KEY - VERSION #1

25 min to Key

First Name:_____ Last Name:_____

Physics 30 – Momentum – Unit Test

Part 1: Momentum and Impulse ___ / 8 * 1.25 = ___ / 10

Part 2: Collisions in 1-Dimension and 2-Dimensions ___ / 8

IMPORTANT:

- Show work for *MULTIPLE CHOICE* questions for a possible part mark.
- Show work for *NUMERIC RESPONSE* questions to get the full 2 or 3 marks.

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Part 1: Momentum and Impulse – 8 marks

Q1: Which of the following statements ***best*** describes an isolated system?
(MULTIPLE CHOICE – 1 mark)

a) No external forces act on an isolated system
b) Only gravitational forces act on an isolated system
c) Momentum is always conserved in an isolated system
d) Kinetic energy is always conserved in an isolated system

Use the following information to answer questions Q2 and Q3:

> As a child catches a ball, he exerts a force , *F*, on the moving ball for a time interval, Δt. The mass of the ball is 250g and its velocity changes from +5.00 m/s to +1.00 m/s as a result of the force.

Q2: The magnitude of the impulse that the child applies to the ball is:
(MULTIPLE CHOICE – 1 mark)

a) 1.00 Ns
b) 1.25 Ns
c) 2.50×10^2 Ns
d) 1.00×10^3 Ns

$\vec{F}\Delta t = m\Delta\vec{v}$

$\vec{F}(\Delta t) = (0.250\,kg)(4\,m/s)$

$= 1\ N \cdot s$

Q3: If, when catching the ball, the child had applied triple the force, then the length of time that it would have taken to slow the ball would have been:
(MULTIPLE CHOICE – 1 mark)

a) $9\Delta t$
b) $3\Delta t$
c) $\frac{1}{3}\Delta t$
d) $\frac{1}{9}\Delta t$

$F\Delta t = 1\ N \cdot s$

$(3F)(\frac{1}{3}\Delta t) = 1\ N \cdot s$

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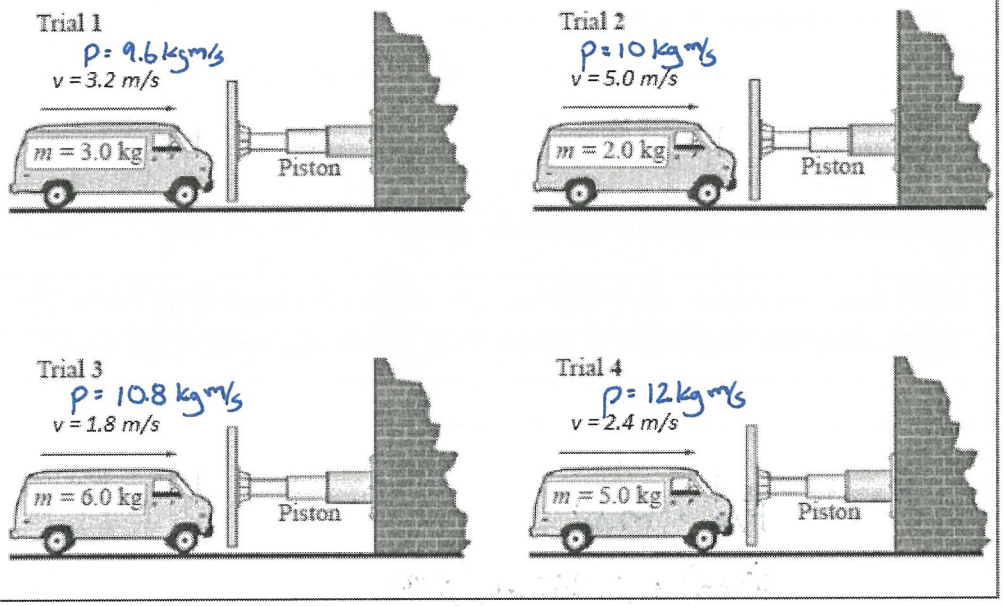
Use the following information to answer question Q4.

A student performs an experiment to investigate the time required to stop a toy van. In each of four trials, the student varies the speed and mass of the van. The toy van is brought to rest by a piston that applies a uniform force that is the same for each trial.



Q4: When the trials above are listed in order from the trial that has the longest stopping time to the trial that has the shortest stopping time, the order is

4 , 3 , 2 , 1

LONGEST *SHORTEST*

(Record all **four digits** of your answer in the numerical-response section below)

(NUMERIC RESPONSE – 2 marks)

4	3	2	1

$F\Delta t = m\Delta v$

When $m\Delta v$ is larger, Δt must be larger.

