PSU

PHYSICS I Phys 105

Finial Exam

Second Semester - Term 242
Monday, May 26, 2025

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Indicate the answer choice that best completes the statement or answers the question.

Q1. *Garden snails are quite slow, with top speeds reaching 0.0090 km/h. Which of the following correctly converts the snail's speed into another unit?*

a) $2.5\ mm/s$

b) $9.0\ m/s$

c) $250\ cm/s$

d) $2.5 \times 10^{-9} m/s$

Q2. *Which of the following situations is impossible?*

a) An object has velocity directed east and acceleration directed west.

b) An object has velocity directed east and acceleration directed east.

c) An object has constant non-zero acceleration and changing velocity

d) An object has constant non-zero velocity and changing acceleration

Q3. *Two playful Penguins slide down frictionless hillsides of the same height but different slopes. The slope of the hill of Penguin 1 is 30°, while the slope of the hill of Penguin 2 is 60°. If both start from rest, which Penguin is moving faster when it reaches the bottom of its hill? (Use the conservation of mechanical energy)*

a) Penguin 1 is moving faster.

b) Penguin 2 is moving faster.

c) Both Penguins have the same speed at the bottom

d) The heavier penguin is moving faster, no matter which hill it used.

Q4. *A student is driving at 18 km/h on her way to the final exam. When she sees a parking spot, she presses the brakes, and the car slows down at a constant rate of* $3.5\ m/s^2$ *until it stops. How much time does it take for the car to come to a full stop?*

a) 0.5 s

b) 1.4 s

c) 2.5 s

d) 3.6 s

Q5. *A student rushes into the classroom during their physics final exam with a velocity of* $\vec{v} = (4.0\ m/s)\hat{x} + (-2.0\ m/s)\hat{y}$. *Determine the magnitude and direction of the student's velocity.*

a) $v = 2.5$ *m/s,* $\theta = -27°$

b) $v = 3.0$ *m/s,* $\theta = 63°$

c) $v = 4.5$ *m/s,* $\theta = -27°$

d) $v = 5.3$ *m/s,* $\theta = 27°$

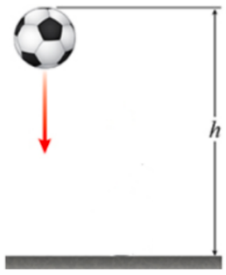
Q6. *A ball is dropped from rest from the top of a building. It strikes the ground after 2.00 s. Assuming negligible air resistance, determine the height of the building.*

a) 19.6 m

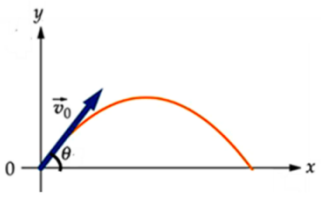
b) 39.3 m

c) 51.1 m

d) 9.81 m



Q7. *A ball is thrown at an angle of 30.0° above the horizontal. If it covers a horizontal distance of 1.40 m in 1.25 s, determine its initial speed.*



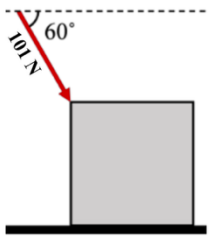
a) 1.29 m/s

b) 1.12 m/s

c) 1.42 m/s

d) 1.56 m/s

Q8. *A box weighing 351 N is pushed from above with force of 101 N at an angle of 60.0° below the horizontal across a frictionless surface. Find the magnitude of the normal force between the box and the ground.*



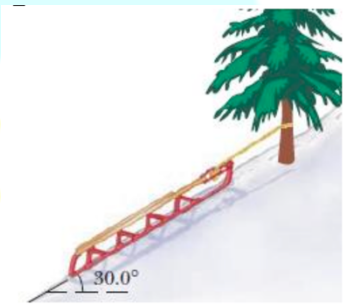
a) 160 N

b) 350 N

c) 438 N

d) 263 N

Q9. *A sled weighing 77.0 N is tied to a tree on a frictionless, snow-covered hill inclined at an angle of 30.0° to the horizontal. If it remains at rest determine the force exerted by the rope on the sled.*



a) 23.4 N

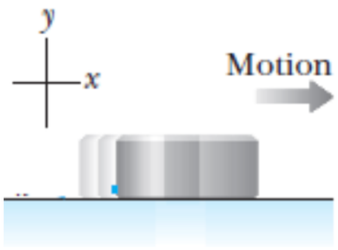
b) 38.5 N

c) 66.7 N

d) 77.0 N

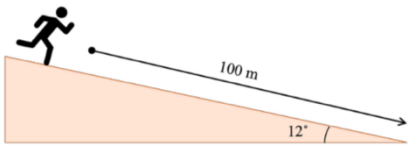
Q10. *A hockey puck is hit on a frozen pond, sliding across the rough ice with a constant deceleration of 1.67 m/s² until it comes to rest. Determine the coefficient of kinetic friction between the puck and the ice.*

