PH105–007 Exam 2 VERSION A

Name___________________________________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) A 1.0–kg block and a 2.0–kg block are pressed together on a horizontal frictionless surface with a compressed very light spring between them. They are not attached to the spring. After they are released and have both moved free of the spring 1) _______

A) the magnitude of the momentum of the heavier block will be greater than the magnitude of the momentum of the lighter block.
B) both blocks will both have the same amount of kinetic energy.
C) the lighter block will have more kinetic energy than the heavier block.
D) the heavier block will have more kinetic energy than the lighter block.
E) both blocks will have equal speeds.

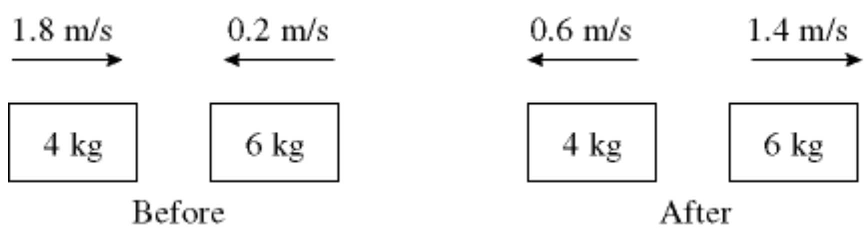
2) A 2.3–kg object traveling at 6.1 m/s collides head–on with a 3.5–kg object traveling in the opposite direction at 4.8 m/s. If the collision is perfectly elastic, what is the final speed of the 2.3–kg object? 2) _______

A) 4.3 m/s B) 7.1 m/s C) 6.6 m/s D) 0.48 m/s E) 3.8 m/s

3) A 620–g object traveling at 2.1 m/s collides head–on with a 320–g object traveling in the opposite direction at 3.8 m/s. If the collision is perfectly elastic, what is the change in the kinetic energy of the 620–g object? 3) _______

A) It gains 0.69 J.
B) It loses 0.47 J.
C) It loses 0.23 J.
D) It loses 1.4 J.
E) It doesn't lose any kinetic energy because the collision is elastic.

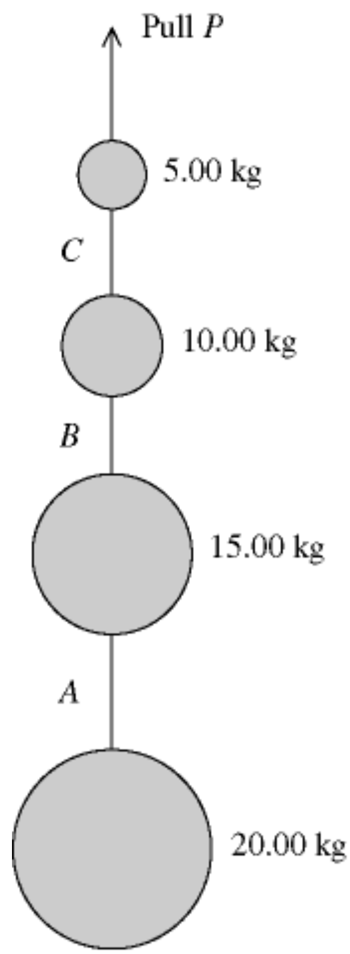
4) In the figure, determine the character of the collision. The masses of the blocks, and the velocities before and after are given. The collision is 4) _______



A) completely inelastic.
B) partially inelastic.
C) perfectly elastic.
D) characterized by an increase in kinetic energy.
E) not possible because momentum is not conserved.

VERSION A

5) A series of weights connected by very light cords are given an upward acceleration of 4.00 m/s^2 by a pull P, as shown in the figure. A, B, and C are the tensions in the connecting cords. The pull P is closest to 5) _______



A) 200 N. B) 50 N. C) 690 N. D) 290 N. E) 490 N.

