2026

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AP® Physics 1: Circular Motion

Practice Multiple-Choice and Free-Response Questions

Twelve questions on Ferris wheels, banked curves, pendulums, cut pendulum strings, and satellite orbits in the formats of the AP Physics 1 exam, with an answer key, an explanation for every multiple-choice answer, and scoring guidelines for every free-response part.

Section I	Questions 1 to 8, multiple choice, about 16 minutes
Section II	Questions 9 to 12, one free-response question of each type, 95 minutes
Answer key	Explanations and scoring guidelines begin on page 14

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PHYSICS 1: CIRCULAR MOTION
PRACTICE QUESTIONS
SECTION I: 8 QUESTIONS · SECTION II: 4 QUESTIONS

Directions:

This booklet has 12 questions on circular motion and gravitation from Unit 2 of AP Physics 1. Questions 1 to 8 are multiple choice, with four answer choices and one correct answer each. Questions 9 to 12 are free response, one of each type used on the exam: mathematical routines, translation between representations, experimental design and analysis, and qualitative/quantitative translation.

Allow about 16 minutes for Questions 1 to 8 and 95 minutes for Questions 9 to 12. These times follow the pace of the exam.

You may use a calculator, a ruler, and the AP Physics 1 reference information. Use $g = 9.8\ \text{m/s}^2$. Treat strings as ideal and air resistance as negligible unless a question says otherwise.

Mark your answers to Questions 1 to 8 on the grid below. Write your answers to Questions 9 to 12 on separate paper, labeled with the part (A, B, C, D) and sub-part (i, ii, iii) they answer. Draw arrows, graphs, and best-fit lines directly on the figures in this booklet.

Show your work on the free-response questions. Credit depends on choosing the right physics principles, writing derivations and explanations that someone else can follow, and giving units with numerical answers.

The answer key and scoring guidelines begin on page 14.

SECTION I ANSWER GRID

1	A	B	C	D	5	A	B	C	D
2	A	B	C	D	6	A	B	C	D
3	A	B	C	D	7	A	B	C	D
4	A	B	C	D	8	A	B	C	D

Review pages for these topics. Circular motion guide, with worked examples and two animations: burketutoringinfremont.com/ap-physics-1-circular-motion-problems/

AP Physics 1 kinematics study guide, for the projectile motion in Questions 6 and 7: burketutoringinfremont.com/ap-physics-1-kinematics-study-guide/

Online version. Each explanation and scoring guide also sits under its question at burketutoringinfremont.com/ap-physics-1-circular-motion-problems/#practice.

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Section I: Multiple Choice — Questions 1 to 8

1. A Ferris wheel of radius R rotates at constant speed. A rider of mass m sits on a level seat, moves with speed v, and remains in contact with the seat for the whole ride. What is the magnitude of the force exerted on the rider by the seat when the rider is at the highest point of the circle?

(A) $mg + \frac{mv^2}{R}$

(B) $mg - \frac{mv^2}{R}$

(C) mg

(D) $\frac{mv^2}{R}$

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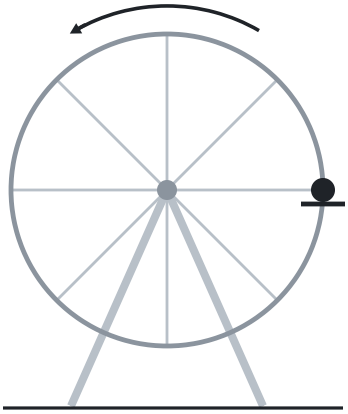
2. A rider sits on a level seat of a Ferris wheel that rotates counterclockwise at constant speed. At the instant shown, the rider is level with the center of the wheel. Which of the following best describes the direction of the total force exerted on the rider by the seat?



(A) Straight up

(B) Horizontally toward the center of the wheel

(C) Upward and toward the center of the wheel

(D) Upward and away from the center of the wheel

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3. A car rounds a curve on a road banked at angle θ. At speed v_0 the car can round the curve with no friction force from the road. The car then rounds the same curve at a constant speed greater than v_0 without sliding. Which of the following describes the static friction force exerted on the car by the road?

(A) It points up the slope, toward the outside of the curve.

(B) It is zero, because the bank alone keeps the car on the curve.

(C) It points horizontally, toward the center of the curve.

(D) It points down the slope, toward the inside of the curve.

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4. A highway curve is banked so that a car moving at 20 m/s can round it with no friction force from the road. A second curve has the same bank angle and twice the radius. At what speed can a car round the second curve with no friction force from the road?

(A) 14 m/s

(B) 20 m/s

(C) 28 m/s

(D) 40 m/s

---

5. A pendulum bob swings back and forth on a string. At each end of the swing, the string makes an angle of 40° with the vertical. Air resistance is negligible. At the instant the bob reaches the highest point of its swing, where it is momentarily at rest, which of the following best describes the direction of the net force on the bob?

(A) The net force is zero.

