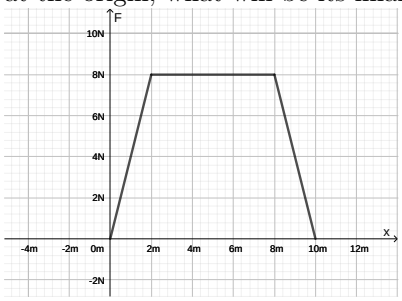
Honors Exam 2, Part 1: MC

Full Name, Period, AP/Honors:

Remember to budget your time. You will have about 3 minutes for each MC. **If you require clarification of what is being asked in a problem, please ask.**

1 Multiple choice

1. You have the following plot of net force as a function of position. If the 2kg object was initially at rest at the origin, what will be its final speed when it reaches 10m?



   A. 0
   B. 8 $\frac{\text{m}}{\text{s}}$
   C. 10 $\frac{\text{m}}{\text{s}}$
   D. 64 $\frac{\text{m}}{\text{s}}$
   E. None of the above.

2. Earth and the Sun experience an attractive gravitational force of F. If there was another planet that was $\frac{1}{1000}$ as massive as the sun and about 5 times as far away, what would be the gravitational force between Earth and that planet?

   A. $\frac{1}{5} \times 10^3 F$
   B. $25 \times 10^{-3} F$
   C. $5 \times 10^{-3} F$
   D. $\frac{1}{25} \times 10^3 F$
   E. $\frac{1}{25} \times 10^{-3} F$

3. You use a spring with coefficient k to launch an object with mass m straight vertically off of the ground. If the spring was compressed by some distance x, what will be the maximum height reached by the object?

   A. $\frac{kx^2}{2mg}$
   B. $\frac{2kx^2}{mg}$
   C. $\frac{2k^2}{xmg}$
   D. $\frac{mgx}{2k^2}$
   E. $\frac{x}{kmg}$

4. Which of these statements are definitely true? **Select two answers.**

   A. 2 objects with the same mass and same kinetic energy have the same momentum

   B. 2 objects with the same mass and same momentum have the same kinetic energy

   C. 2 objects with the speed for the same time have the same displacement

   D. 2 objects with the same displacement over the same time had the same average velocity

   E. 2 objects with the same kinetic energy and different momentum have different masses

5. A ball collides perfectly in-elastically with a rod of length l and mass $M_r >> m_b$ pinned in the center. After the collision, the rod is spinning with an angular speed ω. What was the initial angular momentum of the ball that hit the rod?

   A. $\frac{1}{144}\frac{m_b^2}{M_r^2}L^2\omega$

   B. $\frac{1}{6}\frac{M_r^2}{m_b}L^2\omega$

   C. $\frac{1}{6}\frac{m_b^2}{M_r}L^2\omega$

   D. $\frac{1}{12}M_rL^2\omega$

   E. $\frac{1}{6}L^3\omega$

6. Which of these provides both a correct explanation for the following scenario? Two cars with very different masses impact each other. The driver of the much larger vehicle is fine, while the driver of the much smaller vehicle sustains a serious neck injury.

   A. Since every action has an equal and opposite reaction, the car and truck have the same acceleration. This means that the larger vehicle absorbs more of the force, so less goes into the driver.

   B. Since the forces on the large and small vehicle are equal, the large vehicle will have less acceleration. Thus the driver of the large vehicle stops faster and sustains less injuries.

   C. The change in kinetic energies of the large and small vehicles are the same. Since the kinetic energy is effectively spread over the whole vehicle, including the driver, the driver of the larger car receives less.

   D. The change in momentum of the small vehicle is larger, this results in more momentum transfer to the individual in the smaller vehicle.

   E. None of these options correctly explain this result.

7. You are trying to knock over a rod that is placed vertically on flat ground. Where should you push on the rod?

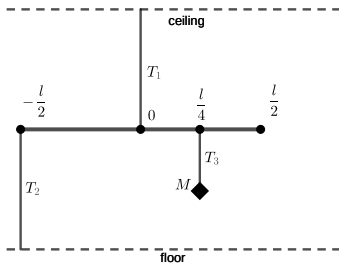
   A. The top

   B. The middle

   C. The bottom

   D. It does not matter

8. A bar with mass M extends from $-\frac{l}{2}$ to $\frac{l}{2}$ as shown. It is held up by a string in the center. A mass M is hung from the beam by a string attached at $\frac{l}{4}$. A second string is placed between the string and the ground at $\frac{-l}{2}$. If $T_2 = \frac{1}{2}mg$, find the tension T_1.



