

Name: _____

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AP Physics 1 — Practice Exam

Instructions: A calculator is permitted. Use $g = 9.8$ meters per second squared unless a question states $g = 10$. Show all working on free-response questions.

Time Limit: 60 minutes

Multiple Choice (15 questions)

- [1 point] 1. A ball is thrown vertically upward at 15 m/s from the edge of a cliff. It rises, falls back past the launch point, and hits the ground at the base of the cliff 5.0 s after launch. Take $g = 10 \text{ m/s}^2$ and ignore air resistance. How high is the cliff?
- A. 50 m
 - B. 75 m
 - C. 125 m
 - D. 200 m
- [1 point] 2. A stone is thrown horizontally at 15 m/s from the roof of a building 20 m tall. Take $g = 10 \text{ m/s}^2$ and ignore air resistance. With what speed does the stone hit the ground?
- A. 15 m/s
 - B. 20 m/s
 - C. 25 m/s
 - D. 35 m/s
- [1 point] 3. Two blocks of mass 2.0 kg and 3.0 kg rest on a frictionless horizontal surface, connected by a light string. A horizontal 10 N force pulls on the 3.0 kg block, directed away from the 2.0 kg block, so the string drags the 2.0 kg block along. What is the tension in the string?
- A. 4.0 N
 - B. 5.0 N
 - C. 6.0 N
 - D. 10 N

- [1 point] 4. A 5.0 kg block slides down a rough incline that makes an angle of 37° with the horizontal. The coefficient of kinetic friction is 0.20. Take $g = 10 \text{ m/s}^2$, $\sin 37^\circ = 0.60$ and $\cos 37^\circ = 0.80$. What is the magnitude of the block's acceleration?
- A. 2.0 m/s^2
 - B. 4.4 m/s^2
 - C. 6.0 m/s^2
 - D. 7.6 m/s^2
- [1 point] 5. A 0.50 kg ball on a 1.0 m string swings in a vertical circle. At the top of the circle its speed is 4.0 m/s. Take $g = 10 \text{ m/s}^2$. What is the tension in the string at that instant?
- A. 3.0 N
 - B. 5.0 N
 - C. 8.0 N
 - D. 13 N
- [1 point] 6. Satellite A moves in a circular orbit of radius r around a planet with period T . Satellite B orbits the same planet in a circular orbit of radius $4r$. What is the period of satellite B?
- A. $2T$
 - B. $4T$
 - C. $8T$
 - D. $16T$
- [1 point] 7. A block is released from rest at the top of a frictionless ramp 5.0 m high. At the bottom it slides onto a horizontal floor where the coefficient of kinetic friction is 0.25. Take $g = 10 \text{ m/s}^2$. How far along the floor does the block slide before stopping?
- A. 5.0 m
 - B. 10 m
 - C. 20 m
 - D. 40 m
- [1 point] 8. A 2.0 kg cart moving at 3.0 m/s on a level track collides with a 1.0 kg cart at rest, and the two carts stick together. What fraction of the initial kinetic energy is lost in the collision?
- A. 0
 - B. $\frac{1}{3}$
 - C. $\frac{1}{2}$
 - D. $\frac{2}{3}$
- [1 point] 9. A 0.50 kg block attached to a horizontal spring oscillates on a frictionless surface with a period of 1.0 s and an amplitude of 2.0 cm. The block is replaced by a 2.0 kg block and the amplitude is increased to 4.0 cm. What is the new period?
- A. 1.0 s
 - B. 2.0 s
 - C. 4.0 s
 - D. 8.0 s