(B) Along the string, toward the pivot

(C) Straight down

(D) Perpendicular to the string, toward the lowest point of the swing

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6. A small ball on a string swings as a pendulum. The string is cut at the instant the ball passes through the lowest point of its swing while moving to the right. Air resistance is negligible. Which of the following describes the path of the ball after the string is cut?

(A) A parabola that starts out moving horizontally to the right

(B) A straight line down to the floor

(C) A straight line to the right, at constant speed

(D) The circular arc of the swing, until the ball stops, and then a straight drop

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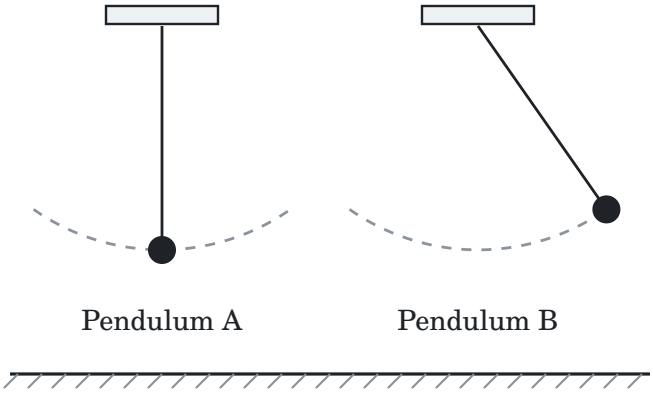
7. Two identical pendulums, A and B, hang from pivots at the same height above the floor and swing with the same amplitude. The string of pendulum A is cut as its bob passes through the lowest point of the swing. The string of pendulum B is cut when its bob is at the highest point of its swing, where it is momentarily at rest, as shown. Air resistance is negligible. Which bob reaches the floor first?



(A) Bob A, because it starts lower and neither bob has a vertical component of velocity when its string is cut

(B) Bob A, because it is moving faster than bob B when its string is cut

(C) The bobs reach the floor at the same time, because neither bob has a vertical component of velocity when its string is cut

(D) Bob B, because it falls straight down instead of moving sideways

---

8. Two satellites move in circular orbits around the same planet. The orbital radius of satellite 2 is 4 times the orbital radius of satellite 1. What is the ratio of the orbital period of satellite 2 to the orbital period of satellite 1?

(A) 4

(B) 8

(C) 16

(D) 64

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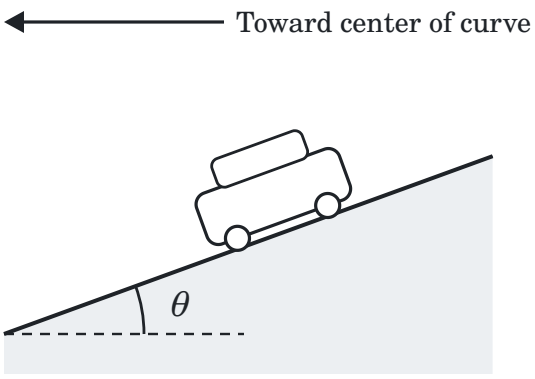
Question 9: Mathematical Routines

9. A car of mass m travels at constant speed around a curve of radius R. The road is banked at angle θ above the horizontal, as shown in Figure 1, which is a view from behind the car. The coefficient of static friction between the tires and the road is μ_s.

Figure 1



Note: Figure not drawn to scale.

Part A

i. **Derive** an expression for the speed v_0 at which the car can round the curve with no friction force exerted on it by the road. Express your answer in terms of R, θ, and physical constants, as appropriate. Begin your derivation by writing a fundamental physics principle or an equation from the reference information.

ii. **Calculate** v_0 for a curve with $R = 50$ m and $\theta = 15°$.

Part B

The car now rounds the curve at a constant speed v that is greater than v_0, without sliding. The dot in Figure 2 represents the car, and the dashed line is parallel to the surface of the road. On the dot, **draw** and **label** the forces (not components) exerted on the car. Each force must be represented by a distinct arrow starting on, and pointing away from, the dot. Draw the relative lengths of all arrows to reflect the relative magnitudes of the forces.

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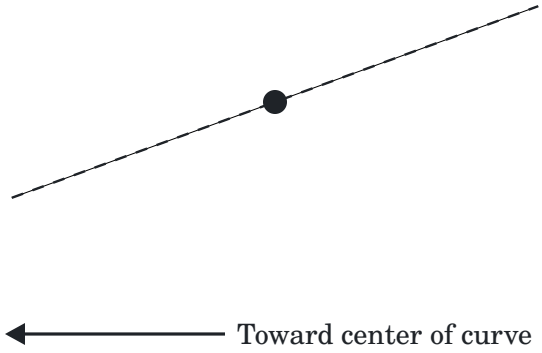
Figure 2



Part C

A truck of mass $2m$ rounds the same curve at the same speed v. **Indicate** whether the smallest coefficient of static friction that keeps the truck from sliding is greater than, less than, or equal to the smallest coefficient that keeps the car from sliding.

