induced along a 25.2 km conductor moving at an orbital speed of 7.72 km/s perpendicular to Earth's  $4.900\text{E}-05$  Tesla magnetic field.
- A.  $7.162\text{E}+03\text{ V}$   
B.  $7.878\text{E}+03\text{ V}$   
C.  $8.666\text{E}+03\text{ V}$   
**D.  $9.533\text{E}+03\text{ V}$**   
E.  $1.049\text{E}+04\text{ V}$
10. Calculate the motional emf induced along a 49.5 km conductor moving at an orbital speed of 7.77 km/s perpendicular to Earth's  $5.310\text{E}-05$  Tesla magnetic field.
- A.  $1.395\text{E}+04\text{ V}$   
B.  $1.534\text{E}+04\text{ V}$

- C.  $1.688\text{E}+04\text{ V}$
- D.  $1.857\text{E}+04\text{ V}$
- E.  $2.042\text{E}+04\text{ V}$**

11. Calculate the motional emf induced along a 34.3 km conductor moving at an orbital speed of 7.86 km/s perpendicular to Earth's  $4.780\text{E}-05$  Tesla magnetic field.

- A.  $8.802\text{E}+03\text{ V}$
- B.  $9.682\text{E}+03\text{ V}$
- C.  $1.065\text{E}+04\text{ V}$
- D.  $1.172\text{E}+04\text{ V}$
- E.  $1.289\text{E}+04\text{ V}$**

12. Calculate the motional emf induced along a 30.3 km conductor moving at an orbital speed of 7.76 km/s perpendicular to Earth's  $5.100\text{E}-05$  Tesla magnetic field.

- A.  $1.090\text{E}+04\text{ V}$
- B.  $1.199\text{E}+04\text{ V}$**
- C.  $1.319\text{E}+04\text{ V}$
- D.  $1.451\text{E}+04\text{ V}$
- E.  $1.596\text{E}+04\text{ V}$

13. Calculate the motional emf induced along a 48.8 km conductor moving at an orbital speed of 7.88 km/s perpendicular to Earth's  $4.660\text{E}-05$  Tesla magnetic field.

- A.  $1.224\text{E}+04\text{ V}$
- B.  $1.346\text{E}+04\text{ V}$
- C.  $1.481\text{E}+04\text{ V}$
- D.  $1.629\text{E}+04\text{ V}$
- E.  $1.792\text{E}+04\text{ V}$**

14. Calculate the motional emf induced along a 14.1 km conductor moving at an orbital speed of 7.8 km/s perpendicular to Earth's  $4.910\text{E}-05$  Tesla magnetic field.

- A.  $3.688\text{E}+03\text{ V}$
- B.  $4.057\text{E}+03\text{ V}$
- C.  $4.463\text{E}+03\text{ V}$
- D.  $4.909\text{E}+03\text{ V}$
- E.  $5.400\text{E}+03\text{ V}$**

15. Calculate the motional emf induced along a 21.3 km conductor moving at an orbital speed of 7.75 km/s perpendicular to Earth's  $5.320\text{E}-05$  Tesla magnetic field.

- A.  $6.598\text{E}+03\text{ V}$
- B.  $7.258\text{E}+03\text{ V}$
- C.  $7.984\text{E}+03\text{ V}$
- D.  $8.782\text{E}+03\text{ V}$**
- E.  $9.660\text{E}+03\text{ V}$

16. Calculate the motional emf induced along a 46.2 km conductor moving at an orbital speed of 7.9 km/s perpendicular to Earth's  $4.630\text{E}-05$  Tesla magnetic field.

- A.  $1.536\text{E}+04\text{ V}$
- B.  $1.690\text{E}+04\text{ V}$**
- C.  $1.859\text{E}+04\text{ V}$
- D.  $2.045\text{E}+04\text{ V}$
- E.  $2.249\text{E}+04\text{ V}$

17. Calculate the motional emf induced along a 24.4 km conductor moving at an orbital speed of 7.79 km/s perpendicular to Earth's  $4.790\text{E}-05$  Tesla magnetic field.

- A.  $6.840\text{E}+03\text{ V}$
- B.  $7.524\text{E}+03\text{ V}$
- C.  $8.277\text{E}+03\text{ V}$
- D.  $9.105\text{E}+03\text{ V}$**
- E.  $1.002\text{E}+04\text{ V}$

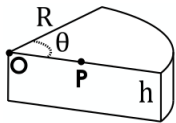
18. Calculate the motional emf induced along a 32.1 km conductor moving at an orbital speed of 7.8 km/s perpendicular to Earth's  $5.280\text{E}-05$  Tesla magnetic field.

- A.  $1.093\text{E}+04\text{ V}$
- B.  $1.202\text{E}+04\text{ V}$
- C.  $1.322\text{E}+04\text{ V}$**
- D.  $1.454\text{E}+04\text{ V}$
- E.  $1.600\text{E}+04\text{ V}$

19. Calculate the motional emf induced along a 24.6 km conductor moving at an orbital speed of 7.89 km/s perpendicular to Earth's  $5.180\text{E}-05$  Tesla magnetic field.

