Dynamics Test
Physics 11 – SPH3U0

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

____ 1. The reason your head feels like it jerks backward when pulling away from a stop sign is best explained by Newton's First Law.

____ 2. An airplane is flying in level flight with constant velocity. The forward "thrust" force acting on the airplane is greater than the "drag" force acting in the opposite direction.

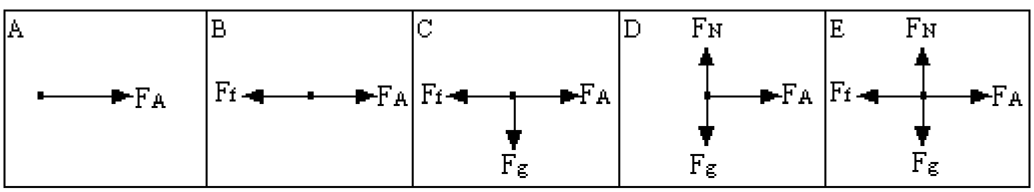
____ 3. If the vector sum of all forces acting on an object is precisely zero, the object could still be moving.

____ 4. For any pair of surfaces, the coefficient of static friction between the surfaces is less than the corresponding coefficient of kinetic friction.

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

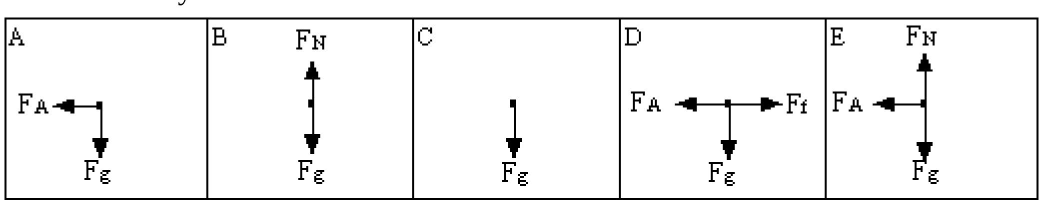
____ 5. Which of the following fundamental forces only exerts forces of attraction, never repulsion?
a. gravitational
b. electromagnetic
c. weak nuclear
d. strong nuclear
e. gravitational and electromagnetic

____ 6. A curling stone is pushed along the ice surface during its delivery. Which of the following free-body diagrams best represents the curling stone?



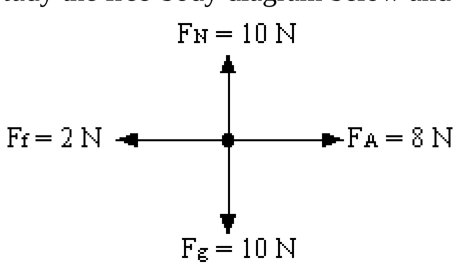
a. A b. B c. C d. D e. E

____ 7. Which of the following free-body diagrams best represents the forces acting on an astronaut orbiting at a constant velocity around the Earth?



a. A b. B c. C d. D e. E

____ 8. Study the free-body diagram below and choose the statement that best describes the dynamics of the situation.



a. There is no net horizontal force.
b. The net force acting is 30 N.
c. The net horizontal force is 10 N.
d. The net force acting is 6 N.
e. The net force acting is 26 N.

____ 9. How much force would you have to apply to just support the weight of an average apple of mass 1 Kg?
a. 9800 N [up]
b. 980 N [up]
c. 98 N [up]
d. 9.8 N [up]
e. 0.98 N [up]

____ 10. A curling stone is sliding along the ice after being released by the curler. Which of the following statements is true?
a. The net force acting on the stone is supplied by friction.
b. The applied force is just equal to the frictional force.
c. The stone is moving with uniform motion.
d. The frictional force is greater than the applied force which is acting.
e. The net force is zero.