_____ Greater than

_____ Less than

_____ Equal to

Justify your answer.

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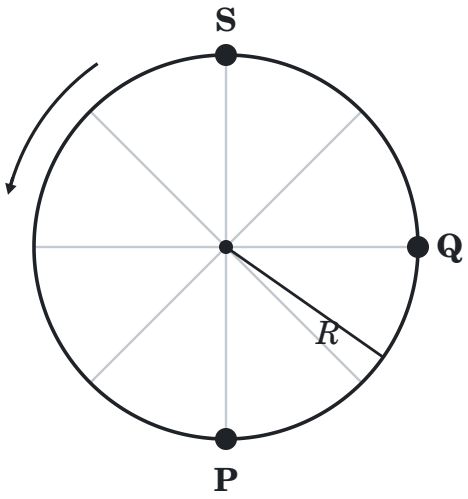
Question 10: Translation Between Representations

10. A student of mass m sits on a scale that rests on a level seat of a Ferris wheel. The wheel has radius R and rotates counterclockwise with a constant period T, as shown in Figure 1. The seat and the scale stay level for the whole ride, and the student remains in contact with the scale throughout. Point P is the lowest point of the student's circle, point Q is level with the center of the wheel, and point S is the highest point.

Figure 1



Note: Figure not drawn to scale.

Part A

The dots in Figure 2 represent the student at point S and at point P. On each dot, **draw** and **label** the forces (not components) exerted on the student. Each force must be represented by a distinct arrow starting on, and pointing away from, the dot. Draw the relative lengths of all arrows to reflect the relative magnitudes of the forces.

Figure 2

Student at point S Student at point P

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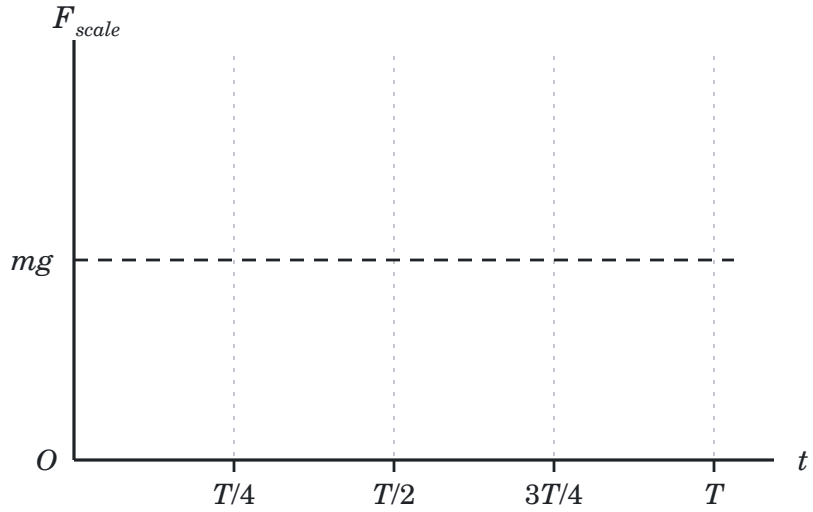
Part B

Derive an expression for the reading of the scale when the student is at point S. Express your answer in terms of m, R, T, and physical constants, as appropriate. Begin your derivation by writing a fundamental physics principle or an equation from the reference information.

Part C

On the axes in Figure 3, **sketch** a graph of the scale reading F_{scale} as a function of time t for one full revolution, starting at $t = 0$ when the student is at point P. The dashed line represents mg.

Figure 3



Part D

The operator makes the wheel turn faster, so the period decreases, and the student still remains in contact with the scale. **Indicate** whether the scale reading when the student is at point Q increases, decreases, or remains the same.

_____ Increases

_____ Decreases

_____ Remains the same

Justify your answer, and explain how your answer is consistent with your graph in Part C.

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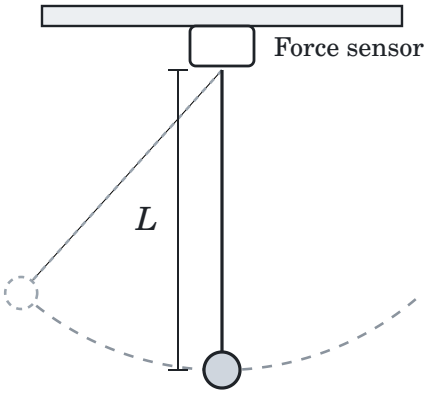
Question 11: Experimental Design and Analysis

The following information applies to Parts A and B.

11. Students study the tension in a pendulum string at the lowest point of the swing. A small metal sphere of unknown mass m hangs from a light string attached to a force sensor, as shown in Figure 1. The distance from the pivot to the center of the sphere is $L = 0.75$ m. The force sensor records the tension F_T in the string throughout each swing.