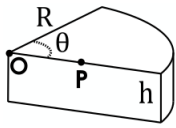
- A.  $9.140\text{E}+03\text{ V}$
- B.  $1.005\text{E}+04\text{ V}$**
- C.  $1.106\text{E}+04\text{ V}$
- D.  $1.217\text{E}+04\text{ V}$
- E.  $1.338\text{E}+04\text{ V}$

2.5



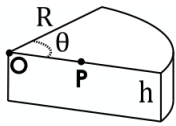
1. A cylinder of height 1.98 cm and radius 2.62 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 1.33 cm from point  $O$  and moves at a speed of 2.0 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A.  $6.980\text{E}+00\text{ cm}^3/\text{s}$
- B.  $7.678\text{E}+00\text{ cm}^3/\text{s}$
- C.  $8.446\text{E}+00\text{ cm}^3/\text{s}$
- D.  $9.290\text{E}+00\text{ cm}^3/\text{s}$
- E.  $1.022\text{E}+01\text{ cm}^3/\text{s}$**



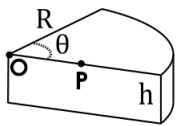
2. A cylinder of height 3.5 cm and radius 5.36 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 2.79 cm from point  $O$  and moves at a speed of 3.24 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A. 5.308E+01 cm<sup>3</sup>/s  
**B. 5.839E+01 cm<sup>3</sup>/s**  
 C. 6.422E+01 cm<sup>3</sup>/s  
 D. 7.065E+01 cm<sup>3</sup>/s  
 E. 7.771E+01 cm<sup>3</sup>/s



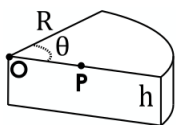
3. A cylinder of height 2.58 cm and radius 9.47 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 3.62 cm from point  $O$  and moves at a speed of 4.7 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A. 1.128E+02 cm<sup>3</sup>/s  
 B. 1.241E+02 cm<sup>3</sup>/s  
 C. 1.365E+02 cm<sup>3</sup>/s  
**D. 1.502E+02 cm<sup>3</sup>/s**  
 E. 1.652E+02 cm<sup>3</sup>/s



4. A cylinder of height 1.3 cm and radius 6.01 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 3.61 cm from point  $O$  and moves at a speed of 2.11 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A. 1.372E+01 cm<sup>3</sup>/s**  
 B. 1.509E+01 cm<sup>3</sup>/s  
 C. 1.660E+01 cm<sup>3</sup>/s  
 D. 1.826E+01 cm<sup>3</sup>/s  
 E. 2.009E+01 cm<sup>3</sup>/s

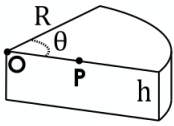


5. A cylinder of height 2.63 cm and radius 6.27 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 2.35 cm from point  $O$  and moves at a speed of 2.7 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A. 4.057E+01 cm<sup>3</sup>/s  
 B. 4.463E+01 cm<sup>3</sup>/s  
 C. 4.909E+01 cm<sup>3</sup>/s

D.  $5.400\text{E}+01 \text{ cm}^3/\text{s}$

**E.  $5.940\text{E}+01 \text{ cm}^3/\text{s}$**



6. A cylinder of height 2.12 cm and radius 2.28 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 1.52 cm from point  $O$  and moves at a speed of 8.21 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

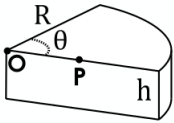
**A.  $2.976\text{E}+01 \text{ cm}^3/\text{s}$**

B.  $3.274\text{E}+01 \text{ cm}^3/\text{s}$

C.  $3.601\text{E}+01 \text{ cm}^3/\text{s}$

D.  $3.961\text{E}+01 \text{ cm}^3/\text{s}$

E.  $4.358\text{E}+01 \text{ cm}^3/\text{s}$



7. A cylinder of height 2.42 cm and radius 6.94 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 2.59 cm from point  $O$  and moves at a speed of 4.87 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

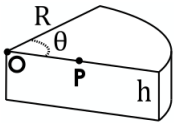
A.  $9.962\text{E}+01 \text{ cm}^3/\text{s}$

**B.  $1.096\text{E}+02 \text{ cm}^3/\text{s}$**

C.  $1.205\text{E}+02 \text{ cm}^3/\text{s}$

D.  $1.326\text{E}+02 \text{ cm}^3/\text{s}$

E.  $1.459\text{E}+02 \text{ cm}^3/\text{s}$



8. A cylinder of height 2.94 cm and radius 5.05 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 2.37 cm from point  $O$  and moves at a speed of 7.29 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

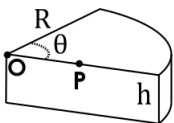
**A.  $1.153\text{E}+02 \text{ cm}^3/\text{s}$**

B.  $1.268\text{E}+02 \text{ cm}^3/\text{s}$

C.  $1.395\text{E}+02 \text{ cm}^3/\text{s}$

D.  $1.535\text{E}+02 \text{ cm}^3/\text{s}$

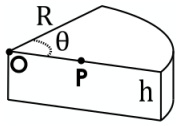
E.  $1.688\text{E}+02 \text{ cm}^3/\text{s}$



9. A cylinder of height 2.15 cm and radius 7.03 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 3.83 cm from point  $O$  and moves at a speed of 5.7 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

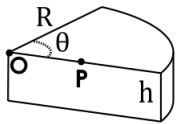
**A.  $6.534\text{E}+01 \text{ cm}^3/\text{s}$**

- B.  $7.188\text{E}+01 \text{ cm}^3/\text{s}$
- C.  $7.907\text{E}+01 \text{ cm}^3/\text{s}$**
- D.  $8.697\text{E}+01 \text{ cm}^3/\text{s}$
- E.  $9.567\text{E}+01 \text{ cm}^3/\text{s}$



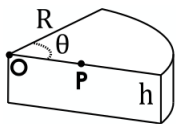
10. A cylinder of height 1.27 cm and radius 8.63 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 3.15 cm from point  $O$  and moves at a speed of 1.26 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A.  $1.892\text{E}+01 \text{ cm}^3/\text{s}$**
- B.  $2.081\text{E}+01 \text{ cm}^3/\text{s}$
- C.  $2.289\text{E}+01 \text{ cm}^3/\text{s}$
- D.  $2.518\text{E}+01 \text{ cm}^3/\text{s}$
- E.  $2.770\text{E}+01 \text{ cm}^3/\text{s}$



