Exam 2 FORM A

Name____________________________________

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

1) A baseball is thrown vertically upward and feels no air resistance. As it is rising 1) ________
A) both its momentum and its mechanical energy are conserved.
B) its kinetic energy is conserved, but its momentum is not conserved.
C) its gravitational potential energy is not conserved, buts its momentum is conserved.
D) its momentum is not conserved, but its mechanical energy is conserved.
E) both its momentum and its kinetic energy are conserved.

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

3) Consider what happens when you jump up in the air. Which of the following is the most accurate statement? 3) ________
A) Since the ground is stationary, it cannot exert the upward force necessary to propel you into the air. Instead, it is the internal forces of your muscles acting on your body itself that propels your body into the air.
B) When you jump up the earth exerts a force F_1 on you and you exert a force F_2 on the earth. You go up because $F_1 > F_2$.
C) It is the upward force exerted by the ground that pushes you up, but this force cannot exceed your weight.
D) When you push down on the earth with a force greater than your weight, the earth will push back with the same magnitude force and thus propel you into the air.
E) You are able to spring up because the earth exerts a force upward on you that is greater than the downward force you exert on the earth.

4) A force on a particle depends on position such that $F(x) = (3.00\ N/m^2)x^2 + (6.00\ N/m)x$ for a particle constrained to move along the x-axis. What work is done by this force on a particle that moves from $x = 0.00$ m to $x = 2.00$ m? 4) ________
A) 24.0 J B) -48.0 J C) 48.0 J D) 20.0 J E) 10.0 J

5) It requires 49 J of work to stretch an ideal very light spring from a length of 1.4 m to a length of 2.9 m. What is the value of the spring constant of this spring? 5) ________
A) 22 N/m B) 44 N/m C) 15 N/m D) 29 N/m

6) 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? 6) ________
A) momentum only
B) momentum and potential energy
C) momentum and mechanical energy
D) momentum and kinetic energy
E) kinetic energy only

7) You slam on the brakes of your car in a panic, and skid a certain distance on a straight, level road. If you had been traveling twice as fast, what distance would the car have skidded, under identical conditions? 7) ______

A) It would have skidded 2 times farther.
B) It would have skidded 1/2 as far.
C) It would have skidded $\sqrt{2}$ times farther.
D) It would have skidded $1/\sqrt{2}$ times farther.
E) It would have skidded 4 times farther.

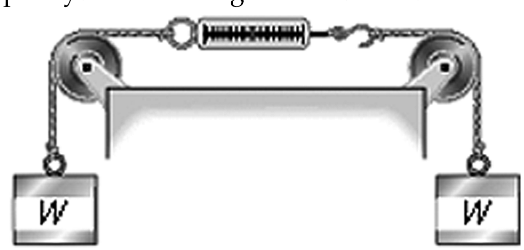
8) A 60.0-kg person drops from rest a distance of 1.20 m to a platform of negligible mass supported by an ideal stiff spring of negligible mass. The platform drops 6.00 cm before the person comes to rest. What is the spring constant of the spring? 8) ______

A) 4.12×10^5 N/m
B) 8.83×10^4 N/m
C) 3.92×10^5 N/m
D) 2.56×10^5 N/m
E) 5.45×10^4 N/m

9) A crane lifts a 425 kg steel beam vertically a distance of 117 m. How much work does the crane do on the beam if the beam accelerates upward at 1.8 m/s^2? Neglect frictional forces. 9) ______

A) 5.8×10^5 J B) 4.9×10^5 J C) 3.4×10^5 J D) 4.0×10^5 J

10) 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 10) ______

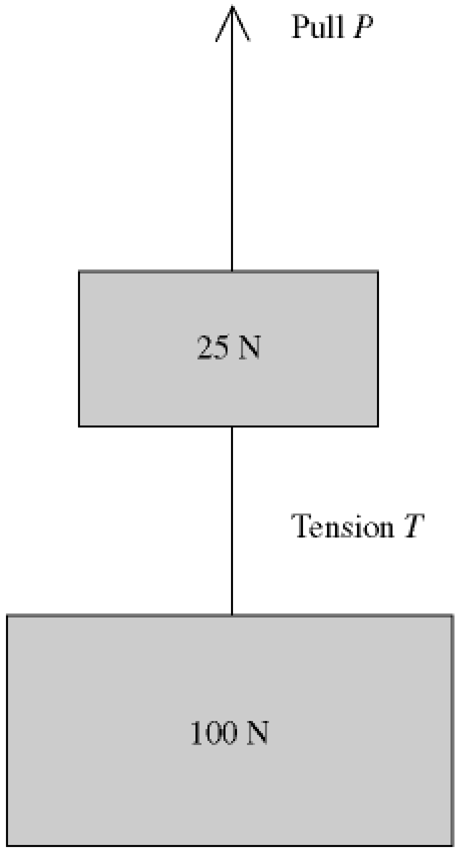


A) more than 2*W*.
B) 2*W*.
C) less than *W*.
D) *W*.
E) more than *W*, but not quite twice as much.