Figure 1



Note: Figure not drawn to scale.

The students must determine m without using a balance. The only other equipment available is a meterstick and a protractor.

Part A

i. **Describe** an experimental procedure the students could use to collect data that would allow them to determine m using a linear graph. Include the quantities they would vary and the quantities they would measure.

ii. Briefly **describe** one way the students could reduce the experimental uncertainty in their measurements.

Part B

i. **Indicate** the quantities the students could plot on the horizontal and vertical axes to produce a linear graph from which m can be determined.

ii. Briefly **describe** how m is related to a feature of the graph from Part B(i). You may include an equation.

The following information applies to Parts C and D.

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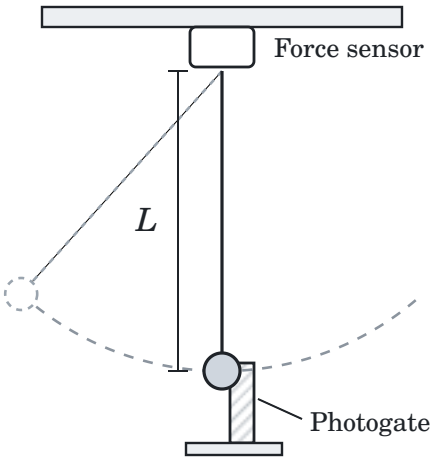
In a second experiment, the students add a photogate at the lowest point of the swing, as shown in Figure 2, to measure the speed v of the sphere as it passes. They release the sphere from several different heights and record v and the tension F_T at the lowest point. Table 1 shows the data.

Figure 2



Note: Figure not drawn to scale.

Table 1

v (m/s)	F_T (N)
1.0	2.21
1.5	2.58
2.0	3.01
2.5	3.65
3.0	4.34

The students make a graph with F_T plotted on the vertical axis.

Part C

i. **Label** the horizontal axis of Figure 3 with a measured or calculated quantity, with units if it has any. Choose a quantity that makes the graph linear and lets you determine m.

ii. On the grid in Figure 3, make a graph that can be used to determine m.

- Add a numerical scale to the horizontal axis.
- **Plot** the data points.
- Work out the values you plot on scratch paper.

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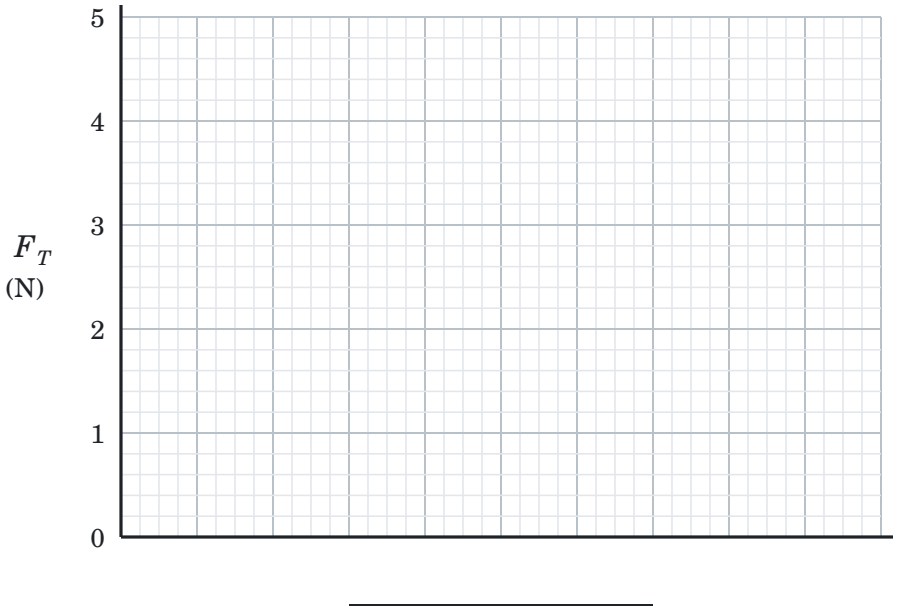
Figure 3



iii. **Draw** a best-fit line through the data you plotted in Part C(ii).

Part D

Use your best-fit line from Part C(iii) to **calculate** an experimental value for m.

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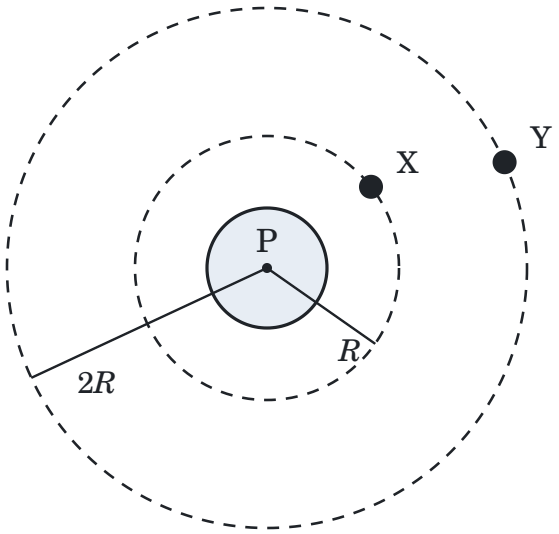
Question 12: Qualitative/Quantitative Translation

12. Satellite X moves in a circular orbit of radius R around planet P, which has mass M_P. Satellite Y has twice the mass of satellite X and moves in a circular orbit of radius $2R$ around the same planet, as shown in Figure 1. The only force on each satellite is the gravitational force exerted by planet P.

