ACADEMIC DISHONESTY POLICY

Academic honesty is one of the foundations of the educational mission and Catholic commitment of this University. Academic dishonesty, including such practices as cheating, plagiarism and fabrication, undermines the learning experience, and, as it involves fraud and deceit, is corrosive of the intellectual principles and is inconsistent with the ethical standards of this University. Academic dishonesty damages the sense of trust and community among students, faculty and administrators.

Types of Academic Dishonesty

Plagiarism is the act of presenting the work or methodology of another as if it were one's own. It includes quoting, paraphrasing, summarizing or utilizing the published work of others without proper acknowledgment, and, where appropriate, quotation marks. Improper use of one's own work is the unauthorized act of submitting work for a course that includes work done for previous courses and/or projects as though the work in question were newly done for the present course/project. Fabrication is the act of artificially contriving or making up material, data or other information and submitting this as fact. Cheating is the act of deceiving, which includes such acts as receiving or communicating or receiving information from another during an examination, looking at another's examination (during the exam), using notes when prohibited during examinations, using electronic equipment to receive or communicate information during examinations, using any unauthorized electronic equipment during examinations, obtaining information about the questions or answers for an examination prior to the administering of the examination or whatever else is deemed contrary to the rules of fairness, including special rules designated by the professor in the course.

By Signing below, I verify that I have taken this test honestly and have neither cheated nor helped anyone else cheat; this is a mark of academic integrity.

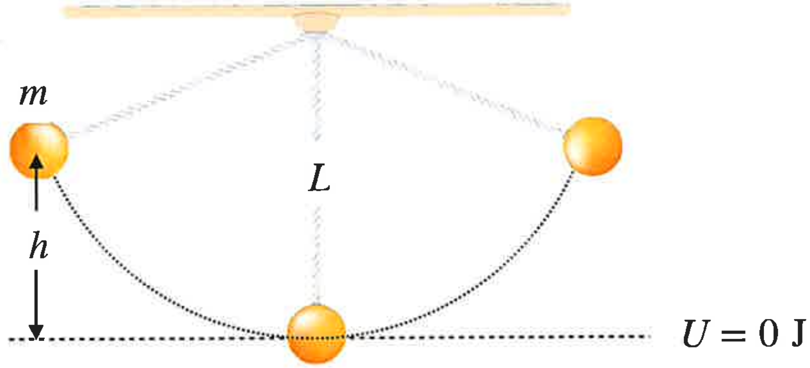
Student Name (Please Print): CARLOS YERO (SOLUTIONS)

Student Signature: ____________________ Date: Apr 10, 2025

Student ID #: ____________________ Course Title/Number: PHYS 101

1	2	3	4	5	TOTAL
15	15	20	20	10	80

1) **(15 pts)** A pendulum of mass $m = 1$ kg and length $L = 1$ m is released from *rest* at a height of $h = 0.75$ m (*hint*: think of K.E. + P.E. at each point)



(a) **(5 pts)** calculate is the *total energy* of the pendulum right before it is released from *rest*

$E = U = mgh = (1\text{kg}) \cdot (10\,\text{m/s}^2) \cdot (0.75\text{ m})$

$\Rightarrow \boxed{U = 7.5\text{ J}} = E$ (total energy is only potential)

(b) **(5 pts)** calculate the *potential* and *kinetic* energy of the pendulum at its lowest point

$\boxed{U = mgh = 0\text{ J}}$ (since $h = 0$ at lowest point)

$E = K = \frac{1}{2}mv^2 \Rightarrow$ total energy has been converted to K.E

$\Rightarrow E = \cancel{U}^{\,0} + K \rightarrow \boxed{K = 7.5\text{ J}}$

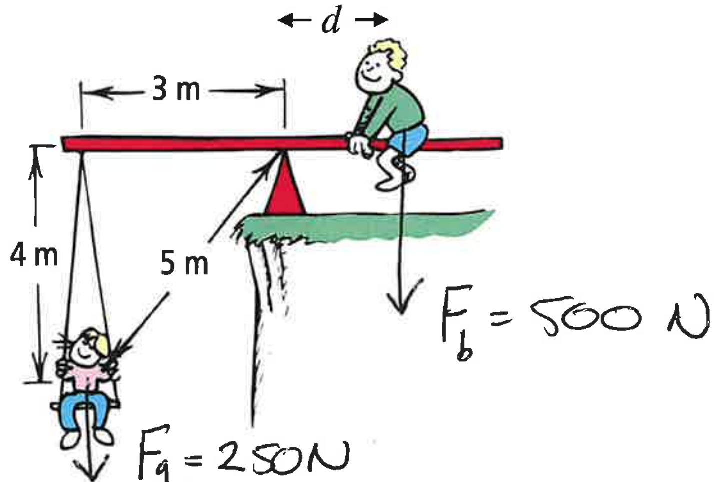
* Apply energy conservation

(c) **(5 pts)** calculate is the *speed* of the pendulum at its lowest point ?

