

Lab Test - Energy & Momentum

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 SKILLS: 11.5/14

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Part A: Multiple Choice (1 mark each for a total of 4 marks)

Select the **most correct** response to the following questions.

Questions 1, 2 and 3 refer to the following situation:

A dynamics cart of mass M moving at a speed of v hits a stationary cart of mass m .

$P = MV$

$P_s = m_1 v_1 + m_2 v_2 = m_1 v_1$

$m_1 v_1 + m_2 v_2 = m_1 v_1 + m_2 v_2$

1. If $M > m$ then the most likely velocity of the first cart after the collision is:

- a) $-v$ b) v c) $-\frac{1}{2}v$ **d) $\frac{1}{2}v$** e) 0

2. If $M = m$ then the most likely velocity of the first cart after the collision is:

- a) $-v$ b) v c) $-\frac{1}{2}v$ d) $\frac{1}{2}v$ **e) 0**

3. If $M < m$ then the most likely velocity of the first cart after the collision is:

- a) $-v$ b) v **c) $-\frac{1}{2}v$** d) $\frac{1}{2}v$ e) 0

4. A moving curling stone, A, collides head on with a stationary stone, B. Both stones are of identical mass. If friction is negligible during this linear elastic collision,

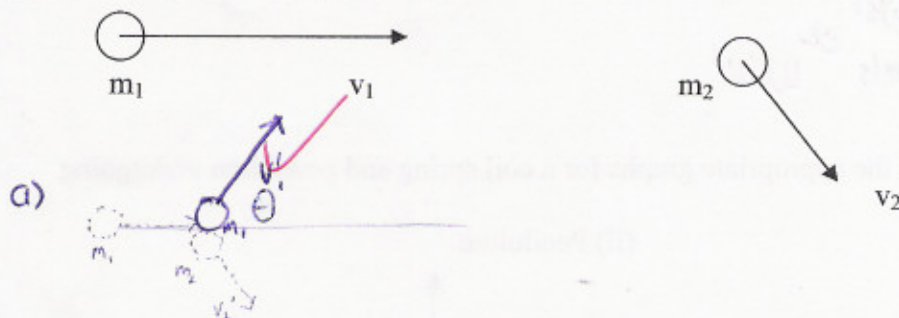
- a) Stone A will slow down
 b) After the collision, the momentum of stone B will be less than that of stone A
 c) Both stones will come to rest shortly after the collision
 d) After the collision, the kinetic energy of the stone B will be less than that of stone A
e) After the collision, stone A will have a speed of zero

Part B: Data Analysis (10 marks)

The following questions can be answered directly on this sheet.

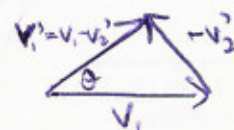
1. A glancing collision occurs between two balls of equal mass, and m_2 initially at rest. Assume the collision is **elastic**.

- a) Sketch the path of the incident ball after the collision. (1 mark)
 b) Give a mathematical proof of your sketch. (4 marks)

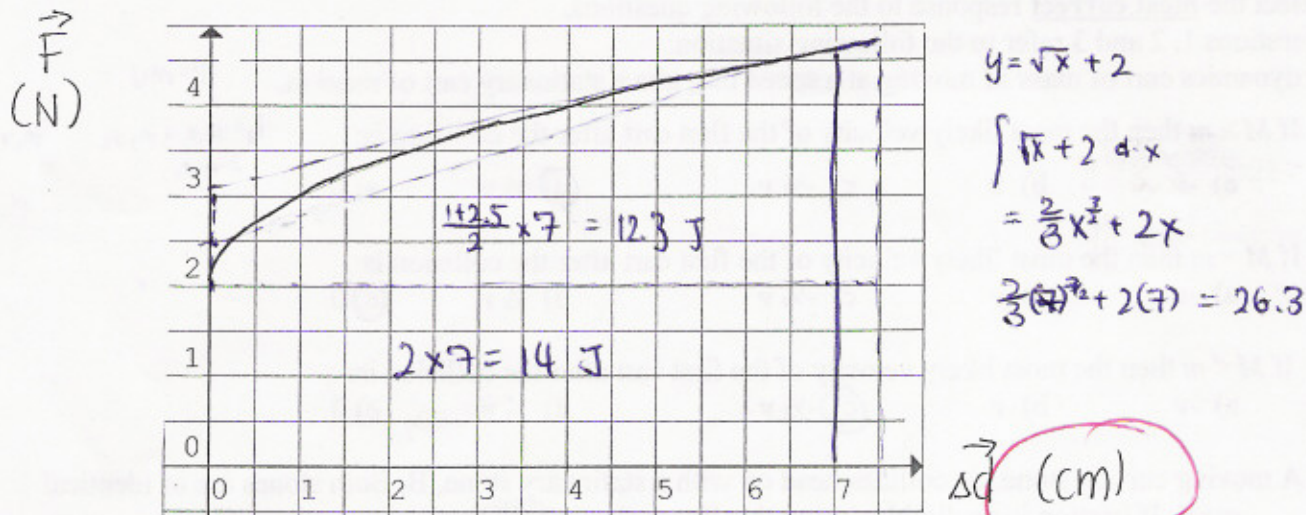


b) $P_{before} = m_1 v_1 + m_2 v_2$
 Since $v_2 = 0$,
 $P_{before} = m_1 v_1$
 $P_{after} = m_1 v_1' + m_2 v_2'$

$P_{before} = P_{after}$
 $m_1 v_1 = m_1 v_1' + m_2 v_2'$
 $v_1 = v_1' + v_2'$
 $v_1' = v_1 - v_2'$



2. The following graph was produced by Sil Vester during his Work & Kinetic Energy lab. Answer the following questions based on his Force-Displacement graph:



(a) How much work did Sil do in setting the mousetrap? (3 marks)

2.5

Area under the graph:

$$2 \times 7 + \frac{14.5}{2} \times 7$$

$$= 14 + 12.3$$

$$= 26.3 \text{ J}$$

∴ Sil did approximately 26 J of work. 0.26 J

(b) Find the maximum speed attained by a 30 g mouse using the mousetrap as a catapult. (2 marks)

2

$$E_k = \frac{1}{2}mv^2$$

$$26.3 = \frac{1}{2}(0.03)v^2$$

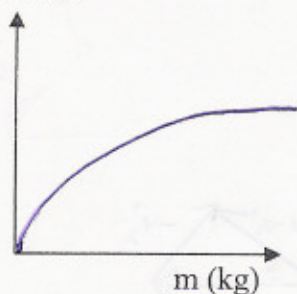
$$v = 41.9 \text{ m/s}$$

ok wow!

BONUS: For 2 marks – Sketch the appropriate graphs for a coil spring and pendulum undergoing SHM.

(i) Coil Spring

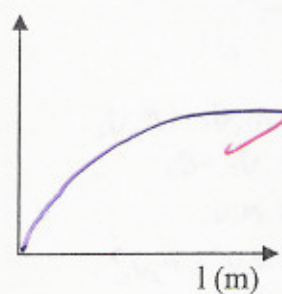
1.2



$T \propto \sqrt{m}$

(ii) Pendulum

T (s)



$T \propto \sqrt{l}$