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## Physics (Grades 9–12)

### Subtest 1 Sample Items

1. A nonlinear spring is modeled by a force law given by  $F(x) = -10x + 3x^2$ , where  $F$  is measured in newtons and  $x$  in meters. How much work is done stretching the spring to  $x = +2.0$  m from its equilibrium position at  $x = 0.0$  m?

- A.  $-7.0$  N•m
- B.  $-8.0$  N•m
- C.  $-12$  N•m
- D.  $-18$  N•m

2. Before assigning a new chapter in the textbook, a physics teacher regularly walks students through the chapter's headings, subheadings, and objectives. The teacher also encourages the students to read the chapter's introduction and summary before they read the entire chapter. These practices promote comprehension of a content-area text most directly by helping the students:

- A. determine what is most important to learn from their reading.
- B. match new vocabulary words in the text to the words' definitions.
- C. identify supplemental materials that are relevant to their reading.
- D. analyze the text from multiple viewpoints and perspectives.

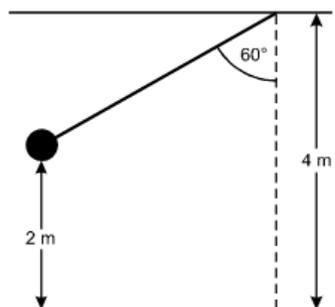
3. A wooden block is given an initial push and slides across a rough horizontal surface with an acceleration of  $-a$ . The block then slides down a plane inclined at an angle  $\theta$  as shown in the diagram below.



If the coefficient of friction has the same value on the horizontal plane and the inclined plane, what is the magnitude of the acceleration of the block down the plane?

- A.  $|-a + g \sin \theta|$
- B.  $|-a \sin \theta + g \sin \theta|$
- C.  $|-a \sin \theta + g \cos \theta|$
- D.  $|-a \cos \theta + g \sin \theta|$

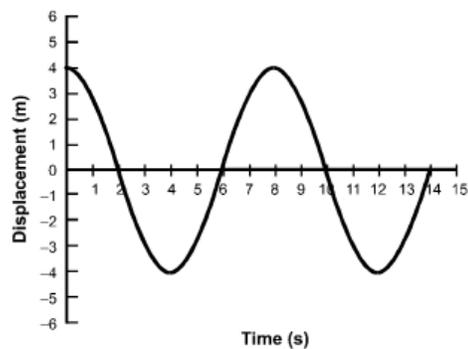
4. A 40.0 kg mass on a 4.00 m long rope swing starts to swing from rest at height of 2.00 m above the equilibrium position of the swing, as shown in the diagram below. Initially, the angle made by the rope is  $60.0^\circ$  with the vertical.



What is the magnitude of the tension in the rope when the mass passes through the equilibrium position for the first time?

- A. 392 N
- B. 784 N
- C. 1176 N
- D. 1568 N

5. The graph below shows the motion of a 2 kg mass undergoing simple harmonic motion.



What is the magnitude of the maximum value of the restoring force on the mass?

- A.  $\frac{\pi^2}{2}$  N
- B.  $\frac{\pi^2}{4}$  N
- C.  $\frac{\pi^2}{8}$  N
- D.  $\frac{\pi^2}{16}$  N

### Answer Key

| Item Number | Correct Response | Subarea                              | Objective |
|-------------|------------------|--------------------------------------|-----------|
| 1           | C                | I. Concepts in Physics               | 0002      |
| 2           | A                | I. Concepts in Physics               | 0003      |
| 3           | D                | II. Linear and Rotational Motion     | 0005      |
| 4           | B                | II. Linear and Rotational Motion     | 0006      |
| 5           | A                | III. Simple Harmonic and Wave Motion | 0008      |

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