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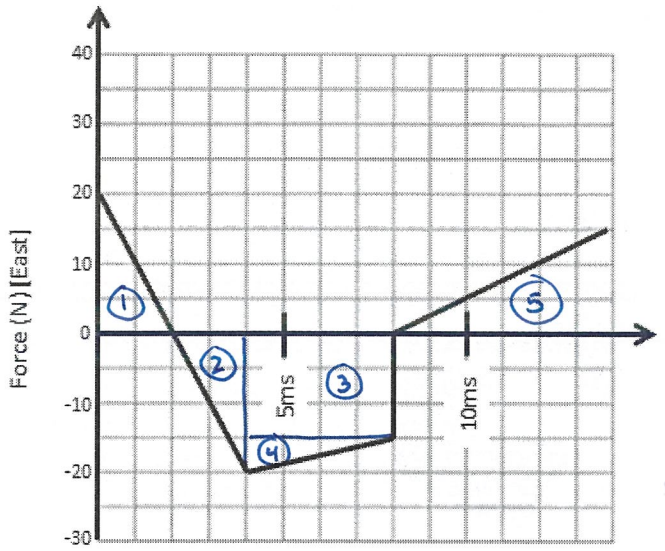
Use the following Force-Time graph to answer question Q5.



$\Delta 1 = \frac{1}{2}(20)(2\times10^{-3}) = +0.02$
$\Delta 2 = \frac{1}{2}(-20)(2\times10^{-3}) = -0.02$
$\square 3 = (-15)(4\times10^{-3}) = -0.06$
$\Delta 4 = \frac{1}{2}(-5)(4\times10^{-3}) = -0.01$
$\Delta 5 = \frac{1}{2}(15)(6\times10^{-3}) = +0.045$
$-0.025\ N\cdot s$

$\vec{F}\Delta t = -0.025\ N\cdot s\ [E]$
$= 2.5\times10^{-2}\ N\cdot s\ [W]$

Q5: What is the magnitude of the impulse acting on this object?
(MULTIPLE CHOICE – 1 mark)

a) - 20 Ns [E]
b) 5 Ns [W]
c) 1.15×10^{-1} Ns [E]
d) 2.50×10^{-2} Ns [W]

Use the following information to answer question Q6.

> A particular supertanker is fully loaded with oil and has a mass of 1.00×10^{9} kg. The supertanker has a cruising speed of 20km/h. One way to stop the ship is to reverse its engines. At maximum reverse thrust, the ship takes 32.0 min to stop.

Q6: The momentum of the supertanker at cruising speed, expressed in scientific notation, is ***b*** x 10^{w} kg*m/s. The value of ***b*** is 5.56.

(Record your **three-digit answer** in the numerical-response section below)
(NUMERIC RESPONSE – 2 marks)

5	.	5	6

$\frac{20\ km}{h} \div 3.6 = 5.\bar{5}\ m/s$

$\vec{p} = m\vec{v}$
$= (1.00\times10^{9}\ kg)(5.\bar{5}\ m/s)$
$= 5.555\times10^{9}\ kg\ m/s$
$= 5.56\times10^{9}\ kg\ m/s$

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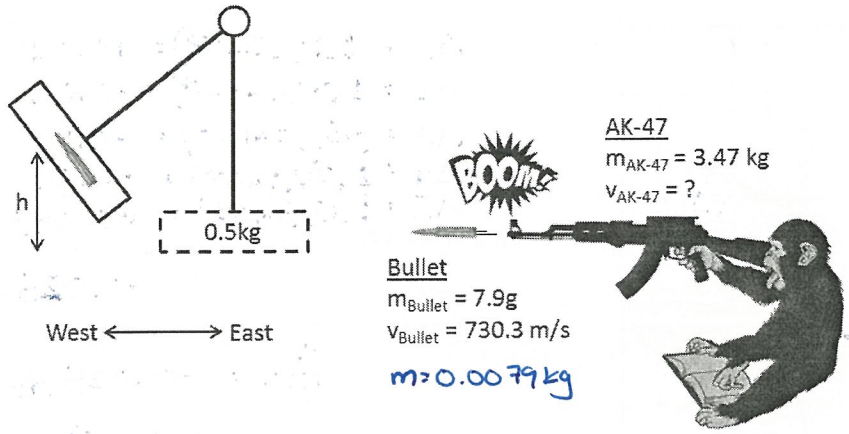
Part 2: Collisions in 1-Dimension and 2-Dimensions – 8 marks

Use the following diagram of an AK-47 assault rifle firing a bullet into a ballistic pendulum to answer questions Q7, Q8, and Q9.