$K = \frac{1}{2}mv^2 \rightarrow v^2 = \sqrt{\frac{2K}{m}}$

$v = \sqrt{\frac{2 \cdot 7.5\text{ J}}{1\text{ kg}}} \rightarrow \boxed{v \cong 3.79\text{ m/s}}$

2) **(15 pts)** A girl of weight 250 N and her brother of weight 500 N sit in a seesaw at *equilibrium*.



(a) **(5 pts)** find the numerical value of the torque exerted by the girl (τ_1)

$\tau_g = 250\ N \cdot 3m \rightarrow \boxed{\tau_g = 750\ N \cdot m}$

(b) **(5 pts)** find an expression for the torque exerted by the brother (τ_2)

$\boxed{\tau_2 = 500\ N \cdot d}$

(c) **(5 pts)** calculate the distance *d* from the axis of rotation her brother must be to maintain *equilibrium*

At equilibrium, all torques <u>must</u> balance out

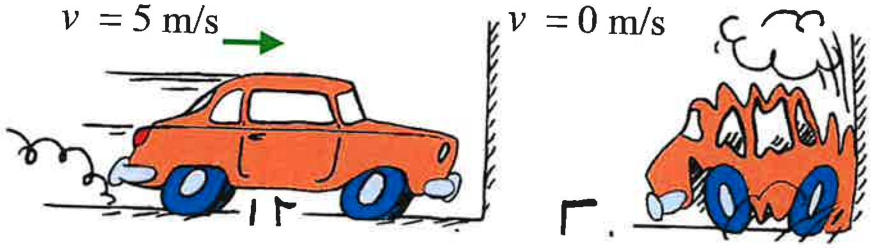
$\tau_1 = \tau_2 \rightarrow 750\ N \cdot m = 500N \cdot d$

$\rightarrow d = \dfrac{750\ \cancel{N} \cdot m}{500\ \cancel{N}} \Rightarrow \boxed{d = 1.5\ m}$

3) **(20 pts)** A vehicle of mass $m = 2000$ kg moving at a speed of $v = 5$ m/s collides with a wall for a brief period of time $\Delta t = 1$ s before coming to a halt

$m = 2000$ kg
$v = 5$ m/s

$m = 2000$ kg
$v = 0$ m/s



(a) **(5 pts)** calculate the *change in momentum* of the vehicle

$\Delta P = m \cdot v_f - m v_i = 0 - (2000 \text{ kg})(5 \text{ m/s})$

$\boxed{\Delta P = -10{,}000 \text{ kg} \cdot \text{m/s}}$

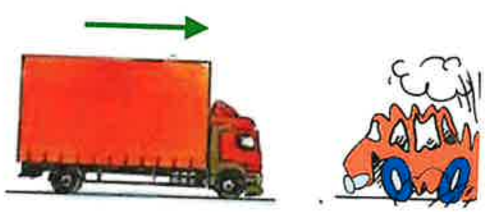
(b) **(5 pts)** calculate the *force* of impact during the collision

$F \Delta t = \Delta(mv) = \Delta P \rightarrow F = \frac{\Delta P}{\Delta t} = -\frac{10{,}000}{1 \text{s}} \Rightarrow \boxed{F = -10{,}000 \text{N}}$

(c) **(10 pts)** if an incoming truck of mass $M = 10{,}000$ kg moving at speed $V = 10$ m/s collides with the *stationary* car and both continue to move together, calculate the final speed of the (*car+truck*) system.

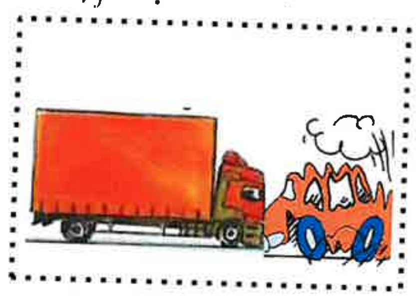
$M = 10{,}000$ kg
$V = 10$ m/s

$m = 2000$ kg
$v = 0$ m/s



before collision

$V_f = ?$



after collision

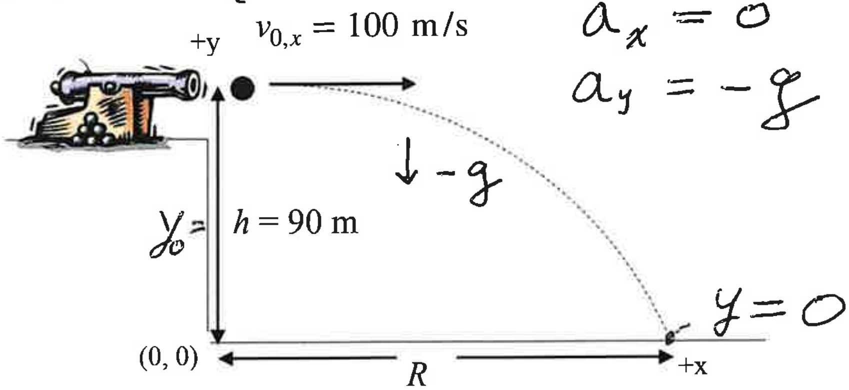
Momentum conservation $\Rightarrow$ $P_{before} = MV$ $P_{after} = (M+m)V_f$

$\hookrightarrow$ $P_{before} = P_{after}$

$MV = (M+m)V_f \rightarrow V_f = \frac{MV}{M+m} = \frac{(10{,}000)(10)}{12{,}000}$

$\boxed{V_f = 8.3 \text{ m/s}}$

4) **(20 pts)** A cannon ball is shot from a 90-m height with initial speed 100 m/s and covers a range *R*.