6) On a frictionless horizontal table, two blocks (A of mass 2.00 kg and B of mass 3.00 kg) are pressed together against an ideal massless spring that stores 75.0 J of elastic potential energy. The blocks are not attached to the spring and are free to move free of it once they are released from rest. The maximum speed achieved by each block is closest to: 6) _______

A) 4.47 m/s (A), 6.71 m/s (B)
B) 5.00 m/s (A), 6.12 m/s (B)
C) 5.48 m/s for both
D) 6.71 m/s (A), 4.47 m/s (B)
E) 6.12 m/s (A), 5.00 m/s (B)

7) A 2.00-kg object traveling east at 20.0 m/s collides with a 3.00-kg object traveling west at 10.0 m/s. After the collision, the 2.00-kg object has a velocity 5.00 m/s to the west. How much kinetic energy was lost during the collision? 7) _______

A) 91.7 J B) 175 J C) 458 J D) 516 J E) 0.000 J

8) A car of mass 1689 kg collides head–on with a parked truck of mass 2000 kg. Spring mounted bumpers ensure that the collision is essentially elastic. If the velocity of the truck is 17 km/h (in the same direction as the car's initial velocity) after the collision, what was the initial speed of the car? 8) _______

A) 10 km/h B) 19 km/h C) 38 km/h D) 29 km/h

9) How much energy is needed to change the speed of a 1600 kg sport utility vehicle from 15.0 m/s to 40.0 m/s? 9) _______

A) 1.10 MJ B) 10.0 kJ C) 40.0 kJ D) 0.960 MJ E) 20.0 kJ

10) A 7.0–kg object is acted on by two forces. One of the forces is 10.0 N acting toward the east. Which of the following forces is the other force if the acceleration of the object is 1.0 m/s^2 toward the east? 10) _______

A) 6.0 N east
B) 9.0 N west
C) 12 N east
D) 3.0 N west
E) 7.0 N west

11) An 1100–kg car traveling at 27.0 m/s starts to slow down and comes to a complete stop in 578 m. What is the magnitude of the average braking force acting on the car? 11) _______

A) 410 N B) 690 N C) 550 N D) 340 N

12) A baseball is thrown vertically upward and feels no air resistance. As it is rising 12) _______

A) both its momentum and its kinetic energy are conserved.
B) its gravitational potential energy is not conserved, buts its momentum is conserved.
C) its momentum is not conserved, but its mechanical energy is conserved.
D) its kinetic energy is conserved, but its momentum is not conserved.
E) both its momentum and its mechanical energy are conserved.

13) A fish weighing 16 N is weighed using two spring scales, each of negligible weight, as shown in the figure. What will be the readings of the scales? 13) _______

A) Each scale will read 16 N.
B) The bottom scale will read 16 N, and the top scale will read zero.
C) The top scale will read 16 N, and the bottom scale will read zero.
D) The scales will have different readings, but the sum of the two readings will be 16 N.
E) Each scale will read 8 N.

14) Consider the motion of a 1.00-kg particle that moves with potential energy given by $U(x) = (-2.00\ \text{J}\cdot\text{m})/x + (4.00\ \text{J}\cdot\text{m}^2)/x^2$. Suppose the particle is moving with a speed of 3.00 m/s when it is located at $x = 1.00$ m. What is the speed of the object when it is located at $x = 5.00$ m? 14) ______

A) 3.67 m/s B) 4.68 m/s C) 3.00 m/s D) 2.13 m/s

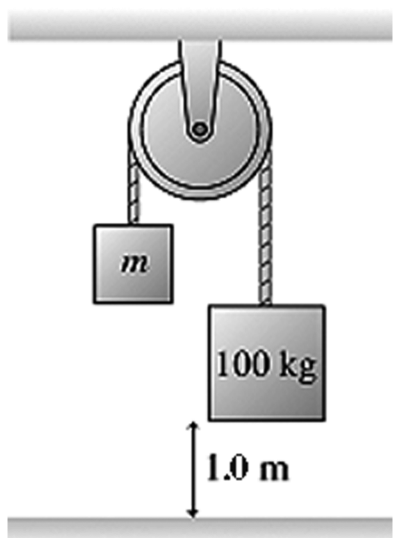
15) You swing a bat and hit a heavy box with a force of 1500 N. The force the box exerts on the bat is 15) ______

A) greater than 1500 N if the box moves.
B) less than 1500 N if the box moves.
C) exactly 1500 N whether or not the box moves.
D) greater than 1500 N if the bat bounces back.
E) exactly 1500 N only if the box does not move.