____ 11. Which of the following observations is explained by Newton's first law?
a. kicking your feet against something solid to remove snow from your boots
b. feeling as though you're being rocked from side-to-side on a roller coaster
c. an apple hanging motionless from the limb of a tree
d. feeling as though your head jerks backward when pulling away at green light
e. all of the above

____ 12. A heavy crate is pushed across a rough surface. The force that is ultimately responsible for the crate's motion is the
a. applied force
b. frictional force
c. gravitational force
d. net force
e. normal force

____ 13. Newton's third law essentially states
a. objects won't move unless pushed
b. acceleration only occurs if there is net force
c. the acceleration of an object depends on its mass and the net force acting on it
d. objects which are moving tend to stay moving
e. forces always occur in pairs

____ 14. If the force of gravity that the earth exerts on you is considered to be the action force then, according to Newton's third law, the corresponding reaction force would be the
a. normal force of the Earth acting upward on you
b. force your feet exert downward on the Earth
c. force of gravity you exert on the Earth
d. force you exert on your feet, pressing them against the Earth
e. force of gravity the Earth exerts on everything else

____ 15. Objects onboard an orbiting space station appear to be "floating" because
a. they're falling together
b. they're weightless
c. they're outside Earth's gravitational pull
d. they're in the vacuum of space
e. they're in the gravitational field of the Moon

____ 16. The force of friction always acts in a direction exactly opposite to the
a. applied force
b. net force
c. gravitational force
d. normal force
e. motion

<u>Dynamics Unit Test – Problems</u>

1. Draw a real world Free-Body Diagram (FBD) of a person in freefall in air
   a) before a parachute opens and
   b) after a parachute opens.

2. A driver approaches an intersection at a speed of 14 m/s [E] when the light turns amber. The driver applies the brakes to get the maximum stopping force without skidding. The car has a mass of 1500 kg, and the coefficient of friction between the tires and the road is 1.07. Ignoring the driver's reaction time, calculate:
   a) The maximum deceleration of the car
   b) The stopping distance

3. A 75.0 kg water-skier is accelerated from rest to 9.00 m/s [E] in 2.50 s. If the force of kinetic friction between the skis and the water surface is 2400 N, calculate the force of tension in the rope that pulled the skier.

4. The COBE satellite (m = 255 kg) occupies a very special point in space where the gravitational pull from Earth is exactly equal to the gravitational pull from the Sun. At this point, a satellite can remain suspended indefinitely without moving any closer or further from the Sun or Earth. This spot exists approximately 9.10×10^2 km above the surface of Earth.
   a) Draw a sketch of this situation and label the forces acting on the COBE satellite.
   b) Calculate the force of gravity between the Earth ($m_E = 5.97 \times 10^{24}$ kg, $r_E = 6.37 \times 10^6$ m,) and the COBE satellite at this point.

5. An 80 kg baseball player slides to a stop at third base. The coefficient of kinetic friction between the player and the ground is 0.70. His speed at the start of the slide is 8.23 m/s.
   a) Calculate his acceleration during the slide.
   b) How long (in time) does he slide until he stops?

Dynamics Unit Test
Answer Section

TRUE/FALSE

1. ANS: T
   The inertia of your head is a resistance to change. As a result, when the car accelerates, it takes a moment for your head to respond with the same acceleration.

2. ANS: F
   If they were not the same, the plane would not be experiencing “constant velocity” but would be accelerating instead.

3. ANS: T

4. ANS: F

MULTIPLE CHOICE

5. ANS: A

6. ANS: E

7. ANS: C

8. ANS: D

9. ANS: D

10. ANS: A

11. ANS: E

12. ANS: D

13. ANS: E

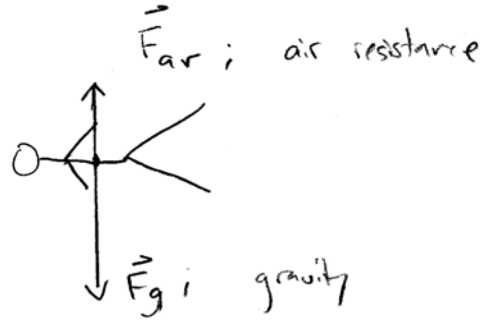
14. ANS: C

15. ANS: A

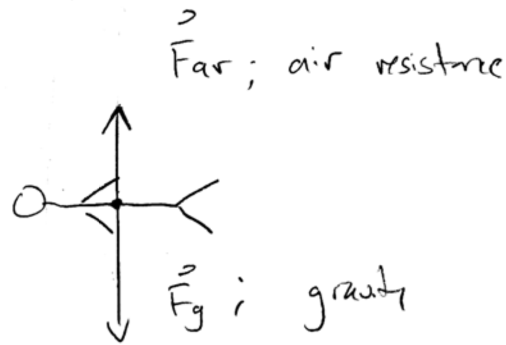
16. ANS: E

1.

