ANSWER SHEET – STAPLE TO FRONT OF EXAM

Name: ________________________________ **CWID**: ________________________________

Lab section (circle one):

5 (R 7pm)
6 (W 3pm)
7 (W 5pm)
8 (W 7pm)
10 (R 5pm)

Multiple choice:

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

Short answer:

16.

17.

18.

19.

20.

PH105–004 Exam 2

Name________________________________ Version A

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

1) While an object is in projectile motion (with upward being positive) with no air resistance — 1) ______

A) the horizontal component of its velocity remains constant and the horizontal component of its acceleration is equal to $-g$.

B) the horizontal component of its velocity remains constant and the vertical component of its acceleration is equal to $-g$.

C) the vertical component of its velocity remains constant and the vertical component of its acceleration is equal to $-g$.

D) the vertical component of both its velocity and its acceleration remain constant.

E) the horizontal component of its velocity remains constant and the vertical component of its acceleration is equal to zero.

2) Two objects, one of mass m and the other of mass $2m$, are dropped from the top of a building. When they hit the ground — 2) ______

A) the heavier one will have $\sqrt{2}$ times the kinetic energy of the lighter one.

B) the heavier one will have four times the kinetic energy of the lighter one.

C) both of them will have the same kinetic energy.

D) the heavier one will have twice the kinetic energy of the lighter one.

3) On a smooth horizontal floor, an object slides into a spring which is attached to another mass that is initially stationary. When the spring is most compressed, both objects are moving at the same speed. Ignoring friction, what is conserved during this interaction? — 3) ______

A) momentum and mechanical energy

B) kinetic energy only

C) momentum and kinetic energy

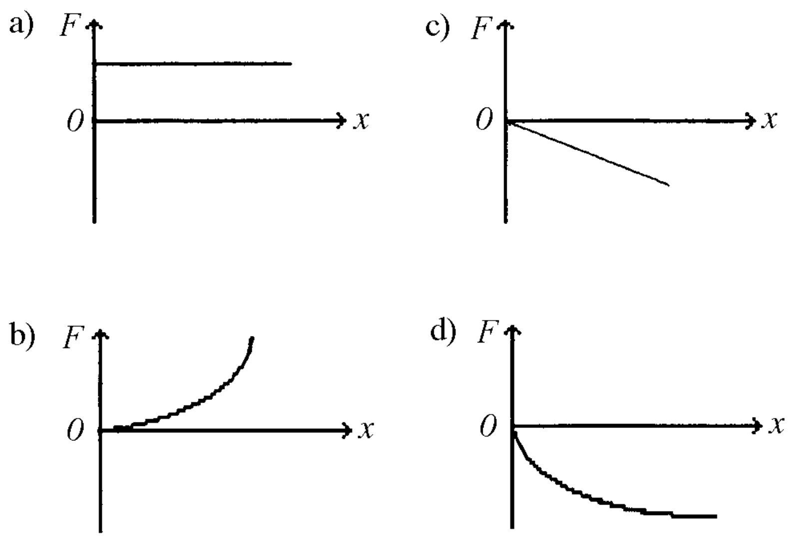
D) momentum and potential energy

E) momentum only

4) A box of mass m is pulled with a constant acceleration a along a horizontal frictionless floor by a wire that makes an angle of 15° above the horizontal. If T is the tension in this wire, then — 4) ______

A) $T < ma$. B) $T > ma$. C) $T = ma$.

5) Which of the graphs in the figure represents a spring that gets less stiff the more it is stretched? 5) _______



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

6) A baseball is thrown vertically upward and feels no air resistance. As it is rising 6) _______

