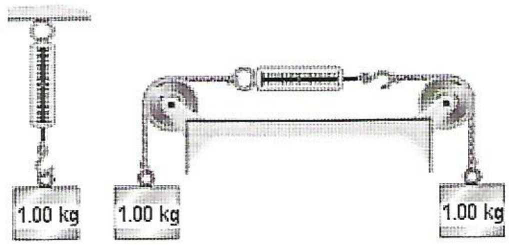
Name KEY

Exam 2 ~~17~~ questions

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

FIGURE 4–1



1) In Fig. 4–1 the scale at left is attached to the ceiling and a mass of 1.00 kg hangs from it. It reads 9.81 N. The identical scale at the right is connected by perfect strings passing over perfect pulleys to two 1.00 kg masses hanging vertically at the end of the strings. That system is at rest. The scale at the right reads ________.

A) exactly 9.81 N.
B) more than 9.81 N, but not quite twice as much.
C) exactly 19.62 N.
D) less than 9.81 N.
E) more than 19.62 N.

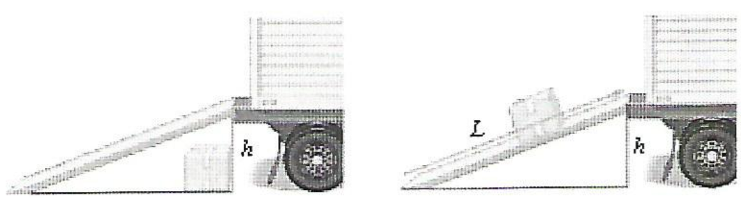
Free body diagrams are identical for each mass!

2) What does the word "normal" mean in the phrase "normal force"?

A) the force is due to contact between two objects.
B) the total force exerted by a surface
C) the component of the force exerted by a surface that is perpendicular to the surface
D) the force that is usually exerted by a surface
E) the component of the force exerted by a surface that is parallel to the surface

See NOTES

FIGURE 8–1



3) You need to load a crate of mass m onto the bed of a truck. One possibility is to lift the crate straight up over a height h, equal to height of the truck's bed. The work done in this case is W_1. The other possibility is to slide the crate up the frictionless ramp of length L as shown in Fig. 8–1. In this case you perform work W_2. What statement is true? In each case the crate begins and ends at rest.

A) $W_1 < W_2$
B) $W_1 > W_2$
C) $W_1 = W_2$
D) No simple relationship exists between W_1 and W_2.

You do the same amount of work in each case BECAUSE for each case box has gained mgh of PE_g.

"Forces do work..." Class notes.

B $v_B = 0$ $y = 1.1$ $TE_A = \frac{1}{2}mv_A^2 = 2.5$ joules $TE_B = mgh = 2.156$ joules
$\therefore$ Ball has "lost" 0.344 joules.

4) A 200 gram ball is thrown straight up into the air with an initl speed of 5 m/s. It reaches a maximum height of 1.10 meters. How much work was done by the air resistance acting on the ball as it traveled to this maximum height?

$y = 0$
A $v_A = 5$

A) 2.50 joules
B) need more information about the drag force
C) 2.16 joules
D) 0.34 joules

5) Two identical balls are thrown from the top of a building with the same speed from the same height. Ball 1 is thrown horizontally, while ball 2 is thrown at an angle θ above the horizontal. Neglecting air resistance, which ball will have the greatest speed when hitting the level ground below?

Both had same T.E. @ top. $\therefore$ Both have same T.E. @ bottom.

A) Ball 1
B) Ball 2
C) Cannot be determined without knowing the height of the building.
D) Cannot be determined without knowing the time each ball is in the air.
E) Both balls reach the ground with the same speed.

6) A potential energy function for a certain system is given by $PE_1(x) = Cx^2 + Bx^3$. The potential energy function for a second system is given by $PE_2(x) = A + Cx^2 + Bx^3$, where A is a positive quantity. How does the force on system 1 relate to the force in system 2 at a given position?

