Department of Physics, KFUPM

PHYSICS 102 – 053 – Final Exam – 17 August 17, 2006

Multiple Choice – **(A)** is the correct choice– ZERO VERSION

Q1.

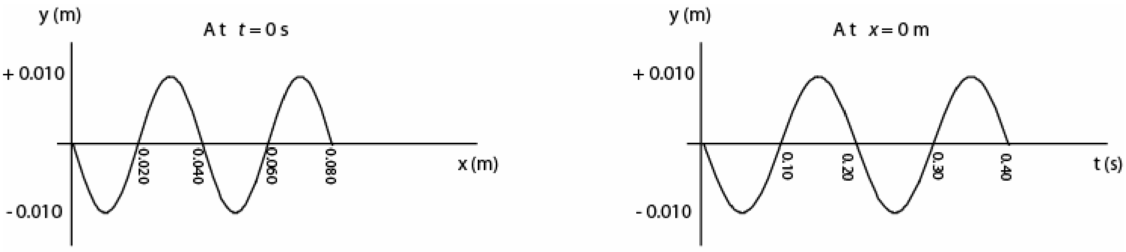

Figure 1

Fig. 1 shows two graphs that represent a transverse wave on a string. Based on the information contained in these graphs, the speed of the wave is:

A) 0.20 m/s.
B) 0.30 m/s
C) 0.40 m/s
D) 0.10 m/s
E) 0.80 m/s

Q2. As a sound wave travels from air into water, which of the following is TRUE?

A) The frequency of the wave does not change
B) The velocity of the wave decreases
C) The wavelength of the wave decreases
D) The wavelength of the wave does not change
E) The frequency of the wave decreases

Q3. A transverse wave is traveling on a string. The displacement *y* of a particle on the string from its equilibrium position is given by $y = 0.021\sin(2.0x - 25t)$, *x* and *y* are in meters, and *t* is in seconds. The linear density of the string is 1.6 x 10^{-2} kg/m. The tension in the string is

A) 2.5 N
B) 1.8 N
C) 3.8 N
D) 4.5 N
E) 10 N

Q4. One cubic meter of water initially at 25 °C absorbs 2.00 x 10^8 J of heat from the sun. Calculate the final temperature of the water. (Specific heat of water 4186 J/kg.K)

A) 72. 8 °C
B) 92. 5 °C
C) -72. 8 °C
D) -92. 8 °C
E) 115 °C

Q5. A copper rod has one end in a heat reservoir of temperature 650 K and the other end at a heat reservoir of temperature 350 K. A total of 1200 J of heat flows from hot reservoir to cold reservoir through the rod. The total change in entropy of the two heat reservoirs is

A) +1.6 J/K
B) -1.6 J/K
C) 3.5 J/K
D) -3.5 J/K
E) 0 J/K

Q6. A monatomic ideal gas is taken from *A* to *B* to *C*, as shown in Fig.2. The curved line between *A* and *C* is an isotherm. During the process the change in the internal energy

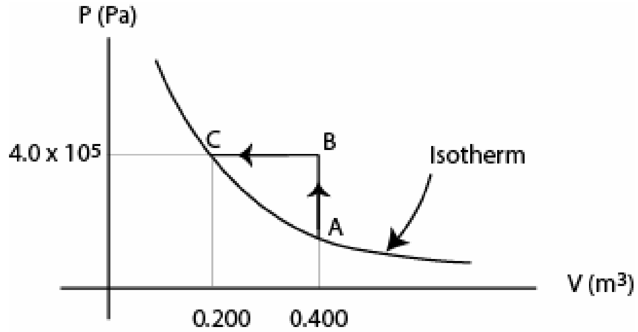

Figure 2

A) zero
B) 8.0 x 10^4 J
C) 4.0 x 10^4 J
D) -4.0 x 10^4 J
E) -8.0 x 10^4 J

Q7. Two neutral metal spheres *A* and *B* on wood stands are touching (see Fig 3). A positively charged rod is held near sphere *A* but not touching it. While the rod is there, sphere *B* is moved so that the spheres no longer touch. Then the rod is removed. Afterward what is the charge state of each sphere?

