Assignment 2
Unit 2 – Newton's Laws
(Outcomes 325-5, 325-8)

Name:_____

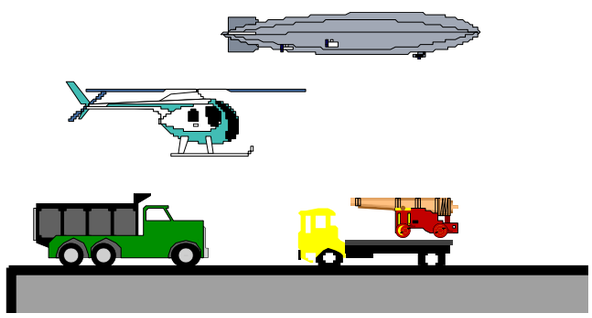
<u>Multiple Choice:</u> **Show all workings for questions that involve multiple choice.**

1 Which choice represents a NON-INERTIAL frame of reference?
(A) a bicycle traveling at 20 km/h [West]
(B) a race car going around a circular track at 200 km/hr
(C) a balloon moving at constant velocity straight upwards.
(D) a spacecraft sitting on the surface of Mars

2 What physical principle is being demonstrated in this situation: a person's head moves rapidly backwards when a rear end collision occurs?
(A) Newton's law of acceleration
(B) Newton's law of action and reaction
(C) Newton's law of inertia
(D) Newton's law of gravitation

3 Which way will an object swing if it is hanging from the rear view mirror of a car moving down a straight road at a constant speed and the car suddenly accelerates?
(A) backward
(B) forward
(C) left
(D) right

4 The driver of a flat bed truck has to suddenly brake to avoid colliding with a stationary truck. For which observer does the 1st Law of motion **fail** to provide an adequate explanation for the resulting motion of the cannon?
(A) The driver of the flat bed truck.
(B) The driver of the parked dump truck.
(C) The pilot of the helicopter, travelling East at a uniform velocity.
(D) The pilot of the blimp, hovering motionless above the scene.



5 Which situation is best explained using Newton's ***second*** Law of Motion?
(A) A care package released from a plane at a height of 200 m lands on the target just as the plane flies over the target.
(B) A cassette tape resting on the dash of a car slides to the right as the car makes a sharp turn to the left.
(C) A train requires a larger force to accelerate it than does a bicycle.
(D) Dust is removed from a cloth by shaking it.

6 An elevator is moving downward at a **<u>constant speed</u>**. Which statement about the forces on the elevator is true?
(A) the forces upward and downward may be equal or unequal.
(B) the forces upward and downward must be equal.
(C) there must be an unbalanced force downward.
(D) there must be an unbalanced force upward.

7 Which quantity is **<u>always</u>** in the same direction as acceleration?
(A) displacement
(B) final velocity
(C) initial velocity
(D) net force

8 Which of the following safety features on an automobile **do not** use principles of dynamics?

(A) Air Bags
(B) Collapsible bumpers
(C) Rear window brake lights
(D) Seat Belts

9 A rocket accelerates upward and the thrust of the engines overcome the frictional forces and the gravity acting against the rocket. Which of Newton's laws of motion best explains this situation?

(A) Newton's first law
(B) Newton's second law
(C) Newton's third law
(D) All the laws combine to explain this situation

10 An iron, sitting on the ironing board, exerts a downward force of 3.5 N on the board. Which of the following would be categorized as the so-called "reaction force?"

(A) The board exerts a downward force on the floor that is increased by 3.5 N (the iron's weight).
(B) The board exerts an upward force of 3.5 N on the iron.
(C) The force is caused by gravity. The iron merely reacts to the earth.
(D) The iron exerts an additional 3.5 N on the board.

11 So-called "action" and "reaction" forces always occur in pairs. Why don't these forces cancel each other?

(A) The action and reaction forces act in the same direction.
(B) The action and reaction forces act on different objects.
(C) The action force is always greater than the reaction force.
(D) The reaction force acts only after the action force is removed.

12 The diagram shows a point P at the place where the stem of the apple meets the apple. F1 is the force of the stem on the apple; F3 is the force of the apple on the stem; F2 is the force of the apple on the earth; F4 is the force of the earth on the apple. Which two forces form an action reaction pair?

