

## 0.1 Homework Week 11 - Questions with Answers

- Day 1, Review
  - Day 2, Test - Differentials, Higher Derivatives, & Max-Mins
  - Day 3, Differentials, 1-5
  - Day 4, 6-10
  - Day 5, Limits 1-5
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?  
 $dw = -2mW$
  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?  
 $dp = 12 \text{ watts}$
  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  $\sigma$  is a constant and  $T$  is the temperature in  $^{\circ}C$ . If  $J = 50$  units when  $T = 1200^{\circ}C$ , approximately what change  $dJ$  in  $J$  results from a change in  $T$  to  $1205^{\circ}C$ ?  
 $dJ = 833.345 \times 10^{-3} \text{ units of heat radiation}$

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  $v = \frac{\pi r^2 h}{3}$ , 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?

$$dv = 13.069\text{cm}^3$$

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.

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