1. Define the following terms: **(4M)**

    a. force

    b. momentum

    c. inertia

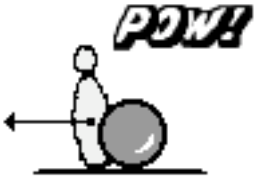
    d. contact force

2. State Newton's Second Law of Motion. **(2M)**

3. State Newton's Third Law of Motion. **(2M)**

4. In the following two questions, one of the forces in the mutual interaction is described. You are required to describe the other force in the action-reaction force pair (direction of the force and which object is acting upon the other). **(4M)**

   a. Baseball pushes glove leftwards.



   b. Bowling ball pushes pin leftwards.

5. The following question deals with a marble that is placed in the middle of the rooftop of Mr S's car. If my car starts forward quickly from a stopped position, then: **(4M)**

   a. Predict where the marble will roll to first.

   b. Explain your prediction in terms of Newton's first law of motion.

6. The following question deals with a marble that is placed in the middle of the rooftop of Mr S's car. As my car moves forward at a constant speed, I apply the brakes and turn right at the same time. **(4M)**

   a. Predict where the marble will roll to first.

   b. Explain your prediction in terms of Newton's first law of motion.

7. You will use a vector diagram in the following questions. You will use a scale of 1 cm = 2 N of force to draw both these diagrams: **(6M)**

   a. A force of 12 N pushes to the left and a second force of 18 N pushes to the right.

      i. Calculate the NET force acting.

      ii. Draw third vector that represents the NET result of the two acting forces

      iii. If the object on which the forces are acting weighs 4 kg, determine the acceleration of the object.

   b. A force of 16 N pushes down while a second force of 22N pulls to the left. **(5M)**

      i. Draw each force vector acting on the box included below.

      ii. Draw a third vector that represents the NET result of the two acting forces.

      iii. Using your scale, determine the amount of the NET force and its direction.

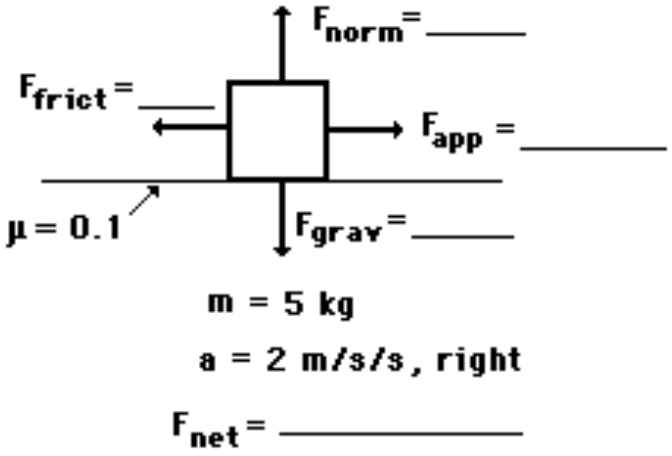
8. Draw free body diagram to show the forces acting in the following questions: **(6M)**

   a. Show and label the forces acting on the bicycle as Mr S is pushing his son's bicycle to the right while his son is learning to ride a bicycle.

   b. Show and label the forces acting on a wagon as Mr S pulls his youngest son to the left in the wagon (Hint: the handle of the wagon is on an angle while I pull.)

   c. Show and label the forces acting on my computer as it is resting upon my desk

9. Use the provided free body diagram to answer the following question: A rightward force is applied to a 5-kg object to move it across a rough surface with a rightward acceleration of 2 m/s/s. The force of friction between the object and the surface is 5.0 N. Use the diagram to determine the gravitational force, normal force, applied force, and net force. (Neglect air resistance.) **(4M)**



For the following word problems, remember the required presentation method. First, list your given & unknown information, write the appropriate formula, show the necessary work and make sure units are included in the final answer.

10. A sailboat that weighs 845 kg is being pushed by a wind force of 400 N. What is the acceleration of the sailboat? **(4M)**

11. The sailboat in the previous question is being pushed by a net wind force of 400 N, but experiences a resisting frictional force (due to the water) of 250 N. What is the new acceleration of the sailboat? (**4M)**

12. A bicycle and its rider have a combined mass of 90 kg. The acceleration is 0.5m/s^2. What is the force being exerted? **(4M)**

13. Which cart has more momentum? Cart A has a mass 1.050 kg is moving at 3.5 m/s. Cart B has a mass of 2.150 kg and is moving at 2.5 m/s. Show the mathematical analysis that leads to your conclusion. (**4M)**

For the following word problems, remember the required presentation method. First, list your given & unknown information, write the appropriate formula, show the necessary work and make sure units are included in the final answer.