(A) F1 and F2
(B) F1 and F3
(C) F1 and F4
(D) F2 and F3

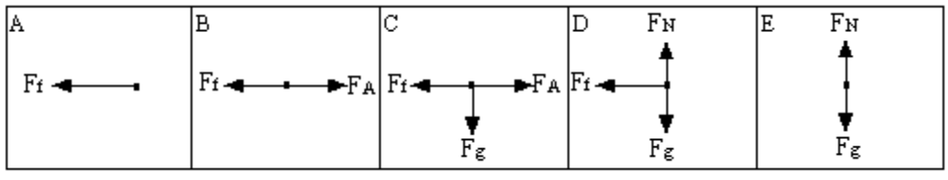
13 If at a constant speed, the force that the tractor exerts on the sled is equal to the force that the sled pulls on the tractor, what force is moving the tractor and the sled forward?

(A) the backward force of the sled on the tractor
(B) the backward force of the tractor's tires on the ground
(C) the forward force of the ground pushing on the tractor's tires.
(D) the froward force of the tractor on the sled.

14 A hockey stick hits a puck with a force of +800 N. With what force does the puck hit the hockey stick?

(A) –400 N
(B) –800 N
(C) Almost 0 N.
(D) Slightly less then +800 N

15 A hockey puck slides along an ice surface shortly after it has left the hockey stick that propelled it. Which of the following free-body diagrams best represents the hockey puck?



16 A parachutist, whose mass is 80 kg is falling at a constant velocity of 8.0 m/s. What is the net (unbalanced) force on the parachutist?
(A) 0 N
(B) 80 N
(C) 640 N
(D) 800 N

17 The acceleration of a rocket missile is 5 m/s^2. If the mass of the missile is halved (by burning its fuel) while the force on it triples, what will be its acceleration?
(A) 5.0 m/s^2
(B) 7.5 m/s^2
(C) 15.0 m/s^2
(D) 30.0 m/s^2

18 A force of 10 N acts on a 0.5 kg block causing it to slide from rest across a horizontal surface. If the force of sliding friction is 5 N, what is the velocity of the block after 5 s?
(A) 20 m/s
(B) 40 m/s
(C) 50 m/s
(D) 100 m/s

19 A box with a mass of 10.0 kg is accelerated from rest to 4.00 m/s in 1.00 s. The force of kinetic friction on the box is 5.00 N. What is the magnitude of the applied force?
(A) 9.00 N
(B) 35.0 N
(C) 40.0 N
(D) 45.0 N

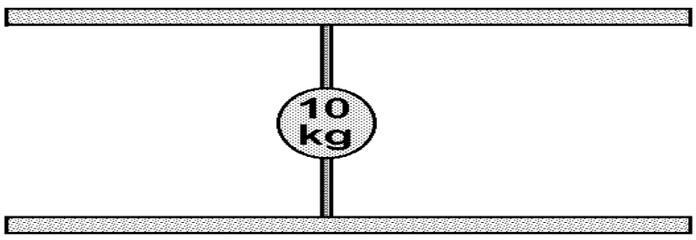
20 An applied force of 200.0 N gives a sled an acceleration of 2.00 m/s^2. If you place an additional 60.0 kg mass on the sled, what will be the acceleration?
(A) 1.00 m/s^2
(B) 1.25 m/s^2
(C) 1.50 m/s^2
(D) 1.75 m/s^2

21 A 2.5×10^3 kg car is travelling due west at 30 m/s when the brakes are applied, exerting a force of 5.0×10^3 N [E]. What is the car's acceleration due to the braking?
(A) 2.0 m/s^2 [E]
(B) 2.0m/s^2 [W]
(C) 15 m/s^2 [E]
(D) 15 m/s^2 [W]

22 The free-body diagram below represents a 200-g rock suspended by a string. What is the rock's acceleration? (Assume 2 significant digits.)
(A) 6.2×10^{-3} m/s^2 [up]
(B) 0.25 m/s^2 [down]
(C) 6.2 m/s^2 [up]
(D) 33 m/s^2 [down]

23 Two skaters, one with a mass of 70.0 kg and the other with a mass of 60.0 kg, are facing each other in the middle of an ice rink. One of them pushes the other with a force of 420 N for 0.10 s. What speed will the 70.0 kg skater reach? Neglect friction.
(A) 0.60 m/s
(B) 0.70 m/s
(C) 6.0 m/s
(D) 7.0 m/s

24 A box of mass 10.0 kg is suspended between the floor and the ceiling by two ropes. The lower rope has tension of 40.0 N. What is the tension in the upper rope?
(A) 30 N
(B) 50 N
(C) 58 N
(D) 138 N



Long Answer: Show **all** workings. **Draw FBD where appropriate.**

25 Each of the following is an illustration of one of Newton's Laws of motion. For each, state which law applies and give reasons. **{6}**

(A) A large cannonball is difficult to get rolling. Once started it is difficult to stop.