16) A 615 N student standing on a scale in an elevator notices that the scale reads 645 N. From this information, the student knows that the elevator must be moving 16) ______

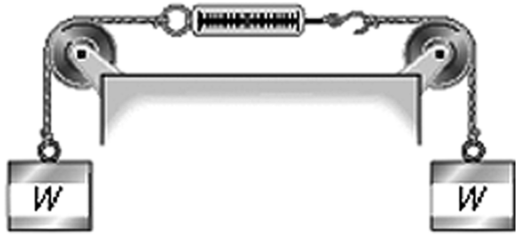
A) downward.
B) upward.
C) You cannot tell if it is moving upward or downward.

17) The figure shows a 100-kg block being released from rest from a height of 1.0 m. It then takes it 0.90 s to reach the floor. What is the mass m of the other block? The pulley has no appreciable mass or friction. 17) ______



A) 54 kg B) 42 kg C) 60 kg D) 48 kg

18) Two objects, each of weight W, hang vertically by spring scales as shown in the figure. The pulleys and the strings attached to the objects have negligible weight, and there is no appreciable friction in the pulleys. The reading in each scale is 18) ______



A) more than 2W.
B) more than W, but not quite twice as much.
C) W.
D) less than W.
E) 2W.

19) A 60.0-kg person rides in an elevator while standing on a scale. The scale reads 400 N. The acceleration of the elevator is closest to 19) ______

A) 3.13 m/s^2 downward.
B) 6.67 m/s^2 downward.
C) 9.80 m/s^2 downward.
D) zero.
E) 6.67 m/s^2 upward.

20) A spring stretches by 21.0 cm when a 135 N object is attached. What is the weight of a fish that would stretch the spring by 31.0 cm? 20) ______

A) 279 N B) 199 N C) 145 N D) 91.0 N

Formula sheet

$$g = 9.81\,\mathrm{m/s^2} \quad G = 6.67\times10^{-11}\,\mathrm{N\,m^2/kg^2}$$
$$N_A = 6.022\times10^{23}\,\text{things/mol} \qquad 1\,\mathrm{L} = 10^{-3}\,\mathrm{m^3}$$
$$k_B = 1.38065\times10^{-23}\,\mathrm{J\cdot K^{-1}} = 8.6173\times10^{-5}\,\mathrm{eV\cdot K^{-1}}$$
$$\text{sphere} \quad V = \frac{4}{3}\pi r^3 \quad A = 4\pi r^2$$
$$ax^2 + bx^2 + c = 0 \Longrightarrow x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$
$$\sin\alpha \pm \sin\beta = 2\sin\frac{1}{2}(\alpha\pm\beta)\cos\frac{1}{2}(\alpha\mp\beta)$$
$$\cos\alpha \pm \cos\beta = 2\cos\frac{1}{2}(\alpha+\beta)\cos\frac{1}{2}(\alpha-\beta)$$
$$c^2 = a^2 + b^2 - 2ab\cos\theta_{ab}$$
$$\frac{d}{dx}\sin ax = a\cos ax \qquad \frac{d}{dx}\cos ax = -a\sin ax$$
$$\int \cos ax\,\mathrm{dx} = \frac{1}{a}\sin ax \qquad \int \sin ax\,\mathrm{dx} = -\frac{1}{a}\cos ax$$
$$\sin\theta \approx \theta \qquad \cos\theta \approx 1 - \frac{1}{2}\theta^2 \qquad \text{small } \theta$$