A. Mg

B. $2Mg$

C. $\frac{5}{2}Mg$

D. $3Mg$

E. The bar would not be stable in this arrangement.

9. You have two variables z and w. They are related by $z^2 = k\alpha w^5$ where k is some known constant. How would you find α?

A. Plot $\frac{w}{k}$ against z. The slope will be α

C. Plot $\frac{z^2}{k}$ against w^5. The slope is α.

D. Plot $\ln\left(\frac{z}{k}\right)$ against $\ln w$. The slope will be α

E. Plot $\ln z$ against $\ln k$. Take the log of the slope. That will be α.

10. A with masses $8M$ is standing on a friction-less skating rink that is tilted at an angle θ from the horizontal. The child is initially at rest. After a time, t, you measure the velocity of the child. What do you measure?

A. 0

B. $gt\sin\theta$

C. $8gt\sin\theta$

D. $-gt\sin\theta$

E. We need to know what speed the ball was thrown with to answer.

11. You have a rope that can handle a maximum tension of $T = 50$ N before snapping. What is the heaviest mass that you can drag across a surface that has a coefficient of friction of 0.5

A. 5 kg

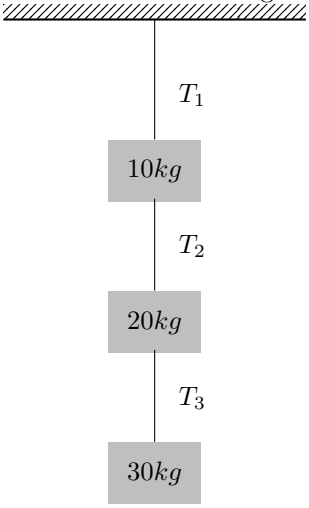
B. $5\sqrt{2}$ kg

C. $5\sqrt{3}$ kg

D. 10 kg

E. $\frac{10}{\sqrt{3}}$ kg

12. You build the following setup near Earth's surface. What is T_2?



A. 100 N

B. 250 N

C. 350 N

D. 500 N

E. 750 N

13. A car and a truck have the following velocities, and initial positions. At what time do they collide?

- Car
  - $\vec{r}_c(0) = 6\ \text{m}\hat{\text{x}} + 12\ \text{m}\hat{\text{y}}$
  - $\vec{v}_c(0) = 6\ \frac{\text{m}}{\text{s}}\hat{\text{x}} - 4\ \frac{\text{m}}{\text{s}}\hat{\text{y}}$
- Truck
  - $\vec{r}_t(0) = 2\ \text{m}\hat{\text{x}} + 4\ \text{m}\hat{\text{y}}$
  - $\vec{v}_t(0) = 8\ \frac{\text{m}}{\text{s}}\hat{\text{x}} - 8\ \frac{\text{m}}{\text{s}}\hat{\text{y}}$

A. $t = 1$ s

B. $t = 2$ s

C. $t = 3.7$ s

D. $t = 4$ s

E. They don't collide

14. What angle should you throw a ball off of a cliff in order for it to have the highest speed on impact?

A. Exactly $45°$

B. $45° < \theta < 90°$

C. $0 < \theta < 45°$

D. Exactly vertical

E. Angle is irrelevant.

15. An object is moving toward the origin and speeding up. If it's acceleration is positive, which side of the origin could it be on?

    A. The negative side

    B. The positive side

    C. Only directly on the origin

    D. Either side would work.

    E. The object cannot be in the same plane as the origin.

16. Which of these might explain why two identical cars, with identical speeds traveling in opposite directions might not come to a complete stop when colliding?

    A. The cars initially have different amounts of kinetic energy.

    B. Momentum is conserved during the collision.

    C. The momentum of the universe changed during the collision.

    D. The collision was not perfectly inelastic, so the cars bounced off each other a little bit.

    E. Some of the momentum of one car was dissipated as heat before the collision.