14. A ball with a mass of 0.060 kg accelerates from 2.5 m/s to 6.0 m/s in 1.1 s. What was the average net force applied to it? **(5M)**

15. A tugboat is traveling at 2.0 m/s and has a mass of 9500 kg. It cuts engines just as it collides with a stationary barge of mass 8500 kg and locks up with it. What is the speed of the two boats after the collision, given that momentum is conserved in the collision? **(5M)**

16. An ICP class was experimenting with balloon jets and investigating the relationship between the mass of the balloon jet and the acceleration of the jet. A group of students generated the following data:

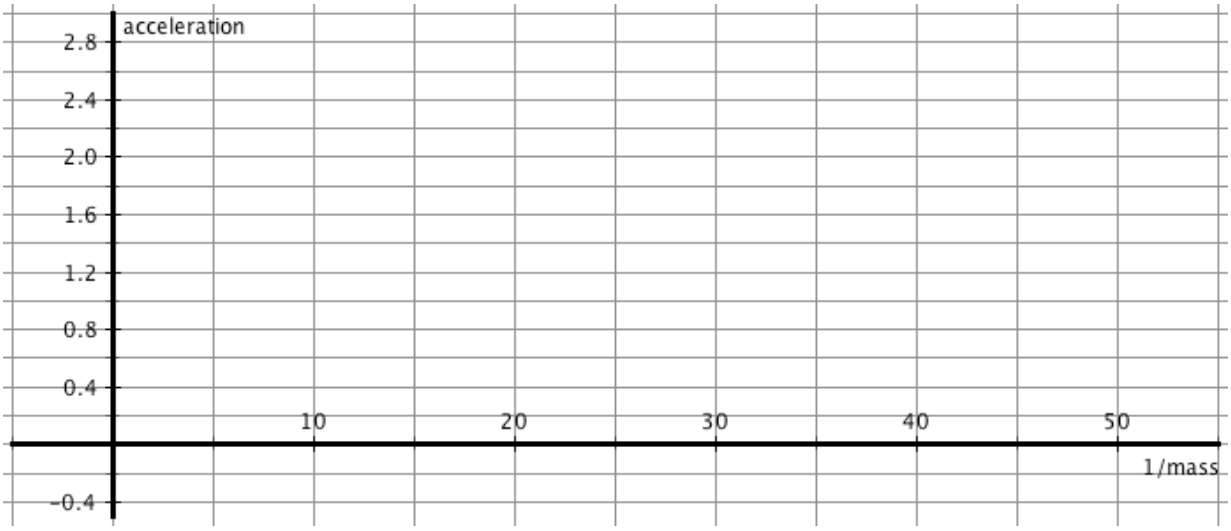
Mass (grams)	20	40	60	80	100	200
Acceleration (m/s^2)	?????	1.14	0.78	0.61	0.48	0.22

a. Experimental Data analysis: The first acceleration is not given, but the students timed the balloon jet and it traveled along the 4.8 m string in 2.02 seconds. Use this information to calculate the acceleration in the first experimental trial. **(2M)**

b. Experimental Data Analysis: Determine the reciprocal of the mass (in kilograms) and complete the data chart below: (**1M)**

1/mass						
Acceleration (m/s^2)		1.14	0.78	0.61	0.48	0.22

c. Now prepare a graph of graph 1/m versus acceleration, calculate the slope and interpret what the slope means in this experiment. **(6M)**

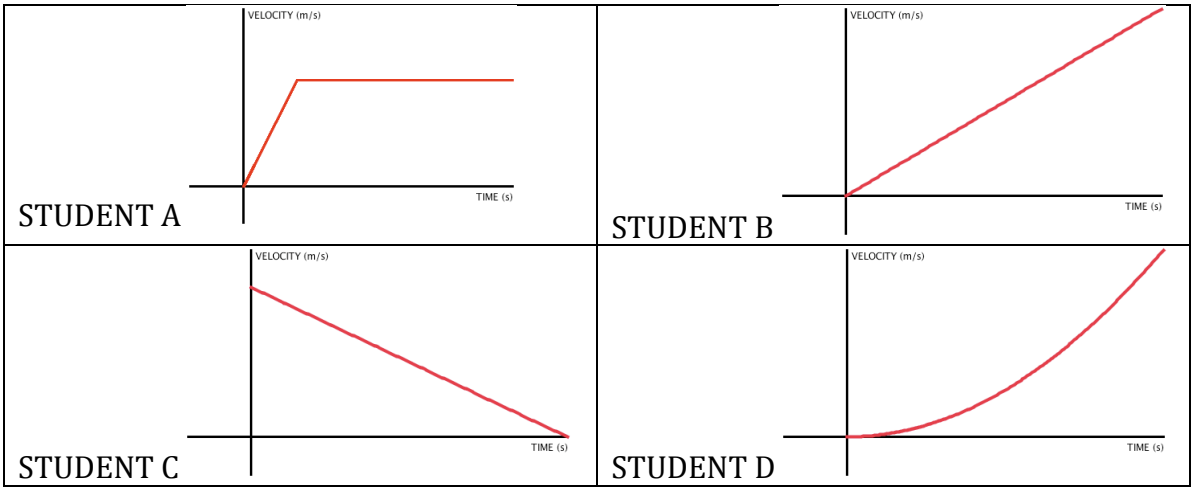


17. An ICP class is conducting an experiment wherein they are testing a hypothesis about forces and motion.

HYPOTHESIS: If a constant force is applied to a stationary object, then the object will achieve and then maintain a state of constant speed.

EXPERIMENT: They use a constant force to push a student on a skateboard who drops markers at intervals of one second.

DATA: Four different students do the experiment, analyze their data and display their data on the following VELOCITY – TIME graphs:



a. Which student's graph SUPPORTS the hypothesis? Explain why. **(2M)**

b. Is the class's hypothesis CORRECT in the first place? Explain your answer or give a correct hypothesis. **(2M)**

c. Which student's graph SUPPORTS a CORRECT hypothesis. Explain why. **(2M)**

d. Explain what the graph of Student C shows about the motion of the rider. **(2M)**