- [1 point] 10. A uniform plank 4.0 m long with mass 20 kg rests horizontally on two supports, one at each end. A 60 kg person stands on the plank 1.0 m from the left end. Take $g = 10 \text{ m/s}^2$. What upward force does the RIGHT support exert on the plank?
- A. 150 N
 - B. 250 N
 - C. 400 N
 - D. 550 N
- [1 point] 11. A uniform solid disk ($I = \frac{1}{2}MR^2$) of mass 2.0 kg and radius 0.50 m is mounted on a frictionless axle through its center. A string wrapped around the rim is pulled tangentially with a constant force of 4.0 N. What is the angular acceleration of the disk?
- A. 2.0 rad/s^2
 - B. 4.0 rad/s^2
 - C. 8.0 rad/s^2
 - D. 16 rad/s^2
- [1 point] 12. A solid disk rotates freely on a frictionless vertical axle with angular speed ω_0 and rotational kinetic energy K_0 . A second identical disk, initially not rotating, is dropped onto the first, and friction between them brings the pair to a common angular speed. What are the final angular speed and the final total kinetic energy?
- A. $\omega_0/2$ and $K_0/2$
 - B. $\omega_0/2$ and K_0
 - C. $\omega_0/\sqrt{2}$ and K_0
 - D. ω_0 and $2K_0$
- [1 point] 13. An open tank contains a 2.0 m deep layer of oil (density 800 kg/m^3) floating on 3.0 m of water (density 1000 kg/m^3). Take $g = 10 \text{ m/s}^2$. What is the gauge pressure at the bottom of the tank?
- A. 30 kPa
 - B. 40 kPa
 - C. 46 kPa
 - D. 50 kPa
- [1 point] 14. A 2.0 kg block of density 800 kg/m^3 is held completely underwater (water density 1000 kg/m^3) by a string tied to the bottom of the tank. Take $g = 10 \text{ m/s}^2$. What is the tension in the string?
- A. 5.0 N
 - B. 20 N
 - C. 25 N
 - D. 45 N
- [1 point] 15. Water (density 1000 kg/m^3) flows steadily through a horizontal pipe. In a section of radius 2.0 cm the speed is 2.0 m/s. The pipe then narrows to a radius of 1.0 cm. By how much is the pressure in the narrow section lower than in the wide section?
- A. 2.0 kPa
 - B. 6.0 kPa
 - C. 30 kPa
 - D. 60 kPa

Calculations (1 question)

[10 points] 16. Collision lab. Cart A (mass 0.25 kg) is pushed against a spring of spring constant 400 N/m at one end of a level, frictionless track, compressing the spring by 0.10 m, and is then released. Farther along the track it collides with cart B (mass 0.75 kg), which is at rest; Velcro makes the carts stick together. The track ends at the edge of a table 1.225 m above the floor, and the joined carts leave the edge moving horizontally. Cart B carries a force sensor that records the force exerted on it during the collision. Use $g = 9.8 \text{ m/s}^2$.

[2 points] (a) Calculate the speed of cart A just after it leaves the spring.

[3 points] (b) Calculate the speed of the joined carts just after the collision, and the amount of kinetic energy converted to other forms during the collision.

[2 points] (c) Calculate the horizontal distance from the table edge to the point where the carts land on the floor.

- [3 points]** (d) The force sensor on cart B records an average force of 15 N during the collision. Calculate the impulse delivered to cart B and the duration of the collision. State, with justification, the impulse delivered to cart A during the collision.

Short Answer (1 question)

- [10 points]** 17. Box on a truck. A box of mass m sits on the flat, horizontal bed of a truck. The coefficient of static friction between the box and the bed is 0.50, and the bed is long enough that the box never touches the cab or tailgate. Take $g = 10 \text{ m/s}^2$. Answer parts (a) and (b) in clear, coherent, paragraph-length responses that refer explicitly to forces and to Newton's laws.
- [3 points]** (a) The truck accelerates forward along a straight road and the box stays in place relative to the bed. Explain in terms of forces why the box accelerates forward with the truck, naming the force responsible and its direction, and calculate the maximum acceleration the truck can have before the box begins to slide.

- [3 points]** (b) The truck now rounds an unbanked circular curve of radius 45 m at constant speed. Explain in terms of forces why the box moves in a circle, and determine the maximum speed at which the truck can take the curve without the box sliding.

- [2 points]** (c) A student claims: "If the box were twice as massive, the maximum safe speed around the curve would be lower, because a heavier box needs a bigger force to keep it moving in a circle." Evaluate this claim.

- [2 points]** (d) Rain reduces the coefficient of static friction to 0.20, and the truck takes the same curve at 15 m/s. Describe the motion of the box relative to the ground and relative to the truck bed, and explain why this happens with reference to Newton's first law.