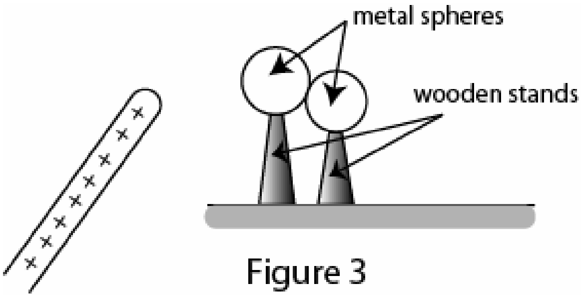

Figure 3

A) Sphere *A* negative, sphere *B* positive
B) Sphere *A* positive, sphere *B* negative
C) Sphere *A* neutral, sphere *B* negative
D) Sphere *A* negative, sphere *B* neutral
E) Sphere *A* neutral, Sphere *B* positive

Q8. A 0.100 g plastic sphere is charged by the addition of 1.00 x 10^{10} excess electrons. What electric field $\vec{E}$ will cause the sphere to hang suspended in the air?

A) 6.13 x 10^{5} N/C, vertically downward
B) 6.13 x 10^{5} N/C, vertically upward
C) -2.51 x 10^{5} N/C, vertically downward
D) 2.51 x 10^{+5} N/C, vertically upward
E) 289 N/C, vertically downward

Q9. Two large and thin metal plates *A* and *B* are facing each other. The surface charge densities on the facing surfaces of the plates are $+\sigma$ and $-\sigma$ respectively and zero on the outer surfaces. Now plate *B* is removed very far from plate *A*. The charge density on plate *A* is:

A) $\frac{\sigma}{2}$
B) σ
C) 2σ
D) $-\sigma$
E) zero

Q10. A ball of radius 20 cm is uniformly charged to 80 nC. The magnitude of electric field strength at *r* =10 cm is

A) 9000 N/C
B) 18000 N/C
C) 3000 N/C
D) 36000 N/C
E) 45000 N/C

Q11. The two segments of the wire in Fig. 4 have equal diameters but different resistivities ρ_1 and ρ_2. Current *I* passes through this wire. If $\rho_2/\rho_1 = \frac{1}{2}$, what is the ratio of E_2/E_1 of the electric field strengths in the two segments?

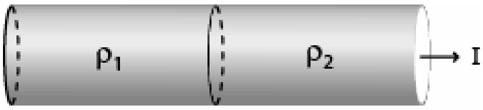

Figure 4

A) $\frac{1}{2}$
B) 2
C) 1
D) 4
E) $\frac{1}{4}$

Q12. A proton's speed as it passes point *A* is 5.0 x 10^4 m/s. It follows the trajectory shown in Fig. 5. What is the proton's speed at point *B*? (mass of the proton is 1.67 x 10^{-27} kg)

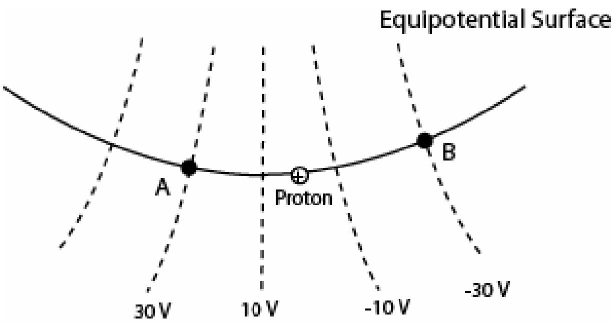

Figure 5

A) 1.2 x 10^5 m/s
B) 3.5 x 10^5 m/s
C) 4.0 x 10^4 m/s
D) 2.1 x 10^6 m/s
E) zero

Q13. A battery with an emf of 60V is connected to the two capacitors shown in Fig. 6. The final charge on capacitor C_2 is 450 μC. What is the capacitance C_2?

