مراجعة نهائية وفق الهيكل الوزاري الخطة C

إعداد: أحمد التميمي

المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة فيزياء في الفصل الثالث	
5	ملخص الوحدة التاسعة الحركة الدائرية

THE GARDEN ACADEMY

Your Guide to Success

هيكل 11ADV حكومي

EOT Term 3
2023/2024

المادة: الفيزياء
المدرس: أحمد التميمي

Grade 11 Advanced (Plan C) – EoT Coverage

MCQ	1	(1) Define the center of mass as the point at which all the mass of an object appears to be concentrated. (2) Recall that center of gravity is equivalent to center of mass in situations where the gravitational force is constant everywhere throughout the object.	Student Book (S.B)	226

Question 1

Which of the following statements are true about the center of mass?

A	The center of mass is always the same as the center of gravity, no matter the size of the object.	B	An object can have more than one center of mass.
C	Some objects do not have a center of mass.	D	The center of mass is where the mass of an object can be considered to be concentrated.

Question 2

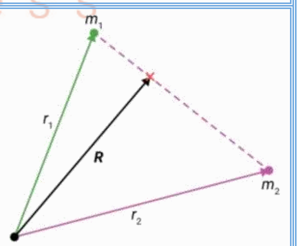
Under which condition is the center of gravity equivalent to the center of mass for an object?

A	When the object is in motion	B	When the gravitational force is constant everywhere throughout the object
C	When the object is in a vacuum	D	When the object has uniform density

MCQ	2	Describe that the location of the center of mass is a fixed point relative to the object or system of objects and does not depend on the location of the coordinate system used to describe it.	Student Book (S.B) Figure 8.2 Concept Check 8.1	227

Question 3

Based on the system shown in the figure, which mass is greater than the other? What does R represent?



A	$m_1 < m_2$, R represents the location of the center of mass of the system	B	$m_1 > m_2$, R represents the location of the center of mass of the system
C	$m_1 > m_2$, R represents the location of the geometric center of the system	D	$m_1 < m_2$, R represents the location of the geometric center of the system

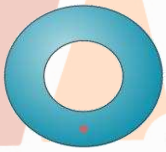
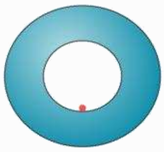
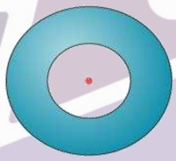
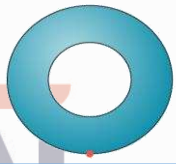
Question 4

A baseball bat has a uniform density. Which image shows a red dot at the closest point to the bat's center of mass?

A		B	
C		D	

Question 5

A donut-shaped object has uniform density. Which image shows a red dot at the object's center of mass?

A		B	
C		D	

Question 6

A system has multiple objects. Where is the center of mass of the system found?

A	It is found at multiple points that model the motion of objects in the system	B	It is found at multiple points that are the centers of mass of the objects in the system
C	It is found at a single point at the geometric center of the volume of the system	D	It is found at a single point where the mass of all the objects is concentrated

Question 7

How is the mass density of an object such that the center of mass of the object is not located at the geometrical center of the body?

A	It will be non-homogenous	B	It will be constant
C	It will be small	D	It will be large

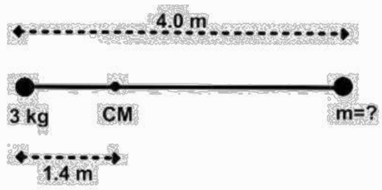
$$X = \frac{x_1m_1 + x_2m_2 + x_3m_3 + \cdots}{m_1 + m_2 + m_3 + \cdots}$$

$$Y = \frac{y_1m_1 + y_2m_2 + y_3m_3 + \cdots}{m_1 + m_2 + m_3 + \cdots}$$

$$Z = \frac{z_1m_1 + z_2m_2 + z_3m_3 + \cdots}{m_1 + m_2 + m_3 + \cdots}$$

Question 8

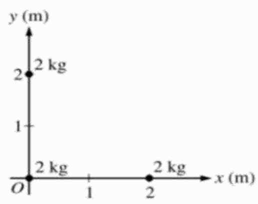
A 4.0 m rod of negligible mass connects two small spheres at its ends. The mass of one sphere is 3.0 kg and the mass of the other is unknown. What is the unknown mass if the center of mass of this system is 1.4 m to the right of the 3.0 kg sphere as shown in the figure below?