11) 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? 11) ______

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

12) Two weights are connected by a massless wire and pulled upward with a constant speed of 1.50 m/s by a vertical pull P. The tension in the wire is T (see figure). Which one of the following relationships between T and P must be true? 12) ______



A) $P = T + 100$ N
B) $P + T = 125$ N
C) $P = T + 25$ N
D) $T > P$
E) $T = P$

13) Is it possible for a system to have negative potential energy? 13) ______
A) No, because this would have no physical meaning.
B) Yes, since the choice of the zero of potential energy is arbitrary.
C) No, because the kinetic energy of a system must equal its potential energy.
D) Yes, as long as the kinetic energy is positive.
E) Yes, as long as the total energy is positive.

14) 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? 14) ______
A) 410 N B) 690 N C) 340 N D) 550 N

15) 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? 15) ______
A) 91.0 N B) 279 N C) 199 N D) 145 N

16) On a horizontal frictionless floor, a worker of weight 0.900 kN pushes horizontally with a force of 0.200 kN on a box weighing 1.80 kN. As a result of this push, which statement could be true? 16) ______

A) The worker will accelerate at 2.17 m/s^2 and the box will accelerate at 1.08 m/s^2, but in opposite directions.

B) The worker and box will both have an acceleration of 2.17 m/s^2, but in opposite directions.

C) The worker and box will both have an acceleration of 1.08 m/s^2, but in opposite directions.

D) The worker will accelerate at 1.08 m/s^2 and the box will accelerate at 2.17 m/s^2, but in opposite directions.

E) The box will not move because the push is less than its weight.

17) 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 17) ______

A) zero.

B) 9.80 m/s^2 downward.

C) 6.67 m/s^2 upward.

D) 3.13 m/s^2 downward.

E) 6.67 m/s^2 downward.

18) If electricity costs 6.00 ¢/kWh (kilowatt-hour), how much would it cost you to run a 120 W stereo system 4.0 hours per day for 4.0 weeks? 18) ______

A) \$2.27 B) \$0.12 C) \$0.81 D) \$1.38

19) 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 19) ______

A) the splashdown speed of Alice is larger than that of Tom.

B) the speed of Alice will always be 25 m/s larger than that of Tom.

C) the speed of Tom will always be 9.8 m/s larger than that of Alice.

D) the speed of Alice is larger than that of Tom.

E) they will both have the same speed.

20) A boy throws a rock with an initial velocity of 2.15 m/s at 30.0° above the horizontal. If air resistance is negligible, how long does it take for the rock to reach the maximum height of its trajectory? 20) ______

A) 0.194 s B) 0.303 s C) 0.110 s D) 0.215 s

21) A catapult is tested by Roman legionnaires. They tabulate the results in a papyrus and 2000 years later the archaeological team reads (distances translated into modern units): Range = 0.20 km; angle of launch = $\pi/4$; landing height = launch height. What is the initial velocity of launch of the boulders if air resistance is negligible? 21) ______

A) 1.4 m/s B) 0.69 m/s C) 22 m/s D) 44 m/s

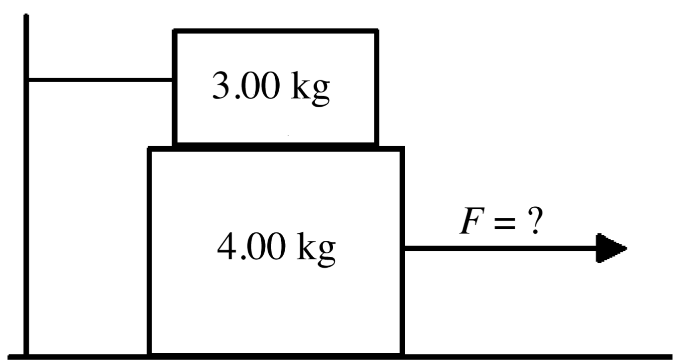
22) A rock is thrown at a window that is located 18.0 m above the ground. The rock is thrown at an angle of 40.0° above horizontal. The rock is thrown from a height of 2.00 m above the ground with a speed of 30.0 m/s and experiences no appreciable air resistance. If the rock strikes the window on its upward trajectory, from what horizontal distance from the window was it released? 22) ______

