

General Physics: Class Exam 2

16 October 2023

Name: _____

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Instructions

- There are 8 questions on 6 pages.
- Show your reasoning and calculations and always explain your answers.

Physical constants and useful formulae

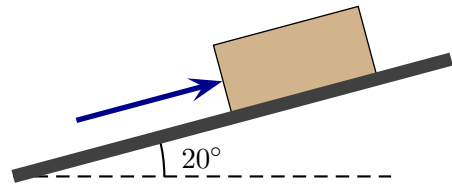
$$g = 9.80 \text{ m/s}^2 \quad G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$$

Question 1

A sleepy 4.5 kg cat lies on a very smooth horizontal floor. The cat is at rest and then a child pushes with a horizontal force on the cat for the next 3.0 s. At the end of this period the cat moves with speed 6.0 m/s. Determine the force exerted by the child on the cat, ignoring friction and air resistance.

Question 2

A 40 kg box lies on a frictionless inclined ramp. You push parallel to the ramp against the block.



- a) Determine the force which which you must push to keep the box at rest.

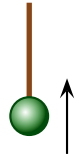
b) Suppose that you push the block so that it moves up the ramp at constant speed. Which of the following is true about the force *while the block moves at constant speed*? Ignore air resistance.

- i) The force you exert is larger than the force needed to keep the block at rest.
- ii) The force you exert is smaller than the force needed to keep the block at rest.
- iii) The force you exert is the same as the force needed to keep the block at rest.

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Question 3

A 0.30 kg ball is suspended from a string and is raised. It moves vertically upward with a constant acceleration of 4.0 m/s^2 . Determine the tension in the string, ignoring air resistance.



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Question 4

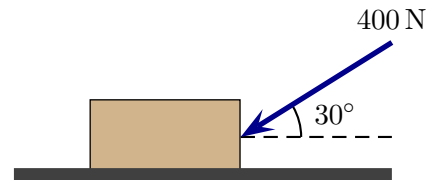
A cart slides horizontally with decreasing speed to the right. Which of the following (choose one) is true while this happens?

- i) The net force on the cart is zero.
- ii) The net force on the cart is down.
- iii) The net force on the cart is to the right.
- iv) The net force on the cart is to the left.

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Question 5

A 50 kg box moves left along a horizontal surface. A person pushes on the box with a force of magnitude 400 N and which is directed 30° below the horizontal. The coefficient of kinetic friction between the box and the floor is 0.20.



- a) Draw a free body diagram for the box.
- b) Determine the normal force exerted by the surface on the box.

Question 5 continued ...

- c) Determine the acceleration of the box.

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Question 6

Two objects, each with mass 15.0 kg, are held fixed at a distance of 0.40 m apart.

- a) Determine the magnitude of the gravitational force that one exerts on the other.

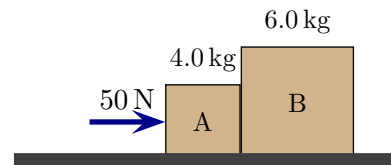
- b) The distance between the objects is decreased so that the force exerted by one on the other is four times what it had been. Which of the following (choose one) is true?

- i) The separation is now 0.30 m.
- ii) The separation is now 0.20 m.
- iii) The separation is now 0.10 m.
- iv) The separation is now 0.05 m.

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Question 7

Two crates move right along a horizontal frictionless surface. A person pushes horizontally to the right on crate A with a 50 N force. The two crates move to the right. Let $F_{A \text{ on } B}$ be the force that A exerts on B. Which of the following (choose one) is true?



- i) $F_{A \text{ on } B} = 50 \text{ N}$.
- ii) $F_{A \text{ on } B} > 50 \text{ N}$.
- iii) $F_{A \text{ on } B} < 50 \text{ N}$.

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Question 8

A 0.080 kg ball is tied to the end of a 1.5 m long string. The string is held at one end and the ball is made to swing in a horizontal circle (it is supported by a horizontal frictionless surface). The string will break once the tension becomes larger than 2.5 N. Determine the maximum speed at which the ball can move without the string breaking.

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