A	4.2 kg	B	3.4 kg
C	2.7 kg	D	1.6 kg

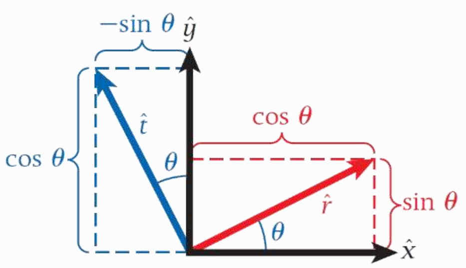
Question 9

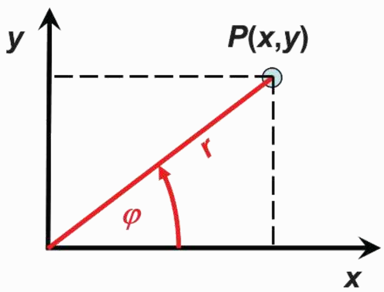
A system consists of 2 kg objects located at coordinates (0,2), (0,0), (2,0), as shown in the figure. What are coordinates (X,Y) of the center of the mass of the system?



A	(0.5, 0.5)	B	(0.67, 0.67)
C	(0.75, 0.75)	D	(1, 1)

MCQ	3	(1) Define the polar coordinate system as a two-dimensional coordinate system such that a point on a plane is defined by its distance r from the origin and the angle θ measured. (2) Express the Cartesian coordinates (x, y) in terms of the polar coordinates (r, θ) and vice versa. (3) Convert polar coordinates to Cartesian coordinates and vice versa.	Student Book (S.B) S.B/Figure 9.3/9.4 Example 9.1	255 256 256





Cartesian → Polar

$r = \sqrt{x^2 + y^2}$

$\theta = \tan^{-1}(\frac{y}{x})$

Polar → Cartesian

$x = r\cos(\theta)$

$y = r\sin(\theta)$

Quadrant الربع	Signs of x and y اشارة x و y	Calculated angle الزاوية المحسوبة	Correction to find θ (التصحيح)
1st	$(+,+)$	$0°\ to\ 90°$	*None needed*
2nd	$(-,+)$	$0°\ to\ -90°$	*Add 180°*
3rd	$(-,-)$	$0°\ to\ 90°$	*Add 180°*
4th	$(+,-)$	$0°\ to\ -90°$	*Add 360°*

Question 10

A point has a value of $\left(6, \frac{\pi}{6}\right)$ in the polar coordinate system. What is the value in cartesian coordinate?

A	(5.0, 4.0)	B	(0.87, 0.50)
C	(4.0, 2.0)	D	(5.2, 3.0)

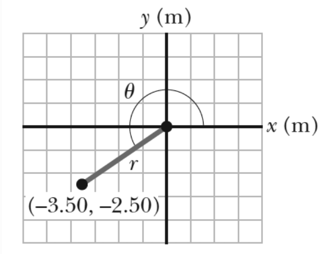
Question 11

A point has a value of $\left(8, \frac{4\pi}{3}\right)$ in the polar coordinate system. What is the value in cartesian coordinate?

A	(-7.98, -0.58)	B	(7.98, 0.58)
C	(-4.0, -6.93)	D	(4.0, -6.93)

Question 12

The cartesian coordinates of a point in the xy-plane are $(x,y)=(-3.50\ m,-2.50\ m)$ as shown. Find the polar coordinates of this point.



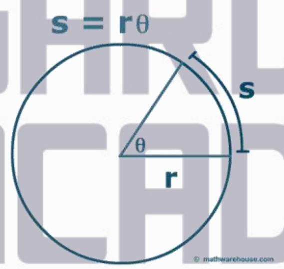
A	(4.30m, 216°)	B	(4.30m, 36°)
C	(2.45m, 216°)	D	(2.45m, 36°)

Question 13

How many degrees correspond to a radian?

A	57.3°	B	90.0°
C	180°	D	360°

MCQ	4	Relate the arc length (s), to the radius (r) of the circular path and the angle (θ), measured in radians.	S.B/Figure 9.3 Student Book	255 257



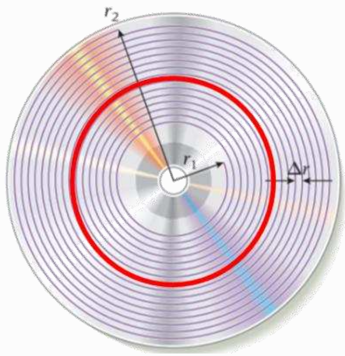
Question 14

A bicycle travels 141 m along a circular track of radius 30 m. What is the angular displacement in radians of the bicycle from its starting position?

A	1.0 rad	B	1.5 rad
C	3.0 rad	D	4.7 rad

Question 15

The track on a compact disc (CD) shown in figure. The track is a spiral, originating at an inner radius of r_1 = 25 mm and terminating at an outer radius of r_2 = 58 mm. The spacing between successive loops of the track is a constant,
Δr = 1.6 μm. What is the total length of this track?



