INSTRUCTIONS FOR USE

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- You may not modify the contents of this file.

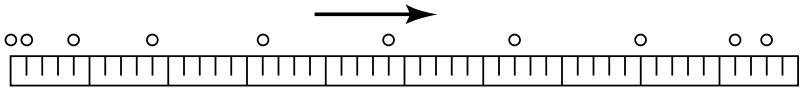
IMPORTANT NOTICE:

You may print this test to evaluate your student’s learning, provided you safeguard the integrity of this test as a diagnostic instrument. Students *must return* all copies of the test to the instructor after completing the test. Since the test is used at many institutions it is important to prevent student circulation of the questions or the answer key. The authors suggest not referring to this test by its name so as to shield the original literature from the students. Instead, a more generic name such as “Diagnostic Test” may be used.

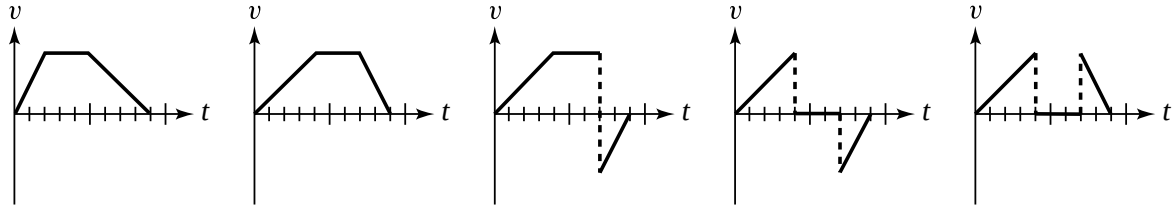
DIAGNOSTIC TEST

Refer to the figure below when answering the first two questions (1 and 2).

This diagram represents a multiflash photograph of an object moving along a horizontal surface. The positions indicated in the diagram are separated by equal time intervals. The first flash occurred just as the object started to move and the last just as it came to rest.