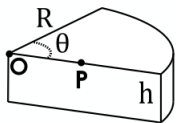
11. A cylinder of height 1.34 cm and radius 2.47 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 1.23 cm from point  $O$  and moves at a speed of 6.23 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A.  $1.414\text{E}+01 \text{ cm}^3/\text{s}$
- B.  $1.556\text{E}+01 \text{ cm}^3/\text{s}$
- C.  $1.711\text{E}+01 \text{ cm}^3/\text{s}$
- D.  $1.882\text{E}+01 \text{ cm}^3/\text{s}$
- E.  $2.070\text{E}+01 \text{ cm}^3/\text{s}$**



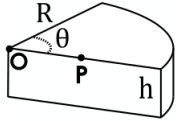
12. A cylinder of height 1.68 cm and radius 3.44 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 1.28 cm from point  $O$  and moves at a speed of 1.41 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A.  $7.479\text{E}+00 \text{ cm}^3/\text{s}$
- B.  $8.227\text{E}+00 \text{ cm}^3/\text{s}$
- C.  $9.049\text{E}+00 \text{ cm}^3/\text{s}$
- D.  $9.954\text{E}+00 \text{ cm}^3/\text{s}$
- E.  $1.095\text{E}+01 \text{ cm}^3/\text{s}$**



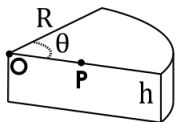
13. A cylinder of height 1.19 cm and radius 4.51 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 2.7 cm from point  $O$  and moves at a speed of 8.35 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A.  $3.093\text{E}+01 \text{ cm}^3/\text{s}$
- B.  $3.403\text{E}+01 \text{ cm}^3/\text{s}$
- C.  $3.743\text{E}+01 \text{ cm}^3/\text{s}$**
- D.  $4.117\text{E}+01 \text{ cm}^3/\text{s}$
- E.  $4.529\text{E}+01 \text{ cm}^3/\text{s}$



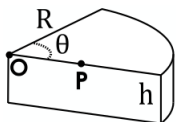
14. A cylinder of height 1.68 cm and radius 2.74 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 1.78 cm from point  $O$  and moves at a speed of 3.44 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A.  $8.324\text{E}+00 \text{ cm}^3/\text{s}$
- B.  $9.157\text{E}+00 \text{ cm}^3/\text{s}$
- C.  $1.007\text{E}+01 \text{ cm}^3/\text{s}$
- D.  $1.108\text{E}+01 \text{ cm}^3/\text{s}$
- E.  $1.219\text{E}+01 \text{ cm}^3/\text{s}$**



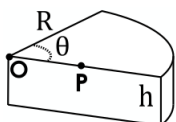
15. A cylinder of height 3.82 cm and radius 5.6 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 2.89 cm from point  $O$  and moves at a speed of 4.25 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

- A.  $7.280\text{E}+01 \text{ cm}^3/\text{s}$
- B.  $8.008\text{E}+01 \text{ cm}^3/\text{s}$
- C.  $8.808\text{E}+01 \text{ cm}^3/\text{s}$**
- D.  $9.689\text{E}+01 \text{ cm}^3/\text{s}$
- E.  $1.066\text{E}+02 \text{ cm}^3/\text{s}$



16. A cylinder of height 2.91 cm and radius 8.33 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate of change if point  $P$  is 3.7 cm from point  $O$  and moves at a speed of 9.14 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point  $O$ .)

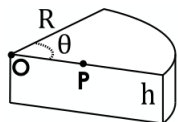
- A.  $2.061\text{E}+02 \text{ cm}^3/\text{s}$
- B.  $2.267\text{E}+02 \text{ cm}^3/\text{s}$
- C.  $2.494\text{E}+02 \text{ cm}^3/\text{s}$**
- D.  $2.743\text{E}+02 \text{ cm}^3/\text{s}$
- E.  $3.018\text{E}+02 \text{ cm}^3/\text{s}$



17. A cylinder of height 1.48 cm and radius 7.74 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius  $R$  and height  $h$  remains constant. What is the volume's rate

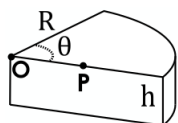
of change if point P is 3.76 cm from point O and moves at a speed of 3.09 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point O.)

- A. 3.312E+01 cm<sup>3</sup>/s
- B. 3.643E+01 cm<sup>3</sup>/s**
- C. 4.008E+01 cm<sup>3</sup>/s
- D. 4.408E+01 cm<sup>3</sup>/s
- E. 4.849E+01 cm<sup>3</sup>/s



18. A cylinder of height 2.25 cm and radius 6.77 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius R and height h remains constant. What is the volume's rate of change if point P is 3.27 cm from point O and moves at a speed of 4.07 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point O.)

- A. 5.834E+01 cm<sup>3</sup>/s
- B. 6.418E+01 cm<sup>3</sup>/s**
- C. 7.059E+01 cm<sup>3</sup>/s
- D. 7.765E+01 cm<sup>3</sup>/s
- E. 8.542E+01 cm<sup>3</sup>/s



19. A cylinder of height 1.69 cm and radius 4.56 cm is cut into a wedge as shown. Now imagine that the volume grows as  $\theta$  increases while the radius R and height h remains constant. What is the volume's rate of change if point P is 2.33 cm from point O and moves at a speed of 4.9 cm/s? Assume that the wedge grows in such a way as the front face moves by rotating around the axis (that contains point O.)

- A. 3.054E+01 cm<sup>3</sup>/s
- B. 3.359E+01 cm<sup>3</sup>/s
- C. 3.695E+01 cm<sup>3</sup>/s**
- D. 4.065E+01 cm<sup>3</sup>/s
- E. 4.471E+01 cm<sup>3</sup>/s

## 2.6

1. A rectangular coil with an area of 0.371 m<sup>2</sup> and 20 turns is placed in a uniform magnetic field of 2.51 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $3.060\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 88\text{ s}$ ?
  - A. 5.694E+04 V**
  - B. 6.263E+04 V
  - C. 6.889E+04 V
  - D. 7.578E+04 V
  - E. 8.336E+04 V
2. A rectangular coil with an area of 0.479 m<sup>2</sup> and 11 turns is placed in a uniform magnetic field of 1.34 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $4.200\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 38\text{ s}$ ?