A) 29.8 m B) 48.7 m C) 71.6 m D) 27.3 m E) 53.2 m

23) A rescue plane flying horizontally at 72.6 m/s spots a survivor in the ocean 182 m directly below and releases an emergency kit with a parachute. Because of the shape of the parachute, it experiences insignificant horizontal air resistance. If the kit descends with a constant vertical acceleration of 5.82 m/s^2, how far away from the survivor will it hit the waves? 23) ______

A) 406 m B) 4.54 km C) 602 m D) 574 m

24) A 4.00-kg block rests between the floor and a 3.00-kg block as shown in the figure. The 3.00-kg block is tied to a wall by a horizontal rope. If the coefficient of static friction is 0.800 between each pair of surfaces in contact, what horizontal force F must be applied to the 4.00-kg block to make it move? 24) ______



A) 54.9 N B) 78.4 N C) 21.1 N D) 16.2 N E) 23.5 N

25) A 6.0 kg box slides down an inclined plane that makes an angle of 39° with the horizontal. If the coefficient of kinetic friction is 0.19, at what rate does the box accelerate down the slope? 25) ______

A) 4.7 m/s^2 B) 6.2 m/s^2 C) 5.2 m/s^2 D) 5.5 m/s^2

Formula sheet

basics

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

$$\text{sphere} \quad V = \frac{4}{3}\pi r^3$$

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

$$\frac{d}{dx}\sin ax = a\cos ax \qquad \frac{d}{dx}\cos ax = -a\sin ax$$

$$\int \cos ax\,\text{dx} = \frac{1}{a}\sin ax \qquad \int \sin ax\,\text{dx} = -\frac{1}{a}\cos ax$$

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

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

$$|\vec{F}| = \sqrt{F_x^2 + F_y^2} \quad \text{magnitude}$$

$$\theta = \tan^{-1}\left[\frac{F_y}{F_x}\right] \quad \text{direction}$$

1D & 2D motion

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

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

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

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

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

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

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

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

$\downarrow$ launched from origin, level ground

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

$$\text{max height} \;= H = \frac{v_i^2\sin^2\theta_i}{2g}$$

$$\text{Range} \;= R = \frac{v_i^2\sin 2\theta_i}{g}$$

momentum

$$\Delta\vec{p} = \vec{0} \quad \vec{p}_f = \vec{p}_i \quad \text{isolated system} \qquad \vec{p} = m\vec{v} \qquad \vec{J} = \Delta\vec{p}$$

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

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

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

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

interactions

$$\Delta U^G = mg\Delta x \qquad \frac{a_{1x}}{a_{2x}} = -\frac{m_2}{m_1}$$

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

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

force

$$\vec{a} = \frac{\sum\vec{F}}{m} \qquad a_{\vec{cm}} = \frac{\sum\vec{F}_{\text{ext}}}{m} \qquad \sum\vec{F} \equiv \frac{d\vec{p}}{dt} \quad \vec{F}_{12} \quad = -\vec{F}_{21}$$

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

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

$$F_{\text{so},x} = -k(x - x_o) \quad \text{small displacement}$$

work

$$\Delta E_{\text{mech}} = \Delta K + \Delta U = W \quad \leftarrow \text{not closed} \qquad \Delta U_{\text{spring}} = \frac{1}{2}k\,(x - x_o)^2$$

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

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

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

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

$$(F_{12}^s)_{\max} = \mu_sF_{12}^n \quad \text{static} \qquad F_{12}^k = \mu_kF_{12}^n \quad \text{kinetic}$$

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

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

sundry bits

Power	Prefix	Abbreviation
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

Derived unit	Symbol	equivalent to
newton	N	$\text{kg}\cdot\text{m/s}^2$
joule	J	$\text{kg}\cdot\text{m}^2/\text{s}^2 = \text{N}\cdot\text{m}$
watt	W	$\text{J/s} = \text{m}^2\cdot\text{kg/s}^3$

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