

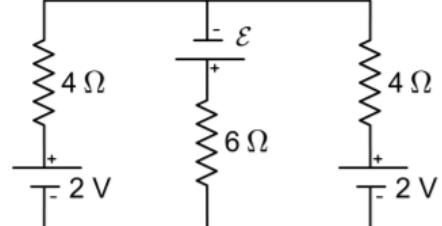


# Polytechnic Tutoring Center

## Final Review – PH 2023 Fall 2021

*Disclaimer: This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.*

1. A horizontal water hose of a 5.0 cm radius ends with a 1.2 cm radius nozzle, which is open to atmosphere. What must the pressure in the hose be for the flow rate to be 0.006  $\text{m}^3/\text{s}$ ?  
a) 257 kPa    b) 299 kPa    c) 149 kPa    d) 189 kPa    e) 221 kPa
  
2. A charge  $3 \mu\text{C}$  sits in a cube with each side having a length of 28 cm. What is the flux through one side of the box? [Hint: the flux through each side is equal.]  
a)  $35,577 \text{ Nm}^2/\text{C}$     b)  $41,129 \text{ Nm}^2/\text{C}$     c)  $48,344 \text{ Nm}^2/\text{C}$   
d)  $56,497 \text{ Nm}^2/\text{C}$     e)  $60,582 \text{ Nm}^2/\text{C}$
  
3. When a 10 nF and a 21 nF capacitor are connected in series to a 12 V battery, what is the voltage across the 10 nF capacitor?  
a) 8.13 V    b) 8.57 V    c) 8.84 V    d) 9.07 V    e) 9.76 V
  
4. In the circuit shown, the currents through the  $4 \Omega$  resistors are both  $0.375 \text{ A}$  and directed upward. What is the emf of the battery in the middle branch?  
a) 4.00 V    b) 6.00 V    c) 8.00 V    d) 10.0 V  
e) 12.0 V
  
5. A deuteron ( $m = 3.34 \times 10^{-27} \text{ kg}$ ,  $q = 1.60 \times 10^{-19} \text{ C}$ ) is accelerated from rest through a 10 kV potential difference and then moves perpendicularly to a uniform magnetic field of strength of 1.6 T. What is the radius of the resulting circular path of the deuteron?  
a) 2.45 cm    b) 1.57 cm    c) 1.08 cm    d) 1.86 cm    e) 1.28 cm
  
6. A wire of length 13 m is used to form an  $N$ -turn circular coil of radius 23 cm. In order for the magnetic field at the center to exactly cancel the earth's magnetic field of 35  $\mu\text{T}$ , what must the current in the wire be?



a) 2.03 A      b) 2.44 A      c) 3.52 A      d) 1.42 A      e) 1.63 A

7. A 0.25 H inductor is connected in series with a  $8\ \Omega$  resistor, 6 V battery and a switch. What is the voltage across the resistor 3 ms after the switch was closed?

a) 0.887 V      b) 0.549 V      c) 0.372 V      d) 1.20 V      e) 1.06 V

8. A point charge of  $-1\text{ nC}$  sits 6 meters from a point charge of  $+3\text{ nC}$ . If the  $-1\text{ nC}$  charge is brought to a distance of 3.5 m from the  $+3\text{ nC}$  charge, the change in its potential energy is

a)  $-4.50\text{ nJ}$       b)  $-3.21\text{ nJ}$       c)  $-8.99\text{ nJ}$       d)  $-2.25\text{ nJ}$       e)  $-6.49\text{ nJ}$

9. A railgun consists of a power source of emf  $100,000\text{ V}$  that sends a current through a bar of mass  $1.5\text{ kg}$  that rests across two frictionless rails  $0.1\text{ m}$  apart, as shown. The resistance of the bar is  $0.5\ \Omega$  and a uniform magnetic field  $B$  of  $5\text{ T}$  passes between the rails. The length of the rails is  $3\text{ m}$ . Assuming the bar starts on the left and, and neglecting the induced emf in the loop, what will the bar's velocity be when it leaves the rails?

a)  $400\text{ m/s}$       b)  $490\text{ m/s}$       c)  $566\text{ m/s}$       d)  $632\text{ m/s}$       e)  $900\text{ m/s}$

10. A circular coil of wire of radius  $5\text{ cm}$  with  $N = 1000$  turns has a resistance of  $2\ \Omega$  and rotates at an angular speed of  $200\text{ rad/s}$  about an axis perpendicular to an external magnetic field of  $0.2\text{ T}$ . If at  $t = 0\text{ s}$ , the plane of the coil is perpendicular to the field, what is the current through the coil at time  $t = 5.236 \times 10^{-3}\text{ s}$ ?

a)  $296\text{ A}$       b)  $136\text{ A}$       c)  $190\text{ A}$       d)  $266\text{ A}$       e)  $236\text{ A}$