a)



b)



By: Randeep Kainth

2. State East is Positive

$\vec{v}_i = 14 m/s$ $m = 1500 kg$
$\vec{v}_f = 0 m/s$ $\mu = 1.07$

a) Find Maximum Deceleration (Negative acceleration)

Use formula: $F_{net} = m \cdot \vec{a}$
$$\vec{a} = \frac{F_{net}}{m}$$

∵ As the question described, the car driver applies the brake to get the Max stopping force.

∴ Only "the force that" decelerate the car is exist in this situation, which is the force of friction
And that F_f = "F_{net}" is
the force of friction between car and road

$$F_f = \mu \times F_{normal}$$
$$= 1.07 \times (1500 kg)(9.81 N/kg)$$
$$= 1.6 \times 10^4 N$$

∵ The Friction is a negative force
∴ $F_f = F_{net} = -1.6 \times 10^4 N$

$$\frac{-1.6 \times 10^4 N}{1.5 \times 10^3 kg} = \vec{a}$$

$$\vec{a} = -10.7 N/kg$$

∴ The maximum deceleration is 10.7 N/kg [West] b)

d = need
$v_i = 14$ m/s
$v_f = 0$ m/s
$\vec{a} = -10.7$ m/s^2

The formula to use

$$v_f^2 = v_i^2 + 2\vec{a}d$$
$$0^2 = 14^2 + 2(-10.7)d$$
$$0 = 196 - 21.4d$$
$$\frac{21.4d}{21.4} = \frac{196}{21.4}$$
$$d = 9.16 \text{ m [E]}$$

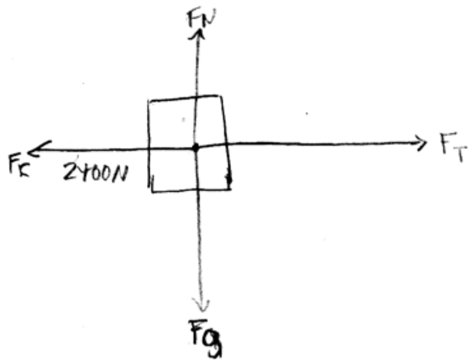
∴ The stopping distance is 9.16 m [E]

By Samuel. W

Harseerat Bhullar

Nov 13th 08

Dynamics Unit Test - Extra Problems



3) $m = 75.0\ kg$

9.00 m/s [E] in 2.50 s

$\vec{F}_K = 2400\ N$

$F_T = ?$

$v_i = 0$

$v_f = 9.00\ m/s\ [E]$

$\Delta t = 2.50\ s$

$\vec{a} = ?$

$$\vec{a} = \frac{v_f - v_i}{\Delta t}$$

$$\vec{a} = \frac{9.00\ m/s\ [E] - 0}{2.50\ s}$$

$$\vec{a} = \frac{9}{2.50}$$

$$\vec{a} = 3.6\ m/s^2$$

$$\vec{F}_{net} = F_T + F_K$$

$$\vec{F}_{net} = F_T - 2400N$$

For FT:

