Quiz 4

Name: _____ Student Number: _____

CALCULATORS ALLOWED.

1. (3 marks) A grandfather clock ticks 1 sec on Earth. It is then moved to Mars where the acceleration due to gravity is ½ that on the Earth. What is the period of the clock on Mars?

$$T = 2\pi\sqrt{\frac{l}{g}}$$

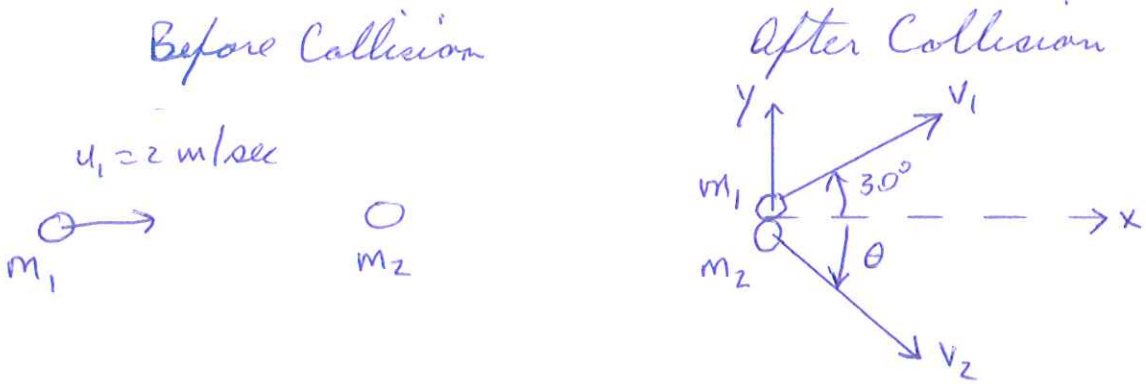
$$T_{Mars} = 2\pi\sqrt{\frac{l}{g_{Mars}}}$$

$$= 2\pi\sqrt{\frac{l}{0.5\,g_{Earth}}}$$

$$= \sqrt{2}\,T_{Earth}$$

$$\therefore T_{Mars} = 1.41 \text{ sec}.$$

2. (3 marks) Consider the elastic collision shown below. Find three independent equations for the unknown final velocities. Explain where each equation comes from. (Note you are not asked to solve the equations!)



Cons. of Mom.

$\hat{x}$: $m_1 u_1 = m_1 V_1 \cos 30° + m_2 V_2 \cos\theta$ (1)

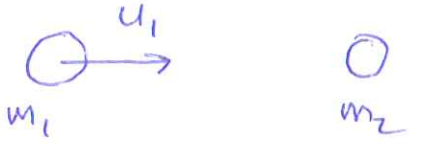
$\hat{y}$: $m_1 V_1 \sin 30° = m_2 V_2 \sin\theta$ (2)

Cons. of Energy.

$$\frac{1}{2} m_1 u_1^2 = \frac{1}{2} m_1 V_1^2 + \frac{1}{2} m_2 V_2^2 \quad (3)$$

3. (4 marks) Consider the collision below.

Before Collision



After Collision

a) What is the ratio of the masses?

Cons. of Mom. $\Rightarrow$ $m_1 u_1 = -\frac{m_1 u_1}{2} + \frac{m_2 u_1}{4}$.

$$\frac{3}{2} m_1 = \frac{m_2}{4}$$

$$\therefore m_2 = 6 m_1$$

b) Is the reaction elastic? If not, what happened to the energy?

Initial K.E. $= \frac{1}{2} m_1 u_1^2$

Final K.E. $= \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$

$$= \frac{1}{2} m_1 \left(\frac{u_1}{2}\right)^2 + \frac{1}{2} 6 m_1 \left(\frac{u_1}{4}\right)^2$$

$$= \frac{1}{2} m_1 u_1^2 \left[\frac{1}{4} + 6 \cdot \frac{1}{16}\right]$$

$$= \frac{5}{18} \text{ Initial K.E.}$$

$\therefore$ Inelastic Collision $\Rightarrow$ Initial K.E. $\Rightarrow$ Noise, heat.