Q7: The AK-47 recoils backward at what speed? *(NUMERIC RESPONSE - 2 marks)*

1	.	6	6

$P_i = P_f$

$0 = (0.0079\,kg)(730.3\,m/s) + (3.47kg)v_{AK-47}$

$v_{AK-47} = 1.662642651\,3\,m/s$

Q8: The bullet embeds itself into the 0.5kg block. At the moment of impact, momentum is _*i*__ and kinetic energy is _***ii***__. *(MULTIPLE CHOICE – 1 mark)*

	i	*ii*
A	Conserved	Conserved
B	Conserved	Not Conserved
X	Not Conserved	Conserved
X	Not Conserved	Not Conserved

a) A b) B c) C d) D

$P_i = P_f$

$(0.0079kg)(730.3m/s) = (0.5079kg)v_f$

$5.76937\,kg\,m/s = (0.5079\,kg)v_f$

$v_f = 11.359263636\,46\,m/s$

$E_{K_i} = \frac{1}{2}mv^2$

$= \frac{1}{2}(0.0079kg)(730.3m/s)^2$

$= 2106.6854555\,J$

$E_{K_f} = \frac{1}{2}mv^2$

$= \frac{1}{2}(0.5079kg)(11.359263636\,46\,m/s)^2$

$= 32.767897417\,8\,J$

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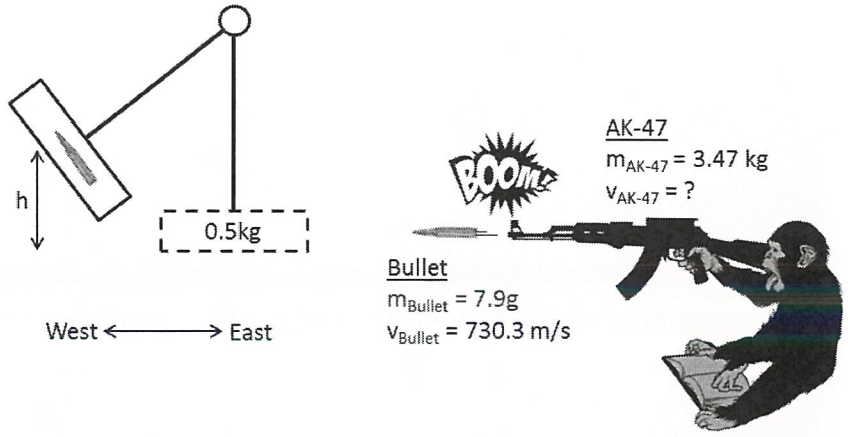
Use the following diagram of an AK-47 assault rifle firing a bullet into a ballistic pendulum to answer questions 1-3.



Q9: After impact, the pendulum swings forward and rises to what height?

(NUMERIC RESPONSE – 2 marks)

6	.	5	8

$P_i = P_f$

$(0.00791\,kg)(730.3\,m/s) = (0.5079\,kg)\,v_f$

$v_f = 11.359263636\,m/s$

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

$= \frac{1}{2}(0.5079\,kg)(11.359263636\,m/s)$

$= 32.767897417855$

$E_K \rightarrow E_P$

$32.767897417855 = (0.5079\,kg)(9.81\,m/s^2)h$

$h = 6.576598895002\,m$

$h = 6.58\,m$

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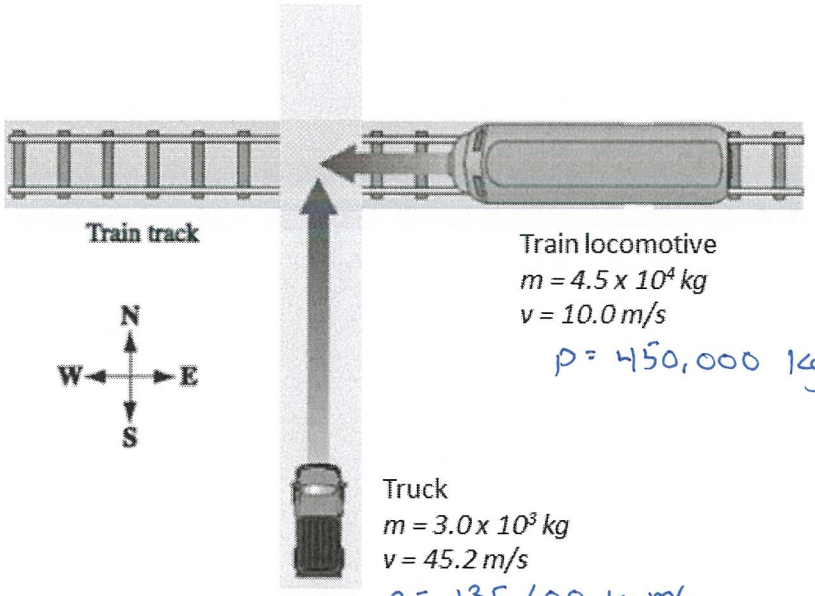
Use the following diagram and information to answer question Q10.

In a movie stunt, a car and a train locomotive intentionally crash. The collision is illustrated in the diagram below.



Q10: The magnitude of the momentum of the car-train system immediately before the collision, expressed in scientific notation, is ***a.b*** x 10^{c} kg*m/s. You will need to record the values of ***a*** and ***b***.

The direction of the momentum of the car-train system immediately before the collision is ***ef*** degrees, north of west. You will need to record the values of ***e*** and ***f***.

The values of ***a, b, e,*** and ***f*** are ____, ____, ____ and ____.
a *b* *e* *f*

(Record all **four digits** of your answer in the numerical-response section below)
(NUMERIC RESPONSE – 3 marks)

4	7	1	7