Q1:

(1): By Newton's second law, $F = ma$, $a = \frac{F}{m} = \frac{20}{3+8+9+5} = \boxed{0.8}\ m/s^2$.

(2): The tension provides the accelerations for A and B.

Therefore, we have $T = ma = (3+8) \cdot 0.8 = \boxed{8.8}\ N$.

(3): The tension provides the accelerations for A, B and C.

Therefore, we have $T = ma = \boxed{16}\ N$.

Q2:

(1): The tension of the upper spring and the compression of the lower spring balanced the weight of the object. We have

$$mg = k(L-x) + k(L-x)$$

$$x = \boxed{L - \frac{mg}{2k}}$$

(2): Using the reference frame outside the elevator, the object is accelerating with an acceleration a.

Therefore, using the reference frame inside the elevator, the ball is decelerating with a deceleration a to remain stationary, which exert a downward force of ma.

On the other hand, there is a downward force mg, the weight of the object.

The tension balanced the forces, and hence has a magnitude of $\boxed{ma + mg}$.

Q3:

Consider the coefficient of restitution, we have $e = -\frac{V_A - V_B}{2V - (-V)}$,

i.e. $V_B - V_A = 3eV$.

Moreover, by the conservation of momentum, we have

$(3M)(2V) + (M)(-V) = (3M)(V_A) + (M)(V_B)$, i.e. $3V_A + V_B = 5V$.

Solving, we have $V_A = \boxed{\dfrac{5V - 3Ve}{4}}$ and $V_B = \boxed{\dfrac{5V + 9Ve}{4}}$.

Q4:

(1): Consider the heat transfer, we have

$$(300 \cdot 4.2 + 400 \cdot 2.0) \cdot (T - 20) = 200 \cdot 0.90 \cdot (95 - T)$$

$$T = \boxed{26}$$

(2):

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$p_2 = \boxed{1.5 \times 10^5}$$

(3): $W_{outside} = -W_{gas} = -p\Delta V = \boxed{400}\ J$.

(4): By $U = \frac{3}{2}nRT$, $\Delta U = 600R = 4980\ J$.

By the first law of thermodynamics, $W_{gas} = Q - \Delta U = 5020\ J$.

Therefore, $p(V_2 - V_1) = 5020$, i.e. $V_2 \approx \boxed{0.14}\ m^3$.

Q5:

(1): $F_B = \frac{k_c q_D q_B}{(3\sqrt{2})^2} = \boxed{2.0 \times 10^{-3}}\ N$.

(2): As the electric field from q_D at C is in the direction (b) and that from q_B is in the direction (d), consider the vector sum, the resultant electric field is in the direction $\boxed{(c)}$.

Moreover, the magnitudes of the two electric fields are both

$\frac{k(2.0\times10^{-6})}{(3.0)^2} = 2 \times 10^3\ N/C$.

Therefore, the magnitude of the resultant electric field is $\sqrt{2}(2\times10^3) \approx \boxed{2.8 \times 10^3}\ N/C$.

(3): The electric potential due to q_B is equal to that due to q_D, which are both $\frac{k(2.0\times10^{-6})}{3.0} = 6 \times 10^3\ V$.

Therefore, $\phi_C = 2 \times 6 \times 10^3 = \boxed{1.2 \times 10^4}\ V$.

Q6:

(1): When S is opened, the equivalent resistance is $\frac{1}{\frac{1}{R_1}+\frac{1}{R_2}} + R_3 = 2.8\ \Omega$.

By Ohm's law, $V = IR$, $I_3 = I = \frac{E}{R} = \boxed{2.5}\ A$.

(2): $I_2 = \frac{R_1}{R_1+R_2} I = \boxed{0.50}\ A$.

(3): When S is closed, the equivalent resistance is $\frac{1}{\frac{1}{R_1}+\frac{1}{R_2}} + \frac{1}{\frac{1}{R_3}+\frac{1}{R_4}} = 2\ \Omega$.

Similar to (1) and (2), $I = 3.5\ A$ and $I_2 = \boxed{0.70}\ A$.

Q7:

Express y as a function of t and x respectively, we have $T = \boxed{2.0}\ s$ and

$\lambda = \boxed{4.8}\ m$.

Then, $v = \frac{\lambda}{T} = \boxed{2.4}\ m/s$.