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

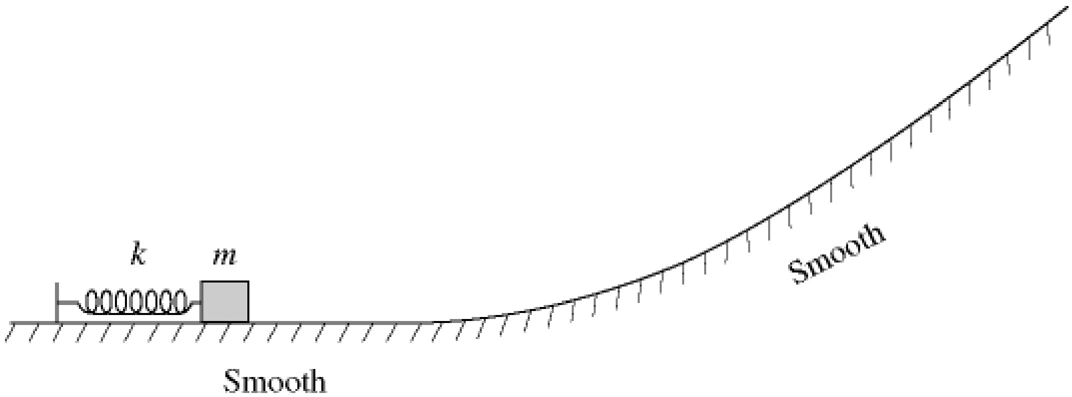
7) A 4.0–kg object is moving with speed 2.0 m/s. A 1.0–kg object is moving with speed 4.0 m/s. Both objects encounter the same constant braking force, and are brought to rest. Which object travels the greater distance before stopping? 7) _______

A) the 1.0–kg object
B) the 4.0–kg object
C) Both objects travel the same distance.
D) It is impossible to know without knowing how long each force acts.

8) A ball is tossed vertically upward. When it reaches its highest point (before falling back downward) 8) _______

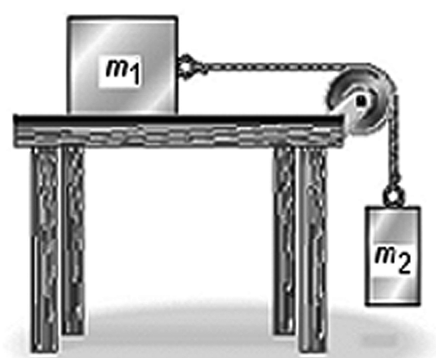
A) the velocity and acceleration reverse direction, but the force of gravity on the ball remains downward.
B) the velocity is zero, the acceleration is zero, and the force of gravity acting on the ball is zero.
C) the velocity is zero, the acceleration is zero, and the force of gravity acting on the ball is directed downward.
D) the velocity, acceleration, and the force of gravity on the ball all reverse direction.
E) the velocity is zero, the acceleration is directed downward, and the force of gravity acting on the ball is directed downward.

9) A box of mass m is pressed against (but is not attached to) an ideal spring of force constant k and negligible mass, compressing the spring a distance x. After it is released, the box slides up a frictionless incline as shown in the figure and eventually stops. If we repeat this experiment with a box of mass $2m$ 9) _______



A) just as it moves free of the spring, the lighter box will be moving twice as fast as the heavier box.
B) just as it moves free of the spring, the heavier box will have twice as much kinetic energy as the lighter box.
C) both boxes will reach the same maximum height on the incline.
D) the lighter box will go twice as high up the incline as the heavier box.
E) both boxes will have the same speed just as they move free of the spring.

10) Two objects having masses m_1 and m_2 are connected to each other as shown in the figure and are released from rest. There is no friction on the table surface or in the pulley. The masses of the pulley and the string connecting the objects are completely negligible. What must be true about the tension T in the string just after the objects are released? 10) ______



A) $T = m_1 g$ B) $T > m_2 g$ C) $T = m_2 g$ D) $T > m_1 g$ E) $T < m_2 g$

11) Two identical balls are thrown directly upward, ball A at speed v and ball B at speed $2v$, and they feel no air resistance. Which statement about these balls is correct? 11) _______

A) The balls will reach the same height because they have the same mass and the same acceleration.
B) At their highest point, the acceleration of each ball is instantaneously equal to zero because they stop for an instant.
C) Ball B will go four times as high as ball A because it had four times the initial kinetic energy.
D) Ball B will go twice as high as ball A because it had twice the initial speed.
E) At its highest point, ball B will have twice as much gravitational potential energy as ball A because it started out moving twice as fast.

