Q1:

(1): The component of the weight in the direction of the slope

$=mg\sin 30° = 19.6\ N$.

As the body is at rest, the forces are balance, i.e. $T = \boxed{19.6}\ N$.

(2): As calculated in (1), the magnitude of the net force is 19.6 N.

By $F = ma$, the magnitude of the acceleration is $\frac{19.6}{4.0} = \boxed{4.9}\ m/s^2$.

Alternative The acceleration is the gravitational acceleration in the direction of the slope. Therefore, its magnitude is $g\sin 30° = \boxed{4.9}\ m/s^2$.

(3): By $v^2 - u^2 = 2as$, we have $v = \sqrt{2 \cdot 4.9 \cdot 5} = \boxed{7}\ m/s$.

Alternative Set the GPE at the initial height be 0. By the conservation of energy: KE+GPE=KE+GPE, we have

$$0 + 0 = \frac{1}{2}mv^2 - mg(5.0 \cdot \sin 30°)$$

$$v = \sqrt{2 \cdot 9.8 \cdot 2.5} = \boxed{7}$$

Q2:

(1): As the coefficient of restitution is 0.50, we have $-\frac{v_A - v_B}{10-(-4.0)} = 0.5$, i.e. $v_A = v_B - 7$.

By the conservation of momentum, we have $2.0 \cdot 10 + 4.0 \cdot (-4.0) = 2.0v_A + 4.0v_B$, i.e. $v_A = 2 - 2v_B$.

Solving, we have $v_A = \boxed{-4}$ and $v_B = \boxed{3}$.

(2): $(\frac{1}{2} \cdot 2.0 \cdot (10)^2 + \frac{1}{2} \cdot 4.0 \cdot (-4)^2) - (\frac{1}{2} \cdot 2.0 \cdot (-4)^2 + \frac{1}{2} \cdot 4.0 \cdot (3)^2)$

$= \boxed{98}\ J$

Q3:

(1): There is no pressure difference between the confined gas and the atmosphere, i.e. the pressure of the confined gas is $1.0 \times 10^5\ Pa$.

By $pV = nRT$, $V = \frac{nRT}{p} = \frac{0.10 \cdot 8.3 \cdot 300}{1.0 \times 10^5} = \boxed{24.9 \times 10^{-4}}\ m^3$.

(2): The compression of the spring is the force due to the pressure difference ($F = kx = 500 \cdot 0.20 = 100\ N$).

Therefore, $(p - p_0)S = (p - 1.0 \times 10^5) \cdot 1.0 \times 10^{-3} = 100$, i.e. $p = \boxed{2.0 \times 10^5}\ Pa$.

(3):

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$
$$\frac{1.0 \times 10^5 \cdot 24.9 \times 10^{-4}}{300} = \frac{2.0 \times 10^5 \cdot (24.9 \times 10^{-4} + 1.0 \times 10^{-3} \cdot 0.20)}{T_2}$$
$$T_2 \approx \boxed{648}$$

(4): Work done by the atomosphere on the gas

$=1.0 \times 10^5 \cdot (-0.20 \cdot 1.0 \times 10^{-3}) = -20\ J.$

Work done by the spring on the gas$=-\frac{1}{2}kx^2 = -10\ J.$

Therefore, total work done on the gas$=-30\ J$ and the work done by the gas$=\boxed{30}\ J.$

Q4:

(1): Refer to the graph, $\lambda = \boxed{4.0}\ m.$

(2): Refer to the graph, the wave travelled by $\frac{3}{4}$ period after 0.30 s. Therefore, $\frac{3}{4}T = 0.30$, i.e. $T = \boxed{0.40}\ s.$

Moreover, $v = \frac{\lambda}{T} = \boxed{10}\ m/s.$

(3): The amptitude of the wave is 1.0 m. And the medium at $x = 2.0\ m$ has a 0 phase.

$y(t) = A\sin(\frac{2\pi}{T}t - \phi) = \boxed{\sin(5\pi t)}$

Q5:

(1): Let θ be the angle between the electric force due to the charge at $x = -4L$ and the y-axis, we have $\cos\theta = \frac{3}{5}$.

By symmetry, the net eletric force$=2 \cdot k\frac{qQ}{5L^2}\cos\theta = \boxed{\dfrac{6kqQ}{125L^2}}\ N.$

(2): The electric potential due to the charge at $x = -4L$ is $k \cdot \frac{Q}{5L}$.

Similarly for the charge at $x = 4L$.

Therefore, the electric potential= $\boxed{\dfrac{2kQ}{5L}}$.

(3): Similar to (2), the electric potential at B=$\frac{kQ}{4L}$.

The difference in electric potential=$\frac{3kQ}{20L}$.

The difference in electric potential energy=$\frac{3kqQ}{20L}$.

By the conservation of energy, we have

$$\Delta KE = \Delta EPE$$

$$\frac{1}{2}mv^2 = \frac{3kqQ}{20L}$$

$$v = \boxed{\sqrt{\frac{3kqQ}{10mL}}}$$

Q6:

(1): By Ohm's law, $V = IR$, $I = \frac{V}{R} = \frac{1.5}{5.0} = \boxed{0.3}\ A$.

(2): $F = BIL = 3.0 \cdot 0.3 \cdot 0.2 = \boxed{0.18}\ N$.

(3): $\Phi = BA = Blx$.

$\frac{d\Phi}{dt} = Bl \cdot \frac{dx}{dt} = Blv$.

By Faraday's law, $E = \frac{d\Phi}{dt} = 3.0 \cdot 0.20 \cdot 1.5 = \boxed{0.9}\ V$.

(4): The induced EMF is in clockwise direction by Fleming's right hand rule.

Therefore, the equilibrium voltage across the circuit$=1.5 - 0.9 = 0.6\ V$.

By Ohm's law, $V = IR$, $I = \frac{V}{R} = \frac{0.6}{5.0} = \boxed{0.12}\ A$.