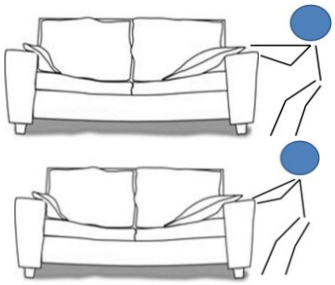
Exam 2 – Version A
Physics 220
Fall 2013

Name: _____ Group: _____

1. A boy slides down a playground slide. The force pair for his normal force is
   a. The slide on the boy
   b. The earth on the boy
   c. The boy on the earth
   d. The boy on the slide
   e. Friction

2. The earth applies a gravitational force on a ball when you drop it. Therefore the ball rushes towards the earth (in other words it falls to the ground). Your friend says, "according to Newton's 3rd law, the ball exerts just as big a force on the Earth. If that's true the Earth should rush up to meet the ball." You explain that
   a. Newton's 3rd law isn't true for gravity – a non-contact force.
   b. The acceleration is much smaller for the earth towards the ball
   c. The force of the ball on the earth is smaller than the force of the earth on the ball.
   d. The earth does rush up to meet the ball halfway.

3. A person is moving their couch in their living room. In one case, they pull perfectly horizontally. In the other they pull at an angle as shown in the 2nd diagram. In which case is it easier to move the sofa? When
   a. Pulling Horizontally
   b. Pulling at an angle
   c. Both are equally as difficult



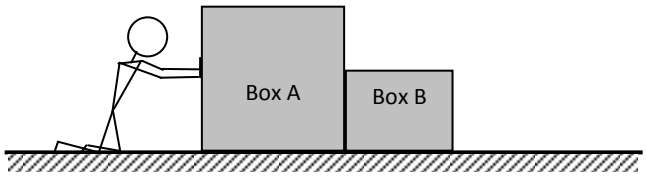
4. A large truck breaks down out on the road and receives a push back into town by a small compact car as shown in the figure below.

While the car, still pushing the truck, is traveling at a constant speed, we know that the force of the car on the truck *equals* the force of the truck on the car.

The reason for this is:
   a. since the truck is traveling at a constant speed, the net force will be zero; therefore, the two forces are equal and opposite.
   b. these two forces are force pairs so are equal and opposite.
   c. not related to the speeding up, slowing down or constant speed of the truck.
   d. Both a and b
   e. Both b and c

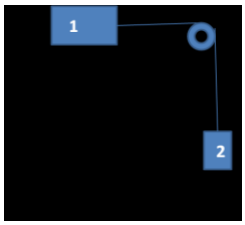
5. Two children fight over a 200 g stuffed bear. The 25 kg boy pulls to the right with a 15 N force and the 20 kg girl pulls to the left with an 18 N force. Ignore all other forces on the bear (such as its weight). What is the magnitude and direction of its acceleration?
   a. 10 m/s^2
   b. 15 m/s^2
   c. 20 m/s^2
   d. 1.5 m/s^2

6. Two boxes are being pushed on a frictionless surface, one in front of the other, as shown in the diagram. Box A has a mass of 60 kg and Box B a mass of 40 kg. The push on Box A is a horizontal force of 200 N. What is the force on Box B?
    a. 80 N
    b. 200 N
    c. 60 N
    d. 100N



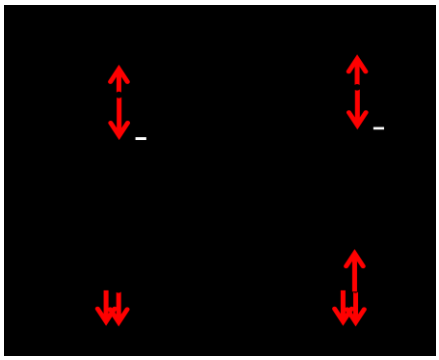
7. *Apparent weight* is defined as
    a. Gravity
    b. Mass times gravity
    c. Normal force

8. What is the acceleration of mass 2 if there is no friction on Mass 1?
    a. Less than 9.8 m/s^2
    b. 9.8 m/s^2
    c. More than 9.8 m/s^2



9. The earth's gravitational force on the sun is
    a. Larger than the sun's gravitational force on the earth.
    b. smaller than the sun's gravitational force on the earth.
    c. Equal to the sun's gravitational force on the earth.

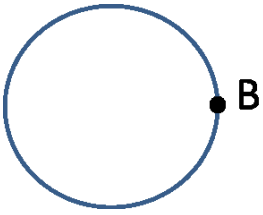
10. A ball on the end of a string swings in a horizontal circle once every second. The **magnitude** of the centripetal acceleration is
    a. Zero
    b. Constant (but non-zero)
    c. Changing



11. The ball on the end of a string is spun in a vertical circle (like your bucket swing in lab). Choose the correct free-body diagram for the instant when the ball is at the top of its swing.

12. A person is riding on a Ferris wheel. At the instant they are at the highest point,
    a. Normal force is greater than weight
    b. Normal force is less than weight
    c. Normal force equals weight
    d. We can't tell about the normal force without knowing the speed.