$a_x = 0$

$a_y = -g \; (-10\ m/s^2)$

(a) **(5 pts)** *how long* (time) does it take the cannonball to hit the ground ?

$y = y_0 + v_{0y} \cdot t + \frac{1}{2} \cdot a_y \cdot t^2 \rightarrow v_{0y} = 0,\ a_y = -g$

$y = 0$ (cannon ball at ground)

$y = y_0 - \frac{1}{2} g t^2 \longrightarrow t = \sqrt{\frac{2y_0}{g}} = \sqrt{\frac{2(90\,m)}{10}}$

$\Rightarrow \boxed{t = 4.24\ s}$

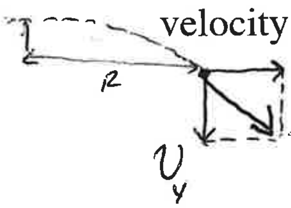
(b) **(5 pts)** calculate the *horizontal range R* the cannonball covers

$x = x_0 + v_{0x} \cdot t + \frac{1}{2} a_x t^2$, $a_x = 0$, define $R \equiv x - x_0$

$R = v_{0x} \cdot t = (100\ m/s)(4.24\ s)$

$\boxed{R = 424\ m}$

(c) **(5 pts)** calculate the *vertical* and *horizontal* component (v_y, v_x) of the velocity of the cannonball right before it hits the ground



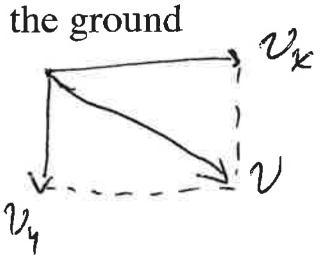
$v = \sqrt{v_x^2 + v_y^2}$,

$\boxed{v_x = v_{0x} = 100\ m/s}$

$v_y = -gt = -10\ m/s^2 \cdot 4.24\ s$

$\boxed{v_y = -42.4\ m/s}$

(d) **(5 pts)** calculate the final speed of the cannonball right before it hits the ground



$v = \sqrt{v_x^2 + v_y^2}$ (Use Pythagorean Theorem)

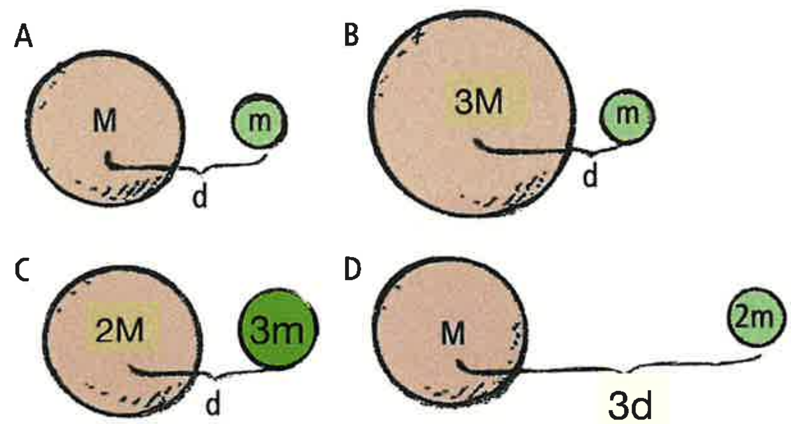
$= \sqrt{(100)^2 + (-42.4)^2}$

$\boxed{v = 108.6\ m/s}$

5) **(10 pts)** A planet and its moon gravitationally attract each other. For each of the figures below:

general formula

$$F_g = G\frac{Mm}{d^2}$$



(a) **(8 pts)** **calculate** the general expression for the force of attraction between each pair

A: $\boxed{F_g = G\frac{Mm}{d^2}}$

B: $\boxed{F_g = 3G\frac{Mm}{d^2}}$

C: $F_g = G\frac{(2M)(3m)}{d^2}$

$\boxed{F_g = 6G\frac{Mm}{d^2}}$

D: $F_g = G\frac{M(2m)}{(3d)^2}$

$\boxed{F_g = \frac{2}{9}G\frac{Mm}{d^2}}$

(b) **(2 pts)** **rank** the forces from greater to least

C	B	A	D
greatest			least