Question 16

A child, riding on a large merry-go-round, travels a distance of 3000 m in a circle of diameter 40 m. The total angle through which she revolves is _____.

A	50 rad	B	75 rad
C	150 rad	D	314 rad

Question 17

An object rotates along a circular path with a constant speed to complete 2 revolutions in 20 seconds. If the radius of this circular path is known to be 10 cm. Find the length of the path covered by the object.

A	3.14m	B	0.58m
C	1.26m	D	4.3m

Question 18

A drone flies along a circular path and completes 3 revolutions in 15 minutes. If the length of the path covered by the drone is 1.5 kilometers, what is the diameter of the circular path?

A	80m	B	160m
C	320m	D	540m

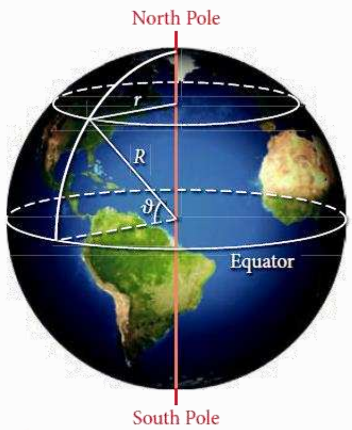
MCQ	5	Apply the relation for the magnitude of angular velocity in terms of frequency and period of rotation	Example 9.3 Additional Exercises/9.61(a)	260 282

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$v = r\omega$$

Question 19

The Earth orbits around the Sun and also rotates on its pole-to-pole axis. What are the angular velocities, frequencies, and linear speeds of these motions?



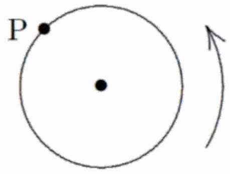
Question 20

A boy is on a Ferris wheel, which takes him in a vertical circle of radius 9.00 m once every 12.0 s. What is the angular speed of the Ferris wheel?

Question 21			
The angular speed of the minute hand of a clock (in radians per second) is:			
A	0.05 rad/s	B	6.28 rad/s
C	3.20 rad/s	D	0.10 rad/s

MCQ	6	Relate the magnitudes of linear (tangential) and angular velocities for circular motion as, and explain that this relation does not hold for tangential and angular velocity vectors which point in different directions	Exercises/Q. 9.44	281

$$v = r\omega$$

Question 22			
The figure shows a cylinder of radius 0.7 m rotating about its axis at 10 rad/s. The linear speed of the point P is: 			
A	4.0 m/s	B	7.0 m/s
C	11.0 m/s	D	13.0 m/s

Question 23			
A car travels along a circular track and completes 4 revolutions in 40 seconds. If the radius of this circular track is 20 meters, calculate the angular velocity and the linear velocity of the car at the time it completes the 4 revolutions.			
A	0.43 rad/s - 12.57 m/s	B	0.63 rad/s – 6.58 m/s
C	0.63 rad/s - 12.57 m/s	D	0.84 rad/s - 12.57 m/s

MCQ	7	Relate the magnitude of the net acceleration in circular motion to the tangential acceleration and centripetal acceleration	Exercises for Question 9.44 (part f), Exercises for Question 9.46, Additional Exercises for Question 9.63.	281 282
MCQ	13	Express the linear acceleration vector for an object in circular motion as $\vec{a} = a_t\hat{t} - a_c\hat{r}$	(S.B) Exercise/Q.9.46	262 281

$$\vec{a} = a_t\hat{t} - a_c\hat{r}$$

$$a_t = r\alpha$$

$$a_c = v\omega = \omega^2 r = \frac{v^2}{r}$$

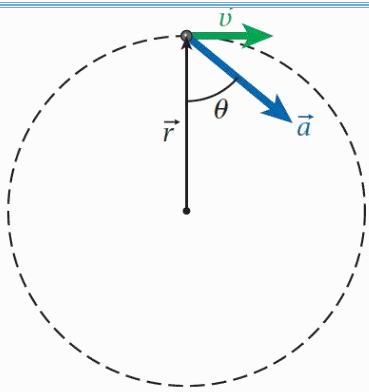
Question 24

A discus thrower (with arm length of 1.20 m) starts from rest and begins to rotate counterclockwise with an angular acceleration of 2.50 rad/s^2.

a) How long does it take the discus thrower's speed to get to 4.70 rad/s?
b) How many revolutions does the thrower make to reach the speed of 4.70 rad/s?
c) What is the linear speed of the discus at 4.70 rad/s?
d) What is the linear acceleration of the discus thrower at this point?
e) What is the magnitude of the centripetal acceleration of the discus thrown?
f) What is the magnitude of the discus's total acceleration?

