Student #: _____ Student Name: _____

Physics 11 Homework Unit 3: Newton's Laws of Motion

1. Are the normal force and the force of gravity on an object on a surface always equal in magnitude? Explain, or give an example.

2. Friction can be your best friend or your worst enemy. Describe a situation where friction is helpful in your daily life and a situation where friction is not helpful.

3. A man is suing the bus company for a physical injury he received while riding on the bus. He claims that the bus driver accelerated forward so quickly that a suitcase came flying from the back of the bus hitting him in the head. Use your vast knowledge of Newton's laws of motion to explain why this man does or does not have a case.

4. An $11\,\text{kg}$ block is being pushed forward on a flat surface with a force of magnitude $45\,\text{N}$. The coefficient of static friction on the block is 0.15 and the coefficient of kinetic friction on the block is 0.12.
   (a) Draw a free body diagram of the block.
   (b) What is the net force acting on the block?
   (c) What is the acceleration of the block?

5. You have a weight of $652.58\,\text{N}$ [down] while standing on a spring scale on Earth near the equator. (Hint: consult the values of g from class notes.)
   (a) Calculate your mass.
   (b) Determine your weight on Earth near the North Pole
   (c) Determine your weight on the International Space Station.

6. A student pushes a $2100\,\text{g}$ textbook along a lab bench at constant velocity with $3.50\,\text{N}$ of force.
   (a) Draw a free body diagram of the book.
   (b) Determine the normal force supporting the textbook.
   (c) Calculate the force of friction and the coefficient of friction between the book and the bench.

7. A swimmer is propelled directly north by a force of $35.0\,\text{N}$. Moving water exerts a second force of $20\,\text{N}$ [E]. Determine the net force acting on the swimmer.

8. At 560 metric tons ($1\,\mathrm{t} = 1000\,\mathrm{kg}$), the Airbus A380 is the world's largest airliner. What is the lift (upward force) generated by the wings when the plane is:
   (a) flying at constant altitude?
   (b) accelerating upwards at $1.1\,\mathrm{m/s^2}$ to avoid some bad weather?

9. A $10\,\mathrm{kg}$ box slides down a plane inclined at an angle ($\theta = 30^\circ$). The plane has a coefficient of friction ($\mu = 0.70$). The box starts from $5.0\,\mathrm{m/s}$.
   (a) Draw a free-body diagram of this situation, and label all the forces on the box.
   (b) Calculate the force of friction on the box.
   (c) Calculate the acceleration of the box.
   (d) Calculate the distance that the box moves down the plane.

10. A $100\,\mathrm{kg}$ box is sitting on a 10° incline with a coefficient of friction of 0.50. At what angle must the incline be raised to start sliding the box? (Hint: Start with a free-body diagram.)

_____ 11. When an object undergoes an acceleration,

(a) its mass always increases.
(b) its speed always increases.
(c) it always falls toward the Earth.
(d) a net force always acts upon it.

_____ 12. A force acts on an object that is free to move. If we know the net unbalanced force and the mass of the object, Newton's second law of motion enables us to determine the object's:

(a) weight
(b) position
(c) speed
(d) acceleration

_____ 13. An automobile is towing a trailer at a constant speed on a level road. The force that the automobile exerts on the trailer is

(a) equal to the force the trailer exerts on the automobile.
(b) greater than the force the trailer exerts on the automobile.
(c) equal to the force the trailer exerts on the road.
(d) greater than the force friction exerts on the trailer.

_____ 14. An automobile that is towing a trailer is accelerating on level road. The force that the automobile exerts on the trailer is

(a) equal to the force the trailer exerts on the automobile.
(b) greater than the force the trailer exerts on the automobile.
(c) equal to the force the trailer exerts on the road.
(d) equal to the force the road exerts on the trailer.

_____ 15. When a horse pulls a wagon, the force that causes the horse to move forward is the force

(a) he exerts on the wagon.
(b) the wagon exerts on him.
(c) he exerts on the ground.
(d) the ground exerts on him.

_____ 16. The frictional force between two surfaces in contact depends on

(a) the normal force pressing one against the other.
(b) the types of materials.
(c) whether a lubricant is used or not.
(d) all of the previous choices.

_____ 17. When a $1\,\mathrm{N}$ net force acts on a $1\,\mathrm{kg}$ object that is able to move freely, the object receives

(a) a speed of $1\,\mathrm{m/s}$.
(b) an acceleration of $0.102\,\mathrm{m/s^2}$.
(c) an acceleration of $1\,\mathrm{m/s^2}$.
(d) an acceleration of $9.8\,\mathrm{m/s^2}$.

