**Name:** _____ **Section:** _____ **Score:** _____**/20**

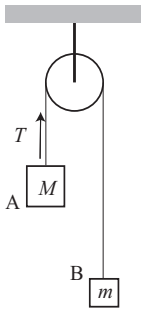
**1**. A cannon and the target are on a horizontal terrain. A cannon ball is shot from the ground to aim at the target which is distance $L$ away from the cannon. The initial velocity of the cannon ball makes 45 degrees from the horizontal, and its initial speed is $V$. You must write your answers in terms of symbols $V$, $L$, and $g$, the acceleration of gravity (you need not use all of them).

(a) What is the speed (in terms of the initial speed $V$) of the cannon ball when it reaches the highest point? [5]

(b) Find the initial speed $V$ required to hit the target. [5]

(**2** on the next page)

**2**. From an ideal pulley (massless and frictionless) hang two blocks A (with mass $M$) and B (with mass $m$) as shown in the figure.



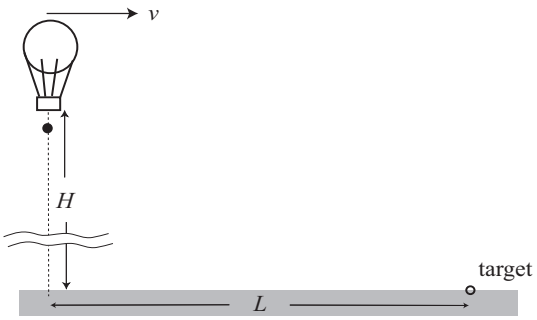

(a) The masses are undergoing an accelerated motion. What is the magnitude of the tension $T$ in the figure? [5]

(b) Suppose $M/m$ is far larger than 1. What is the magnitude of the acceleration of Block B approximately? [5]

**Physics 101 (S11)** **Q4B**

**Name:** _____ **Section:** _____ **Score:** _____**/20**

**1**. A balloon is flying horizontally to the east at a speed $v$ at a height $H$. We wish to throw a ball of mass $m$ from the balloon to the target that is distance $L$ away to the east on the level ground from the point exactly below the balloon as illustrated.

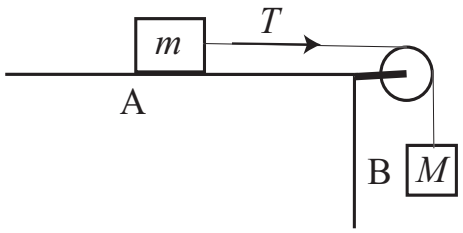



(a) It is calculated that if the ball is gently released (that is, with zero velocity *relative* to the balloon) from the balloon now, it will hit the target. Write the speed $v$ of the balloon in terms of $L$, $H$, $m$, and $g$ (acceleration of gravity); you need not use all of them. [5]

(b) Write the speed of the ball when it hits the target in terms of $v$, $H$ and $g$ (that is, you need not express $v$ as required in (a)]. [5]

(**2** on the next page)

**2**. On a horizontal table is Block A of mass $m$, which is connected to Block B of mass $M$ with a massless flexible string through a frictionless and massless pulley as illustrated below. The coefficient of kinetic friction between the table and Block A is 1/3.



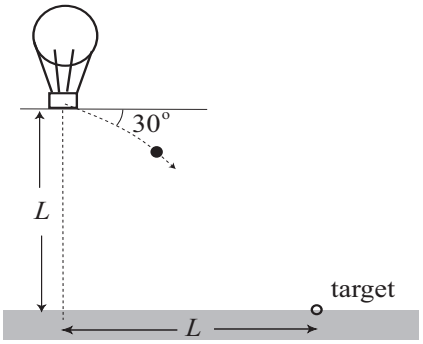

(a) Suppose $M = 2m$. When Block B is gently released, Block A starts to slide on the table. What is the magnitude of the tension $T$ in the string in terms of symbols $m$ and $g$, the acceleration of gravity? [5]

(b) Suppose the mass $M$ of Block B is far larger than that of Block A (i.e, $M/m$ is much larger than 1). What is the estimate of the (magnitude of the) acceleration of Block A? You must justify your answer. [5]

**Physics 101 (S11)** **Q4C**

**Name:** _____ **Section:** _____ **Score:** _____**/20**

**1**. A balloon is stationary relative to the ground at height $L$. We wish to throw a ball of mass $m$ from the balloon to the target that is distance $L$ away on the level ground from the point exactly below the balloon as illustrated.

