Integrals applied

1) $q = \int i\, dt$

2) $v_c = (1/C)\int i\, dt$

3) $w = \int p\, dt$

4) $\Phi = (-1/N) \int v_{ind}\, dt$

5) $i = (-1/L) \int v_{ind}\, dt$

6) $i_1 = (-1/M) \int v_2\, dt$

Kirchoff's Laws Applied:

7) The current Law.

The sum of the currents toward any point in a circuit ant any instant equals zero.

$$i_g = C\, dv/dt + (v/R) - (1/L) \int v\, dt$$

8) The voltage Law.

The sum of the voltage drops around a circuit, at any instant, equals zero.

$$v_g = -L\, di/dt + Ri + (1/C) \int i\, dt$$

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1) The current in a circuit was $i = 4t^3$ amps. How many coulombs were transmitted in 3 seconds?

2) An 80μf capacitor is charged to 100 volts. We then apply a current $i_c = 0.04t^3$ amps in the same polarity as the initial charge. After how many seconds will the capacitor voltage reach 225 volts?

3) The voltage applied to a circuit was $v = 2t + 1$ volts. If the current followed the equation $i = 0.03t$ amperes, find the energy w delivered from $t = 0$ to $t = 50$ seconds.

4) A 110 turn winding carries a flux of 0.8 weber. If we now want to vary the flux so that a voltage $v_{ind} = -5t^2$ volts appears in the winding, what equation must the flux through the winding follow?

5) A DC current of 0.3 ampere flows in a 15 henry inductor. Superimposed on this DC is a varying current such that the voltage $v_{ind} = 120t^{1/3}$ volts appears in the inductor. Find the instantaneous total current when $t = 1$ second (Assume that the DC and AC currents have the same polarity when $t = 1$ second).

6) An inductance of 8 henrys is connected in series with a 12Ω resistor. Apply to this circuit a voltage $v = 20t^2$ volts. If $i = 0$ when $t = 0$, find an equation for i.

7) If we apply a voltage $v = 90t^{1/2}$ to a circuit consisting of a 30 henry inductance shunted by a 50 ohm resistance, what current flows when $t = 4$ seconds? (Let $i = 0$ when $t = 0$).

8) If we apply a voltage $v = 20t^4$ volts across a parallel RL combination, where $R = 500\Omega$ and $L = 40$ henrys, find the total current when $t = 0.2$ seconds. Let $i = 4\mu A$ when $t = 0$.

9) In a parallel RL circuit, $R = 5\Omega$ and $L = 0.2$ henrys. If a voltage $v = t^{3/2} + 2$ volts were applied, what would the current i be when $t = 4$ seconds? Assume $i = 0.4$ amps when $t = 0$.

10) A current $i = 0.005t^{1/2}$ amps flows in a parallel RC circuit where $R = 8.8 \times 10^4\ \Omega$ and $C = 1\mu f$. Find a formula for the voltage across the circuit as a function of time t. Assume the capacitor to be initially discharged.

11) The current function $i = 1 \times 10^{-3}\, t^{1/2}$ amperes is applied to a series *RC* circuit where $R = 8.8 \times 10^{4}\ \Omega$ and $C = 1\ \mu f$. Find a formula for the impressed voltage as a function of time *t*. (Assume the initial capacitor charge to be 100 v.)

12) A series *LC* circuit where $L = 0.1$ henry and $C = 100\ \mu f$ has applied to it a current $i = 0.1A$ from $t = 0$ onward. Find (a) the formula for the voltage across the circuit, and (b) the rate of change of the voltage at $t = 2$ sec. (Assume $V_c = 0$ when $t = 0$).

13) A series circuit has these constants: $R = 5k\Omega$, $L = 200$ henrys, and $C = 20\ \mu f$. If we supply to the circuit a current $i = 0.02t^2$ amperes, at what rate does the voltage across the circuit change when $t = 0.2$ seconds?

14) In a series *RCL* circuit, let $R = 10\Omega$, $C = 10{,}000\mu f$, and $L = 10$ henrys. Through this circuit we pass a current $i = 1 - t^{1/2}$ amps. Find the total voltage *v* across this circuit when $t = 4$ seconds. Assume $v = 0.25$ volts when $t = 1$ second.