$$F_T - 2400N = m\vec{a}$$

$$F_T = (m\vec{a}) + 2400N$$

$$F_T = (75.0kg)(3.6\ m/s^2) + 2400N$$

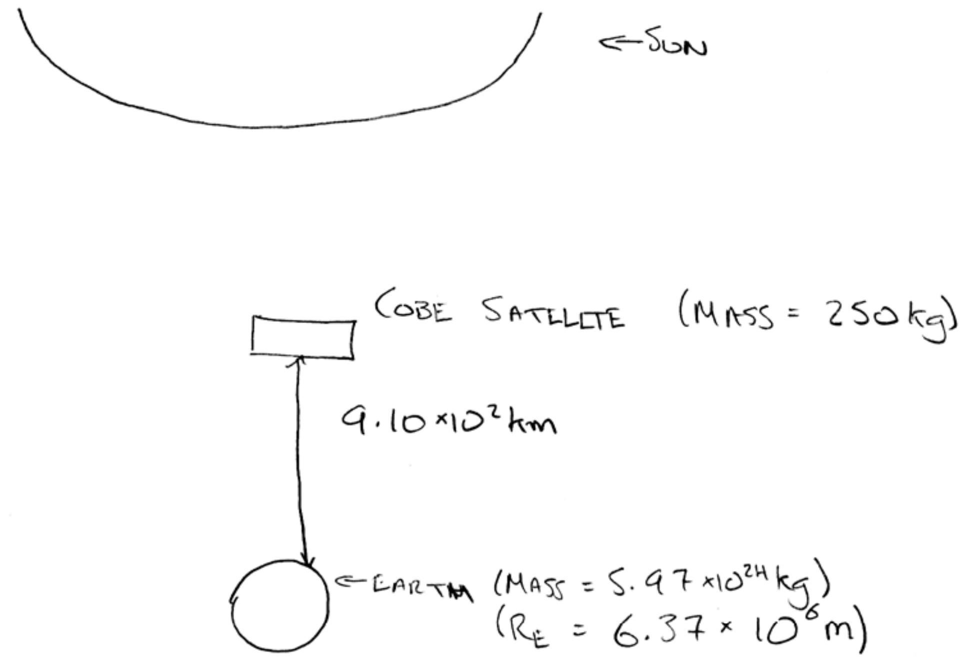
$$F_T = 270N + 2400N$$

$$F_T = 2670N$$

∴ the force of tension in the rope that pulled the skier is 2670N.

DYNAMICS UNIT TEST (PRACTISE) RYAN S.

4a)



b)

$$F_G = \frac{G m_1 m_2}{d^2}$$

$$= \frac{(6.67\times10^{-11}\ Nm^2/kg^2)(5.97\times10^{24}\ kg)(250\ kg)}{[(9.10\times10^2\ km)+(6.37\times10^6\ m)]^2}$$

$$= \frac{(6.67\times10^{-11}\ Nm^2/kg^2)(5.97\times10^{24}\ kg)(250\ kg)}{(910000\ m + 6370000\ m)^2}$$

$$= \frac{9.954975\times10^{16}}{52998400000000\ m}$$

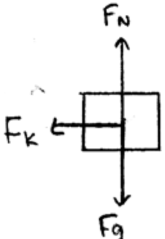
$$= 1878.35\ N$$

$$= 1.88\times10^3\ N$$

Thurkaa.S

5. An 80 kg baseball player slides to a stop at third base. The coefficient of kinetic friction between the player and the ground is 0.70. His speed at start of the slide is 8.23 m/s.

a. calculate his acceleration during the slide.



$m = 80 kg$
$F_{net} = F_K$
$a = need$
$\vec{g} = 9.8 N/kg [\downarrow]$
$\mu = 0.70$

$F_K = \mu F_N$
$F_K = \mu(m\vec{g})$
$F_K = 0.70(80 \times 9.8)$
$F_K = 0.70(784)$
$F_K = 548.8 N$
$\therefore F_{net} = 548.8 N$

$F_{net} = m\vec{a}$
$548.8 = 80\vec{a}$
$\vec{a} = \frac{548.8}{80}$
$\vec{a} = 6.86 m/s^2$ [backward]

$\therefore$ the acceleration of the baseball player is 6.86 m/s^2 [Backward]

b. How long (in time) does he slide until he stops?

$\vec{V}_1 \rightarrow 8.23 m/s$ [forward]
$\vec{V}_f \rightarrow 0 m/s$ [forward]
$\vec{a} \rightarrow -6.86 m/s^2$ [forward]
$\Delta t \rightarrow ?$

$\vec{a} = \frac{V_f - V_1}{\Delta t}$

$\Delta t = \frac{V_f - V_1}{\vec{a}}$

$t = \frac{0 - 8.23}{-6.86}$

$t = 1.20 s$

$\therefore$ it took 1.20 s for the baseball player to stop.