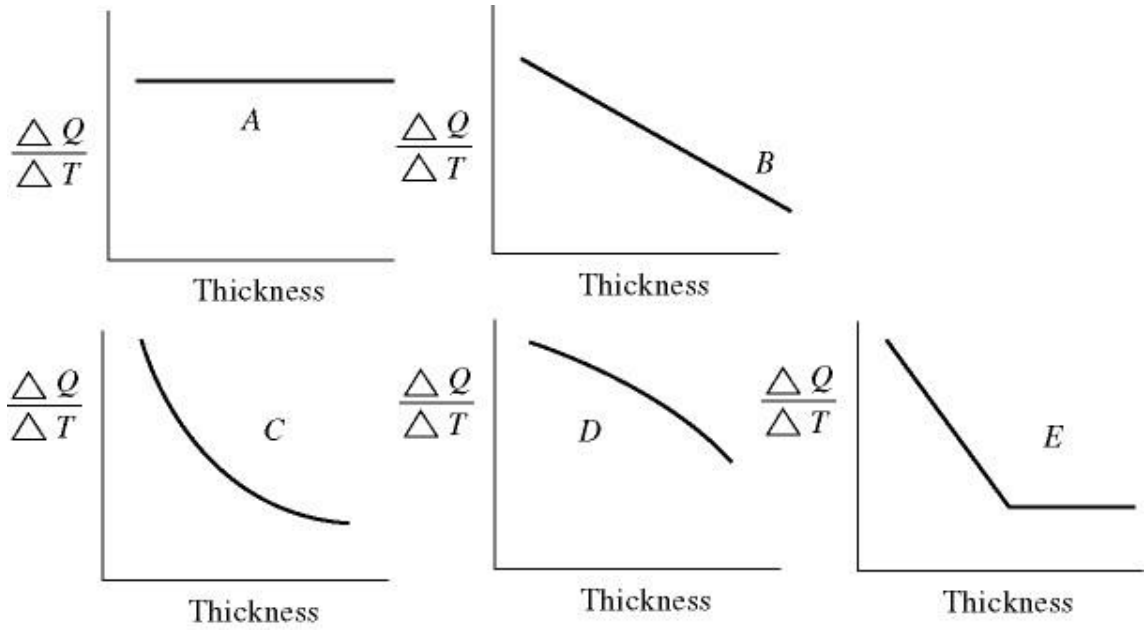
Practice Final Exam 2
PHYS1220

1) An architect is interested in estimating the heat loss (in kcal/s) through a sheet of insulating material as a function of the thickness of the sheet. Assuming fixed temperatures on the two faces of the sheet, which one of the graphs in the figure best represents the rate of heat transfer as a function of the thickness of the insulating sheet?



A) A B) B C) C D) D E) E

2) A 406.0 kg copper bar is put into a smelter for melting. The initial temperature of the copper is 300.0 K. How much heat must the smelter produce to completely melt the copper bar? (The specific heat for copper is 386 J/kg • K, the heat of fusion for copper is 205 kJ/kg, and its melting point is 1357 K.)

A) 2.96×10^5 kJ B) 1.66×10^{11} kJ
C) 2.49×10^5 kJ D) 1.66×10^8 kJ

3) A cube at 100°C radiates heat at a rate of 80.0 J/s. If its surface temperature is increased to 200°C, the rate at which it will now radiate is closest to

A) 1280 J/s. B) 160 J/s. C) 640 J/s. D) 207 J/s. E) 320 J/s.

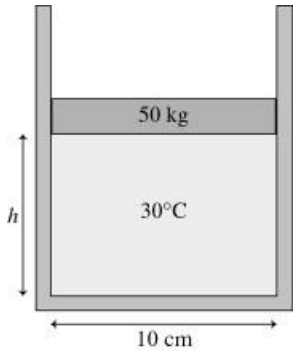
4) If the temperature of a fixed amount of an ideal gas is increased, it NECESSARILY follows that

A) the volume of the gas will increase.
B) the speed of the gas molecules will increase.
C) the pressure of the gas will increase.
D) All of the above statements are correct.

