Week 11 Questions and Answer Key

- Day 1, Review
- Day 2, Test
- Day 3, Differentials, 1-5
- Day 4, 6-10
- Day 5, Review

1. An electron (whose mass is M_e) moves at a speed V. Its momentum is $p = mV$. Find a formula for the approximate change dp in momentum resulting from a small increase dv, in speed.

   $dp = m\ dv$

2. The low-frequency inductance of a single-layer solenoid is approximately $L = kDn^2$, where k is a form factor, D is the diameter in centimeters, and n is the number of turns. Find a formula for the approximate change dl in the inductance resulting from the addition of a small part of a turn dn.

   $dL = 2KDn\ dn$

3. The power in a circuit was $p = t - 5$ watts. What was the approximate energy dw in joules expended from $t = 4$ sec to $t = 4.002$ sec?

   $dp = -2mW$

4. The induced voltage in an 8-henry inductor varied according to $vind = 3t^2 - t$. About how much change di occurred in the inductor current from $t = 2$ sec to $t = 2.01$ sec?

   $di = -12.5mA$

5. The power in a circuit is given by $p = Ri^2$, where $R = 100\Omega$ and i is the current in amperes. If i changes from 12 amps to 12.005 amps, approximately what change dp occurs in power in watts?

   $dp = 12\ watts$

6. The current i amperes in a circuit varied with time t seconds according to $i = t^2 + 3t$. About what current change di occurred as t changed from 0.98 sec to 1 sec?

   $di = 99.2mA$

7. The intensity J of the heat radiation from a transmitting tube plate varies with its absolute temperature according to $J = \sigma T^4$ where σ is a constant and T is the temperature in $°C$. If $J = 50$ units when $T = 1200°C$, approximately what change dJ in J results from a change in T to $1205°C$?

   $dJ = 833.345 \times 10^{-3}$ units

8. If the resistance r ohms in a circuit varies with time t seconds according to $r = 100 + t^{\frac{1}{2}}$, what approximate change dr in r occurs as t changes from 4 sec to 4.001 sec?

   $dr = 250\mu\Omega$

9. A right circular cone used in constructing a broadband antenna has a volume $v = \pi r^2 h$, where r is the radius of the base and h is the altitude of the cone. If $r = 10$ cm, and $h = 24$ cm, what approximate change dv in the volume occurs when r changes to 10.052 cm?

   $dv = 78.414cm^3$

10. An increase in the apparent mass Ma of a moving particle occurs in accord with $Ma = \frac{Mo}{[1-(\frac{V}{C})^2]^{\frac{1}{2}}}$ where Mo is the mass of the particle at reset, V is its speed, and C is the speed of light in a vacuum. What approximate change d_{Ma} occurs in the apparent mass as a result of a small change d_V in the speed of the particle? Express your answer as a formula.

    $dma = \frac{Vmo}{c^2[1-(\frac{v}{c})^2]^{\frac{3}{2}}}\ dv$