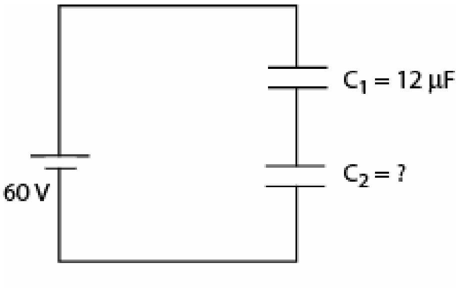

Figure 6

A) 20 μF
B) 10 μF
C) 30 μF
D) 40 μF
E) 5 μF

Q14. In Fig. 7, what is the rate at which energy is supplied by the battery $\mathscr{E}_1$?

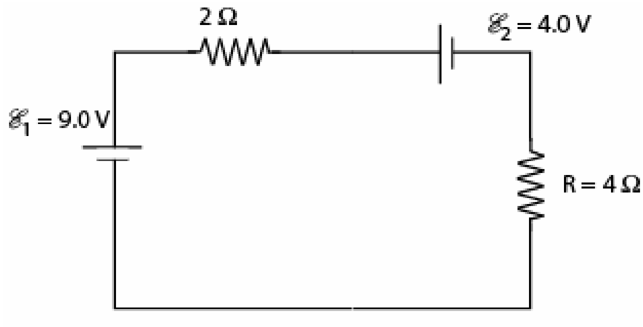

Figure 7

A) 7.5 W
B) 2.1 W
C) 11.0 W
D) 20.1 W
E) 22.3 W

Q15. In Fig. 8, all the batteries are ideal with $\mathscr{E}_1$=6.0 V $\mathscr{E}_2$=5.0 V, and $\mathscr{E}_3$= 4.0 V. What is the potential difference across resistor R_2?

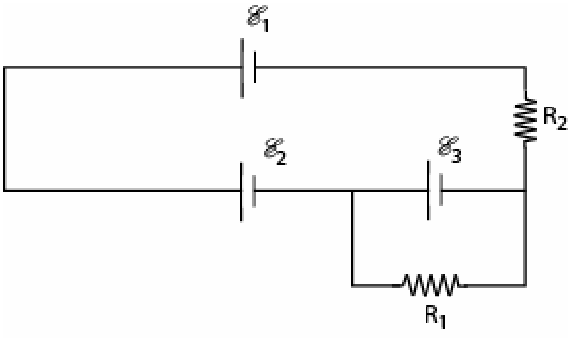

Figure 8

A) 3 V
B) 6 V
C) 9 V
D) 1.5 V
E) 4.5 V

Q16. In Fig. 9, ℰ = 4.2 kV, C = 6.5 μF, $R_1 = R_2 = R_3 = 0.92$ M Ω. After switch S_1 has been closed for a long time, what is the current in R_2?

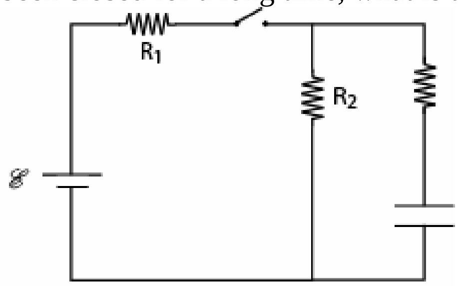

Figure 9

A) 2.3 mA
B) 4.6 mA
C) 11 mA
D) 8.2 mA
E) zero

Q17. A battery has an emf of 12.00 volts. When a current I = 1.00 A flows through the battery, the terminal voltage is 11.99 volts. What is the internal resistance of the battery?

A) 0.01 Ω
B) 2.0 Ω
C) 0.003 Ω
D) 0.02 Ω
E) 8.0 Ω

Q18. A 22-V battery is connected across the terminals *a* and *b* in Fig. 10. If each resistor is 40 Ω, what is the potential drop across the resistor labeled *R*?

