Name: ____ **Assignment Due Date: December 6, 2011**

AP Physics: Newton's Laws 1

True/False
Indicate whether the statement is true or false.

____ 1. Action-reaction forces never act on the same object.

____ 2. Action equals reaction only if the objects are not accelerating.

____ 3. If there are no forces acting on an object, it will not accelerate.

____ 4. If an object is not accelerating, there must be no forces acting on it.

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 5. An object is observed to be moving at constant velocity in an inertial reference frame. It follows that
- a. no forces act on the object.
- b. a constant force acts on the object in the direction of motion.
- c. the net force acting on the object is zero.
- d. the net force acting on the object is equal and opposite to its weight.

____ 6. A body moves with constant speed in a straight line in an inertial reference frame. Which of the following statements must be true?
- a. No force acts on the body.
- b. A single constant force acts on the body in the direction of motion.
- c. A single constant force acts on the body in the direction opposite to the motion.
- d. A net force of zero acts on the body.
- e. A constant net force acts on the body in the direction of motion.

____ 7. A particle of mass m is traveling at an initial speed v_o = 25.0 m/s. It is brought to rest in a distance of 62.5m when a net force of 15.0N acts on it. What is *m?*
- a. 37.5 kg
- b. 3.00 kg
- c. 1.50 kg
- d. 6.00 kg
- e. 3.75 kg

____ 8. On the moon, the acceleration due to gravity is only about 1/6 of that on earth. An astronaut whose weight on earth is 600 N travels to the lunar surface. His mass as measured on the moon will be
- a. 600 kg.
- b. 100 kg.
- c. 61.2 kg.
- d. 9.81 kg.
- e. 360 kg.

____ 9. An 80-kg man on ice skates pushes a 40-kg boy also on skates with a force of 100 N. The force exerted by the boy on the man is
- a. 200 N.
- b. 100 N.
- c. 50 N.
- d. 40 N.

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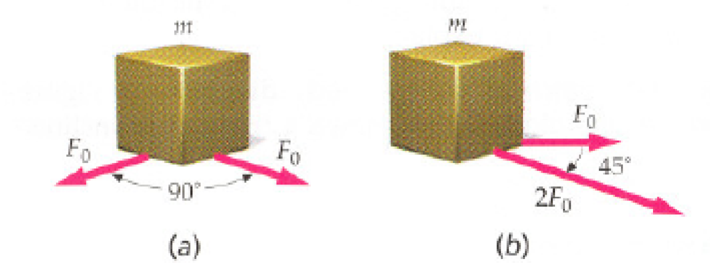
____ 10. A baseball player hits a ball with a bat. If the force with which the bat hits the ball is considered the action force, what is the reaction force?

a. The force the bat exerts on the batter's hands.
b. The force on the ball exerted by the glove of the person who catches it.
c. The force the ball exerts on the bat.
d. The force the pitcher exerts on the ball while throwing it.
e. Friction, as the ball rolls to a stop.

Problem

11. *(a)* An object experiences an acceleration of 3 m/s^2 when a certain force F_o acts on it. What is its acceleration when the force is doubled? *(b)*A second object experiences an acceleration of 9 m/s^2 under the influence of the force F_o. What is the ratio of the masses of the two objects? *(c)* If the two objects are tied together, what acceleration will the force F_o produce?

12. A force F_o causes an acceleration of 3 m/s^2 when it acts on an object of mass m sliding on a frictionless surface. Find the acceleration of the same object in the circumstances shown in Figures *a* and *b* below.



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13. A single force of 12 N acts on a particle of mass *m.* The particle starts from rest and travels in a straight line a distance of 18 m in 6 s. Find *m.*

14. To drag a 75-kg log along the ground at constant velocity, you have to pull on it with a horizontal force of 250 N. *(a)* What is the resistive force exerted by the ground? *(b)* What force must you exert if you want to give the log an acceleration of 2 m/s^2?

15. Caught without a map again, Hayley lands her spacecraft on an unknown planet. Visibility is poor, but she finds someone on a local communications channel and asks for directions to Earth. "You're already on Earth," is the reply, "Wait there and I'll be right over." Hayley is suspicious, however, so she drops a lead ball of mass 76.5 g from the top of her ship, 18 m above the surface of the planet. It takes 2.5 s to reach the ground. *(a)* If Hayley's mass is 68.5 kg, what is her weight on this planet? *(b)* Is she on Earth?

