Quiz 04: Newton's Laws

The table on the right summarizes data collected for the cart and hanger system. The acceleration shown is the value measured experimentally.

Trial	Cart M (kg)	Hanger m (kg)	Acceleration (m/s^2)	Force (N)
1	0.564	0.010	0.119	0.098
2	0.559	0.015	0.203	0.147
3	0.554	0.020	0.335	0.196
4	0.549	0.025	0.372	
5	0.545	0.030	0.457	0.294
6	0.539	0.035	0.541	0.343

1. Using Newton's Second Law, what is the correct way to predict the acceleration of the system?

   A) $a = (m + M)g$

   B) $a = \dfrac{(m + M)g}{m}$

   C) $a = \dfrac{mg}{(m + M)}$

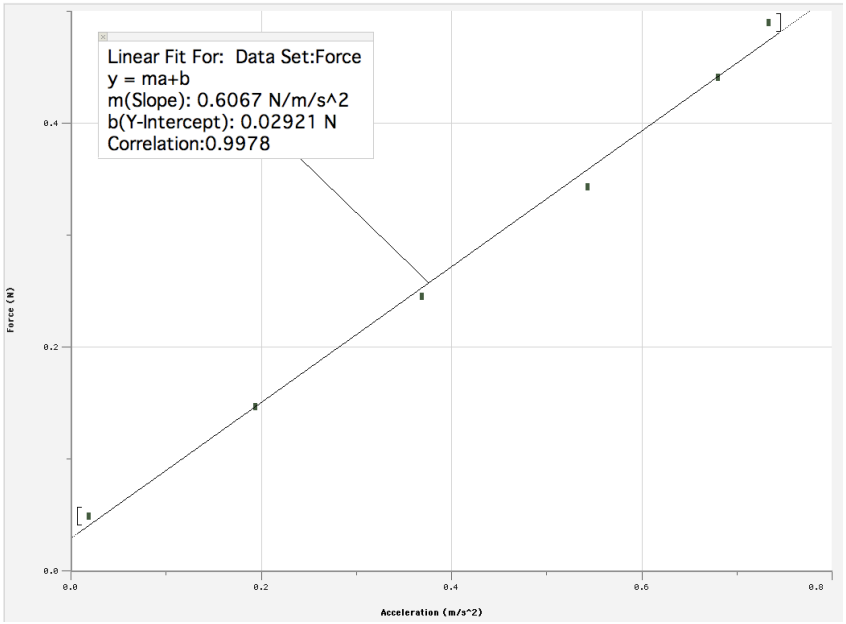
   D) $a = \dfrac{(m + M)}{mg}$

2. For the **second trial**, calculate this **predicted acceleration** of the system using the method you used in lab.

$$a = \frac{(0.015\text{kg})\left(9.8\,\frac{\text{m}}{\text{s}^2}\right)}{(0.559 + 0.015)\text{kg}} = 0.256\,\frac{\text{m}}{\text{s}^2}$$

3. For the **fourth trial**, calculate the amount of **force** exerted by gravity on the hanging mass m.

$$mg = (0.025\text{kg})\left(9.8\,\frac{\text{m}}{\text{s}^2}\right) = 0.245\text{N}$$



4. The data in the table have been plotted on the right. What does the **slope** of this graph represent?
   A) The units are force per speed, so the slope represents how much force is required to move the cart at 1 m/s down the track..
   B) The slope represents the system mass, which is the cart + hanger + extra disks = 0.574 kg.
   C) The slope represents the mass of the cart alone. The hanger and disks are not part of the system mass.
   D) The slope represents the system acceleration, because F = ma.
   E) The slope has no real physical meaning. That the graph is a line is just a coincidence. A different cart pulled by different masses might graph as a parabola or some other shape.

5. How **accurate** is this graph?
   A) 99.78% accurate. This is what the correlation coefficient is telling us.
   B) The correlation coefficient actually tells us that there is (100-0.99.78)% = 0.22% random error in the results.
   C) The intercept b = 0.02921 indicates that the data have about 2.9% associated random error.
   D) There is a 5.7% error in the slope, compared to the predicted value.
   E) There are several data that do not fall on the line. This tells us that the results have been compromised, so there is no point calculating a % error.

6. Our analysis in lab was incomplete. We ignored several possible forces acting on the system. Consider the effect of **friction** between the wheels of the cart and the track.
   A) Rolling friction would oppose the motion of the cart. The system acceleration would be smaller than we predicted.
   B) Rolling friction would act on the cart in the direction of motion. System acceleration would be greater than predicted.
   C) Static friction would cause the cart to move. The system acceleration would be greater than we predicted.
   D) Static friction would oppose the motion of the system, making the acceleration smaller than the predicted value.
   E) Static and rolling friction would be equal and opposite. This would result in no change in our predicted acceleration.

7. Would the effect of **friction** be random or systematic? Answer **A) Random** or **B) Systematic**.

8. If the track was not level, the force on the cart due to gravity would have to be resolved into components parallel and perpendicular to the track. The component perpendicular to the track would be balanced by the normal force. What effect on the system would the component parallel to the track have? Assume that the track is sloped so that the cart travels **uphill**.
   A) None.
   B) The experimental system acceleration would be smaller than predicted.
   C) The experimental system acceleration would be greater than predicted.

9. Would the effect of track tilt be random or systematic? Answer **A) Random** or **B) Systematic**.