_____ 18. The weight of $600\,\text{g}$ of salami is:

(a) $0.061\,\text{N}$
(b) $5.9\,\text{N}$
(c) $61\,\text{N}$
(d) $5880\,\text{N}$

_____ 19. A $2400\,\text{kg}$ car accelerates from $10\,\text{m/s}$ to $30\,\text{m/s}$ in $10\,\text{s}$. The average net force acting on the car is:

(a) $816\,\text{N}$
(b) $8000\,\text{N}$
(c) $12\,000\,\text{N}$
(d) $4800\,\text{N}$

_____ 20. The coefficient of static friction between two wooden surfaces is:

(a) 0.5
(b) $0.5\,\text{N}$
(c) $0.5\,\text{kg/N}$
(d) $0.5\,\text{N/kg}$

_____ 21. A minimum force of $40\,\text{N}$ is needed to set a $10\,\text{kg}$ steel box moving across a wooden floor. The coefficient of static friction is:

(a) 0.08
(b) 0.25
(c) 0.4
(d) 2.5

_____ 22. The coefficient of static friction for steel on ice is 0.10. The force needed to set a $70\,\text{kg}$ skater in motion is approximately:

(a) $0.1\,\text{N}$
(b) $0.7\,\text{N}$
(c) $7\,\text{N}$
(d) $70\,\text{N}$

_____ 23. The Moon's mass is much smaller than Earth's mass. Compared to the gravitational force Earth exerts on the Moon, the gravitational force the Moon exerts on Earth

(a) is smaller
(b) is the same
(c) is greater
(d) is zero

_____ 24. A woman whose mass is $60\,\text{kg}$ on the Earth's surface is in a spacecraft at a height of one Earth's radius above the surface, where $g = 2.45\,\text{m/s}^2$. Her mass is:

(a) $15\,\text{kg}$
(b) $30\,\text{kg}$
(c) $60\,\text{kg}$
(d) $147\,\text{kg}$

_____ 25. A man whose weight is $800\,\text{N}$ on the Earth's surface is also in a spacecraft at a height of one Earth's radius above the earth, where $g = 2.45\,\text{m/s}^2$. His weight there is:

(a) $200\,\text{N}$
(b) $400\,\text{N}$
(c) $800\,\text{N}$
(d) $0\,\text{N}$

_____ 26. Astronauts feel a sensation of "weightlessness" even in orbits close to the Earth due to

(a) $g = 0\,\text{m/s}^2$ at that radius
(b) the pull of the moon pulling in the opposite direction
(c) nausea
(d) the "free fall" of both the spacecraft and its contents

_____ 27. A $1000\,\text{kg}$ car accelerates from $25\,\text{m/s}$ to $35\,\text{m/s}$ under a net force of $500\,\text{N}$. The distance that it travelled is:

(a) $150\,\text{m}$
(b) $150\,\text{km}$
(c) $375\,\text{m}$
(d) $600\,\text{m}$

_____ 28. The action and reaction forces referred to in Newton's third Law

(a) act upon the same object.
(b) act upon different objects.
(c) need not to be equal in magnitude but need to have the same line of action.
(d) must be equal in magnitude but need not to have the same line of action.

_____ 29. A horizontal force of $150\,\text{N}$ is applied to a $51\,\text{kg}$ carton (initially at rest) on a level floor. The coefficient of static friction is 0.50. The frictional force acting on the carton if the carton does not move is:

(a) $150\,\text{N}$
(b) $200\,\text{N}$
(c) $250\,\text{N}$
(d) $500\,\text{N}$

_____ 30. The coefficients of static and sliding (kinetic) friction for wood on wood are respectively 0.50 and 0.30. If a $100\,\text{N}$ wooden box is continually pushed across a horizontal wooden floor with just enough force to overcome the force of static friction, the moving box's acceleration is:

(a) $0.2\,\text{m/s}^2$
(b) $0.5\,\text{m/s}^2$
(c) $2.0\,\text{m/s}^2$
(d) $5.0\,\text{m/s}^2$

_____ 31. A toboggan reaches the foot of a hill at a speed of $4.0\,\text{m/s}$ and coasts on level snow for $15\,\text{m}$ before coming to a stop. The coefficient of sliding friction is:

(a) 0.004
(b) 0.05
(c) 0.16
(d) 0.27

_____ 32. If Earth were 3 times farther from the sun than it is now, the gravitational force exerted on it by the sun would be

(a) three times as large as it is now.
(b) nine times as large as it is now.
(c) one-third as large as it is now.
(d) one-ninth as large as it is now.

_____ 33. A shoe sits on a ramp without moving. As the angle of the ramp is increased, the shoe starts to move. This is because

(a) the normal force has increased.
(b) the coefficient of static friction has decreased.
(c) the component of the normal force along the ramp has increased.
(d) the component of gravity acting along the plane of the ramp has increased.

34. Which of Newton's laws is being exemplified in the following paragraph, where the sentences have been separated? Place the number of the law after each statement which describes the motion or event.

(a) A car is travelling straight down the road at a constant speed. _____

(b) The driver turns the steering wheel but the slippery conditions result in the car failing to change direction. _____

(c) The car slides across the intersection without losing speed or changing direction. _____

(d) The car slams into a large snow bank and quickly comes to a stop. _____

(e) The driver (with no seatbelt or airbag) is "thrown" forward towards the windshield. _____

(f) The face of the driver slams into the windshield and stops rapidly. _____

(g) The windshield is broken and the driver's nose is also broken and very painful. _____

35. Draw a neat, properly labelled free-body diagram for each of the following objects. Indicate the size of forces with the lengths of the arrows. (i.e. if two forces are the same size, then draw the arrows the same length; if they are different sizes, then draw the larger force longer.) Forces on the may or may not include weight F_g, normal force F_N, friction F_f, and applied force F_a.
    (a) A cart being pushed up along a ramp.
    (b) The Space Shuttle accelerating vertically immediately after leaving the launch pad.
    (c) A car going straight on the highway at $100\,\mathrm{km/h}$.
    (d) A baseball just after it leaves the pitcher's hand.