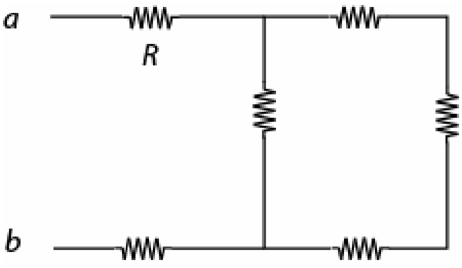

Figure 10

A) 8 V
B) 11 V
C) 14.7 V
D) 12 V
E) 16 V

Q19. The magnetic force on a point charge in a magnetic field is largest for a given speed when it:

A) moves perpendicular to the magnetic field
B) moves in the direction of the magnetic field
C) moves in the direction opposite to the magnetic field
D) has velocity components both parallel to and perpendicular to the field
E) has velocity components both perpendicular and anti-parallel to the filed.

Q20.

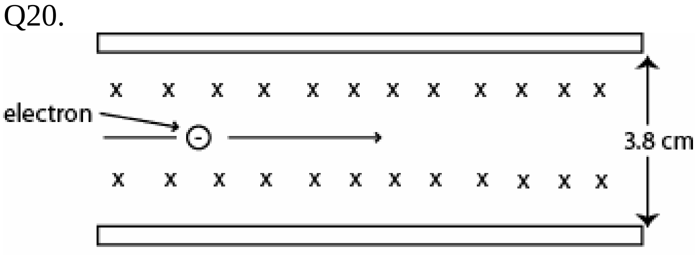

Figure 11

The parallel plates shown in Fig. 11 are 3.8 cm apart. A 0.064-T magnetic field is present in the space between the plates perpendicular to the plane of the paper. When an electron traveling horizontally with a speed of 5.1×10^5 m/s enters the region, it passes through undeflected. The potential difference between the plates is:

A) 1.24 kV

B) 3.14 kV
C) 10.1 kV
D) 14.0 kV
E) zero

Q21. A 62.8-m wire is made into a closely packed solenoid of diameter 1.00 cm. The length of the solenoid is 20.0 cm. What current through the wire will produce a magnetic field of 0.0126 T at its center?

A) 1.00 A
B) 8.21 A
C) 2.31 A
D) 4.21 A
E) 3.11 A

Q22.

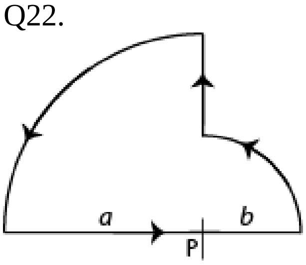

Figure 12

In Fig. 12, two circular arcs having radii *a* =13.5 cm and *b*=10.7 cm carry the same current *i* =0.411 A and share the same center of curvature P. The magnitude of the magnetic field at P is:

A) 1.08×10^{-6} T
B) 8.41×10^{-6} T
C) 2.11×10^{-6} T
D) 9.89×10^{-6} T
E) 1.11×10^{-6} T

Q23. In Fig. 13, two long straight wires are perpendicular to the page. Each carries a current of 25.0 A directed out of the page. In unit vector notation, what is the net magnetic force per unit length on the wire at the origin?

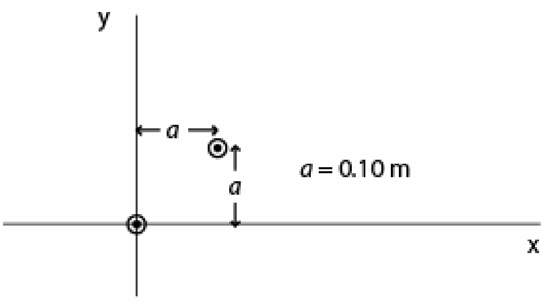

Figure 13

A) 6.25×10^{-4} $(\hat{i} + \hat{j})$ N/m.

B) 1.84×10^{-4} $(\hat{i} - \hat{j})$ N/m.

C) 6.25×10^{-4} $(-\hat{i} - \hat{j})$ N/m.

D) 1.84×10^{-4} $(-\hat{i} - \hat{j})$ N/m.

E) 2.16×10^{-4} $(-\hat{i} + \hat{j})$ N/m.

