Physics 101 (F11) **Q1A**

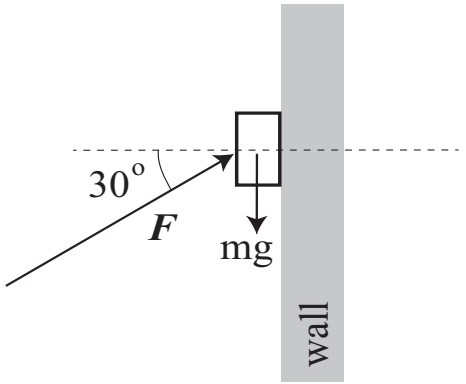
Name: _____ **Section:** _____ **Score:** _____**/20**

1. We wish to go to a town 21 km away within 15 minutes by car. What is the minimum (average) speed in miles per hour we need? (1 mile = 1.6 km) [5]

2. Planet A has radius R and mass M_A, and Planet B has radius $2.3R$ and mass M_B. The weight of mass m on the surface of Planet A is W and that on the surface of Planet B is $1.2W$. What is the ratio M_B/M_A? [5]

(**3** on the next page)

3. A sanding block of mass m is pushed against a vertical wall with a force of magnitude F with an angle 30° from the normal direction of the wall as illustrated below. The block does not move (due to the static friction).



(a) In the above figure already the force $\boldsymbol{F}$ and the gravitational force acting on mass m are drawn. Draw the remaining (two) forces acting on the block to complete the free body diagram in the figure above. (Try to be quantitative, using appropriate lengths of arrows. The vectors already drawn are quantitative.) [5]

(b) Find the magnitude of the friction force in terms of $F = |\boldsymbol{F}|$, m and g. [5]

Physics 101 (F11) **Q1B**

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

1. Proxima Centauri (the closest star to the sun) is 4.24 light-years away from us. How many years does it take a spaceship with a speed 210,000 miles/h (this speed is of the same order of but faster than the speed of our fastest rocket) to reach this star from the earth? 1 lightyear $= 9.5 \times 10^{12}$ km, and 1 mile $= 1.6$ km. [5]

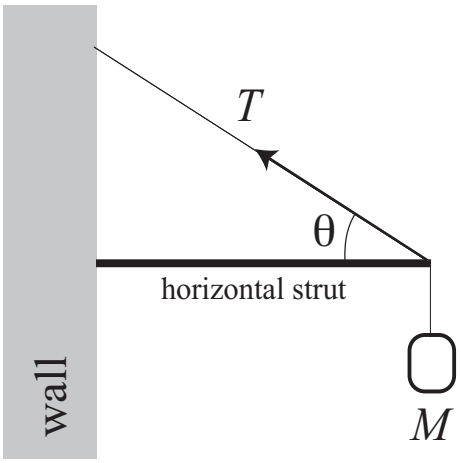
2. From the following relation

$$\frac{m}{m+M} = 0.25$$

find m/M.

(**2** on the next page)

3. A block of mass M is suspended from a horizontal strut with negligible mass. The strut is supported by a cable as illustrated below.



(a) You may assume that the force from the wall on the strut is horizontal. Draw in the figure all the forces (actually, two more forces) acting on the strut. The tension in the string is already drawn.[5]

(b) Find the tension T in the string in terms of M, g and the angle θ. [5]

Physics 101 (F11) **Q1C**

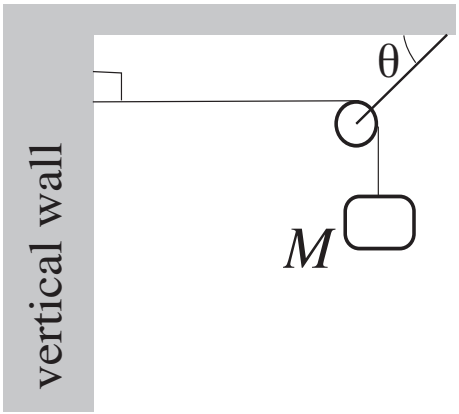
Name: _____ **Section:** _____ **Score:** _____**/20**

1. A snail can crawl at a speed of 0.6 cm/s. How many hours does it take the snail to crawl from one goal to the other goal of the football field (100 yards apart)? 1 yard = 0.914 m. [5]

2. Planet A has radius R_A and mass M, and Planet B has radius R_B and mass $10.5M$. The weight of mass m on the surface of Planet A is W and that on the surface of Planet B is $1.1W$. What is the ratio R_B/R_A? [5]

(**3** on the next page)

3. A massless and frictionless pulley hangs from the ceiling by a rope. A block of mass M is suspended by another rope that passes over the pulley and is attached to the vertical wall. The rope end is fixed to the wall with a right angle.



(a) Draw all the forces acting on the massless pulley in the figure. [5]

(b) What is the angle θ? You must justify your answer. [5]

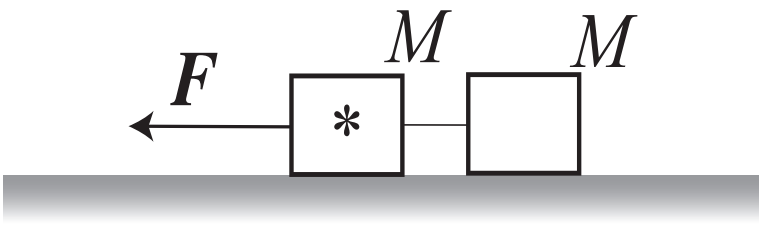
Name: _____ **Section:** _____ **Score:** _____**/20**

1. Suppose we go from Urbana to San Francisco using a hybrid car that can cover 38 km per ℓ. The distance you must drive is 2131 miles. How much does it cost to go from Urbana to San Francisco? Assume that the gas price is \$3.5/gallon. 1 gallon = 3.8 ℓ, and 1 mile = 1.6 km. [5]

2. Let $K = (1/2)I\omega^2$, and $L = I\omega$. What is KI/L^2? [5]

(**3** on the next page)

3. Two identical blocks of mass M are on the horizontal floor. They are connected horizontally by a short string, and the left block is pulled by the horizontal force $\boldsymbol{F}$ to the left. However, due to friction, the blocks do not move. You may assume that the coefficients of static friction between the block and the floor are the same for both the blocks.



(a) Draw all the forces acting on the block with $*$. [5]

(b) What is the magnitude of the friction force acting on the block with $*$? [5]