- A. **2.148E+04 V**  
B. 2.363E+04 V  
C. 2.599E+04 V  
D. 2.859E+04 V  
E. 3.145E+04 V
3. A rectangular coil with an area of  $0.39 \text{ m}^2$  and 16 turns is placed in a uniform magnetic field of 3.07 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $3.320\text{E}+03 \text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 44 \text{ s}$ ?
- A. 3.792E+04 V  
B. 4.172E+04 V  
C. 4.589E+04 V  
D. **5.048E+04 V**  
E. 5.552E+04 V
4. A rectangular coil with an area of  $0.137 \text{ m}^2$  and 18 turns is placed in a uniform magnetic field of 1.18 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $4.120\text{E}+03 \text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 47 \text{ s}$ ?
- A. 1.086E+04 V  
B. **1.195E+04 V**  
C. 1.314E+04 V  
D. 1.446E+04 V  
E. 1.590E+04 V
5. A rectangular coil with an area of  $0.219 \text{ m}^2$  and 14 turns is placed in a uniform magnetic field of 3.71 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $7.540\text{E}+03 \text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 15 \text{ s}$ ?
- A. 2.959E+04 V  
B. 3.255E+04 V  
C. 3.581E+04 V  
D. **3.939E+04 V**  
E. 4.332E+04 V
6. A rectangular coil with an area of  $0.449 \text{ m}^2$  and 20 turns is placed in a uniform magnetic field of 3.58 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $4.990\text{E}+03 \text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 66 \text{ s}$ ?
- A. 7.734E+04 V  
B. **8.507E+04 V**  
C. 9.358E+04 V  
D. 1.029E+05 V  
E. 1.132E+05 V

7. A rectangular coil with an area of  $0.157\text{ m}^2$  and 17 turns is placed in a uniform magnetic field of 3.64 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $5.890\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 9\text{ s}$ ?
- A.  $4.464\text{E}+04\text{ V}$   
 B.  $4.911\text{E}+04\text{ V}$   
**C.  $5.402\text{E}+04\text{ V}$**   
 D.  $5.942\text{E}+04\text{ V}$   
 E.  $6.536\text{E}+04\text{ V}$
8. A rectangular coil with an area of  $0.315\text{ m}^2$  and 20 turns is placed in a uniform magnetic field of 3.45 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $9.480\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 26\text{ s}$ ?
- A.  $1.342\text{E}+04\text{ V}$**   
 B.  $1.476\text{E}+04\text{ V}$   
 C.  $1.624\text{E}+04\text{ V}$   
 D.  $1.786\text{E}+04\text{ V}$   
 E.  $1.965\text{E}+04\text{ V}$
9. A rectangular coil with an area of  $0.23\text{ m}^2$  and 20 turns is placed in a uniform magnetic field of 1.66 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $1.380\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 4\text{ s}$ ?
- A.  $2.317\text{E}+03\text{ V}$**   
 B.  $2.549\text{E}+03\text{ V}$   
 C.  $2.804\text{E}+03\text{ V}$   
 D.  $3.084\text{E}+03\text{ V}$   
 E.  $3.393\text{E}+03\text{ V}$
10. A rectangular coil with an area of  $0.178\text{ m}^2$  and 17 turns is placed in a uniform magnetic field of 2.62 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $4.380\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 45\text{ s}$ ?
- A.  $1.068\text{E}+04\text{ V}$   
 B.  $1.175\text{E}+04\text{ V}$   
**C.  $1.293\text{E}+04\text{ V}$**   
 D.  $1.422\text{E}+04\text{ V}$   
 E.  $1.564\text{E}+04\text{ V}$
11. A rectangular coil with an area of  $0.412\text{ m}^2$  and 18 turns is placed in a uniform magnetic field of 3.81 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $2.120\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 79\text{ s}$ ?
- A.  $4.465\text{E}+04\text{ V}$   
 B.  $4.912\text{E}+04\text{ V}$   
 C.  $5.403\text{E}+04\text{ V}$

**D. 5.943E+04 V**

E. 6.538E+04 V

12. A rectangular coil with an area of  $0.815\text{ m}^2$  and 11 turns is placed in a uniform magnetic field of 3.62 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $4.700\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 59\text{ s}$ ?

A. 1.197E+05 V

**B. 1.316E+05 V**

C. 1.448E+05 V

D. 1.593E+05 V

E. 1.752E+05 V

13. A rectangular coil with an area of  $0.432\text{ m}^2$  and 16 turns is placed in a uniform magnetic field of 3.7 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $5.020\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 55\text{ s}$ ?

A. 1.055E+05 V

**B. 1.161E+05 V**

C. 1.277E+05 V

D. 1.405E+05 V

E. 1.545E+05 V

14. A rectangular coil with an area of  $0.446\text{ m}^2$  and 13 turns is placed in a uniform magnetic field of 3.17 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $5.060\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 54\text{ s}$ ?

**A. 1.957E+03 V**

B. 2.153E+03 V

C. 2.368E+03 V

D. 2.605E+03 V

E. 2.865E+03 V

15. A rectangular coil with an area of  $0.897\text{ m}^2$  and 8 turns is placed in a uniform magnetic field of 2.83 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $8.740\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 3\text{ s}$ ?

**A. 4.695E+04 V**

B. 5.165E+04 V

C. 5.681E+04 V

D. 6.249E+04 V

E. 6.874E+04 V

16. A rectangular coil with an area of  $0.45\text{ m}^2$  and 18 turns is placed in a uniform magnetic field of 2.68 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $3.730\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 87\text{ s}$ ?

- A. 4.861E+04 V
- B. 5.347E+04 V
- C. 5.882E+04 V**
- D. 6.470E+04 V
- E. 7.117E+04 V

17. A rectangular coil with an area of  $0.182\text{ m}^2$  and 5 turns is placed in a uniform magnetic field of 2.74 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $2.390\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 79\text{ s}$ ?