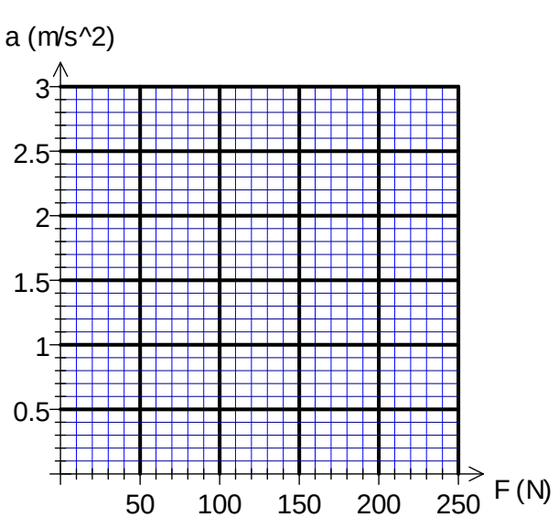
(B) A force of 10 N will accelerate a large brick at 2 m/s. If the brick is twice as large, however, it will only accelerate at 1 m/s.

(C) When you slam on the brakes of a pickup, thing that are stored away in the pan tend to slide forward.

26 In order to observe the effect of increased force on acceleration, two students used the following procedure: One student stood on a skateboard while the other applied various forces using a tow rope. A Vernier ultrasonic motion detector measured the acceleration. The following results were obtained:

F (N)	50	100	150	200	250
a (m/s^2)	.25	.88	1.6	2.1	2.7

(A) With force on the *y*-axis, plot a neat graph of the results obtained. {4}



(B) Explain whether or not the results support Newton's Second Law of Motion. {2}

(C) Explain how the *y*-intercept of the graph helps you to determine the amount of friction that was present. {2}

(D) The mass of the skate-board is 4 kg. Use the slope of the graph obtained in part (a) to help you determine the mass of the person on it. {3}

(E) Suppose that you were to repeat the measurements above except you used a person whose combined mass of himself and the skateboard was twice as great as the one that you used previously. Use Newton's second law of motion to help you explain how the results would be different. {2}

27 A hockey puck of mass 200 g slides along the ice with a speed of 1.2 m/s when it reaches a rough section where the force of friction is 0.49 N. How long will it take the puck to stop sliding? Include a free-body diagram. (Assume 2 significant digits.) **{4}**

28 Suppose you have two identical cans, one filled with lead and the other empty, and you are in an orbiting spaceship where the two cans are "weightless." How could you tell which has the greater mass? **{3}**

29 A box of mass 4.5 kg is pushed across a rough surface against a frictional force of 2.1 N. for a distance of 2.0 m by a constant force of 10 N. If the object reaches a speed of 3.0

m/s by the end of the push, what was its speed at the beginning of the push? (Assume 2 significant digits.) **{4}**

30 A force of 16.2 N is applied, at an angle of 28^{o} to the horizontal, to a dynamics cart with a mass of 1.43 kg. A frictional force of 5.6 N resists the motion. Calculate the acceleration of the cart. **{4}**

31 A tow rope is directed upwards at an angle of 48^{o} to the horizontal. When a force of 243 N is applied to the tow rope, it accelerates the attached mass at 2.1 m/s^2. If the frictional force is 87 N, what is the mass of the moving object? **{4}**

32 The driver's handbook states that the minimum safe distance between two vehicles on the highway is the distance the vehicle can travel in 2.0 s at a constant speed. Assume that a 1 200 kg car is travelling at 72 km/h [S] when a truck ahead crashes into a northbound truck and stops suddenly.

(A) If the car is at the required safe distance behind the truck, what is the separation? **{2}**

(B) If the average breaking force exerted by the car is 6 400 N [N], how long would it take the car to stop? **{3}**

(C) Determine whether or not a collision would occur. The driver's reaction time is 0.20 s. **{4}**

33 An elevator and its passengers have a combined mass of 650 kg. If the elevator descends with an acceleration of 2.5 m/s^2, what will be the tension in the supporting cable? **{4}**

34 A skydiver jumps from a plane and at some point during his fall, he is accelerating at 6.0 m/s^2. If his mass is 71.4 kg, what is the frictional force at that point? **{4}**

35 A swimmer releases a 16.5 kg rock from rest under water. If the resistance and buoyancy provided by the water is 125 N, how long will it take for the rock to fall 1.9 m? **{5}**

36 Just prior to a satellite recovery in the ocean, a parachute attached to a 165 kg satellite exerts a retarding force of 1278 N. Calculate the satellite's acceleration. **{4}**