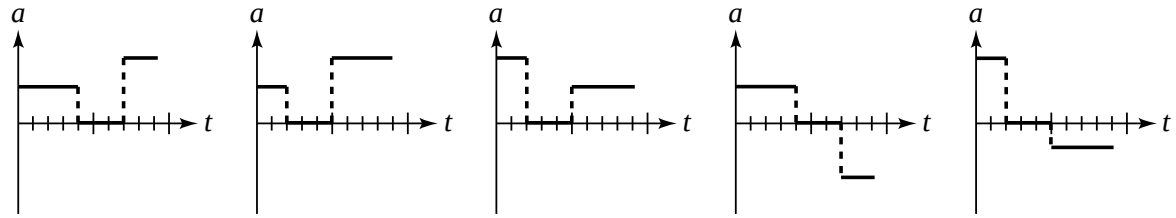


1. Which of the graphs 1–5 below best represents the object's velocity as a function of time?



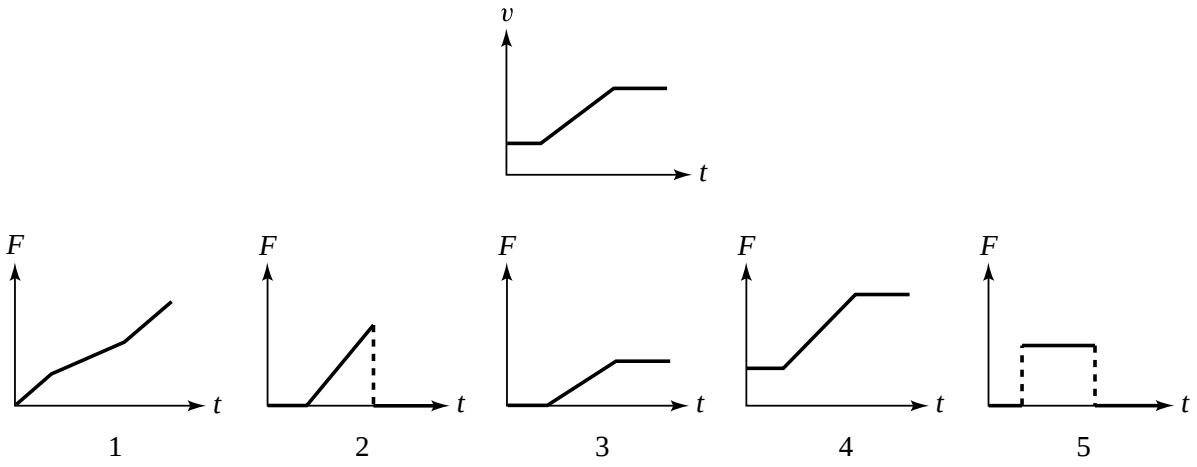
1 2 3 4 5

2. Which of the graphs 1–5 below best represents the object's acceleration as a function of time?



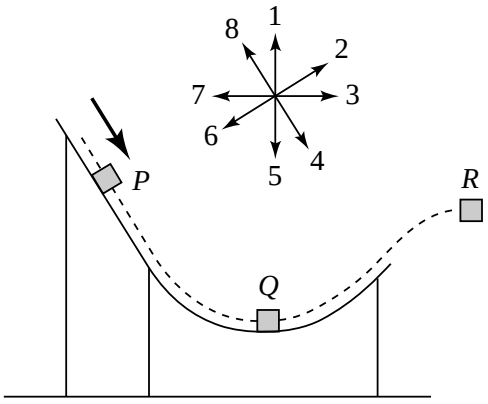
1 2 3 4 5

3. The velocity of an object as a function of time is shown in the following graph. Which of the graphs 1–5 best represents the net-force vs. time relationship for this object?



Refer to the following figure when answering the next three questions (4 through 6).

This diagram depicts a block sliding along a frictionless ramp. The eight numbered arrows in the diagram represent directions to be referred to when answering questions 4–6.



4. The direction of the acceleration of the block, when in position *P*, is best represented by which of the arrows in the diagram?

___ 1. Arrow 1

___ 2. Arrow 2

___ 2. Arrow 4

___ 4. Arrow 5

___ 5. None of the arrows, the acceleration is zero.

5. The direction of the acceleration of the block when in position *Q* is best represented by which of the arrows in the diagram?

___ 1. Arrow 1

___ 2. Arrow 3

___ 3. Arrow 5

___ 4. Arrow 7

___ 5. None of the arrows, the acceleration is zero.

6. The direction of the acceleration of the block (after leaving the ramp) at position *R* is best represented by which of the arrows in the diagram?

___ 1. Arrow 2

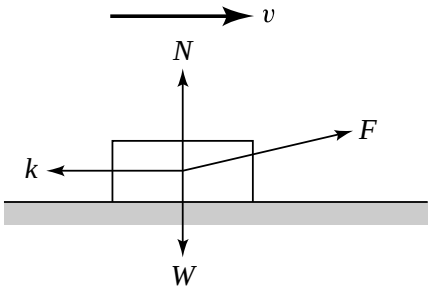
___ 2. Arrow 3

___ 3. Arrow 5

___ 4. Arrow 6

___ 5. None of the arrows, the acceleration is zero.

7. A person pulls a block across a rough horizontal surface at a *constant speed* by applying a force *F*. The arrows in the diagram below correctly indicate the directions, but not necessarily the magnitudes of the various forces on the block. Which of the following relations among the force magnitudes *W, k*, *N,* and *F must be true*?



___ 1. $F = k$ and $N = W$

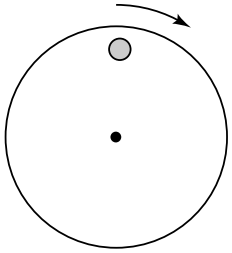
___ 2. $F = k$ and $N > W$

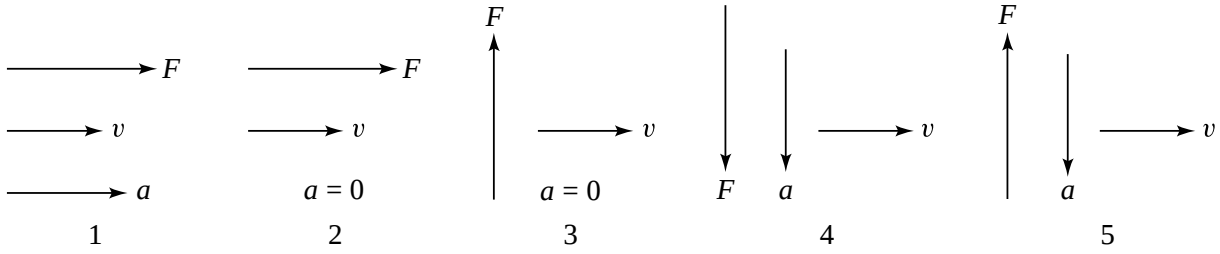
___ 3. $F > k$ and $N < W$

___ 4. $F < k$ and $N = W$

___ 5. None of the above choices

8. A small metal cylinder rests on a circular turntable, rotating at a constant speed as illustrated in the diagram below. Which of the sets of vectors 1–5 below best describes the velocity, acceleration, and net force acting on the cylinder at the point indicated in the diagram?