- A. 1.656E+03 V**
- B. 1.821E+03 V
- C. 2.003E+03 V
- D. 2.204E+03 V
- E. 2.424E+03 V

18. A rectangular coil with an area of  $0.291\text{ m}^2$  and 6 turns is placed in a uniform magnetic field of 2.63 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $7.130\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 35\text{ s}$ ?

- A. 1.490E+04 V
- B. 1.639E+04 V
- C. 1.803E+04 V
- D. 1.983E+04 V
- E. 2.181E+04 V**

19. A rectangular coil with an area of  $0.587\text{ m}^2$  and 13 turns is placed in a uniform magnetic field of 1.62 T. The coil is rotated about an axis that is perpendicular to this field. At time  $t=0$  the normal to the coil is oriented parallel to the magnetic field and the coil is rotating with a constant angular frequency of  $3.800\text{E}+03\text{ s}^{-1}$ . What is the "magnitude" (absolute value) of the induced emf at  $t = 93\text{ s}$ ?

- A. 2.512E+04 V
- B. 2.763E+04 V
- C. 3.039E+04 V
- D. 3.343E+04 V
- E. 3.677E+04 V**

## 2.7

1. A spatially uniform magnetic points in the z-direction and oscillates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.26\text{ T}$  and  $\omega = 9.250\text{E}+03\text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius  $0.385\text{ m}$  that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

- A. 6.029E+04 V
- B. 6.631E+04 V
- C. 7.295E+04 V**
- D. 8.024E+04 V

E. 8.826E+04 V

2. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.29 \text{ T}$  and  $\omega = 4.720\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.658 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

**A. 6.420E+04 V**

B. 7.062E+04 V

C. 7.768E+04 V

D. 8.545E+04 V

E. 9.400E+04 V

3. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 1.89 \text{ T}$  and  $\omega = 1.710\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.476 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 7.262E+03 V

B. 7.988E+03 V

C. 8.787E+03 V

**D. 9.666E+03 V**

E. 1.063E+04 V

4. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.71 \text{ T}$  and  $\omega = 6.600\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.31 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

**A. 4.769E+04 V**

B. 5.246E+04 V

C. 5.771E+04 V

D. 6.348E+04 V

E. 6.983E+04 V

5. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 2.18 \text{ T}$  and  $\omega = 4.840\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.387 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 1.928E+04 V

B. 2.120E+04 V

C. 2.332E+04 V

**D. 2.566E+04 V**

E. 2.822E+04 V

6. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.7 \text{ T}$  and  $\omega = 8.100\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.827 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 1.416E+05 V

**B. 1.557E+05 V**

C. 1.713E+05 V

D. 1.884E+05 V

E. 2.073E+05 V

7. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 2.34 \text{ T}$  and  $\omega = 2.670\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.646 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 1.905E+04 V

B. 2.096E+04 V

C. 2.305E+04 V

**D. 2.536E+04 V**

E. 2.790E+04 V

8. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.84 \text{ T}$  and  $\omega = 4.410\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.379 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 3.333E+04 V

B. 3.666E+04 V

**C. 4.033E+04 V**

D. 4.436E+04 V

E. 4.879E+04 V

9. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.54 \text{ T}$  and  $\omega = 1.860\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.642 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 2.415E+04 V

**B. 2.656E+04 V**

C. 2.922E+04 V

D. 3.214E+04 V

E. 3.535E+04 V

10. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 2.25 \text{ T}$  and  $\omega = 8.280\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.227 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

**A. 2.657E+04 V**

B. 2.923E+04 V

C. 3.215E+04 V

D. 3.537E+04 V

E. 3.890E+04 V

11. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.75 \text{ T}$  and  $\omega = 1.740\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.417 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.
- A. 1.168E+04 V  
 B. 1.284E+04 V  
 C. 1.413E+04 V  
 D. 1.554E+04 V  
**E. 1.710E+04 V**
12. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.75 \text{ T}$  and  $\omega = 9.800\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.22 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.
- A. 4.198E+04 V  
 B. 4.618E+04 V  
**C. 5.080E+04 V**  
 D. 5.588E+04 V  
 E. 6.147E+04 V
13. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.79 \text{ T}$  and  $\omega = 7.280\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.668 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.
- A. 7.910E+04 V  
 B. 8.701E+04 V  
 C. 9.571E+04 V  
 D. 1.053E+05 V  
**E. 1.158E+05 V**
14. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 1.8 \text{ T}$  and  $\omega = 1.530\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.519 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.
- A. 7.422E+03 V  
 B. 8.164E+03 V  
**C. 8.981E+03 V**  
 D. 9.879E+03 V  
 E. 1.087E+04 V
15. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 1.97 \text{ T}$  and  $\omega = 5.410\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.244 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.
- A. 1.485E+04 V  
**B. 1.634E+04 V**  
 C. 1.797E+04 V

D. 1.977E+04 V

E. 2.175E+04 V

16. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.31 \text{ T}$  and  $\omega = 8.360\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.547 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 7.145E+04 V

B. 7.860E+04 V

C. 8.646E+04 V

**D. 9.510E+04 V**

E. 1.046E+05 V

17. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.58 \text{ T}$  and  $\omega = 4.310\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.879 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 7.043E+04 V

B. 7.747E+04 V

**C. 8.522E+04 V**

D. 9.374E+04 V

E. 1.031E+05 V

18. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 3.11 \text{ T}$  and  $\omega = 1.150\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.171 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

A. 2.887E+03 V

B. 3.176E+03 V

C. 3.493E+03 V

**D. 3.843E+03 V**

E. 4.227E+03 V

19. A spatially uniform magnetic points in the z-direction and oscilates with time as  $\vec{B}(t) = B_0 \sin \omega t$  where  $B_0 = 1.71 \text{ T}$  and  $\omega = 4.780\text{E}+03 \text{ s}^{-1}$ . Suppose the electric field is always zero at point  $\mathcal{O}$ , and consider a circle of radius 0.294 m that is centered at that point and oriented in a plane perpendicular to the magnetic field. Evaluate the maximum value of the line integral  $\oint \vec{E} \cdot d\vec{s}$  around the circle.