12) A small car has a head–on collision with a large truck. Which of the following statements concerning the magnitude of the average force due to the collision is correct? 12) _______

A) The small car and the truck experience the same average force.
B) The small car experiences the greater average force.
C) The truck experiences the greater average force.
D) It is impossible to tell since the masses are not given.
E) It is impossible to tell since the velocities are not given.

13) Jan and Len throw identical rocks off a tall building at the same time. The ground near the building is flat. Jan throws her rock straight downward. Len throws his rock downward and outward such that the angle between the initial velocity of the rock and the horizon is 30°. Len throws the rock with a speed twice that of Jan's rock. If air resistance is negligible, which rock hits the ground first? 13) _______

A) Jan's rock hits first.
B) They hit at the same time.
C) Len's rock hits first.
D) It is impossible to know from the information given.

14) A stalled car is being pushed up a hill at constant velocity by three people. The net force on the car is 14) _______

A) down the hill and greater than the weight of the car.
B) up the hill and equal to the weight of the car.
C) up the hill and greater than the weight of the car.
D) down the hill and equal to the weight of the car.
E) zero.

15) Alice and Tom dive from an overhang into the lake below. Tom simply drops straight down from the edge, but Alice takes a running start and jumps with an initial horizontal velocity of 25 m/s. Neither person experiences any significant air resistance. Just as they reach the lake below 15) _______

A) the speed of Alice will always be 25 m/s larger than that of Tom.
B) the speed of Alice is larger than that of Tom.
C) the speed of Tom will always be 9.8 m/s larger than that of Alice.
D) they will both have the same speed.
E) the splashdown speed of Alice is larger than that of Tom.

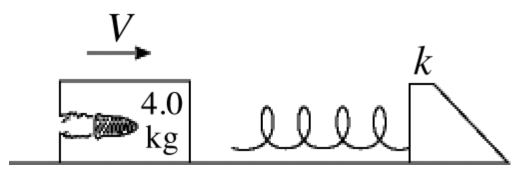
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

16) 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? 16) ______________

17) A 1.00-kg mass is attached to a very light ideal spring hanging vertically and hangs at rest in the equilibrium position. The spring constant of the spring is 1.00 N/cm. The mass is pulled downward 2.00 cm and released. What is the speed of the mass when it is 1.00 cm above the point from which it was released? 17) ______________

18) A hobby rocket reaches a height of 66.6 m and lands 128 m from the launch point with no air resistance. What was the angle of launch? 18) ______________

19) An 8.0-g bullet is shot into a 4.0-kg block, at rest on a frictionless horizontal surface (see the figure). The bullet remains lodged in the block. The block moves into an ideal massless spring and compresses it by 8.7 cm. The spring constant of the spring is 2400 N/m. The initial velocity of the bullet is closest to 19) ______________



20) A 50.0-N box is sliding on a rough horizontal floor, and the only horizontal force acting on it is friction. You observe that at one instant the box is sliding to the right at 1.75 m/s and that it stops in 2.25 s with uniform acceleration. What magnitude force does friction exert on this box? 20) ______________

Formula sheet

$$g = |\vec{a}_{\text{free fall}}| = 9.81\,\text{m/s}^2 \quad \text{near earth's surface}$$

$$0 = ax^2 + bx^2 + c \Longrightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$1\,\text{J} = 1\,\text{kg}\cdot\text{m}^2/\text{s}^2 = 1\,\text{N}\cdot\text{m}$$

$$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$$

$$\text{speed} = v = |\vec{v}| \quad \vec{v}_{av} \equiv \frac{\Delta\vec{r}}{\Delta t} \quad \vec{v} = \lim_{\Delta t\to 0}\frac{\Delta\vec{r}}{\Delta t} \equiv \frac{d\vec{r}}{dt}$$

$$a_{x,av} \equiv \frac{\Delta v_x}{dt} \quad a_x = \lim_{\Delta t\to 0}\frac{\Delta v_x}{\Delta t} \equiv \frac{dv_x}{dt} = \frac{d}{dt}\left(\frac{dx}{dt}\right) = \frac{d^2x}{dt^2}$$