9. Suppose that the metal cylinder in the last problem has a mass of 0.10 kg and that the coefficient of static friction between the surface and the cylinder is 0.12 If the cylinder is 0.20 m from the center of the turntable, at what maximum speed v can the cylinder move along its circular path without slipping off the turntable?

___ 1. $0 < v \leq 0.5$ m/s.

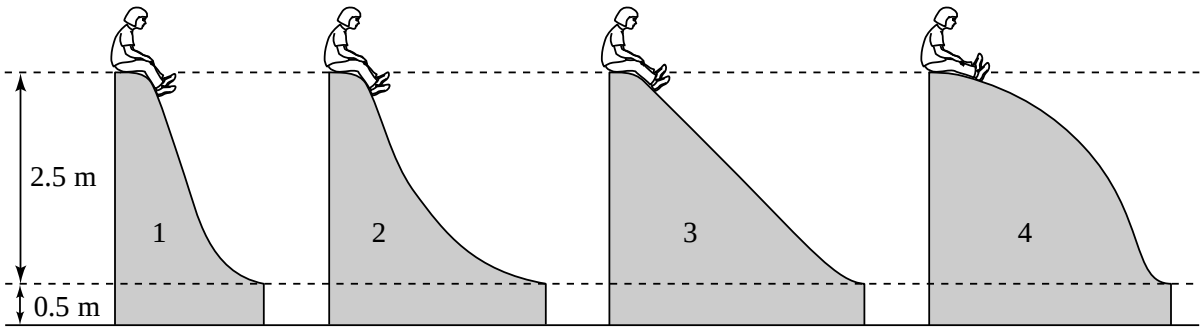
___ 2. $0.5 < v \leq 1.0$ m/s.

___ 3. $1.0 < v \leq 1.5$ m/s.

___ 4. $1.5 < v \leq 2.0$ m/s.

___ 5. $2.0 < v \leq 2.5$ m/s.

10. A young girl wishes to select one of the *frictionless* playground slides illustrated below to give her the greatest possible speed when she reaches the bottom of the slide.



Which of the slides illustrated in the diagram above should she choose?

___ 1. Slide 1

___ 2. Slide 2

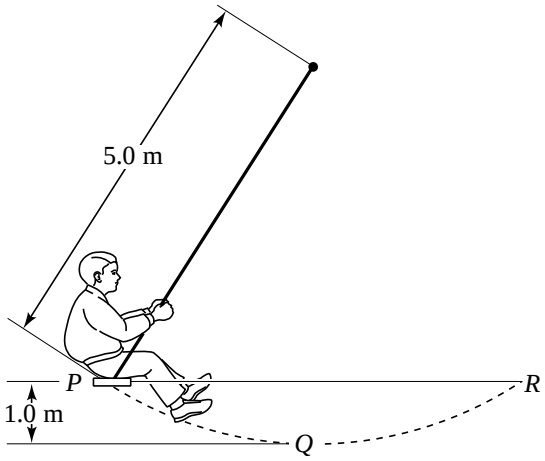
___ 3. Slide 3

___ 4. Slide 4

___ 5. It doesn't matter, her speed would be the same for each slide.

Refer to the figure below when answering the next two questions (11 and 12).

P and *R* mark the highest and *Q* the lowest positions of a 50.0-kg boy swinging as illustrated in the following figure.



11. What is the boy's speed at point *Q*?

___ 1. 2.5 m/s

___ 2. 7.5 m/s

___ 3. 10.0 m/s

___ 4. 12.5 m/s

___ 5. None of the above.

12. What is the tension in the rope at point *Q*?

___ 1. 250 N

___ 2. 525 N

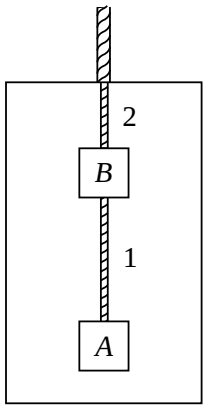
___ 3. 7×10^2 N

___ 4. 1.1×10^3 N

___ 5. None of the above.

Refer to the figure below when answering the next two questions (13 and 14).