Figure 1



Note: Figure not drawn to scale.

Part A

Indicate whether the speed of satellite Y is greater than, less than, or equal to the speed of satellite X.

_____ Greater than

_____ Less than

_____ Equal to

Without deriving or using equations, **justify** your answer. Address both the different masses and the different orbital radii of the satellites.

Part B

Derive expressions for the speed v_X of satellite X and the speed v_Y of satellite Y. Express your answers in terms of M_P, R, and physical constants, as appropriate. Begin your derivation by writing a fundamental physics principle or an equation from the reference information.

Part C

Explain how your expressions from Part B support your reasoning in Part A, including the role of the satellites' masses.

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Answer Key

Section I explanations, then scoring guidelines for Questions 9 to 12. Equivalent correct methods earn the same points.

Section I: Multiple Choice — Questions 1 to 8

Question	Answer	Topic	Explanation
1	**(B)**	Ferris wheel	At the top, the rider's acceleration $\frac{v^2}{R}$ points down, toward the center. Taking down as positive, Newton's second law gives $mg - F_N = \frac{mv^2}{R}$, so $F_N = mg - \frac{mv^2}{R}$. Choice (A) is the force at the bottom of the wheel, where the acceleration points up. Choice (C) would require zero acceleration, and choice (D) treats the seat as the only force on the rider.
2	**(C)**	Ferris wheel	The rider moves in a circle at constant speed, so the net force points horizontally toward the center. Gravity points straight down. The seat must supply an upward part equal to mg, so that the vertical forces balance, and a horizontal part toward the center equal to $\frac{mv^2}{R}$. Together these point up and toward the center. Choice (B) gives the direction of the net force, which includes gravity, and choice (A) leaves out the horizontal part.
3	**(D)**	Banked road	Faster than v_0, the car needs a larger net force toward the center than the normal force alone supplies at this bank angle. Without friction the car would slide up the slope, toward the outside of the curve, so static friction acts down the slope, and its horizontal component adds to the net force toward the center. Friction acts along the road surface, so on a banked road it cannot point horizontally, which rules out (C). Choice (A) describes a car moving slower than v_0.
4	**(C)**	Banked road	With no friction, $\tan\theta = \frac{v^2}{rg}$, so $v = \sqrt{rg\tan\theta}$. With the bank angle unchanged, v is proportional to $\sqrt{r}$. Doubling the radius multiplies the speed by $\sqrt{2}$: (20 m/s)(1.41) = 28 m/s. Choice (D) treats the speed as proportional to the radius, and choice (B) assumes the speed does not depend on the radius.
5	**(D)**	Pendulum	At the highest point the speed is zero, so the centripetal acceleration $\frac{v^2}{L}$ is zero and the forces along the string balance: $F_T = mg\cos 40°$. The component of gravity perpendicular to the string, $mg\sin 40°$, is unbalanced, so the net force points along the arc, toward the lowest point. The bob is at rest for only an instant, so the net force is not zero, which rules out (A). Choice (C) would require the tension to be zero, which happens only when the string is horizontal at the end of the swing.

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Question	Answer	Topic	Explanation
6	**(A)**	String cut	Once the string is cut, gravity is the only force on the ball, so it moves as a projectile. Its velocity at the cut is horizontal and to the right, so it starts out horizontally and curves downward along a parabola, like an object launched horizontally. Without tension nothing holds the ball on the circle, which rules out (D). Choice (C) ignores gravity, and choice (B) ignores the ball's velocity at the cut.
7	**(A)**	String cut	After each cut, gravity is the only force, and the time to reach the floor depends only on the vertical motion. Both bobs start with zero vertical velocity: bob A is moving horizontally and bob B is at rest. Bob A starts lower, at the bottom of the swing, so it has less distance to fall and lands first. Choice (B) names the right bob for the wrong reason, since horizontal speed does not change the fall time. Choice (C) ignores the difference in starting heights.
8	**(B)**	Satellite orbits	Gravity supplies the centripetal force: $\frac{GMm}{r^2} = \frac{4\pi^2 mr}{T^2}$, so $T^2 = \frac{4\pi^2}{GM} r^3$. The period is proportional to $r^{3/2}$, and $4^{3/2} = 8$. Choice (D) is the ratio of the squared periods, and choice (C) treats the period as proportional to r^2.

