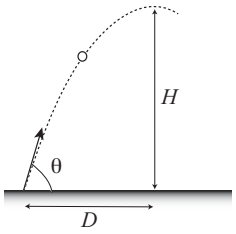
Physics 101 (F11) **Q4A**

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

1. A ball is shot (by a pitching machine) from horizontal ground. It reaches the highest point after 3.2 seconds.



(a) What is the height H of the highest point? [5]

(b) The highest point is exactly above the point which is $D = 100$ m horizontally away from the starting point as in the figure. What is the initial angle θ? [If you are not sure about your answer to (a), find $\tan\theta$ in terms of H and D.] [Hint. Try to obtain the x-component v_x and y-component v_y of the initial velocity in terms of D and H, respectively.] [5]

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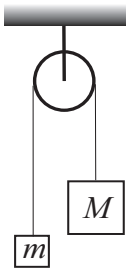
2. Two masses m and M are connected with a massless string and hang from a massless and frictionless pulley as illustrated below.



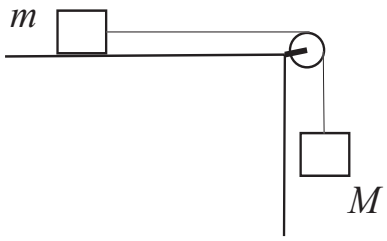
(a) Suppose $m = M/2$. What is the magnitude a of the acceleration of the blocks? Give the value of a/g, where g is the acceleration due to gravity. [5]

(b) Suppose M is much larger than m (say, $M = 10^4 m$). What is the magnitude a of the acceleration of m? [5]

Physics 101 (F11) **Q4B**

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

1. A block of mass m is on a rough and horizontal table with coefficient of kinetic friction $\mu_k = 0.2$ and is connected to another block of mass M via a massless string through a massless and frictionless pulley as shown below.

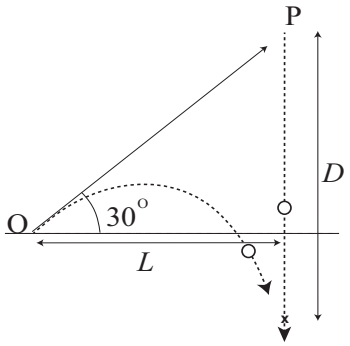


(a) Suppose $m = M/2$. What is the magnitude of the acceleration a of the block of mass m on the table? Give the ratio a/g, where g is the acceleration due to gravity. [5]

(b) Suppose M is much larger than m (say, $M = 10^4 m$). What is the ratio a/g just discussed? You must justify your answer. [2]

(**2** on the next page)

2. At the moment when a ball is gently released from P, you shoot another ball from O aiming at the ball at P. The point P is exactly above the point that is $L = 3$ m horizontally away from you as illustrated. The line connecting O and P makes an angle of 30° with the horizontal.



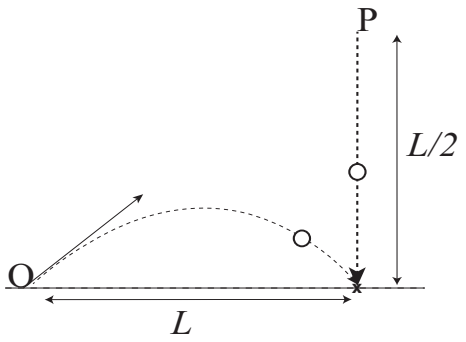
(a) The two balls collide at the cross-mark, which is $D = 4.9$ m below P. Find the initial speed V. [Hint. First, try to calculate the x-component V_x of the initial velocity.] [5]

(b) Suppose you do the same experiment on a planet whose acceleration of gravity is one half that on earth (i.e., $g/2$). To keep the L and D, what is the new initial speed V'? Obtain V'/V. [5]

Physics 101 (F11) **Q4C**

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

1. At the moment when a ball is gently released from P, you throw another ball from O aiming at the ball at P. The point is exactly above the point that is $L = 5$ m horizontally away from you as illustrated. The line, which is the direction of the initial velocity, connecting O and P, makes an angle of 30° with the horizontal.

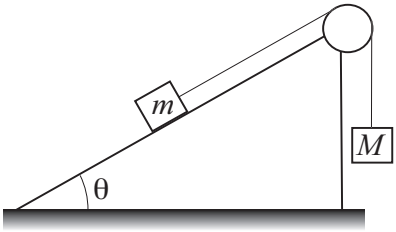


(a) Obtain the x-component of the initial velocity of the ball you throw. [5]

(b) What is the speed of the ball you throw when it hits the other ball? [5]

(**2** on the next page)

2. On a frictionless slope that makes an angle $\theta = 35^\circ$ with the horizontal is a block of mass m, which is connected to another identical block of mass M with a massless string through a massless and frictionless pulley as illustrated below.



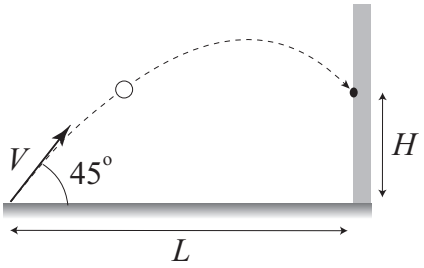
(a) Suppose $m = M$. What is the magnitude of the acceleration of the blocks?[5]

(b) Suppose M is much larger than m (say, $M = 10^4 m$). What is the acceleration of the block of mass m? [5]

Physics 101 (F11) **Q4D**

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

1. We wish to aim at the target on the wall that is $L = 15$ m away at a height of $H = L/2 = 7.5$ m. You throw a ball with an initialvelocity of $\boldsymbol{V} = (V_x, V_y)$.



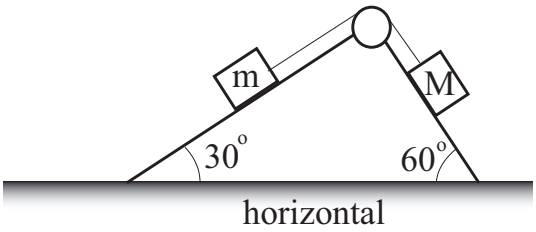
What is the initial speed $V = |\boldsymbol{V}|$? Let us solve this in two parts.

(a) In terms of the x-component V_x of the initial velocity, it takes the ball $t = L/V_x$ to reach the wall. Using this time, write down H in terms of the x-component of the initial velocity V_x ($= V_y$), L and the acceleration due to gravity g. [5]

(b) Obtain V_x and then V. [5]

(**2** on the next page)

2. On frictionless slopes are two blocks of mass M and of mass m as illustrated below. They are connected by a massless cord through a massless and frictionless pulley.



(a) Suppose $m = M$. What is the magnitude of the acceleration of the blocks? [5]

(b) Suppose M is much larger than m (say, $M = 10^4 m$). What is the magnitude of the acceleration of the block of mass m? [5]