PHYS 105 · Chapter 6: Force and Motion — II

Past-Exam Review — questions from PSU past midterm (Major 1 & 2) and final exams

Constant: g = 9.81 m/s² · The source of each question is shown in [brackets].

Part 1: Multiple-Choice Questions (25)

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

6.1 Friction

Q1. *When a car goes around a curve, it tends to skid outward. The frictional force between the tires and the road that keeps it from skidding is:* **[Final 221]**

A *kinetic*
B *static*
C *both of the above*
D *not enough information*

Q2. *A 7 kg block accelerates to the right at 3 m/s² on a rough floor under a 35 N horizontal force. What is the coefficient of kinetic friction?* **[Major 2 · 211]**

A *5*
B *0.2*
C *6*
D *12*

Q3. *You pull a cart with a horizontal force of 100 N. The friction force is 20 N and the cart accelerates at 2 m/s². What is its mass?* **[Major 2 · 201]**

A *10 kg*
B *80 kg*
C *50 kg*
D *40 kg*

Q4. *A 7.5 kg block on a horizontal surface is tied over a pulley to a hanging mass m_2. The system stays at rest if m_2 is not larger than 5.2 kg. What is μ_s?* **[Major 2 · 201]**

A *1.44*
B *0.69*
C *2.30*
D *0.77*

Q5. *Block A (5.0 kg) on a flat table is connected over a pulley to a hanging block B. If $\mu_s = 0.80$, what mass of B keeps the system in equilibrium (at the limit)?* **[Final 232]**

A *2 kg*
B *4 kg*
C *3 kg*
D *5 kg*

Q6. *A 5.0 kg block is pulled horizontally by a string with $\mu_k = 0.20$ and accelerates at 2.0 m/s². Find the tension.* **[Final 232]**

A *0.200 N*
B *19.8 N*
C *9.80 N*
D *10.0 N*

Q7. *A hockey puck slides on rough ice with a constant deceleration of 1.67 m/s^2. What is μ_k?* **[Final 242]**

A *0.39*
B *0.17*
C *0.29*
D *0.36*

Q8. *A 250 g glass slides on a table and stops with a constant deceleration of 2.85 m/s^2. What is μ_k?* **[Final 241]**

A *0.39*
B *0.16*
C *0.29*
D *0.36*

Q9. *A 3 kg block slides down a rough surface inclined at 40°. If $\mu_k = 0.32$, what is the magnitude of its acceleration?* **[Final 182]**

A *3.9 m/s^2*
B *6.3 m/s^2*
C *2.4 m/s^2*
D *7.5 m/s^2*

6.2 Uniform Circular Motion

Q10. *If an object moves in a circle at constant speed, then:* **[Final 202]**

A *its centripetal acceleration is zero*
B *its tangential acceleration is zero*
C *its total acceleration is zero*
D *anything is possible*

Q11. *For an object in uniform circular motion, the centripetal acceleration is:* **[Final 231]**

A *equal to the angular acceleration*
B *perpendicular to the plane of motion*
C *constant in direction*
D *directed toward the center of motion*

Q12. *Which of the following is TRUE about centripetal acceleration?* **[Major 2 · 211]**

A *It is due to the change in the direction of velocity*
B *It is always directed away from the center*
C *It is directly proportional to the radius*
D *It is inversely proportional to the velocity*

Q13. *What is the speed of a car moving around a curve of radius 40 m with a centripetal acceleration of 4.9 m/s^2?* **[Final 211]**

A *8.2 m/s*
B *196 m/s*
C *14 m/s*
D *2.86 m/s*

Q14. *A particle moves in a circle of radius 12 m. Find its speed when the centripetal acceleration is 27 m/s^2.* **[Major 2 · 211]**

A *2.25 m/s*
B *18 m/s*
C *324 m/s*
D *112 m/s*

Q15. *A 5 g bee flies in a circle of radius 50 cm at constant speed. If its centripetal acceleration is 0.16 m/s^2, what is its speed?* **[Final 202]**

A *0.283 m/s*
B *2.83 m/s*
C *0.08 m/s*
D *1.6 m/s*

Q16. *An object moves at a constant 9 m/s in a circle of radius 1.5 m. What is its centripetal acceleration?* **[Final 222]**