Question 9: Mathematical Routines (MR) — 10 points

Part A		5 points
A1	For a vertical equation in which the vertical component of the normal force balances gravity, such as $F_N \cos\theta = mg$	1 point
A2	For a horizontal Newton's second law equation with the horizontal component of the normal force as the net force toward the center, such as $F_N \sin\theta = \frac{mv_0^2}{R}$	1 point
A3	For combining the two equations to eliminate F_N, such as $\tan\theta = \frac{v_0^2}{gR}$	1 point
A4	For a correct expression: $v_0 = \sqrt{gR\tan\theta}$	1 point
A5	For a speed consistent with Part A(i): $v_0 = 11.5$ m/s	1 point

EXAMPLE RESPONSE

Vertical: $F_N \cos\theta - mg = 0$. Horizontal, toward the center: $F_N \sin\theta = \frac{mv_0^2}{R}$.

Dividing the second equation by the first: $\tan\theta = \frac{v_0^2}{gR}$, so $v_0 = \sqrt{gR\tan\theta}$.

$v_0 = \sqrt{(9.8\ \text{m/s}^2)(50\ \text{m})\tan 15^\circ} = 11.5\ \text{m/s}$

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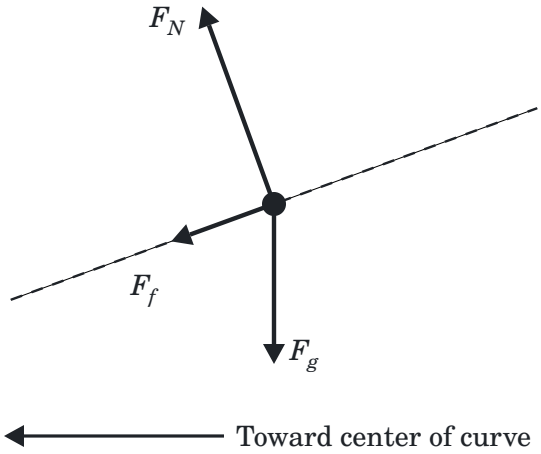
Part B		3 points
B1	For a downward gravitational force and a normal force perpendicular to the road surface, pointing away from it, each labeled, with no forces other than these and friction (an arrow labeled “centripetal force” loses this point)	1 point
B2	For a static friction force parallel to the road surface, pointing down the slope, labeled	1 point
B3	For a normal force arrow that is longer than the gravitational force arrow	1 point

EXAMPLE RESPONSE



Scoring note: B3 follows from the vertical forces. The vertical part of the normal force balances gravity and also the downward vertical part of friction, so $F_N \cos\theta = mg + F_f \sin\theta$, which makes F_N greater than mg. The length of the friction arrow is not scored.

Part C		2 points
C1	For indicating “Equal to” with an attempt at a relevant justification	1 point
C2	For a justification that the gravitational force and the net force needed toward the center are both proportional to the mass, so the friction force needed and the normal force are both proportional to the mass and the smallest coefficient, F_f/F_N, does not depend on mass	1 point

EXAMPLE RESPONSE

Equal to. On the same curve at the same speed, the truck needs twice the net force toward the center, and gravity pulls on it twice as hard, so every force in its free-body diagram is twice the matching force on the car. The truck needs twice the friction, but it also presses on the road with twice the normal force, so the smallest coefficient that works, $\mu_s = F_f/F_N$, is the same for both.

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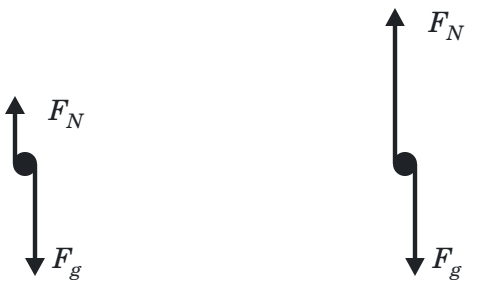
Question 10: Translation Between Representations (TBR) — 12 points

Part A		3 points
A1	For drawing on each dot only a downward gravitational force and an upward force from the scale, labeled, with no other forces (an arrow labeled “centripetal force” loses this point)	1 point
A2	For an upward arrow at point S that is shorter than the downward arrow at point S	1 point
A3	For an upward arrow at point P that is longer than the downward arrow at point P, with the gravitational force arrows the same length on both diagrams	1 point

EXAMPLE RESPONSE



Student at point S Student at point P

Part B		3 points
B1	For applying Newton’s second law at point S with the net force toward the center, which is down, such as $mg - F_N = ma_c$	1 point
B2	For a centripetal acceleration written in terms of R and T, such as $a_c = \frac{v^2}{R}$ with $v = \frac{2\pi R}{T}$	1 point
B3	For a correct expression: $F_{scale} = m(g - \frac{4\pi^2 R}{T^2})$	1 point

EXAMPLE RESPONSE

At S the acceleration points down, toward the center: $mg - F_N = m\frac{v^2}{R}$.

