A conical pendulum is constructed from a rope of length $l$ and negligible mass, which is suspended from a fixed pivot attached to the ceiling. A small ball of mass $M$ is attached to the lower end of the rope. The ball moves in a circle with constant speed in the horizontal plane, while the rope makes an angle $\theta$ with respect to the vertical, as shown in the diagram. Let $g$ (where $g > 0$) denote the acceleration of gravity.

**a)** Find the tension $T$ in the rope and the period of the motion (that is, how long does it take the ball to make one circle in the horizontal plane?). Explain your plan for solving this problem. Include all graphs or diagrams that you intend to use. Your answer should be expressed in terms of the given variables, $l$, $M$, $\theta$, and $g$ as needed.

**b)** Suppose that a horizontal rope is attached between the ball and a vertical shaft that runs through the pivot, as shown in the diagram. The rope is massless and inextensible, and is pivoted at the vertical shaft so that it can rotate as the ball rotates, all with negligible friction. The horizontal rope has just the right length to be taut when the upper rope is at an angle $\theta$, as shown. When the ball is moving at a constant speed $v_2$, find the tension $T_2$ in the upper rope and the tension $T_3$ in the horizontal rope. You may express your answer in terms of any of the variables $l$, $M$, $\theta$, $g$, and $v_2$ as needed. Explain your plan for solving this problem. Include all graphs or diagrams that you intend to use.