**A. 1.510E+04 V**

B. 1.661E+04 V

C. 1.827E+04 V

D. 2.010E+04 V

E. 2.211E+04 V



## 2.8

1. A long solenoid has a radius of 0.442 m and 63 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 7$  A and  $\alpha = 22 \text{ s}^{-1}$ . What is the induced electric field at a distance 1.94 m from the axis at time  $t = 0.0331$  s ?  
A. **2.964E-04 V/m**  
B. 3.260E-04 V/m  
C. 3.586E-04 V/m  
D. 3.945E-04 V/m  
E. 4.339E-04 V/m
2. A long solenoid has a radius of 0.521 m and 46 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 1$  A and  $\alpha = 30 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.42 m from the axis at time  $t = 0.0449$  s ?  
A. **2.529E-05 V/m**  
B. 2.782E-05 V/m  
C. 3.060E-05 V/m  
D. 3.366E-05 V/m  
E. 3.703E-05 V/m
3. A long solenoid has a radius of 0.8 m and 77 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 5$  A and  $\alpha = 28 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.2 m from the axis at time  $t = 0.0757$  s ?  
A. 1.616E-04 V/m  
B. 1.778E-04 V/m  
C. 1.955E-04 V/m  
D. 2.151E-04 V/m  
E. **2.366E-04 V/m**
4. A long solenoid has a radius of 0.413 m and 17 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 1$  A and  $\alpha = 21 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.25 m from the axis at time  $t = 0.0689$  s ?  
A. 3.006E-06 V/m  
B. 3.307E-06 V/m  
C. 3.637E-06 V/m  
D. **4.001E-06 V/m**  
E. 4.401E-06 V/m
5. A long solenoid has a radius of 0.644 m and 20 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 7$  A and  $\alpha = 27 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.84 m from the axis at time  $t = 0.083$  s ?  
A. 3.353E-05 V/m  
B. **3.689E-05 V/m**  
C. 4.058E-05 V/m  
D. 4.463E-05 V/m  
E. 4.910E-05 V/m

6. A long solenoid has a radius of 0.45 m and 35 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 1 \text{ A}$  and  $\alpha = 28 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.35 m from the axis at time  $t = 0.0709 \text{ s}$  ?
- A. 5.475E-06 V/m
  - B. 6.023E-06 V/m
  - C. 6.625E-06 V/m
  - D. 7.288E-06 V/m**
  - E. 8.017E-06 V/m
7. A long solenoid has a radius of 0.716 m and 96 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 9 \text{ A}$  and  $\alpha = 23 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.67 m from the axis at time  $t = 0.0226 \text{ s}$  ?
- A. 1.426E-03 V/m**
  - B. 1.568E-03 V/m
  - C. 1.725E-03 V/m
  - D. 1.897E-03 V/m
  - E. 2.087E-03 V/m
8. A long solenoid has a radius of 0.806 m and 41 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 2 \text{ A}$  and  $\alpha = 21 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.67 m from the axis at time  $t = 0.0701 \text{ s}$  ?
- A. 6.040E-05 V/m**
  - B. 6.644E-05 V/m
  - C. 7.309E-05 V/m
  - D. 8.039E-05 V/m
  - E. 8.843E-05 V/m
9. A long solenoid has a radius of 0.786 m and 60 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 2 \text{ A}$  and  $\alpha = 21 \text{ s}^{-1}$ . What is the induced electric field at a distance 1.98 m from the axis at time  $t = 0.049 \text{ s}$  ?
- A. 1.605E-04 V/m
  - B. 1.766E-04 V/m**
  - C. 1.942E-04 V/m
  - D. 2.136E-04 V/m
  - E. 2.350E-04 V/m
10. A long solenoid has a radius of 0.578 m and 34 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 7 \text{ A}$  and  $\alpha = 27 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.63 m from the axis at time  $t = 0.0462 \text{ s}$  ?
- A. 1.473E-04 V/m**
  - B. 1.621E-04 V/m
  - C. 1.783E-04 V/m
  - D. 1.961E-04 V/m
  - E. 2.157E-04 V/m

11. A long solenoid has a radius of 0.777 m and 67 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 6 \text{ A}$  and  $\alpha = 20 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.39 m from the axis at time  $t = 0.0399 \text{ s}$  ?
- A. 3.924E-04 V/m  
 B. 4.317E-04 V/m  
 C. 4.748E-04 V/m  
 D. 5.223E-04 V/m  
**E. 5.745E-04 V/m**
12. A long solenoid has a radius of 0.434 m and 41 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 9 \text{ A}$  and  $\alpha = 28 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.28 m from the axis at time  $t = 0.0392 \text{ s}$  ?
- A. 1.479E-04 V/m  
 B. 1.627E-04 V/m  
**C. 1.789E-04 V/m**  
 D. 1.968E-04 V/m  
 E. 2.165E-04 V/m
13. A long solenoid has a radius of 0.845 m and 65 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 6 \text{ A}$  and  $\alpha = 30 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.63 m from the axis at time  $t = 0.0561 \text{ s}$  ?
- A. 3.371E-04 V/m  
**B. 3.709E-04 V/m**  
 C. 4.079E-04 V/m  
 D. 4.487E-04 V/m  
 E. 4.936E-04 V/m
14. A long solenoid has a radius of 0.583 m and 38 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 6 \text{ A}$  and  $\alpha = 24 \text{ s}^{-1}$ . What is the induced electric field at a distance 2.09 m from the axis at time  $t = 0.0388 \text{ s}$  ?
- A. 1.655E-04 V/m  
 B. 1.821E-04 V/m  
 C. 2.003E-04 V/m  
**D. 2.203E-04 V/m**  
 E. 2.424E-04 V/m
15. A long solenoid has a radius of 0.394 m and 13 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 9 \text{ A}$  and  $\alpha = 28 \text{ s}^{-1}$ . What is the induced electric field at a distance 1.8 m from the axis at time  $t = 0.0757 \text{ s}$  ?
- A. 2.132E-05 V/m**  
 B. 2.345E-05 V/m  
 C. 2.579E-05 V/m  
 D. 2.837E-05 V/m  
 E. 3.121E-05 V/m