Q24. Fig. 14 shows the cross section of a long solid wire carrying a uniform current *i*. The radius of the wire is *R*. What is the value of the integral $\oint \vec{B}.d\vec{s}$ over the circular closed path of radius *r* shown in the Figure?

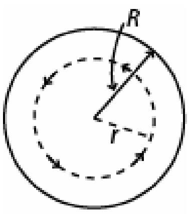

Figure 14

A) $\mu_o i \left(\frac{r}{R}\right)^2$

B) $\mu_o i \, \frac{r}{R^2}$

C) $\mu_o i \, \frac{R}{r}$

D) $\mu_o i \, \frac{R^2}{r}$

E) $\mu_o i$

Q25.

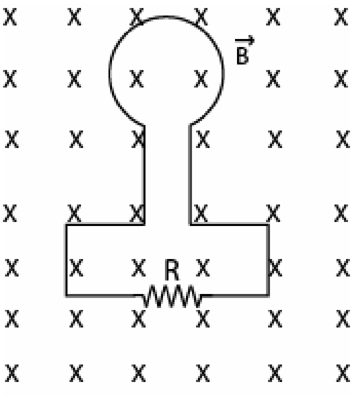

Figure 15

In Fig. 15, the magnetic flux through the loop increases according to the relation $\Phi_B = 2.0\,t^6 + 7$, where Φ_B is $T\cdot m^2$ and *t* in seconds. The magnitude and direction of the current through the resistor $R = 24\ \Omega$ at $t = 1$ s are:

A) 0.50 A, counter clockwise
B) 0.50 A, clockwise
C) 1.5 A, counter clockwise
D) 1.5 A, clockwise
E) 2.8 A, counter clockwise

Q26. A wire of length 1.00 m is formed into a circular loop and placed perpendicular to a uniform magnetic field that is increasing at a constant rate of 20 mT/s. If the resistance of the wire is 100 Ω, at what rate is thermal energy generated in the loop?

A) 2.5×10^{-8} W
B) 8.3×10^{-8} W
C) 3.1×10^{-8} W
D) 0.25×10^{-8} W
E) 12×10^{-8} W

Q27. The wing span (tip to tip) of a Boeing 747 airplane is 59 m. The plane is flying horizontally at a speed of 220 m/s. The vertical component of the earth's magnetic field is 5.0×10^{-5} T. Find the induced emf between the wing tips.

A) 0.65 V
B) 0.032 V
C) 2.5 V
D) 0.12 V
E) 1.8 V

Q28. In Fig. 16, a copper ring passes through a rectangular region where a constant magnetic field is directed into the page. In which position is the induced current through the ring is clockwise?

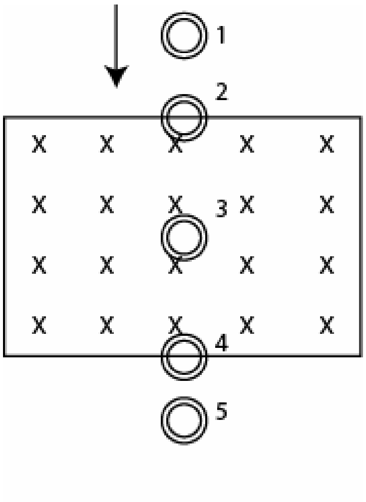

Figure 16

A) 4
B) 2
C) 1
D) 1 and 5
E) 2,3 and 5

Q29. An ion of charge 1.60 x 10^{-19} C has a mass of 1.16 x 10^{-26} kg. It accelerates from rest through a potential of 500 V and enters a magnetic field of 0.400 T, moving perpendicular to the field. What is the radius of its circular path in the magnetic field?

A) 2.13 cm
B) 1.07 cm
C) 4.19 cm
D) 6.20 cm
E) 12.5 cm

Q30. A certain coil of wire consists of 5 circular loops of radius 0.0400 m. It is placed in a region of uniform magnetic field parallel to the plane of the coil. The magnetic field is increasing at the rate of 0.200 T/s. The magnitude of the resulting induced emf is:

A) zero
B) 0.271 V
C) 0.889 V
D) 0.101 V
E) 0.387 V