a) 0.39
b) 0.17
c) 0.29
d) 0.36



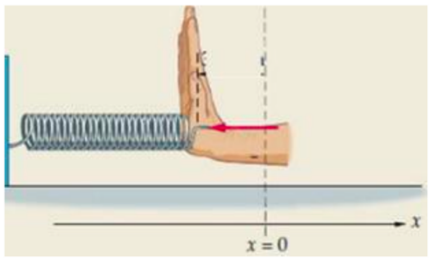
Q11. *A hill is 100 m long and makes an angle of 12° with the horizontal. As a 50-kg jogger runs DOWN the hill, how much work does gravity do on the jogger?*

a) 10198 J
b) 0 J
c) 1088 J
d) 30178 J



Q12. *A spring with a force constant of 551 N/m is compressed by 2.47 cm. Determine the potential energy stored in the spring.*

a) 6.88 J
b) 0.34 J
c) 0.17 J
d) 1720 J



Q13. *A 1.0-kg ball moving at 2.0 m/s perpendicular to a wall rebounds from the wall at 1.5 m/s. The change in the momentum of the ball is:*

a) -0.5 *kg. m/s*

b) 3.5 *kg. m/s*

c) -3.5 *kg. m/s*

d) 0.5 *kg. m/s*

Q14. *A wheel rotates at an initial speed of 33 revolutions per minute (rpm) and comes to a complete stop in 20 seconds. Calculate its angular acceleration* α.

a) $-11\,\pi\ rad/s^2$

b) $11\,\pi\ rad/s^2$

c) $-\frac{11\,\pi}{200}\ rad/s^2$

d) $\frac{11\,\pi}{200}\frac{rad}{s^2}$

Q15. *A ventilation fan has blades 25 cm in radius rotating at 20 rpm. What is the tangential speed of each blade tip?*

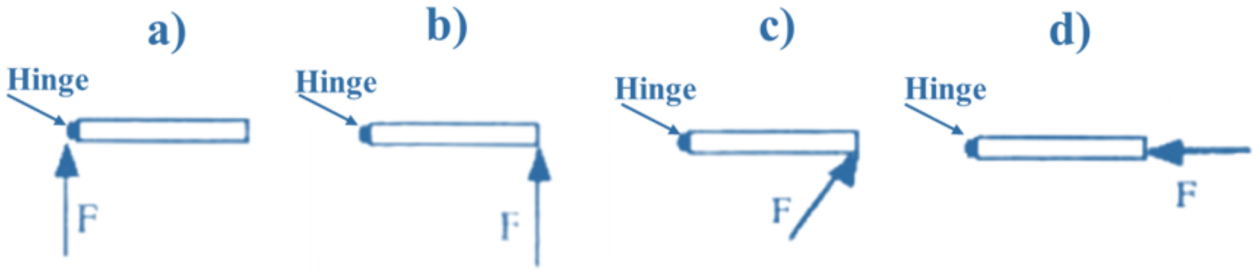
a) 0.52 *m/s*

b) 2.0 *m/s*

c) 5.0 *m/s*

d) 20 *m/s*

Q16. *In which of the cases shown in the figures below does the applied force F generate the largest torque on the door? Assume the door is viewed from above, with its hinges located on the left side.*



Q17. *Heat is energy in transit from*

a) *the hotter coffee cup to the colder hand.*

b) *the warmer hand to the colder glass of ice water.*

c) *Both of the above*

d) *None of the above.*

Q18. *Which of the following is an example of heat transfer by radiation?*

a) *The circulation of warm air in a room when a heater is turned on.*

b) *The warmth you feel when you place your hand near a hot stove burner.*

c) *The transfer of heat through a metal rod when one end is heated*

d) *The heating of water in a pot on a stove*

Q19. *On a very cold day in upstate New York, the temperature is −25°C, which is equivalent to what temperature in Fahrenheit?*

a) *−46°F*

b) *−77°F*

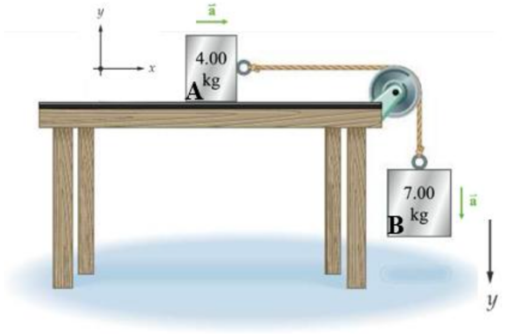
c) *18°F*

d) *−13°F*

Part 2 (21 Marks):

Solve the following five problems. Show your detailed solution and include units.