Question 25

A particle is moving clockwise in a circle of radius 1.00 m. At a certain instant, the magnitude of its acceleration is a = 25.0 m/s^2 and the acceleration vector has an angle of θ = 50.0° with the position vector, as shown in the figure. At this instant, find the speed, $v = |\vec{v}|$ of this particle.



Question 26

A car accelerates uniformly from rest and reaches a speed of 22.0 m/s in 9.00 s. The diameter of a tire on this car is 58.0 cm.

a) Find the number of revolutions the tire makes during the car's motion, assuming that no slipping occurs.

b) What is the final angular speed of a tire in revolutions per second?

MCQ	8	Identify that the centripetal force, necessary for circular motion, can be provided by different forces such as the force of friction, tension, gravitational force, Coulomb force, or the normal force.	Student Book (S.B) Exercises/Q. 9.50	264 281

$$F_c = ma_c = mv\omega = m\frac{v^2}{r} = m\omega^2 r$$

Question 27

Calculate the centripetal force exerted on a vehicle of mass m = 1500. kg that is moving at a speed of 15.0 m/s around a curve of radius R = 400. m. Which force plays the role of the centripetal force in this case?

Question 28

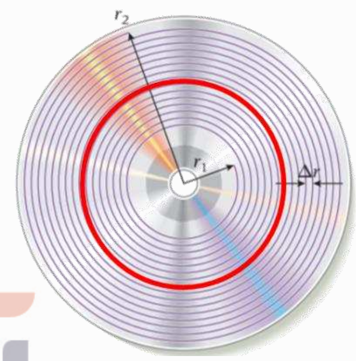
Calculate the centripetal force exerted on a stone of mass m = 2.0 kg that is being swung at a speed of 6.0 m/s around a circular path with a radius R=1.5 meters. Which force plays the role of the centripetal force in this case?

MCQ	9	Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time.	Example 9.6 Example 9.7 Exercises/Q. 9.35	264 271 280

	Linear Motion		Circular Motion
(i)	$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$	(i)	$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
(ii)	$x = x_0 + \bar{v}_x t$	(ii)	$\theta = \theta_0 + \bar{\omega} t$
(iii)	$v_x = v_{x0} + a_x t$	(iii)	$\omega = \omega_0 + \alpha t$
(iv)	$\bar{v}_x = \frac{1}{2}(v_x + v_{x0})$	(iv)	$\bar{\omega} = \frac{1}{2}(\omega + \omega_0)$
(v)	$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$	(v)	$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$.

Question 29

In Example 9.2, we established that a CD track is 5.4 km long. A music CD can store 74 min of music. What are the angular velocity and the tangential acceleration of the disc as it spins inside a CD player, assuming a constant linear velocity?



Question 30

In hammer throw competetion, the hammer's total length is 121.5 cm, and its total mass is 7.26 kg. The athlete has to accomplish the throw from within a circle of radius 2.13 m, and the best way to throw the hammer is for the athlete to spin, allowing the hammer to move in a circle around him, before releasing it. An athlete broke the Olympic record distance of 84.80 m. He took seven turns before releasing the hammer, and the period to complete each turn was obtained from examining the video recording frame by frame: 1.52 s, 1.08 s, 0.72 s, 0.56 s, 0.44 s, 0.40 s, and 0.36 s.

a) What was the average angular acceleration during the seven turns? Assume constant angular acceleration for the solution.

b) Assuming that the radius of the circle on which the hammer moves is 1.67 m (the length of the hammer plus the arms of the athlete), what is the linear speed with which the hammer is released?

c) What is the centripetal force that the hammer thrower has to exert on the hammer right before he releases it?

d) After release, what is the direction in which the hammer moves?

Question 31

A vinyl record plays at 33.3 rpm. Assume it takes 5.00 s for it to reach this full speed, starting from rest.

a) What is its angular acceleration during the 5.00 s?

b) How many revolutions does the record make before reaching its final angular speed?