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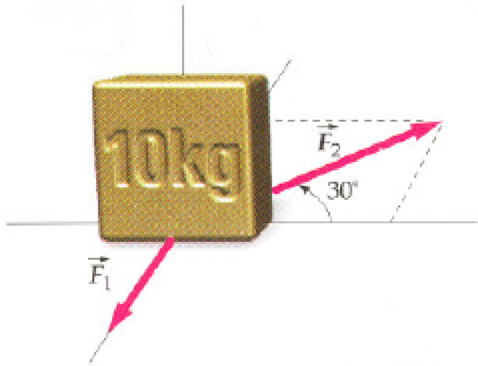
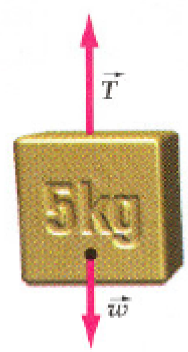
16. A 10-kg object on a Frictionless table is subjected to two horizontal forces, $\vec{F}_1$ and $\vec{F}_2$ with magnitudes $\vec{F}_1$ = 20 N and $\vec{F}_2$ = 30 N, as shown in the figure below. *(a)* Find the acceleration $\vec{a}$ of the object. *(b)* A third force $\vec{F}_3$ is applied so that the object is in static equilibrium. Find $\vec{F}_3$.



17. A vertical force T is exerted on a 5-kg body near the surface of the earth, as shown in the figure below. Find the acceleration of the body if *(a)* T = 5 N, *(b)* T = 10 N, and *(c)* T = 100 N.



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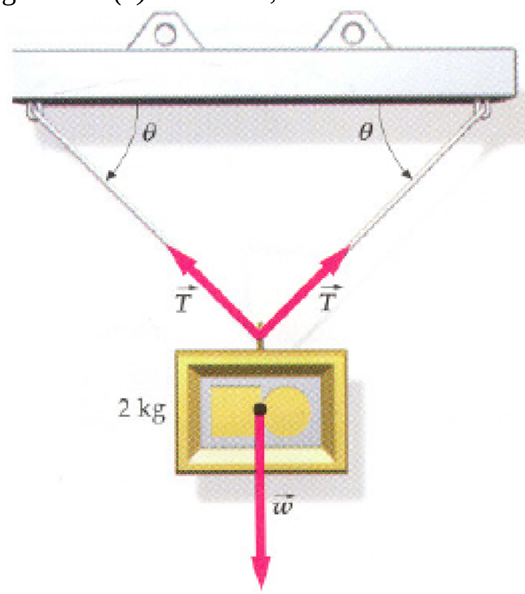
18. A rifle bullet of mass 9 g starts from rest and exits from the 0.6-m barrel at 1200 m/s. Find the force exerted on the bullet, assuming it to be constant, while the bullet is in the barrel.

19. A 2-kg picture is hung by two wires of equal length. Each makes an angle of θ with the horizontal, as shown in the figure below. *(a)* Find the general equation for tension *T*, given θ and weight *w* for the picture. For what angle θ is *T* the least? The greatest? *(b)* If θ = 30°, what is the tension in the wires?



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20. A 1000-kg load is being moved by a crane. Find the tension in the cable that supports the load as *(a)* it is accelerated upward at 2 m/s^2, *(b)* it is lifted at constant speed, and *(c)* it moves upward with speed decreasing by 2 m/s each second.

AP Physics: Newton's Laws 1

Answer Section

TRUE/FALSE

1.	ANS: T	REF:	Tipler4thed.p.106#26a
2.	ANS: F	REF:	Tipler4thed.p.106#26b
3.	ANS: T	REF:	Tipler4thed.p.111#86a
4.	ANS: F	REF:	Tipler4thed.p.111#86b

MULTIPLE CHOICE

5.	ANS: C	REF:	Tipler4thed.p.104#6
6.	ANS: D	REF:	Tipler4thed.p.104#7
7.	ANS: B	REF:	Tipler4thed.p.105#9
8.	ANS: C	REF:	Tipler4thed.p.105#21
9.	ANS: B	REF:	Tipler4thed.p.106#27
10.	ANS: C	REF:	Tipler4thed.p.106#29

