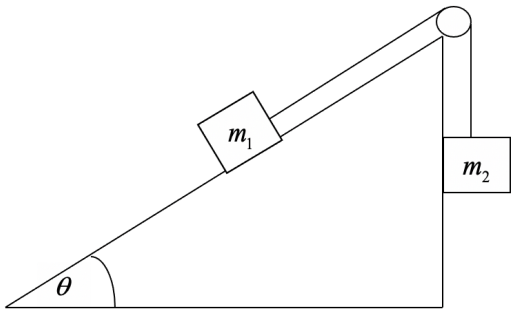
Question 13

A particle of mass m_1 kg is on a smooth plane, inclined at an angle of θ to the horizontal. It is connected by a light string which passes around a smooth pulley to another mass of m_2 kg hanging vertically, as shown in the diagram.



Which of the following is **false?**

A. The tension in the string is equal to $\dfrac{m_1 m_2\left(1+\sin(\theta)\right)}{m_1+m_2}$ kg-wt.

B. If $m_2 > m_1\sin(\theta)$ the mass m_2 moves downwards with an acceleration $\dfrac{g\left(m_2 - m_1\sin(\theta)\right)}{m_1+m_2}$ ms^{-2}.

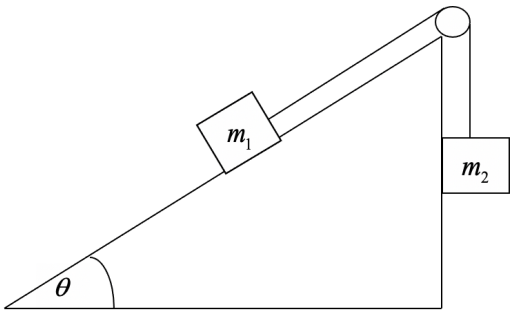
C. If $m_2 = m_1\sin(\theta)$ the masses remain at rest.

D. If $m_2 = 2m_1$ and $\theta = 30^0$ the tension in the string is $\dfrac{g}{2}$ newtons.

E. If $m_2 = 2m_1$ and $\theta = 30^0$ the mass m_2 moves downwards with an acceleration $\dfrac{g}{2}$ ms^{-2}.

ANSWER D

See next page . . .



resolving up parallel to plane around the m_1 kg mass $(1)\ \ T - m_1 g\sin(\theta) = m_1 a$

resolving downwards around the m_2 kg mass $(2)\ \ m_2 g - T = m_2 a$

adding to eliminate the tension in the string, to find the acceleration *a*, of the system

$(1)+(2)\ \ m_2 g - m_1 g\sin(\theta) = m_1 a + m_2 a \ \Rightarrow\ a = \dfrac{g\left(m_2 - m_1\sin(\theta)\right)}{m_1 + m_2}$

$a > 0$ when $m_2 > m_1\sin(\theta)$ and $a = 0$ when $m_2 = m_1\sin(\theta)$

B. and **C**. are correct.

$(1)\times m_2\ \ Tm_2 - m_1 m_2 g\sin(\theta) = m_1 m_2 a$

$(2)\times m_1\ \ m_2 m_1 g - Tm_1 = m_1 m_2 a$ subtracting to eliminate the acceleration, gives

the tension in the string is equal to $\dfrac{m_1 m_2 g\left(1+\sin(\theta)\right)}{m_1 + m_2}$ newtons or $\dfrac{m_1 m_2\left(1+\sin(\theta)\right)}{m_1 + m_2}$ kg-wt.

A. is correct.

When $m_2 = 2m_1$ and $\theta = 30^0$, $T = \dfrac{m_1 \times 2m_1 g\left(1+\dfrac{1}{2}\right)}{m_1 + 2m_1} = m_1 g$ newtons. **D.** is incorrect

When $m_2 = 2m_1$ and $\theta = 30^0$, $a = \dfrac{g\left(2m_1 - \dfrac{m_1}{2}\right)}{m_1 + 2m_1} = \dfrac{g}{2}\ \text{ms}^{-2}$ **E.** is correct

