Q1:

The gravitational attraction in the direction of the inclined plane

$=mg\sin 30^\circ = 10\ N$.

The normal reaction acting on the two blocks$=mg\cos 30^\circ = 10\sqrt{3}\ N$.

Consider the forces in the direction of the inclined plane (gravitational attraction, friction and tension) acting on each block, we have:

$$\begin{cases} 10-(10\sqrt{3})(0.30)-T=2a \\ 10+T-(10\sqrt{3})(0.10)=2a \end{cases}.$$

Solving, we have $a=5-\sqrt{3}\approx \boxed{3.3}\ m/s^2$ and $|T|=\sqrt{3}\approx \boxed{1.7}\ N$.

Q2:

(1): Considering the coefficient of restitution, we have $-\frac{-v-v}{6.0-0}=1.0$, i.e. $v=\boxed{3.0}\ m/s$.

(2): By the conservation of momentum, we have

$$2.0\cdot 6.0+M\cdot 0.0=2.0\cdot(-3)+M\cdot(3)$$

$$M=\boxed{6.0}$$

(3): $2.0\cdot|-3-6|=\boxed{18}\ N\cdots$

(4): $\frac{1}{2}\cdot 2.0(6^2-3^2)=\boxed{27}\ J$

Q3:

(1): By $pV = nRT$, $n = \frac{pV}{RT} = \frac{3.0\times10^5\cdot0.50}{8.3\cdot300} \approx \boxed{60}\ mol$.

(2): $W = p\Delta V = 3.0\times10^5(0.60-0.50) = \boxed{3.0\times10^4}\ J$.

(3): By $U = \frac{3}{2}pV$, we have $\Delta U = \frac{3}{2}p\Delta V = \boxed{4.5\times10^4}\ J$.

(4): By the first law of thermodynamics, $Q = \Delta U + W_{gas} = \boxed{7.5\times10^4}\ J$.

Q4:

When S is opened, the equivalent resistance is $R_1 + R_2 + R_3$. By Ohm's law, we have $R_1 + R_2 + R_3 = \frac{9.0}{1.5\times10^{-3}} = 6\times10^3$.

When S is switched to a, the equivalent resistance is $R_1 + \frac{R_2}{2} + R_3$. By Ohm's law, we have $R_1 + \frac{R_2}{2} + R_3 = \frac{9.0}{1.8\times10^{-3}} = 5\times10^3$.

When S is switched to b, the equivalent resistance is $R_1 + R_2 + \frac{R_3}{2}$. By Ohm's law, we have $R_1 + R_2 + \frac{R_3}{2} = \frac{9.0}{2.0\times10^{-3}} = 4.5\times10^3$.

Solving, we have $R_1 = \boxed{1}\ k\Omega$, $R_2 = \boxed{2}\ k\Omega$ and $R_3 = \boxed{3}\ k\Omega$.

Q5:

(1): $E = \frac{V}{d} = \frac{5.0\times10^3}{2.0\times10^{-2}} = \boxed{2.5\times10^5}\ N/C$.

(2): $F = qE = 3.0 \times 10^{-13} \cdot 2.5 \times 10^5 = \boxed{7.5 \times 10^{-8}}\ N.$

(3): When the charge has moved by 10 cm, time travelled=$\frac{10\times10^{-2}}{20} = 5\times10^{-3}\ s.$

Then, $Y = vt + \frac{1}{2}at^2 = 0 + \frac{1}{2} \cdot (\frac{7.5\times10^{-8}}{2.5\times10^{-10}}) \cdot (5 \times 10^{-3})^2 = \boxed{3.8 \times 10^{-3}}\ m$

Q6:

(1): By Snells' law, $n_G \sin\theta = n_A \sin\phi$, $n_G = \frac{1.0 \sin 45^\circ}{\sin 30^\circ} \approx \boxed{1.4}$.

(2): By the definition of refractive index, $n_G = \frac{c}{v}$, i.e. $v = \frac{3.0\times10^8}{1.4} \approx \boxed{2.1 \times 10^8}\ m/s.$

(3): By $v = f\lambda$, $\lambda = \frac{v}{f} \approx \boxed{4.2 \times 10^{-7}}\ m.$

(4): $n_G \sin\theta_C = 1.0 \sin 90^\circ$, $\sin\theta_C = \frac{1}{n_G} \approx \boxed{0.71}$.