PROBLEM

11. ANS:

(*a*) Use $F = ma$ $\quad a = 2 \times (3\ \text{m/s}^2) = 6\ \text{m/s}^2$

(*b*) $m_2a_2 = m_1a_1 = F_0$; $m_2/m_1 = a_1/a_2$ $\quad m_2/m_1 = 3/9 = 1/3$

(*c*) $m_1 + m_2 = (4/3)m_1$; $a = (3/4)a_1$ $\quad a = (3/4)(3\ \text{m/s}^2) = 2.25\ \text{m/s}^2$

REF: Tipler4thed.p.105#10

12. ANS:

(*a*) $F = (F_x^2 + F_y^2)^{1/2} = \sqrt{2}F_0$ $\quad a = \sqrt{2}(3\ \text{m/s}^2) = 4.24\ \text{m/s}^2$

(*b*) $F_x = 2F_0 + F_0 \cos 45°$; $F_y = F_0 \sin 45°$ $\quad F_x = 2.707F_0$; $F_y = 0.707F_0$; $F = 2.8F_0$; $a = 8.39\ \text{m/s}^2$

REF: Tipler4thed.p.105#12

13. ANS:

$a = 2s/t^2 = F/m$; $m = Ft^2/2s$ $\quad m = [(12 \times 36)/(2 \times 18)]\ \text{kg} = 12\ \text{kg}$

REF: Tipler4thed.p.105#14

14. ANS:

(*a*) Since $a = 0$, $F_{net} = 0$; F_{res}, resistive force, = 250 N.

(*b*) $F_{net} = (75\ \text{kg})(2\ \text{m/s}^2) = 150\ \text{N} = F_{appl} - F_{res}$; $F_{appl} = (250 + 150)\ \text{N} = 400\ \text{N}$.

REF: Tipler4thed.p.105#15

15. ANS:

(*a*) Use $s = \frac{1}{2}at^2$ to find accel. of gravity, g' $\quad g' = (2 \times 18/2.5^2)\ \text{m/s}^2 = 5.76\ \text{m/s}^2$

$w = mg'$ $\quad w = (68.5 \times 5.76)\ \text{N} = 395\ \text{N}$

(*b*) Evidently, she is not on Earth.

REF: Tipler4thed.p.106#25

16. ANS:

(*a*) Find the components of $\boldsymbol{F}_1$ and $\boldsymbol{F}_2$; add components to find $\boldsymbol{F}_{tot}$ $\quad \boldsymbol{F}_1 = 20\boldsymbol{j}$ N; $\boldsymbol{F}_2 = (30 \cos 30°\ \boldsymbol{i} - 30 \sin 30°\ \boldsymbol{j})$ N = $(26\boldsymbol{i} - 15\boldsymbol{j})$ N; $\boldsymbol{F}_{tot} = (26\boldsymbol{i} + 5\boldsymbol{j})$ N

(*b*) $\boldsymbol{a} = \boldsymbol{F}_{tot}/m$ $\quad \boldsymbol{a} = (2.6\ \boldsymbol{i} + 0.5\ \boldsymbol{j})\ \text{m/s}^2$

(*c*) $\Sigma\boldsymbol{F} = 0 = \boldsymbol{F}_3 + \boldsymbol{F}_{tot}$ $\quad \boldsymbol{F}_3 = -\boldsymbol{F}_{tot} = -(26\boldsymbol{i} + 5\boldsymbol{j})$ N

This answer contains minor errors (i.e. 26i-5j)

REF: Tipler4thed.p.107#42

17. ANS:

a.) -8.81 m/s2

b.) -7.81 m/s2

c.) 10.19 m/s2

REF: Tipler4thed.p.107#43

18. ANS:

$a = v^2/2s$; $F = ma = mv^2/2s$ $F = [(1200^2 \times 0.009)/(2 \times 0.6)]$ N $= 1.08 \times 10^4$ N

REF: Tipler4thed.p.107#46

19. ANS:

(*a*) $w = 2T \sin\theta$; $T = w/(2\sin\theta)$. T least for $\theta = 90°$; T greatest as $\theta \to 0°$.

(*b*) Use result of (*a*); $T = (2 \times 9.81)/(2 \times \sin 30°) = 19.6$ N.

REF: Tipler4thed.p.107#47

20. ANS:

(*a*), (*b*), and (*c*) $T = m(a - g)$; $g = -9.81$ m/s^2 (*a*) $T = 11810$ N; (*b*) $T = 9810$ N; (*c*) $T = 7810$ N

REF: Tipler4thed.p.107#49