$F(x) = \underbrace{-\frac{\partial}{\partial x} PE(x)}\,\hat{i}$ SAME for both functions

A) The force is identical in the two systems.
B) The force in the second system will be with greater than the force in the first system.
C) There is no relationship between the force in the two systems.
D) The force in the second system will be with less than the force in the first system.
E) The force in the two systems will be in opposite directions.

Lots of ways to see this.

7) A constant force $\vec{F} = 2.00\ \hat{i} + 3.00\ \hat{j}$ acts on a 5.00 kg object as it moves in a straight line from the position $\vec{r}_1 = 1.00\ \hat{i} + 1.00\ \hat{j}$ to a position $\vec{r}_2 = 4.00\ \hat{i} - 1.00\ \hat{j}$. All units are SI. What is the work done by the force during this motion? RECALL that the displacment vector is given by $(\vec{r}_2 - \vec{r}_1) = (3\hat{i} - 2\hat{j}) = \vec{D}$

$\vec{F} \cdot \vec{D} = 0$ but it also $|\vec{F}||\vec{D}|\cos\theta$

A) 12.7 J
B) 0.00 J
C) 2.00 J
D) 5.00 J
E) 13.0 J

So angle between force and displacement is 90°. Force does no work!

8) A spring with a spring constant of 2500 N/m. is stretched 4.00 cm. What is the work required to stretch the spring?

Work Done = $\Delta PE_{spring} = \frac{1}{2}(2500)(0.04)^2 - 0$

A) 3.00 J
B) 1.00 J
C) 2.00 J
D) 0 J
E) 4.00 J

9) A person applies a constant force of 20 N to a rock of mass 1000 kg, for a total of 20 seconds. What is the work done by this person on the rock if the rock does not move ?

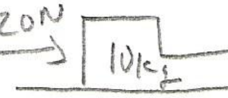
A) 1000 J
B) 0 J
C) 20,000 J
D) 2000 J
E) 400 J

Do free body diagram for each block and solve for the normal force between blocks.

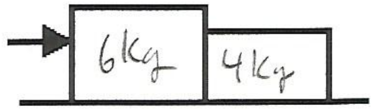
OR a shortcut gives acceleration for the system

FIGURE 4–12

* 20N



$a = \frac{20}{10} = 2\,m/s^2$



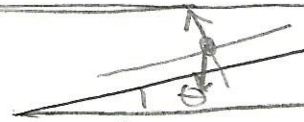
$\therefore F_{on\,4kg} = 4 \times 2 = 8$ newtons

10) A 6.00–kg block is in contact with a 4.00–kg block on a frictionless surface as shown in Fig. 4–12. The 6.00–kg block is being pushed by a 20.0–N force toward the 4.00–kg block. What is the magnitude of the force of the 6.00–kg block on the 4.00–kg block?

A) 8.00 N ✓ B) 12.0 N C) 4.00 N D) 6.00 N E) 10.0 N

11) An object is moving with constant velocity in a straight line. Which of the following statements is true?

A) A constant force is being applied in the direction opposite of motion.
B) The net force on the object is zero. ✓ 2nd Law, BEST answer.
C) There are ~~no forces~~ acting on the object.
D) There is no frictional force acting on the object.
E) A constant force is being applied in the direction of motion.
Maybe, maybe not...



$F_{g_x} = -mg\sin\theta$

12) A 4.00–kg block slides down a frictionless inclined plane with an acceleration 3.00 m/s^2. What is the angle of the incline above horizontal?