MCQ	10	Convert angle measurements between degrees and radians.	Student Book (S.B)	256

Angle Conversions					
Degree Vs. Radians		Degree Vs. Revolutions		Radians Vs. Revolutions	
Deg. → rad	rad → Deg.	Deg. → rev	rev → Deg.	rad → rev	rev → rad
$(angle(°) \times \frac{\pi}{180})$	$(angle(rad) \times \frac{180}{\pi})$	$(\frac{angle(°)}{360°})$	$(angle(rev) \times 360°)$	$(\frac{angle(rad)}{2\pi})$	$(angle(rev) \times 2\pi)$

Question 32

One complete revolution (360°) is the same as

A	$\frac{\pi}{4}\ rad$	B	$\frac{\pi}{2}\ rad$
C	$\pi\ rad$	D	$2\pi\ rad$

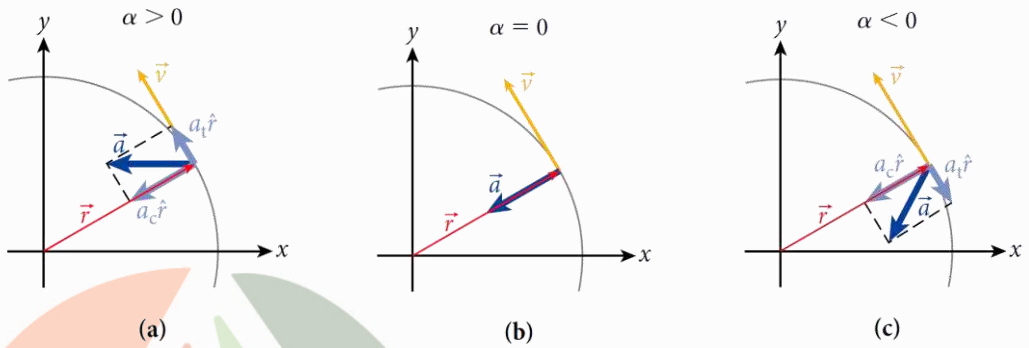
Question 33

1. Convert 3 revolution into degrees.

2. Convert $(\frac{4}{3}\pi)\ rad$ to revolutions.

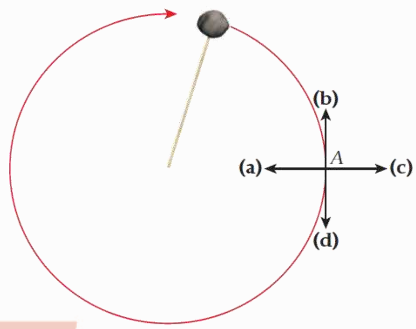
3. Convert 225° to revolutions.

MCQ	11	Sketch the path taken in circular motion (uniform and non-uniform) and explain the velocity and acceleration vectors (magnitudes and directions) during the motion	S.B/Figure 9.12 S.B/MCQ/Q.9.4	262 278



Question 34

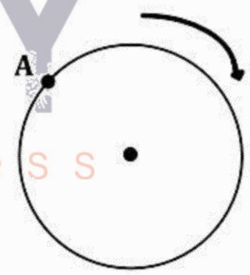
A rock attached to a string moves clockwise in uniform circular motion. In which direction from point A is the rock thrown off when the string is cut?



A	(a)	B	(b)
C	(c)	D	(d)

Question 35

Consider an object that moves in a circular path at constant speed. When it reaches point A, which of the following describes the direction of its centripetal acceleration (a_c) and velocity (v)?



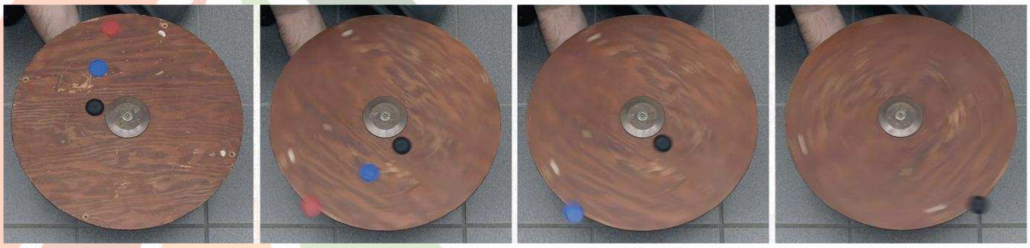
A	a_c ↗	v ↘	B	a_c ↙	v ↖
C	a_c ↙	v ↘	D	a_c ↘	v ↗

MCQ	12	Identify that for an object in circular motion with a given angular velocity, the centripetal force increases with the distance from the center.	(S.B) Example 9.8	264 273

$$F_c = m \cdot \frac{4\pi^2 r}{T^2}$$

Question 36

Which piece would fall first as the angular speed of the spinning table increases?