$$x_f = x_i + v_{x,i}\Delta t + \frac{1}{2}a_x(\Delta t)^2$$

$$v_{x,f} = v_{x,i} + a_x\Delta t$$

$$x(t) = x_i + v_{x,i}t + \frac{1}{2}a_xt^2$$

$$v_x(t) = v_{x,i} + a_xt$$

$$v_{x,f}^2 = v_{x,i}^2 + 2a_x\Delta x$$

$\downarrow$ launched from origin, level ground

$$y(x) = (\tan\theta_o)\,x - \frac{gx^2}{2v_o^2\cos^2\theta_o}$$

$$\Delta\vec{p} = \vec{0} \quad \vec{p}_f = \vec{p}_i \quad \text{isolated system}$$

$$\vec{p} \equiv m\vec{v}$$

$$m_u = -\frac{\Delta v_{s,x}}{\Delta v_{u,x}}m_s$$

$$\vec{J} = \Delta\vec{p}$$

$$v_{1f} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)v_{i1} + \left(\frac{2m_2}{m_1 + m_2}\right)v_{2i} \quad \text{1D elastic}$$

$$v_{2f} = \left(\frac{2m_1}{m_1 + m_2}\right)v_{1i} + \left(\frac{m_2 - m_1}{m_1 + m_2}\right)v_{2i} \quad \text{1D elastic}$$

$$\vec{v}_{12} = \vec{v}_2 - \vec{v}_1 \quad \text{relative velocity}$$

$$v_{12} = |\vec{v}_2 - \vec{v}_1| \quad \text{relative speed}$$

$$\Delta U^G = mg\Delta x$$

$$\frac{a_{1x}}{a_{2x}} = -\frac{m_2}{m_1}$$

$$E_{\text{mech}} = K + U \quad K = \frac{1}{2}mv^2$$

$$\Delta E = \Delta K + \Delta U = 0 \quad \text{non-dissipative, closed}$$

$$\vec{a} = \frac{\sum\vec{F}}{m} \qquad a_{\vec{cm}} = \frac{\sum\vec{F}_{\text{ext}}}{m} \qquad \sum\vec{F} \equiv \frac{d\vec{p}}{dt}$$

$$\vec{J} = \left(\sum\vec{F}\right)\Delta t \quad \text{constant force}$$

$$\vec{J} = \int_{t_i}^{t_f}\sum\vec{F}(t)\,dt \quad \text{time-varying force}$$

$$\vec{F}_{12} = -\vec{F}_{21}$$

$$\Delta E = W$$

$$\Delta U_{\text{spring}} = \frac{1}{2}k\,(x - x_o)^2$$

$$P = \frac{dE}{dt}$$

$$P = F_{\text{ext,x}}\,v_x \quad \text{one dimension}$$

$$W = \left(\sum\vec{F}\right)\Delta x_F \quad \text{constant foce 1D}$$

$$W = \sum_n\left(F_{\text{ext,x}}\,\Delta x_{Fn}\right) \quad \text{const nondiss., many particles, 1D}$$

$$W = \int_{x_i}^{x_f}F_x(x)\,dx \quad \text{nondiss. force, 1D}$$

$$(F_{12}^s)_{\max} = \mu_sF_{12}^n$$

$$F_{12}^k = \mu_kF_{12}^n$$

$$\vec{A} = \vec{A}_x + \vec{A}_y = A_x\,\hat{\imath} + A_y\,\hat{\jmath}$$

$$\vec{A}\cdot\vec{B} = AB\cos\phi = A_xB_x + A_yB_y$$

$$W = \vec{F}\cdot\Delta\vec{r}_F \quad \text{const non-diss force}$$

$$W = \int_{\vec{r}_i}^{\vec{r}_f}\vec{F}(\vec{r})\cdot d\vec{r} \quad \text{variable nondiss force}$$

Power	**Prefix**	**Abbreviation**
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	µ
10^{-3}	milli	m
10^{-2}	centi	c
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T

Answer Key
Testname: F15 PH105 EXAM 1B

1) B
2) D
3) A
4) B
5) D
6) C
7) C
8) E
9) D
10) E
11) C
12) A
13) B
14) E
15) B
16) 3.67 m/s
17) 1.73 m/s
18) 64.3°
19) 1100 m/s.
20) 3.97 N