5) A 3.2-L volume of neon gas (Ne) is at a pressure of 3.3 atm and a temperature of 330 K. The atomic mass of neon is 20.2 g/mol, Avogadro's number is 6.022×10^{23} molecules/mol, and the ideal gas constant is $R = 8.314\ \text{J/mol} \cdot \text{K} = 0.0821\ \text{L} \cdot \text{atm/mol} \cdot \text{K}$. The mass of the neon gas is closest to

A) 7.9×10^{-3} kg.
B) 7.8 kg.
C) 4.6×10^{-3} kg.
D) 7.8×10^{2} kg.
E) 3.8 kg.

6) The figure shows a 50-kg frictionless cylindrical piston that floats on 0.68 mol of compressed air at 30°C. How far does the piston move if the temperature is increased to 300°C?



A) 130 cm B) 250 cm C) 120 cm D) 1300 cm

7) What is the average kinetic energy of an ideal gas molecule at 569°C.
A) 3.93×10^{-19} J B) 5.81×10^{-21} J
C) 1.18×10^{-17} J D) 1.74×10^{-20} J

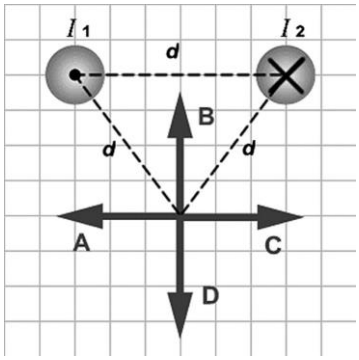
8) An oxygen molecule falls in a vacuum. From what height must it fall so that its kinetic energy at the bottom equals the average energy of an oxygen molecule at 800 K? (The molecular weight of oxygen is 32.0 g/mol).

A) 42.3 km B) 10.6 km C) 31.8 km D) 21.1 km

9) When an ideal gas increases in volume at constant pressure, the average kinetic energy of the gas molecules

A) does not change.
B) decreases.
C) increases.
D) may either increase or decrease, depending on whether or not the process is carried out adiabatically.
E) may or may not change, but insufficient information is given to make such a determination.

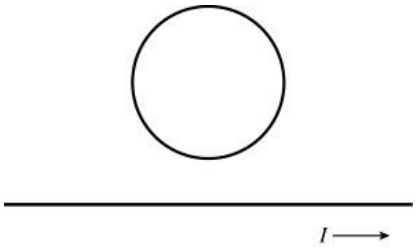
10) The figure shows two long wires carrying equal currents I_1 and I_2 flowing in opposite directions. Which of the arrows labeled A through D correctly represents the direction of the magnetic field due to the wires at a point located at an equal distance d from each wire?



A) A
B) B
C) C
D) D
E) The magnetic field is zero at that point.

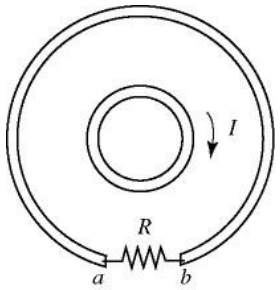
11) The magnetic field at a distance of 2 cm from a current carrying wire is 4 μT. What is the magnetic field at a distance of 4 cm from the wire?
A) 4 μT B) 1 μT C) 8 μT D) 2 μT E) 1/2 μT

12) A circular metal ring is situated above a long straight wire, as shown in the figure. The straight wire has a current flowing to the right, and the current is increasing in time at a constant rate. Which statement is true?



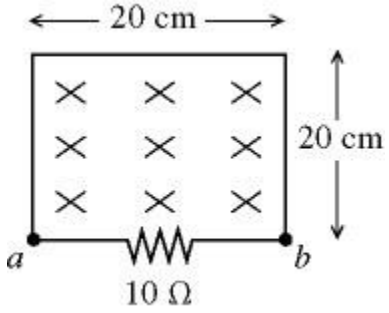
A) There is no induced current in the metal ring because the current in the wire is changing at a constant rate.
B) There is an induced current in the metal ring, flowing in a counter-clockwise direction.
C) There is an induced current in the metal ring, flowing in a clockwise direction.

13) In the figure, the inner loop carries a clockwise current *I* that is increasing. The resistor *R* is in the outer loop and both loops are in the same plane. The induced current through the resistor *R* is



A) from *a* to *b*.
B) from *b* to *a*.
C) There is no induced current through the resistor.