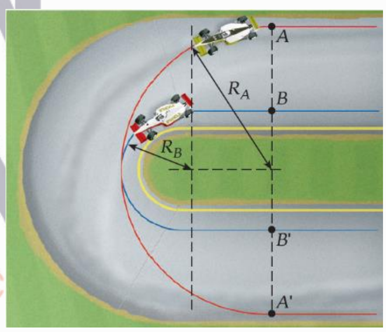


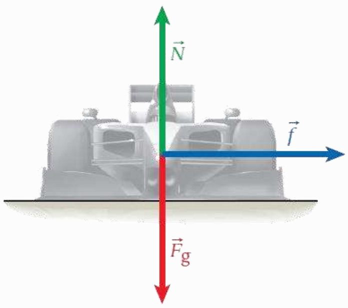
(a) (b) (c) (d)

A	(a)	B	(b)
C	(c)	D	(d)

Question 37

Suppose that cars move through the U-turn shown in Figure at constant speed and that the coefficient of static friction between the tires and the road is μ_s = 1.2. If the radius of the inner curve shown in the figure is R_B = 10.3 m and radius of the outer is R_A = 32.2 m and the cars move at their maximum speed, how much time will it take to move from point A to A' and from point B to B'?





MCQ	14	Distinguish between tangential acceleration and radial acceleration, specifying the cause and direction of each.	Student Book (S.B) Exercises/ Q. 9.46/9.43	261 281

Question 38

Calculate the required frequency and the linear speed of a sample in an ultracentrifuge. The sample is subjected to a centripetal acceleration of 840,000 g at a distance of 23.5 cm from the ultracentrifuge's rotation axis.

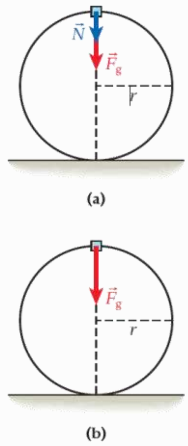
Question 39

A centrifuge in a medical laboratory rotates at an angular speed of 3600. rpm (revolutions per minute). When switched off, it rotates 60.0 times before coming to rest. Find the constant angular acceleration of the centrifuge.

MCQ	15	Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve,...)	S.B/Figure 9.18/9.19 S.B/Figure 9.20 S.B/MCQ/Q.9.11 Added Q	266 268 278

Question 40

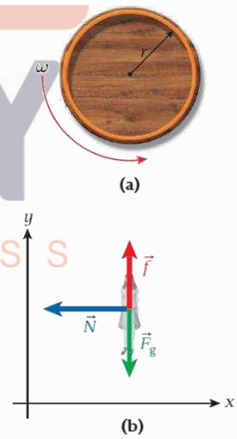
Perhaps the biggest thrill to be had at an amusement park is on a roller coaster with a vertical loop in it , where passengers feel almost weightless at the top of the loop. Suppose the vertical loop has a radius of 5.00 m. What does the linear speed of the roller coaster have to be at the top of the loop for the passengers to feel weightless? (Assume that friction between roller coaster and rails can be neglected.)



What speed must the roller coaster have at the top of the loop to accomplish the same feeling of weightlessness if the radius of the loop is doubled?

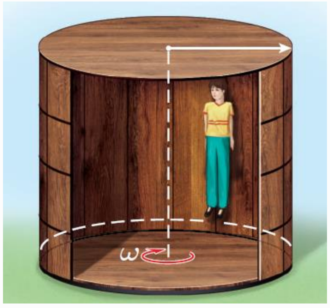
Question 41

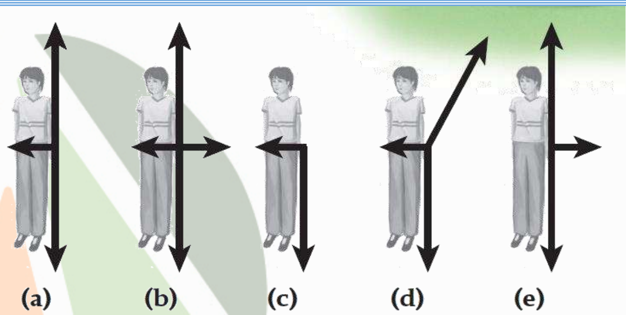
One of the rides found at carnivals is a rotating cylinder. The riders step inside the vertical cylinder and stand with their backs against the curved wall. The cylinder spins very rapidly, and at some angular velocity, the floor is pulled away. The thrill-seekers now hang like flies on the wall. If the radius of the cylinder is r = 2.10 m, the rotation axis of the cylinder remains vertical, and the coefficient of static friction between the people and the wall is μs = 0.390, what is the minimum angular velocity, ω, at which the floor can be withdrawn?



Question 42

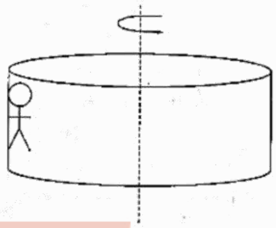
The figure shows a rider stuck to the wall without touching the floor in the Barrel of Fun at a carnival. Which diagram correctly shows the forces acting on the rider?