$$\vec{\mathbf{v}} = \lim_{\Delta t\to 0}\frac{\Delta\vec{\mathbf{r}}}{\Delta t} \equiv \frac{d\vec{\mathbf{r}}}{dt}$$
$$a_x = \lim_{\Delta t\to 0}\frac{\Delta v_x}{\Delta t} \equiv \frac{dv_x}{dt} = \frac{d}{dt}\left(\frac{dx}{dt}\right) = \frac{d^2x}{dt^2}$$
$$\Delta v_x = \int_{t_i}^{t_f} a_x(t)\,dt \qquad \Delta x = \int_{t_i}^{t_f} v_x(t)\,dt$$
$$x(t) = x_i + v_{x,i}t + \frac{1}{2}a_x t^2$$
$$v_x(t) = v_{x,i} + a_x t$$
$$v_{x,f}^2 = v_{x,i}^2 + 2a_x\Delta x$$
$$a_{x,\mathrm{ramp}} = g\sin\theta$$

$$\Delta U^G = mg\Delta x \qquad \frac{a_{1x}}{a_{2x}} = -\frac{m_2}{m_1}$$
$$E_{\mathrm{mech}} = K + U \quad K = \frac{1}{2}mv^2$$
$$\Delta E = \Delta K + \Delta U = 0 \quad \text{non-dissipative, closed}$$

$$\Delta\vec{\mathbf{p}} = \vec{\mathbf{0}} \quad \text{isolated system}$$
$$\vec{\mathbf{p}}_f = \vec{\mathbf{p}}_i \quad \text{isolated system}$$
$$\vec{\mathbf{p}} \equiv m\vec{\mathbf{v}}$$
$$m_u = -\frac{\Delta v_{s,x}}{\Delta v_{u,x}}m_s$$
$$\vec{\mathbf{J}} = \Delta\vec{\mathbf{p}}$$
$$v_{1f} = \left(\frac{m_1-m_2}{m_1+m_2}\right)v_{i1} + \left(\frac{2m_2}{m_1+m_2}\right)v_{2i} \quad \text{1D elastic}$$
$$v_{2f} = \left(\frac{2m_1}{m_1+m_2}\right)v_{1i} + \left(\frac{m_2-m_1}{m_1+m_2}\right)v_{2i} \quad \text{1D elastic}$$
$$\Delta E = 0 \quad \text{isolated system}$$
$$K = \frac{1}{2}mv^2$$
$$\vec{v}_{12} = \vec{\mathbf{v}}_2 - \vec{\mathbf{v}}_1 \quad \text{relative velocity}$$

$$\vec{\mathbf{a}} = \frac{\sum\vec{\mathbf{F}}}{m} \qquad \mathbf{a}_{\vec{\mathbf{cm}}} = \frac{\sum\vec{\mathbf{F}}_{\mathrm{ext}}}{m} \qquad \sum\vec{\mathbf{F}} \equiv \frac{d\vec{\mathbf{p}}}{dt}$$
$$\vec{\mathbf{J}} = \left(\sum\vec{\mathbf{F}}\right)\Delta t \quad \text{constant force}$$
$$\vec{\mathbf{J}} = \int_{t_i}^{t_f}\sum\vec{\mathbf{F}}(t)\,dt \quad \text{time-varying force}$$
$$\vec{\mathbf{F}}_{12} = -\vec{\mathbf{F}}_{21} \qquad F_{\mathrm{grav}} = -mg \qquad F_{\mathrm{spring}} = -k\Delta x$$

Isolated systems: $\vec{\mathbf{p}}$, $E = K + U$ conserved.
Static equilibrium: $\sum F = 0$ about any axis.
Elastic collision: KE and p are both conserved.
Inelastic collision: only p is conserved, not KE.

Derived unit	Symbol	equivalent to
newton	N	kg·m/s^2
joule	J	kg·m^2/s^2 = N·m
watt	W	J/s=m^2·kg/s^3

Power	Prefix	Abbreviation
10^{-6}	micro	µ
10^{-3}	milli	m
10^{-2}	centi	c
10^{3}	kilo	k
10^{6}	mega	M

1) C
2) B
3) C
4) C
5) C
6) D
7) C
8) B
9) A
10) D
11) B
12) C
13) A
14) A
15) C
16) C
17) C
18) C
19) A
20) B