Blocks *A* and *B*, each with a mass of 1.0 kg, are hung from the ceiling of an elevator by ropes 1 and 2.



13. What is the force exerted by rope 1 on block *A* when the elevator is traveling upward at a constant speed of 2.0 m/s?

___ 1. 2 N

___ 2. 10 N

___ 3. 12 N

___ 4. 20 N

___ 5. 22 N

14. What is the force exerted by rope 1 on block *B* when the elevator is stationary?

___ 1. 2 N

___ 2. 10 N

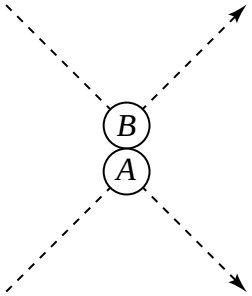
___ 3. 12 N

___ 4. 20 N

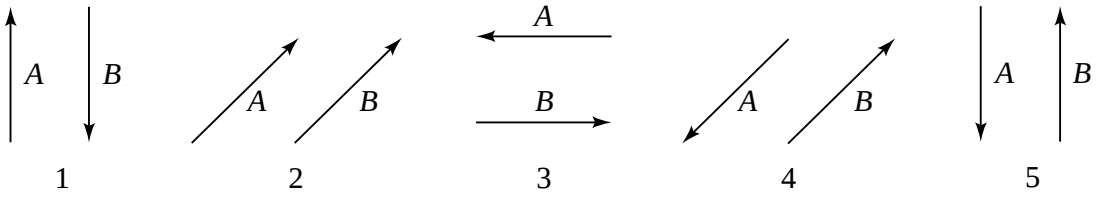
___ 5. 22 N

Refer to the following figure when answering the next two questions (15 and 16).

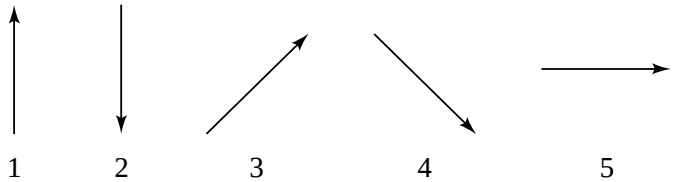
The figure below depicts the paths of two colliding steel balls, *A* and *B*.



15. Which set of arrows best represents the direction of the change in momentum of each ball?



16. Which arrow best represents the impulse applied to ball *B* by ball *A* during the collision?



17. A car has a maximum acceleration of 3.0 m/s^2. What would its maximum acceleration be while towing a second car twice its mass?

___ 1. 2.5 m/s^2

___ 2. 2.0 m/s^2

___ 3. 1.5 m/s^2

___ 4. 1.0 m/s^2

___ 5. 0.5 m/s^2

18. A woman weighing 6.0×10^2 N is riding an elevator from the 1st to the 6th floor. As the elevator approaches the 6th floor, it decreases its upward speed from 8.0 to 2.0 m/s in 3.0 s. What is the average force exerted by the elevator floor on the woman during this 3.0-s interval?

___ 1. 120 N

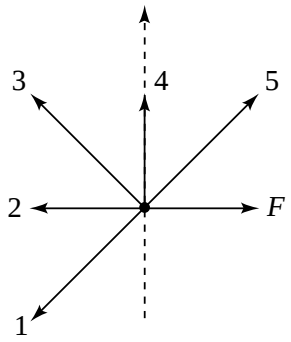
___ 2. 480 N

___ 3. 600 N

___ 4. 720 N

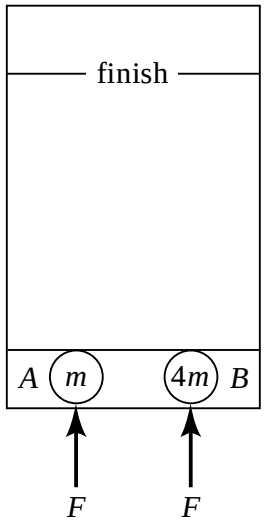
___ 5. 1200 N

19. The diagram below depicts a hockey puck moving across a *horizontal, frictionless* surface in the direction of the dashed arrow. A constant force *F*, shown in the diagram, is acting on the puck. For the puck to experience a net force *in the direction of the dashed arrow,* another force must be acting in which of the directions 1–5 below?



Refer to the following figure when answering the next three questions (20 through 22).