Question 43

An amusement park ride has the shape of a cylindrical shell of radius 12 m. First, a passenger stands against the wall of the ride, and when the ride reaches a speed of 15 m/s, the floor underneath the passenger is lowered. What is the minimum coefficient of static friction that allows the passenger to remain pinned against the wall of the ride?



A	0.52	B	0.68
C	0.71	D	0.80

End of MCQ part

FRQ	16	(1) Identify that the linear velocity, of a particle in circular motion always points tangential to the circular path (circumference) and is always perpendicular to the position vector, which points in the radial direction. (2) Sketch the path taken in circular motion (uniform and non-uniform) and explain the velocity and acceleration vectors (magnitudes and directions) during the motion. (3) Explain that for uniform circular motion, where the angular velocity is constant, the tangential acceleration is zero, but the velocity vector still changes direction continuously as the object moves in its circular path. (4) Relate the magnitudes of linear (tangential) and angular velocities for circular motion.	Exercises/Q. 9.46 Exercises/Q. 9.47.(a) Exercises/Q. 9.50	281

Question 44

In a tape recorder, the magnetic tape moves at a constant linear speed of 5.60 cm/s. To maintain this constant linear speed, the angular speed of the driving spool (the take-up spool) has to change accordingly.

a) What is the angular speed of the take-up spool when it is empty, with radius r_1 = 0.800 cm?

b) What is the angular speed when the spool is full, with radius r_2 = 2.20 cm?

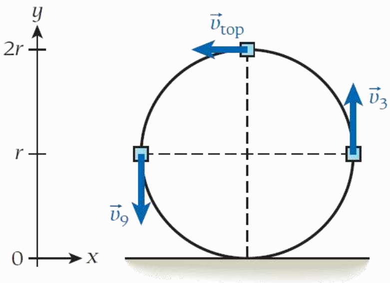
c) If the total length of the tape is 100.80 m, what is the average angular acceleration of the take-up spool while the tape is being played?

FRQ	17	(1) Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve…). (2) Determine the location of the center of mass of two or several particles or extended objects with uniform mass distribution (the object can be divided into simple geometric figures, each of which can be replaced by a particle at its center) by applying suitable mathematical equations	Solved Problem (9.1) Conceptual Questions (9.20) Exercises/Q. 9.55 Additional Exercises/Q. 9.60	266 279 281 282

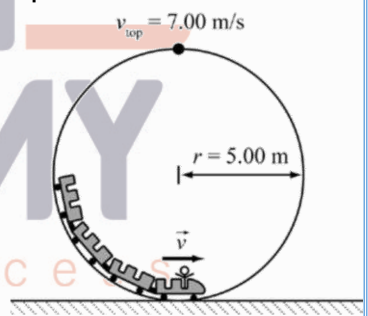
$$E = K + U$$

Question 45	تابع لسؤال (40) في الاعلى

Find the velocities at 3 o'clock and 9 o'clock positions.

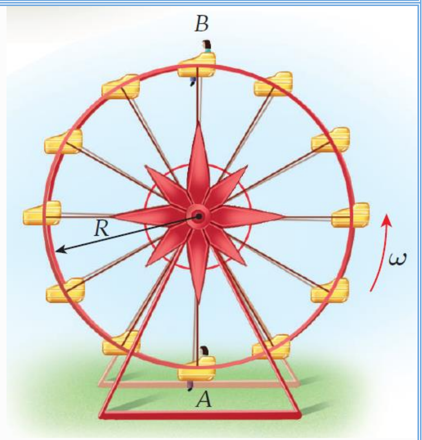


What is the apparent weight of a rider on the roller coaster at the bottom of the loop?



Question 46

A person rides on a Ferris wheel of radius R, which is rotating at a constant angular velocity ω. Compare the normal force of the seat pushing up on the person at point A to that at point B in the figure. Which force is greater, or are they the same?



Question 47

A particular Ferris wheel takes riders in a vertical circle of radius 9.00 m once every 12.0 s.

a) Calculate the speed of the riders, assuming it to be constant.

b) Draw a free-body diagram for a rider at a time when she is at the bottom of the circle. Calculate the normal force exerted by the seat on the rider at that point in the ride.