A *54 m/s^2*
B *6 m/s^2*
C *121 m/s^2*
D *0.019 m/s^2*

Q17. *A 20 kg object moves in a circular orbit of radius 20 m at 10 m/s. What centripetal force is needed?* **[Final 231]**

A *20 N*
B *100 N*
C *10 N*
D *40 N*

Q18. *A frictionless racing road with radius of curvature 60 m is banked so that a car at 13 m/s can make the turn without sliding. What is the banking angle?* **[Major 2 · 211]**

A *1.5°*
B *25.3°*
C *1.2°*
D *16°*

Q19. *An 80 kg pilot flies a vertical loop of radius 58 m. At the bottom the plane moves at 45 m/s. Find the normal force on the pilot.* **[Major 2 · 201]**

A *3577.1 N*
B *2009.1 N*
C *2793.1 N*
D *1453.1 N*

Q20. *A 0.2 kg pendulum swings in a vertical arc of radius 0.8 m. Its speed at the bottom is 2 m/s. What is the tension at that point?* **[Final 241]**

A *2.31 N*
B *2.96 N*
C *0.96 N*
D *1.35 N*

Q21. *A 70 kg motorcyclist moves at a constant 15 m/s on a vertical circular path of radius 3 m. What normal force acts on him at the top of the path?* **[Final 182]**

A *5936 N*
B *4564 N*
C *5250 N*
D *686 N*

Spring Force (Hooke's Law)

Q22. *The negative sign in Hooke's law ($F = -kx$) indicates:* [Final 231]

- **A** *inverse proportionality between force and stretch magnitude*
- **B** *direct proportionality between force and stretch magnitude*
- **C** *the force is opposite to the stretching direction*
- **D** *the force is along the stretching direction*

Q23. *A ball hangs in equilibrium from a spring with $k = 32$ N/m. The spring stretches by 5 cm. What is the mass of the ball?* [Major 2 · 201]

- **A** *163 g*
- **B** *640 g*
- **C** *32 g*
- **D** *63 g*

Q24. *By how much is a spring with $k = 1200$ N/m stretched when it is pulled by a force of 84 N?* [Final 211]

- **A** *3.4 cm*
- **B** *5.1 cm*
- **C** *7 cm*
- **D** *14.3 cm*

Q25. *A spring stretches 5 cm when pulled by a 20 N force. What is its spring constant?* [Final 241]

- **A** *200 N/m*
- **B** *1000 N/m*
- **C** *800 N/m*
- **D** *400 N/m*

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Part 2: Problems (5)

Solve the following problems and show your work in detail.

Problem 1. *A 12 kg box starts from rest on a rough floor ($\mu_k = 0.25$) under two forces: 30 N horizontal and 40 N at 30° above the horizontal, both pointing forward.* **[Final 211]**

a) *Draw the free-body diagram.*

b) *Find the normal force.*

c) *Find the friction force.*

d) *Find the net force.*

e) *Find the acceleration.*

f) *How fast is it moving after 50 m?*

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Problem 2. *To move a 32 kg crate across a rough floor ($\mu_s = 0.57$), you push it with a horizontal force F.* **[Final 222]**

a) *Draw the free-body diagram.*

b) *Find the normal force.*

c) *Find the force needed to start it moving.*

d) *Find the acceleration if F = 330 N and μ_k = 0.45.*

Problem 3. *A 0.4 kg box is placed on a surface inclined at 30° (μ_k = 0.2) and starts to slide from rest.* **[Final 241]**

a) *Draw the free-body diagram.*

b) *Find the normal force.*

c) *Find the acceleration.*

Problem 4. *Block $m_2 = 9$ kg on a 30° incline ($\mu_k = 0.25$) is connected over a pulley to a hanging block $m_1 = 2$ kg. m_2 slides down the incline.* **[Major 2 · 211]**

a) *Draw the free-body diagram for each body.*

b) *Find the acceleration.*

c) *Find the tension.*

Problem 5. *A 0.2 kg ball on a 50 cm string moves in a vertical circle. Its speed at the top (A) is 4 m/s and the tension at the bottom (B) is 27.56 N.* **[Major 2 · 211]**

a) *Draw the free-body diagram for each body.*

b) *Find the centripetal acceleration at A.*

c) *Find the tension at A.*

d) *Find the speed at B.*

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