$\sum F_x = ma_x$

A) 53.7° B) 17.8° ✓ C) 35.3° D) 23.6° E) 45.2°

$-mg\sin\theta = -m(3)$

$\therefore \theta = 17.8°$

FIGURE 5–4

for 3kg: $\vec{N}_1$, $\vec{T}$, $\vec{F}_g$, $\vec{f}_{s_1} = +\mu_s N_1 \hat{i}$

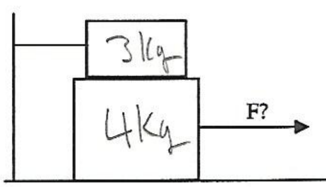
$\sum F_y = 0$

$N_1 - M_1 g = 0$

$N_1 = M_1 g$

$\sum F_x = 0$

$-T + \mu_s N_1 = 0$



for 4kg: $\vec{N}_2$, $\vec{F}$, $+\hat{i}$, $\vec{f}_{s_1}$, $\vec{f}_{s_2}$, $\vec{N}_1$, $\vec{F}_g$

$\sum F_x = 0$

$F = f_{s_1} + f_{s_2}$

$\sum F_y = 0$

$N_2 = 7g$

13) A 4.00–kg block rests between the floor and a 3.00–kg block as shown in Fig. 5–4. 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 is the maximum force that can be applied horizontally to the 4.00–kg block before it begins to move.?

So we have $|\vec{f}_{s_1}| = 23.52$

$\therefore |f_{s_2}| = \mu_s N_2 = 54.88$

A) 21.1 N B) 23.5 N C) 78.4 N ✓ (54.88 + 23.52) D) 54.9 N E) 16.2 N

14) Is it possible for a system to have negative potential energy?

A) Yes, as long as ~~the total~~ energy is positive.
B) Yes, as long as the ~~kinetic energy~~ is positive.
C) Yes, since the choice of the zero of potential energy is arbitrary. ✓
D) No, because the kinetic energy ~~of a system must~~ equal its potential energy.
E) No, because this would ~~have no physical~~ meaning.

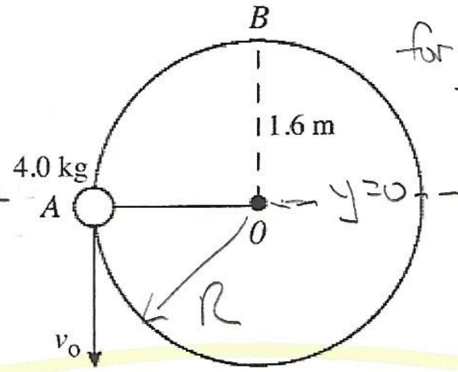
15) In the figure, a 4.0-kg ball is on the end of a 1.6-m rope that is fixed at O. The ball is held at point A, with the rope horizontal, and is given an initial downward velocity. The ball moves through three quarters of a circle with no friction and arrives at B, with the rope barely under tension(meaning that you may let T=0 at B). The initial velocity of the ball, at point A, is closest to ________________.

$TE_{A} = \frac{1}{2} m v_0^2$

$TE_{B} = mgR + \frac{1}{2} m v_B^2$

Cons. Energy: $\frac{1}{2} m v_0^2 = mgR + \frac{1}{2} m v_B^2$

$v_0 = \sqrt{v_B^2 + 2gR}$



for ball @ B

$+\hat{j}$, $+\hat{i}$

$\vec{F}_g = -mg\hat{j}$

2nd $\sum F_y = ma_y$

$-mg = m\left(-\frac{v_B^2}{R}\right)$

$\therefore v_B = \sqrt{gR}$

A) 5.6 m/s B) 7.9 m/s C) 6.9 m/s $\sqrt{3gR}$ D) 6.3 m/s E) 4.0 m/s

16) A 5.00-kg box slides 3.00 m across a horizontal floor before coming to rest. What is the coefficient of kinetic friction between the floor and the box if the box had an initial speed of 3.00 m/s?

A) 1.50 B) 0.587 C) 0.306 D) 0.200 E) 0.153 ✓

17) A car goes around a curve at a constant speed. What is the direction of the net force on the car?

A) toward the front of the car
B) toward the back of the car
C) the net force is zero
D) toward the curve's center
E) away from the curve's center

SEE NOTES

"Forces do work..."

$W_{friction} = (\mu_k mg)(3)\cos(180) = -3mg\mu_k$

$\Delta KE = -\frac{1}{2} m (3)^2$

$\therefore \frac{9m}{2} = 3mg\mu_k$

$0.153 = \frac{3}{2g} = \mu_k$