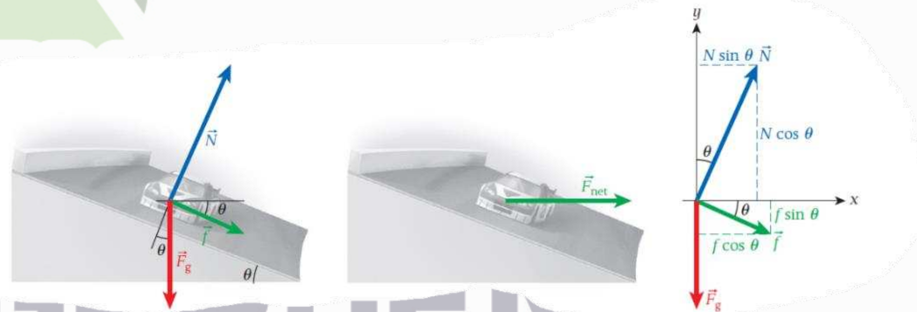
c) Perform the same analysis as in part (b) for a point at the top of the ride.

Cases

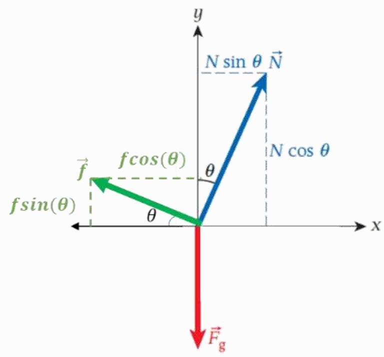
➢	**Moving on a flat curved road**	$v = \sqrt{R\mu_s g}$
➢	**Minimum speed on a curved banked road**	$v = \sqrt{\frac{Rg(\sin\theta - \mu_s \cos\theta)}{\cos\theta + \mu_s \sin\theta}}$
➢	**Maximum speed on a curved banked road**	$v = \sqrt{\frac{Rg(\sin\theta + \mu_s \cos\theta)}{\cos\theta - \mu_s \sin\theta}}$
➢	**Minimum speed on a Frictionless banked road**	$v = \sqrt{Rg\tan(\theta)}$

Question 48

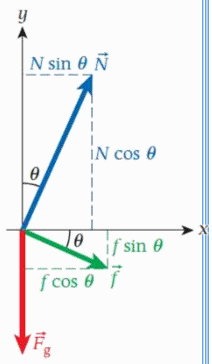
- Given a banked curve with a radius of R=110m and a banking angle of θ=21.1°, calculate the maximum speed a driver can maintain without slipping if the coefficient of static friction between the track and the tires is μ_s=0.620.



- Find the minimum speed at which the car can travel with as it negotiates the banked curve?



- Find the minimum speed at which the car has to move with if the surface is frictionless.



Question 49

A car speeds over the top of a hill. If the radius of curvature of the hill at the top is 9.00 m, how fast can the car be traveling and maintain constant contact with the ground?

FRQ	18	(1) Apply the kinematic relationships for circular motion with constant angular acceleration to calculate angular position, angular displacement, angular velocity, angular acceleration, or time. (2) Solve problems related to rotation with constant angular acceleration. (3) Relate the magnitude of the net acceleration in circular motion to the tangential acceleration and centripetal acceleration.	Exercises/Q. 9.35 Exercises/Q. 9.44 Additional Exercises/Q. 9.63	280 281 282

All questions mentioned in this part were solved in the previous parts. (Repeated questions)

FRQ	19	Apply Newton's laws of motion and/or energy conservation principles to analyze circular motion in a vertical or horizontal plane (motion in vertical loop of an amusement park ride, rotating cylinder, moving through a levelled or banked curve…).	Solved Problem /Q.9.4 Exercises/Q. 9.59	275 282

Question 50

A speedway turn, with radius of curvature R, is banked at an angle θ above the horizontal.

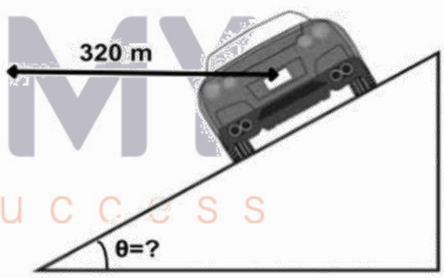
a) What is the optimal speed at which to take the turn if the track's surface is iced over (that is, if there is very little friction between the tires and the track)?

b) If the track surface is ice-free and there is a coefficient of friction μs between the tires and the track, what are the maximum and minimum speeds at which this turn can be taken?

c) Evaluate the results of parts (a) and (b) for $R = 400.$ m, θ = 45.0°, and μs = 0.700.

Question 51

The raceway of a car race is banked at an angle θ above the horizontal. What must the value of θ be if a race car, moving with a speed of 45 m/s, maintains a circular motion of radius 320 m, assuming it is raining and the friction between the tires and the road is negligible?



End of FRQ part

مع تمنايتي لكم بالتوفيق والنجاح