14) As shown in the figure, a wire and a 10-Ω resistor are used to form a circuit in the shape of a square, 20 cm by 20 cm. A uniform but non-steady magnetic field is directed into the plane of the circuit. The magnitude of the magnetic field is decreased from 1.50 T to 0.50 T in a time interval of 63 ms. The average induced current and its direction through the resistor, in this time interval, are closest to



A) 38 mA, from *a* to *b*.
B) 95 mA, from *a* to *b*.
C) 63 mA, from *a* to *b*.
D) 63 mA, from *b* to *a*.
E) 38 mA, from *b* to *a*.

15) Two identical small conducting spheres are separated by 0.60 m. The spheres carry different amounts of charge and each sphere experiences an attractive electric force of 10.8N. The total charge on the two spheres is -24 μC. The two spheres are now connected by a slender conducting wire, which is then removed. The electric force on each sphere is closest to

A) 5.4 N, attractive.
B) 3.6 N, attractive.
C) 5.4 N, repulsive.
D) zero.
E) 3.6 N, repulsive.

16) An initially-stationary electric dipole of dipole moment $\vec{p}$ = (5.00 × 10^{-10} C • m) $\hat{i}$ placed in an electric field $\vec{E}$ = (2.00 × 10^{6} N/C) $\hat{i}$ + (2.00 × 10^{6} N/C) $\hat{j}$. What is the magnitude of the maximum torque that the electric field exerts on the dipole?

A) 1.40 × 10^{-3} N • m
B) 0.00 N · m
C) 1.00 × 10^{-3} N • m
D) 2.00 × 10^{-3} N • m
E) 2.80 × 10^{-3} N • m

17) A spherical, non-conducting shell of inner radius r_1 = 10 cm and outer radius r_2= 15 cm carries a total charge Q = 15 μC distributed uniformly throughout the volume of the shell. What is the magnitude of the electric field at a distance r = 12 cm from the center of the shell?
A) 2.87 × 10^{3} N/C
B) 5.75 × 10^{6} N/C
C) 2.87 × 10^{6} N/C
D) 5.75 × 10^{3} N/C
E) zero

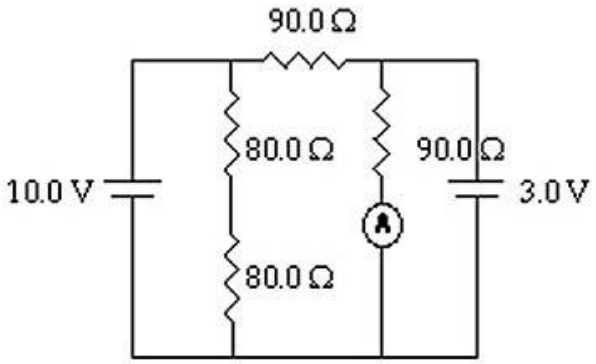
18) A 6.00-μF parallel-plate capacitor has charges of ±40.0 μC on its plates. How much potential energy is stored in this capacitor?

A) 133 μJ B) 143 μJ C) 103 μJ D) 123 μJ E) 113 μJ

19) Calculate the current through a 10.0-m long 22 gauge (having radius 0.321 mm) nichrome wire if it is connected to a 12.0-V battery. The resistivity of nichrome is 100 × 10^{-8} Ω • m.

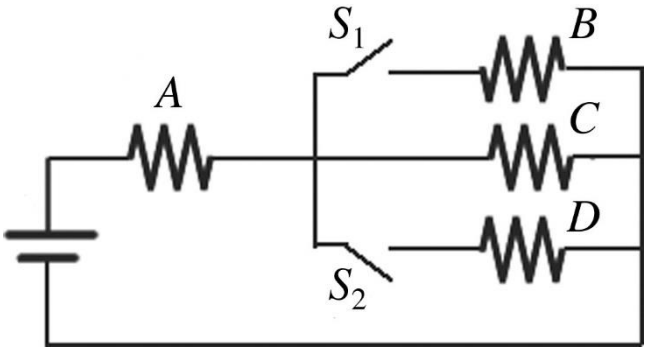
A) 776 mA B) 30.9 A C) 17.5 A D) 61.8 A E) 388 mA

20) For the circuit shown in the figure, what current does the ideal ammeter read?



A) 0.078 A B) 0.033 A C) 0.12 A D) 0.23 A

21) In the circuit shown in the figure, four identical resistors labeled *A* to *D* are connected to a battery as shown. S_1 and S_2 are switches. Which of the following actions would result in the GREATEST amount of current through resistor *A*?