16. A long solenoid has a radius of 0.887 m and 43 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 7$  A and  $\alpha = 28$  s<sup>-1</sup>. What is the induced electric field at a distance 2.66 m from the axis at time  $t = 0.0332$  s ?
- A. **6.182E-04 V/m**  
 B. 6.801E-04 V/m  
 C. 7.481E-04 V/m  
 D. 8.229E-04 V/m  
 E. 9.052E-04 V/m
17. A long solenoid has a radius of 0.624 m and 84 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 6$  A and  $\alpha = 20$  s<sup>-1</sup>. What is the induced electric field at a distance 1.78 m from the axis at time  $t = 0.0579$  s ?
- A. 3.597E-04 V/m  
 B. 3.956E-04 V/m  
 C. **4.352E-04 V/m**  
 D. 4.787E-04 V/m  
 E. 5.266E-04 V/m
18. A long solenoid has a radius of 0.306 m and 98 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 6$  A and  $\alpha = 22$  s<sup>-1</sup>. What is the induced electric field at a distance 2.52 m from the axis at time  $t = 0.0246$  s ?
- A. 1.598E-04 V/m  
 B. **1.758E-04 V/m**  
 C. 1.934E-04 V/m  
 D. 2.127E-04 V/m  
 E. 2.340E-04 V/m
19. A long solenoid has a radius of 0.757 m and 90 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 7$  A and  $\alpha = 30$  s<sup>-1</sup>. What is the induced electric field at a distance 2.08 m from the axis at time  $t = 0.0442$  s ?
- A. 6.527E-04 V/m  
 B. 7.180E-04 V/m  
 C. 7.898E-04 V/m  
 D. **8.688E-04 V/m**  
 E. 9.556E-04 V/m

## 2.9

1. A long solenoid has a radius of 0.508 m and 90 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 7$  A and  $\alpha = 25$  s<sup>-1</sup>. What is the induced electric field at a distance 0.145 m from the axis at time  $t = 0.0643$  s ?
- A. 2.614E-04 V/m  
 B. **2.875E-04 V/m**  
 C. 3.163E-04 V/m  
 D. 3.479E-04 V/m  
 E. 3.827E-04 V/m

2. A long solenoid has a radius of 0.732 m and 55 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 9$  A and  $\alpha = 25$  s<sup>-1</sup>. What is the induced electric field at a distance 0.203 m from the axis at time  $t = 0.0448$  s ?
- A. **5.150E-04 V/m**  
 B. 5.665E-04 V/m  
 C. 6.232E-04 V/m  
 D. 6.855E-04 V/m  
 E. 7.540E-04 V/m
3. A long solenoid has a radius of 0.682 m and 38 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 2$  A and  $\alpha = 27$  s<sup>-1</sup>. What is the induced electric field at a distance 0.16 m from the axis at time  $t = 0.0736$  s ?
- A. 2.571E-05 V/m  
 B. **2.828E-05 V/m**  
 C. 3.111E-05 V/m  
 D. 3.422E-05 V/m  
 E. 3.764E-05 V/m
4. A long solenoid has a radius of 0.887 m and 45 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 3$  A and  $\alpha = 25$  s<sup>-1</sup>. What is the induced electric field at a distance 0.169 m from the axis at time  $t = 0.072$  s ?
- A. 4.896E-05 V/m  
 B. 5.385E-05 V/m  
 C. **5.924E-05 V/m**  
 D. 6.516E-05 V/m  
 E. 7.168E-05 V/m
5. A long solenoid has a radius of 0.845 m and 78 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 3$  A and  $\alpha = 20$  s<sup>-1</sup>. What is the induced electric field at a distance 0.214 m from the axis at time  $t = 0.0655$  s ?
- A. 1.160E-04 V/m  
 B. 1.276E-04 V/m  
 C. 1.403E-04 V/m  
 D. 1.544E-04 V/m  
 E. **1.698E-04 V/m**
6. A long solenoid has a radius of 0.851 m and 12 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 3$  A and  $\alpha = 30$  s<sup>-1</sup>. What is the induced electric field at a distance 0.14 m from the axis at time  $t = 0.0531$  s ?
- A. 1.319E-05 V/m  
 B. 1.451E-05 V/m  
 C. 1.596E-05 V/m  
 D. 1.756E-05 V/m  
 E. **1.932E-05 V/m**