With $v = \frac{2\pi R}{T}$: $F_N = mg - \frac{4\pi^2 mR}{T^2}$. The scale reads F_N.

Part C		3 points
C1	For a graph with maximum values above the mg line at $t = 0$ and $t = T$	1 point
C2	For a minimum value at $t = T/2$ that is below the mg line and above zero	1 point
C3	For a smooth curve that equals mg at $t = T/4$ and $t = 3T/4$ and is symmetric about $T/2$	1 point

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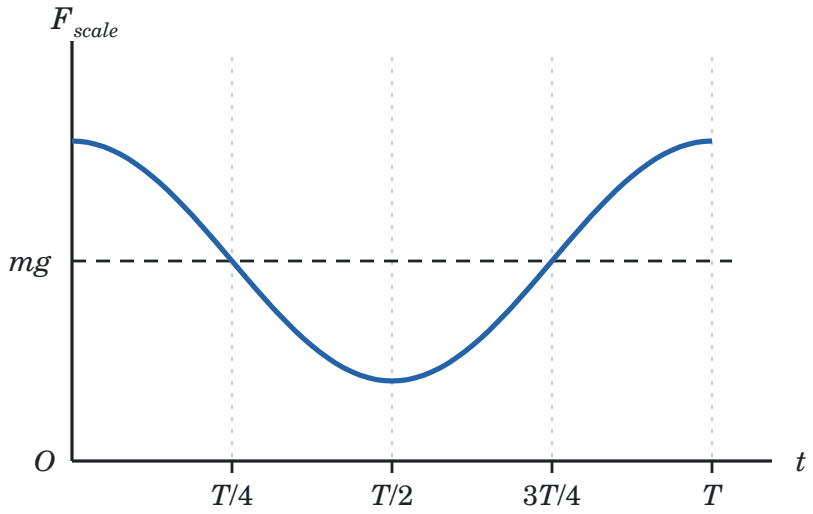
EXAMPLE RESPONSE



Scoring note: A curve with the correct values at 0, $T/4$, $T/2$, $3T/4$, and T earns full credit; the exact shape between those times is not scored.

Part D		3 points
D1	For indicating "Remains the same" with an attempt at a relevant justification	1 point
D2	For explaining that at point Q the acceleration points horizontally toward the center, so it has no vertical component and the vertical forces balance at any rotation rate	1 point
D3	For connecting to the graph: the curve crosses the *mg* line when the student is at point Q, one quarter of a period after P. With a shorter period the student reaches Q sooner, the maximum is higher, and the minimum is lower	1 point

EXAMPLE RESPONSE

Remains the same. At point Q the student's acceleration points horizontally, toward the center of the wheel, so the vertical forces still balance and the scale reads *mg*. Turning faster increases the horizontal force the student needs, which comes from friction with the scale or from the seat back, not from the scale's upward push. On the graph from Part C, the curve crosses the *mg* line when the student is at Q. The reading at Q remains *mg*, but Q is reached earlier, one quarter of the new, shorter period after P. The peak at P is higher and the dip at S is lower.

Question 11: Experimental Design and Analysis (LAB) — 10 points

Part A		2 points
A1	For a procedure that releases the sphere from rest at several different measured release heights (or angles) and records the largest tension reading, at the lowest point, for each	1 point

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A2	For a valid way to reduce uncertainty, such as releasing from each height several times and averaging the largest readings, measuring heights to the center of the sphere, or using a wide range of release heights	1 point

EXAMPLE RESPONSE

Pull the sphere aside and release it from rest at a measured height h above its lowest position, measured with the meterstick to the center of the sphere. Record the largest tension reading, which occurs as the sphere passes through the lowest point. Repeat for at least five release heights, releasing from each height three times and averaging the largest readings.

Part B		**2 points**
B1	For axes that give a linear graph, such as the largest tension F_T on the vertical axis and the release height h on the horizontal axis	1 point
B2	For relating m to a feature of the graph, such as: the vertical intercept equals mg, so m = (intercept)/g; or the slope equals $\frac{2mg}{L}$, so $m = \frac{(\text{slope})L}{2g}$	1 point

EXAMPLE RESPONSE

Energy conservation gives $v^2 = 2gh$ at the lowest point, and there $F_T - mg = \frac{mv^2}{L}$. Together: $F_T = mg + \frac{2mg}{L}h$. A graph of F_T (vertical) against h (horizontal) is a straight line with vertical intercept mg, so m = (intercept)/g.

Scoring note: Other linear choices earn credit with a matching relationship, such as F_T against $(1 - \cos\theta_0)$, where θ_0 is the release angle; that graph has slope $2mg$ and intercept mg.