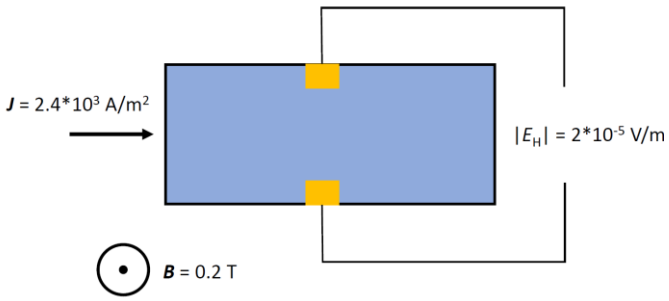


A) leaving both switches open as shown B) closing S_2 only
C) closing S_1 only D) closing both switches

22) A charged particle of mass 0.0020 kg is subjected to a 6.0 T magnetic field which acts at a right angle to its motion. If the particle moves in a circle of radius 0.20 m at a speed of 5.0 m/s, what is the magnitude of the charge on the particle?

A) 0.00040 C B) 0.0083 C C) 120 C D) 2500 C

23) We have a Hall bar on an unknown material pictured below. We are sourcing $2.4*10^3$ A/cm^2 in the +x-direction in a uniform magnetic field of 0.2 T in the +z-direction. If the magnitude of the electric field between A and B is measured to be $2*10^{-5}$ V/m, what is the carrier concentration of the material, *n*?



A) $1.5*10^{26}$ m^{-3} B) $1.2*10^{8}$ m^{-3} C) $8.3*10^{20}$ m^{-3}
D) $5.6*10^{15}$ m^{-3} E) $3.0*10^{30}$ m^{-3}

24) If we know that the variable *D* is related to the measured variables, *A*, *B*, and *C* as: $D = A^4B^2/C^5$, and the error in *A* is 1%, error in *B* is 2%, and the error in *C* is 3%, what is the error in *D*?

A) 0.5% B) 16% C) 1.9% D) 0.016% E) 6%

25) At T = 0 K, what can we say about a particle? (Choose all that apply)

A) Average translational KE is 0
B) All motion is zero
C) Entropy is 0
D) No phase changes can occur
E) All matter must be in the solid phase

26) In a circuit, a conduction current flows through a capacitor when:

A) A capacitor is discharging or charging
B) Only during dielectric breakdown
C) Never
D) When a change in electric flux occurs
E) In the fully charged or discharged state

27) We have a steel wall that has an area of 100 m^2 sandwiched between two concrete walls, all initially at 295 K. The steel wall has hot water tubes going through it, which raise the steel wall temperature to 325 K. If the coefficient of linear expansion of the steel is $1.2*10^{-5}$ K^{-1} and the Young's modulus, Y, is 200 GPa, what is the thermal stress exerted on the concrete walls?

A) 780 MPa B) 3.5 MN C) 6 TPa D) 7.2 GN E) 72 MPa

28) We have a capacitor, in a piece of equipment called a streak camera, with a 100 V/m field that discharges in 100 ps. The capacitor plate area is 10 cm^2. What is the measured magnetic field 1 cm away from the center of the capacitor?

A) $1.8*10^{-8}$ T B) 2000 T C) $1.4*10^{-2}$ T D) 0 T E) $1.8*10^{-4}$ T

29) Heat and electrical conduction is typically high in metals because:

A) Plasmons B) Large lattice vibrations (phonons) C) High nuclear masses
D) High carrier (electron and hole) mobilities E) Dielectric constant is equal to 1

30) We have two wires that are 1 cm apart. One wire is permanently fixed, while the other is free to move. We source 100 A through both in opposite directions causing one of the wires to move 0.1 cm. If work, W, is defined as: $W = \int \vec{F} \cdot d\vec{l}$, then how much work is done by the magnetic field generated by the current in the immovable wire in the outward direction?

A) 10^{-4} N B) $9.5*10^{-5}$ N C) $-9.5*10^{-5}$ N D) 0 N

1) C
2) C
3) D
4) B
5) A
6) C
7) D
8) C
9) C
10) B
11) D
12) C
13) A
14) D
15) E
16) C
17) C
18) A
19) E
20) B
21) D
22) B
23) A
24) B
25) A, C
26) B
27) E
28) A
29) D
30) D