The diagram below depicts two pucks on a frictionless table. Puck *B* is four times as massive as puck *A*. Starting from rest, the pucks are pushed across the table by two *equal* forces.



20. Which puck has the greater kinetic energy upon reaching the finish line?

___ 1. Puck *A*

___ 2. Puck *B*

___ 3. They both have the same amount of kinetic energy.

___ 4. too little information to answer

21. Which puck reaches the finish line first?

___ 1. Puck *A*

___ 2. Puck *B*

___ 3. They both reach the finish line at the same time.

___ 4. too little information to answer

22. Which puck has the greater momentum upon reaching the finish line?

___ 1. Puck *A*

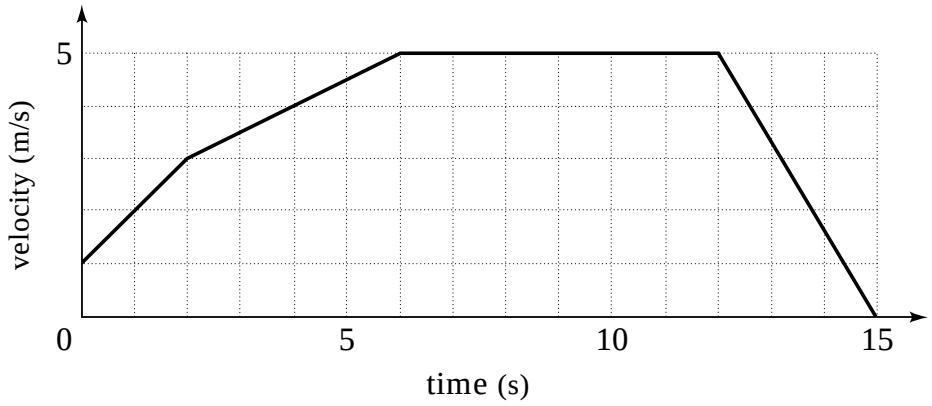
___ 2. Puck *B*

___ 3. They both have the same momentum.

___ 4. too little information to answer

Refer to the following figure when answering the next three questions (23 through 25).

The graph below represents the motion of an object moving in one dimension.



23. What was the object's average acceleration between $t = 0$ s and $t = 6.0$ s?

___ 1. 3.0 m/s^2

___ 2. 1.5 m/s^2

___ 3. 0.83 m/s^2

___ 4. 0.67 m/s^2

___ 5. none of the above

24. How far did the object travel between $t = 0$ and $t = 6.0$ s?

___ 1. 20.0 m

___ 2. 8.0 m

___ 3. 6.0 m

___ 4. 1.5 m

___ 5. none of the above

25. What was the average speed of the object for the first 6.0 s?

___ 1. 3.3 m/s

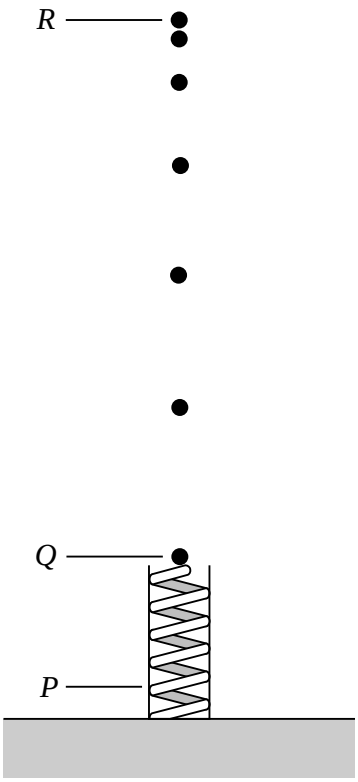
___ 2. 3.0 m/s

___ 3. 1.8 m/s

___ 3. 1.3 m/s

___ 5. none of the above

26. The figure below represents a multiflash photograph of a small ball being shot straight up by a spring. The spring, with the ball atop, was initially compressed to the point marked *P* and released. The ball left the spring at the point marked *Q*, and reached its highest point at the point marked *R*.



Assuming that the air resistance was negligible:

___ 1. The acceleration of the ball was greatest just before it reached point *Q* (still in contact with the spring).

___ 2. The acceleration of the ball was decreasing on its way from point *Q* to point *R*.

___ 3. The acceleration of the ball was zero at point *R*.

___ 4. All of the above responses are correct.

___ 5. The acceleration of the ball was the same for all points in its trajectory from points *Q* to *R*.