Part C		**4 points**
C1	For labeling the horizontal axis with a quantity that makes the graph linear, such as v^2, in m^2/s^2	1 point
C2	For a linear numerical scale on the horizontal axis that lets the data use at least half of the grid	1 point
C3	For plotting the five data points correctly for the chosen quantity	1 point
C4	For a straight best-fit line that follows the trend of the data, with points on both sides of the line	1 point

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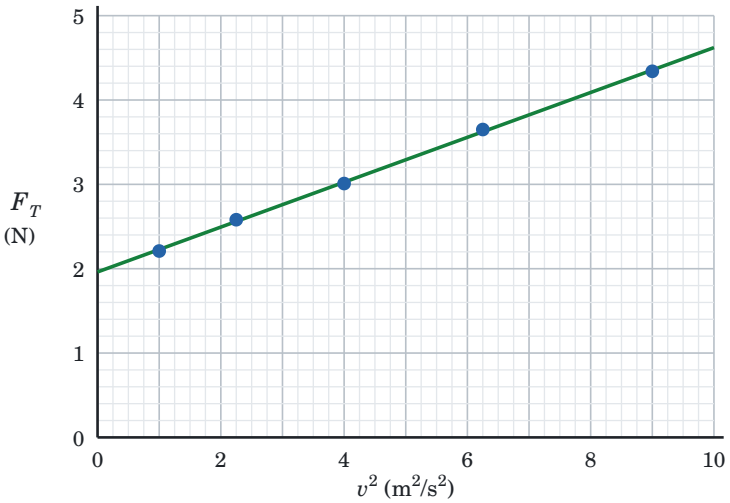
EXAMPLE RESPONSE



Values plotted

v^2 (m²/s²)	F_T (N)
1.00	2.21
2.25	2.58
4.00	3.01
6.25	3.65
9.00	4.34

Part D		**2 points**
D1	For relating the slope of the best-fit line to m, such as slope = $\frac{m}{L}$, using two points on the line rather than two data points	1 point
D2	For an experimental value of m between 0.18 kg and 0.22 kg, with units	1 point

EXAMPLE RESPONSE

Two points on the best-fit line: (0, 1.96 N) and (9.00 m²/s², 4.35 N). Slope = $\frac{4.35 - 1.96}{9.00} = 0.266$ kg/m.

At the lowest point $F_T = mg + \frac{m}{L}v^2$, so the slope equals $\frac{m}{L}$ and m = (slope)L = (0.266 kg/m)(0.75 m) = 0.20 kg.

Scoring note: The vertical intercept, about 1.96 N, equals mg, which gives m = 1.96/9.8 = 0.20 kg. A correct calculation from the intercept also earns both points.

Question 12: Qualitative/Quantitative Translation (QQT) — 8 points

Part A		**3 points**
A1	For indicating "Less than" with an attempt at a relevant justification	1 point
A2	For explaining that the satellite's mass does not affect its motion, because the gravitational force on a satellite is proportional to its mass, so satellites at the same distance have the same acceleration	1 point
A3	For explaining that the planet's gravitational pull per kilogram is weaker at the larger radius by more than the reduction in the acceleration needed to follow the larger circle, so satellite Y must move more slowly	1 point

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EXAMPLE RESPONSE

Less than. The larger mass of satellite Y does not matter: the planet pulls on each kilogram of a satellite equally at a given distance, so a heavier satellite gets the same acceleration as a lighter one in the same place. The radius does matter. At twice the distance, the planet's pull on each kilogram is a quarter as strong. A circle twice as large needs only half the acceleration at the same speed, but the pull drops by more than that, so satellite Y can stay on its circle only by moving more slowly than satellite X.

Part B		**3 points**
B1	For setting the gravitational force equal to the satellite's mass times its centripetal acceleration, such as $\frac{GM_Pm}{r^2} = \frac{mv^2}{r}$	1 point
B2	For $v_X = \sqrt{\frac{GM_P}{R}}$	1 point
B3	For $v_Y = \sqrt{\frac{GM_P}{2R}}$, which equals $\frac{v_X}{\sqrt{2}}$	1 point

EXAMPLE RESPONSE

$\frac{GM_Pm}{r^2} = \frac{mv^2}{r}$, so $v = \sqrt{\frac{GM_P}{r}}$.

$v_X = \sqrt{\frac{GM_P}{R}}$ and $v_Y = \sqrt{\frac{GM_P}{2R}} = \frac{v_X}{\sqrt{2}} \approx 0.71v_X$.

Part C		**2 points**
C1	For explaining that the satellite's mass cancels and does not appear in the expressions, which agrees with the reasoning that mass does not affect orbital speed	1 point
C2	For explaining that the speed is proportional to $1/\sqrt{r}$, so the larger radius gives the smaller speed, which agrees with Part A	1 point

EXAMPLE RESPONSE

The satellite's mass m cancels from both sides, so neither expression contains it, which matches the reasoning that a heavier satellite at the same distance moves the same way. The expressions show v proportional to $1/\sqrt{r}$: doubling the radius divides the speed by $\sqrt{2}$, so v_Y is less than v_X, as Part A argued.

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