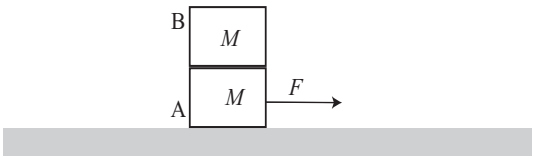



(a) We wish to throw the ball 30 degrees downward from the horizontal (as illustrated). What initial speed $V_0$ do we need to hit the target? Write this $V_0$ in terms of $L$, $g$ (the acceleration of gravity) and $m$ (you need not use all of them). [5]

(b) Write the speed $V$ of the ball when it hits the target in terms of $V_0$, $L$ and $g$ (that is, you need not write $V_0$ in terms of $L$, $g$, etc., as in (a)). [5]

(**2** on the next page)

**2**. On a frictionless horizontal floor is Block A of mass $M$, on which sits Block B of mass $M$ (the same as A). The coefficient of static friction between the two blocks is 2/3.



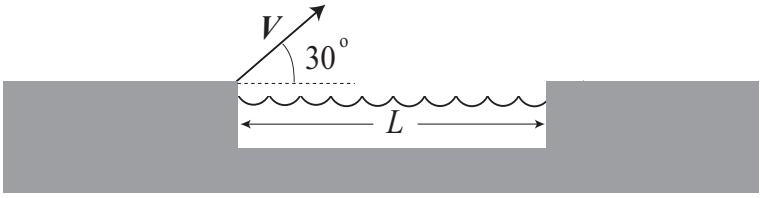

(a) Write down the equation of motion (Newton's second law) for Block A and Block B in the horizontal direction separately, assuming they move together. You may assume that the friction between the two blocks is $f$. Use $a$ for the acceleration of Block A. [Hint: $F$ and $f$ work on Block A in the opposite directions.] [5]

(b) If $f$ exceeds the maximum static friction, Block B will slide off of Block A. Write the maximum magnitude $F_M$ of the force $F$ that allows Block B to stay on Block A in terms of $M$ and $g$ (the acceleration of gravity) (compute the number $F_M/Mg$). [5]

**Physics 101 (S11)** **Q4D**

**Name:** _____ **Section:** _____ **Score:** _____**/20**

**1**. A person wishes to jump across a moat of width $L$ with the initial velocity that makes $30^\circ$ with the horizontal as illustrated below.

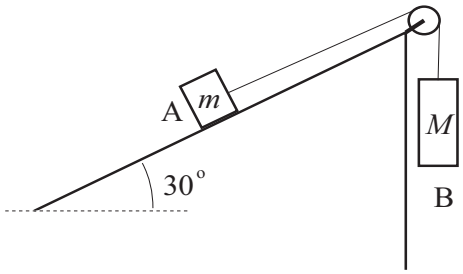



(a) What is the speed of the person at his highest point while crossing the moat in terms of the initial speed $V$?[5]

(b) Write down the minimum initial speed $V$ (the absolute value of the initial velocity) he needs to go beyond the moat in terms of $L$ and $g$, the acceleration of gravity. [5]

(**2** on the next page)

**2**. On a frictionless incline is Block A of mass $m$, to which Block B of mass $M$ is attached with a massless flexible string through a massless frictionless pulley as illustrated below.




(a) Suppose $m = M$. Write down the magnitude of the acceleration of Block B in terms of $g$, the acceleration of gravity. [5]

(b) Suppose $m$ of Block A is much bigger than that of Block B (that is, $m/M$ is much larger than 1). What is the approximate acceleration of Block B? [5]