7. A long solenoid has a radius of 0.447 m and 85 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 7$  A and  $\alpha = 23$  s<sup>-1</sup>. What is the induced electric field at a distance 0.212 m from the axis at time  $t = 0.0819$  s ?
- A. 1.893E-04 V/m  
 B. 2.082E-04 V/m  
 C. 2.290E-04 V/m  
 D. 2.519E-04 V/m  
**E. 2.771E-04 V/m**
8. A long solenoid has a radius of 0.596 m and 19 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 5$  A and  $\alpha = 29$  s<sup>-1</sup>. What is the induced electric field at a distance 0.209 m from the axis at time  $t = 0.0604$  s ?
- A. **6.277E-05 V/m**  
 B. 6.904E-05 V/m  
 C. 7.595E-05 V/m  
 D. 8.354E-05 V/m  
 E. 9.190E-05 V/m
9. A long solenoid has a radius of 0.645 m and 37 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 9$  A and  $\alpha = 23$  s<sup>-1</sup>. What is the induced electric field at a distance 0.189 m from the axis at time  $t = 0.0698$  s ?
- A. 1.372E-04 V/m  
 B. 1.509E-04 V/m  
 C. 1.660E-04 V/m  
**D. 1.826E-04 V/m**  
 E. 2.009E-04 V/m
10. A long solenoid has a radius of 0.857 m and 58 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 1$  A and  $\alpha = 21$  s<sup>-1</sup>. What is the induced electric field at a distance 0.144 m from the axis at time  $t = 0.0898$  s ?
- A. 1.256E-05 V/m  
 B. 1.382E-05 V/m  
 C. 1.520E-05 V/m  
**D. 1.672E-05 V/m**  
 E. 1.839E-05 V/m
11. A long solenoid has a radius of 0.436 m and 87 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 4$  A and  $\alpha = 27$  s<sup>-1</sup>. What is the induced electric field at a distance 0.153 m from the axis at time  $t = 0.02$  s ?
- A. 4.785E-04 V/m  
**B. 5.264E-04 V/m**  
 C. 5.790E-04 V/m  
 D. 6.369E-04 V/m  
 E. 7.006E-04 V/m

12. A long solenoid has a radius of 0.793 m and 45 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 2$  A and  $\alpha = 29$  s<sup>-1</sup>. What is the induced electric field at a distance 0.216 m from the axis at time  $t = 0.0208$  s ?
- A. 1.456E-04 V/m  
 B. 1.601E-04 V/m  
 C. 1.762E-04 V/m  
**D. 1.938E-04 V/m**  
 E. 2.132E-04 V/m
13. A long solenoid has a radius of 0.517 m and 23 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 1$  A and  $\alpha = 30$  s<sup>-1</sup>. What is the induced electric field at a distance 0.162 m from the axis at time  $t = 0.0679$  s ?
- A. 6.256E-06 V/m  
 B. 6.882E-06 V/m  
 C. 7.570E-06 V/m  
 D. 8.327E-06 V/m  
**E. 9.160E-06 V/m**
14. A long solenoid has a radius of 0.861 m and 28 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 1$  A and  $\alpha = 20$  s<sup>-1</sup>. What is the induced electric field at a distance 0.106 m from the axis at time  $t = 0.055$  s ?
- A. 1.026E-05 V/m  
 B. 1.129E-05 V/m  
**C. 1.242E-05 V/m**  
 D. 1.366E-05 V/m  
 E. 1.502E-05 V/m
15. A long solenoid has a radius of 0.749 m and 62 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 9$  A and  $\alpha = 25$  s<sup>-1</sup>. What is the induced electric field at a distance 0.139 m from the axis at time  $t = 0.071$  s ?
- A. 2.065E-04 V/m**  
 B. 2.271E-04 V/m  
 C. 2.499E-04 V/m  
 D. 2.748E-04 V/m  
 E. 3.023E-04 V/m
16. A long solenoid has a radius of 0.591 m and 41 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 1$  A and  $\alpha = 30$  s<sup>-1</sup>. What is the induced electric field at a distance 0.234 m from the axis at time  $t = 0.0208$  s ?
- A. 6.618E-05 V/m  
 B. 7.280E-05 V/m  
 C. 8.008E-05 V/m  
 D. 8.809E-05 V/m  
**E. 9.689E-05 V/m**

17. A long solenoid has a radius of 0.603 m and 51 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 2$  A and  $\alpha = 26$  s<sup>-1</sup>. What is the induced electric field at a distance 0.105 m from the axis at time  $t = 0.0659$  s ?
- A. 2.154E-05 V/m
  - B. 2.369E-05 V/m
  - C. 2.606E-05 V/m
  - D. 2.867E-05 V/m
  - E. 3.154E-05 V/m**
18. A long solenoid has a radius of 0.613 m and 75 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 2$  A and  $\alpha = 22$  s<sup>-1</sup>. What is the induced electric field at a distance 0.206 m from the axis at time  $t = 0.0387$  s ?
- A. 1.370E-04 V/m
  - B. 1.507E-04 V/m
  - C. 1.657E-04 V/m
  - D. 1.823E-04 V/m**
  - E. 2.005E-04 V/m
19. A long solenoid has a radius of 0.442 m and 41 turns per meter; its current decreases with time according to  $I_0 e^{-\alpha t}$ , where  $I_0 = 4$  A and  $\alpha = 20$  s<sup>-1</sup>. What is the induced electric field at a distance 0.2 m from the axis at time  $t = 0.0833$  s ?
- A. 6.438E-05 V/m
  - B. 7.082E-05 V/m
  - C. 7.790E-05 V/m**
  - D. 8.569E-05 V/m
  - E. 9.426E-05 V/m



## 3 Attribution

### Notes

<sup>1</sup>Example 13.1 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:BTZF6vX4@2/131-Faradays-Law.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>2</sup>Example 13.2 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:ZNcjduzK@4/132-Lenzs-Law.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>3</sup>Example 13.3 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:ZNcjduzK@4/132-Lenzs-Law.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>4</sup>Example 13.3 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:ZNcjduzK@4/132-Lenzs-Law.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>5</sup>Example 13.5 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:UbKygyP4@2/133-Motional-Emf.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>6</sup>Example 13.6 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:UbKygyP4@2/133-Motional-Emf.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>7</sup>Example 13.7 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:F-UkvfQz@3/134-Induced-Electric-Fields.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>8</sup>Example 13.8 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:F-UkvfQz@3/134-Induced-Electric-Fields.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>

<sup>9</sup>Example 13.8 from OpenStax University Physics2: <https://cnx.org/contents/eg-XcBxE@9.7:F-UkvfQz@3/134-Induced-Electric-Fields.1> placed in Public Domain by Guy Vandegrift: <https://en.wikiversity.org/wiki/special:permalink/xxx>