13. A person is riding on a Ferris wheel. At the instant they pass point B,
    a. Normal force is greater than weight
    b. Normal force is less than weight
    c. Normal force equals weight
    d. We can't tell about the normal force without knowing the speed



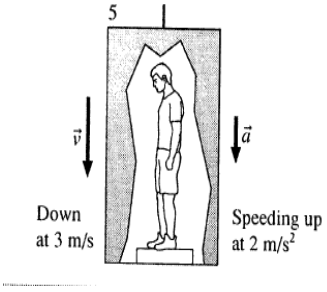
The Singapore Flyer is currently the world's tallest Ferris wheel with a diameter of 150 meters. A passenger on the Ferris wheel finds that one rotation takes 200 seconds to go all the way around.

14. What is the angular velocity of this Ferris wheel?
    a. 0.005 rad/s
    b. 0.031 rad/s
    c. 0.75 rad/s
    d. 2.4 rad/s
    e. 200 rad/s

15. What is the period of the Singapore Flyer?
    a. 0.005 s
    b. 0.031 s
    c. 0.75 s
    d. 2.4 s
    e. 200 s

16. Suppose Neptune could be moved to the location of Earth and put into a circular orbit around the sun. What would Neptune's period be in that orbit?
    a. 24 hours
    b. 365 days
    c. 165 days
    d. 11.9 years
    e. 165 years

17. A person is standing on a scale in an elevator as it moves. At the instant shown, the elevator is moving down at 3 m/s and is speeding up at 2 m/s^2. What does the scale read in Newtons if the person has a mass of 70 kg?
    a. 624 N
    b. 686 N
    c. 826 N
    d. 546 N
    e. 476 N



18. Determine the acceleration due to gravity on Jupiter.
    a. 3.77 m/s^2
    b. 8.88 m/s^2
    c. 9.8 m/s^2
    d. 25.9 m/s^2
    e. 274 m/s^2

19. A pitcher exerts a force (assumed to be horizontal and constant) on a baseball that is pitched at 40 m/s over a distance of 1.0 m, and a baseball has a mass of 145 g.
    a. Draw a free body diagram of the ball during the pitch
    b. Determine the force applied by the pitcher during the pitch.

20. A 5.0 bucket is lowered into a well. Find the tension in the rope for the following two circumstances: (Include a free body diagram and sum of forces for maximum partial credit)
    a. Acceleration downward at 2.0 m/s^2
    b. Constant velocity

21. A 35,000 kg semi's brakes fail as it heads down I-70. Luckily there's a runaway truck ramp nearby with a 10% grade. The semi enters the ramp at 30 m/s and goes up the ramp and the deep gravel quickly brings the truck to a stop in 3.0 s.
    a. Find the force of friction on the truck.
    b. Find the coefficient of friction between the gravel and tires.

$G = 6.67 \times 10^{-11}\ Nm^2/kg^2$ $\quad F_G = \frac{Gm_1m_2}{r^2}$ $\quad$ 1 radian = 57.3°

$T^2 = \frac{4\pi^2}{GM} r^3$ $\quad v = \frac{2\pi r}{T} = \sqrt{\frac{GM}{r}}$ $\quad$ 1000 g = 1 kg

$v = \omega r$ $\quad a = \frac{v^2}{r} = \omega^2 r$ $\quad f = \frac{1}{T}$

$w = mg$ $\quad \Sigma\vec{F} = m\vec{a}$ $\quad g = 9.8 m/s^2$

$v_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t}$ $\quad a_x = \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{\Delta t}$

$x_f = x_i + v_{xi}\Delta t + \frac{1}{2} a_x(\Delta t)^2$ $\quad v_{xf} = v_{xi} + a_x\Delta t$ $\quad v_{xf}^2 = v_{xi}^2 + 2a_x(\Delta x)$

$\sin\theta$ = opp/hyp $\quad \cos\theta$ = adj/hyp $\quad \tan\theta$ = opp/adj $\quad a^2 + b^2 = c^2$

Linear	**Angular**
Δx – displacement	$\Delta\theta$ - angular displacement
v – velocity	ω – angular velocity (omega)
$v = \Delta x/\Delta t$	$\omega = \Delta\theta/\Delta t$

——— $v = \omega r$ ———

	$a = v^2/r = \omega^2 r$
$F = ma$	$F = ma = m\,v^2/r = m\,\omega^2 r$

Astronomical Data

Planetary body	Mean distance from sun (m)	Period (years)	Mass (kg)	Mean radius (m)
Sun	—	—	1.99×10^{30}	6.96×10^{8}
Moon	3.84×10^{8}*	27.3 days	7.36×10^{22}	1.74×10^{6}
Mercury	5.79×10^{10}	0.241	3.18×10^{23}	2.43×10^{6}
Venus	1.08×10^{11}	0.615	4.88×10^{24}	6.06×10^{6}
Earth	1.50×10^{11}	1.00	5.98×10^{24}	6.37×10^{6}
Mars	2.28×10^{11}	1.88	6.42×10^{23}	3.37×10^{6}
Jupiter	7.78×10^{11}	11.9	1.90×10^{27}	6.99×10^{7}
Saturn	1.43×10^{12}	29.5	5.68×10^{26}	5.85×10^{7}
Uranus	2.87×10^{12}	84.0	8.68×10^{25}	2.33×10^{7}
Neptune	4.50×10^{12}	165	1.03×10^{26}	2.21×10^{7}

*Distance from earth