Q1. (5 marks) *A block of mass 4.00-kg, A, on a frictionless tabletop is attached by a light string to a hanging block, B, of mass 7.00 kg. The blocks are released from rest and allowed to move freely.*



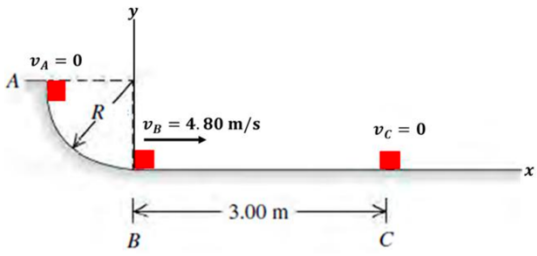
a) ***(2 marks)*** *On the figure, draw a free-body diagram showing all forces acting on them.*

b) ***(1 mark)*** *Find the acceleration of the blocks.*

c) ***(1 mark)*** *Determine the tension force exerted by the rope on the blocks.*

d) ***(1 mark)*** *Determine the magnitude of the normal force which acts on the block A.*

Q2. (5 marks) *At a truck-loading station in a post office, a small 0.200-kg package is released from rest at Point **A** on a rough track that forms a quarter-circle with a radius of 1.60 m. The package slides down the curved track and reaches Point **B** with a speed of 4.80 m/s. From Point **B**, it continues to slide along a horizontal surface with friction for 3.00 m before coming to rest at Point **C**.*



(a) (1.5 marks) *Calculate the mechanical energy of the package at Point **B** and point **C**.*

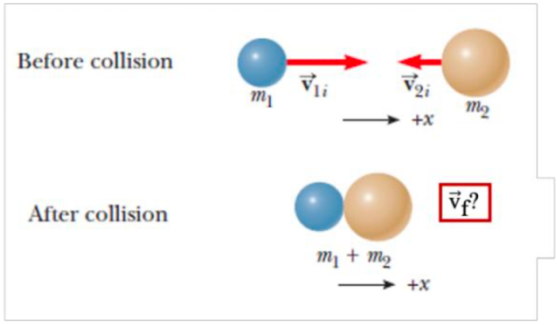
(b) (1 mark) *Determine the work done by friction on the package as it moves from Point **B** to point **C** using the concept of the work done by non-conservative forces*

(c) (1.5 marks) *Calculate the friction force exerted on the package and the coefficient of kinetic friction (μ_k) on the horizontal surface.*

(d) (1 mark) *Calculate the gravitational potential energy of the package at Point **A**.*

Q3. (5 marks) *A ball of mass m1 = 2 kg sliding across a frictionless surface at 12 m/s to the right collides in a head-on collision with a ball of mass m2 = 4 kg sliding at 3 m/s to the left. After the collision, the two balls stick together.*

a) ***(1 mark)*** *What is the magnitude and direction of the velocity of these balls just after they collide and stick together?*

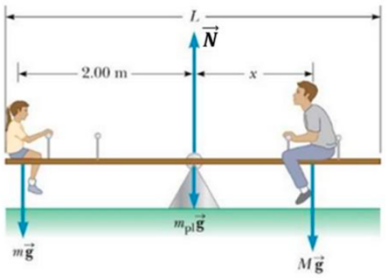


b) ***(1.5 marks)*** *Find the total kinetic energy of the balls before the collision.*

c) ***(1.5 marks)*** *Find the total kinetic energy of the balls after the collision.*

d) ***(1 mark)*** *Find the kinetic energy lost in the collision. Is this collision elastic or inelastic? Explain.*

Q4. (3 marks) *A woman of mass m = 55.0 kg sits at the left end of a seesaw, which is a plank of length L = 4.00 m and mass mpl = 12.0 kg. The plank is pivoted exactly at its midpoint as shown in the figure.*



(a) (1 mark) *Calculate the torque (τ) caused by the woman's weight about the axis of rotation at the pivot.*

(b) (1 mark) *Assuming the seesaw is in static equilibrium, determine the distance x from the pivot at which a man of mass M = 75.0 kg should sit to balance the seesaw?*

(c) (1 mark) *Compute the normal force exerted by the pivot on the seesaw given that it is in equilibrium.*

Q5. (3 marks) *A copper rod with an initial length of 1.5 cm and a coefficient of linear expansion of* $\alpha = 17 \times 10^{-6} K^{-1}$ *is heated from a room temperature of 22°C.*
By how much must the temperature increase for the rod's length to expand by 0.19 mm?