Motion and Design Summative Assessment

1. When using a falling-weight system, if you increase the force (by increasing the number of washers) you,
   a. Increase the speed of the vehicle
   b. Decrease the speed of the vehicle
   c. Do not affect the speed of the vehicle
   d. Affect the speed of the vehicle in an unpredictable way

2. In a falling-weight system, what force gives the push or pull needed to move the vehicle?
   a. Friction
   b. Gravity
   c. Washers
   d. Rubber band

3. Look at the line plot and the data that are recorded on it. What is the average time for the vehicle carrying a one-block load to travel a certain distance?
   a. 1 second
   b. 2 seconds
   c. 3 seconds
   d. 4 seconds

4. You have used a falling-weight system to test the effect that load has on the time needed to travel a certain distance. You tested a vehicle only, a vehicle and one block, a vehicle and two blocks. What would happen if you tested a vehicle and three blocks?
   a. The time needed to travel the same distance would increase.
   b. The time needed to travel the same distance would decrease.
   c. The speed of the vehicle would increase.
d. The load of the vehicle would decrease.

5. In order to make the vehicle in this picture travel from left to right across the page, you would wrap the rubber band around the rear axle (the axle with the large tires). Which way would you wrap the rubber band around the axle?
   a. Under the axle and then clockwise
   b. Over the axle and then counterclockwise around it.

6. When testing your vehicle, you discover that friction affected its movement. Some friction is needed and has a positive effect, and some friction has a negative effect. Which of the examples below describes good or useful friction?
   a. The axle turning inside the yellow connector.
   b. Wheels rubbing against the frame.
   c. Rubber tires making contact with the ground when using a rubber band wrapped around the axle for power.

7. The more turns of the rubber band of the propeller-driven vehicle, the more potential energy is stored?
   a. True
b. False

8. Which of the pictures below shows the sail that would be affected by the wind the least?

Explain your thinking:

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

9. Your design team has designed a Final Design Challenge vehicle. You have tested it and your test time is slower than the challenge time. Write “Yes” next to any of the ways listed below that could possibly help your team get a faster time. Write “No” next to those ideas that would not help you reduce your time.

_____ drag weights behind the vehicle
_____ less turns of the rubber band
_____ increase friction
_____ decrease friction
10. Write a **short paragraph** to explain why, as part of the design process, it is so important to test and evaluate your design before the design goes into production?

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_____________________________________________________________________________________
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_____________________________________________________________________________________
_____________________________________________________________________________________

11. What provides the force in this system?
   a. Friction
   b. Gravity
   c. Rubber bands
   d. Wooden blocks
12. What best describes force?
   a. Any heavy weight
   b. Any lighter weight
   c. Any push or pull
   d. Anything measured in pounds

13. Using the data table above why did Matt and Jan run each vehicle 3 times?
   a. For more accurate data
   b. To give everyone a turn
   c. To try different locations
   d. To try different vehicle

<table>
<thead>
<tr>
<th>Number of Turns of the Rubber Band</th>
<th>Distance Traveled (in cm)</th>
<th>Selected Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 1</td>
<td>Trial 2</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>23</td>
<td>33</td>
</tr>
</tbody>
</table>

14. Using the data table from above what is the changed variable?
   a. Kinds of vehicles
   b. Number of rubber bands
   c. Size of rubber bands
   d. Turns of rubber bands
15. Jake’s vehicle traveled 3 meters in 7.5 seconds. The vehicle needs to travel that distance in under 6 seconds. What should Jake do?
   a. Add more wood blocks
   b. Take off some of the wood blocks
   c. Use less force
   d. Decrease speed of fan.

16. Which two tools could be used to collect data needed to calculate the average speed?
    Describe how each tool is used.

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_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

A standard race car was tested using 2, 4, and 8 turns on a rubberband to measure the distance it would travel. The distances were labeled A, B and C.
The track looked like this:

![Diagram of the track]

17. Which letter best represents the distance the racecar traveled when the rubber band was wound two times? ______________

Explain your choice.

_____________________________________________________________

_____________________________________________________________

17. (Continued)____________________________________________________

_____________________________________________________________

_____________________________________________________________

18. When a vehicle increases its speed, what happens?

   a. Less distance is covered every minute
   b. More distance is covered every minute
   c. The same distance is covered every minute

**Qualifying Trial Data**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Plan 1</th>
<th>Plan 2</th>
<th>Plan 3</th>
<th>Plan 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of turns on the rubber band</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Number of blocks carried</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total distance racecar traveled (cm)</td>
<td>379 cm</td>
<td>490 cm</td>
<td>410 cm</td>
<td>445 cm</td>
</tr>
</tbody>
</table>
19. Using the data collected in the chart, describe two differences between the plans and explain why the difference changed the race results?

_________________________________________________________________

_________________________________________________________________

20. Describe how the rubber band energy and the distance the car travels are related to each other?

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

21. Which racecar would cross the finish line first? __________________________

Explain your answer.

_________________________________________________________________

_________________________________________________________________
Falling Weight System 2

22. Which truck will cross the finish line first? Explain why.

_________________________________________________________________
_________________________________________________________________

Number of Washers vs. Speed of Vehicle

<table>
<thead>
<tr>
<th>Number of Washers</th>
<th>Movement (Speed) of Vehicle</th>
<th>Observation</th>
<th>Rank Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 1</td>
<td>Trial 2</td>
<td>Trial 3</td>
</tr>
<tr>
<td>5</td>
<td>Barely Moved</td>
<td>Barely</td>
<td>Barely</td>
</tr>
<tr>
<td></td>
<td>Moved</td>
<td>Moved</td>
<td>Moved</td>
</tr>
<tr>
<td>10</td>
<td>Steady Movement</td>
<td>jerked,</td>
<td>Moved</td>
</tr>
<tr>
<td></td>
<td>then moved</td>
<td>then moved</td>
<td>along</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>steadily</td>
</tr>
<tr>
<td>16</td>
<td>Zipped to the book</td>
<td>Quickly</td>
<td>Flew to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moved</td>
<td>the book</td>
</tr>
<tr>
<td></td>
<td></td>
<td>book end</td>
<td>end</td>
</tr>
</tbody>
</table>
Use the data collected in the above chart to answer the following questions.

23. Which variable was kept the same (controlled) variable in this investigation?
   a. Length of the string
   b. Movement of the vehicle
   c. Amount of washers used

24. Which variable was the changed (manipulated) variable in this investigation?
   a. Type of vehicle
   b. Speed of vehicle
   c. Number of washers

25. Which variable was the measured (responding) variable in this investigation?
   a. Movement (speed) of vehicle
   b. Length of vehicle
   c. Mass of vehicle