Physics I
Exam 1 Review

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1 Must knows!!

2 Multiple Choice
   - Chapter 2: MOTION ALONG A STRAIGHT LINE
   - Chapter 3: VECTORS
   - Chapter 4: MOTION IN TWO AND THREE DIMENSIONS

3 Problems
   - Problem 1
   - Problem 2
Must Knows!!

Constants:
\[ g = 9.81 \text{ m/s}^2 \]

Volumes:
\[ V_{Sphere} = \frac{4}{3} \pi r^3 \]
\[ V_{Cylinder} = \pi r^2 h \]

Surface Area:
\[ A_{Sphere} = 4\pi r^2 \]
Multiple Choice
Chapter 2: MOTION ALONG A STRAIGHT LINE
**Question 1**

Two automobiles are 150 kilometers apart and traveling toward each other. One automobile is moving at 60 km/h and the other is moving at 40 km/h. In how many hours will they meet?

A 2.5  
B 2.0  
C 1.75  
D 1.5  
E 1.25
Question 1

Two automobiles are 150 kilometers apart and traveling toward each other. One automobile is moving at 60 km/h and the other is moving at 40 km/h. In how many hours will they meet?

A 2.5
B 2.0
C 1.75
D 1.5
E 1.25

Answer: D
Question 2

Each of four particles move along an x axis. Their coordinates (in meters) as functions of time (in seconds) are given by:

Particle 1: \( x(t) = 3.5 - 2.7t^3 \)
Particle 2: \( x(t) = 3.5 + 2.7t^3 \)
Particle 3: \( x(t) = 3.5 + 2.7t^2 \)
Particle 4: \( x(t) = 3.5 - 3.4t - 2.7t^2 \)

Which of these particles have constant acceleration?

A  All four
B  Only 1 and 2
C  only 2 and 3
D  only 3 and 4
E  None of them
Question 2

Each of four particles move along an $x$ axis. Their coordinates (in meters) as functions of time (in seconds) are given by:

Particle 1: $x(t) = 3.5 - 2.7t^3$
Particle 2: $x(t) = 3.5 + 2.7t^3$
Particle 3: $x(t) = 3.5 + 2.7t^2$
Particle 4: $x(t) = 3.5 - 3.4t - 2.7t^2$

Which of these particles have constant acceleration?

A  All four
B  Only 1 and 2
C  only 2 and 3
D  only 3 and 4
E  None of them

Answer: D
Question 3

Of the following situations, which one is impossible?

A. A body having velocity east and acceleration east
B. A body having velocity east and acceleration west
C. A body having zero velocity and non-zero acceleration
D. A body having constant acceleration and variable velocity
E. A body having constant velocity and variable acceleration

Answer: E
Question 3

Of the following situations, which one is impossible?

A A body having velocity east and acceleration east
B A body having velocity east and acceleration west
C A body having zero velocity and non-zero acceleration
D A body having constant acceleration and variable velocity
E A body having constant velocity and variable acceleration

Answer: E
Question 4

An object is shot vertically upward. While it is rising:

A. its velocity and acceleration are both upward
B. its velocity is upward and its acceleration is downward
C. its velocity and acceleration are both downward
D. its velocity is downward and its acceleration is upward
E. its velocity and acceleration are both decreasing

Answer: B
Question 4

An object is shot vertically upward. While it is rising:

A  its velocity and acceleration are both upward
B  its velocity is upward and its acceleration is downward
C  its velocity and acceleration are both downward
D  its velocity is downward and its acceleration is upward
E  its velocity and acceleration are both decreasing

Answer: B
Question 5

As a rocket is accelerating vertically upward at 9.8 m/s/s near Earth's surface, it releases a projectile. Immediately after release the acceleration (in m/s/s) of the projectile is:

A 9.8 down
B 0
C 9.8 up
D 19.6 up
E None of the above
Question 5

As a rocket is accelerating vertically upward at 9.8 m/s/s near Earth’s surface, it releases a projectile. Immediately after release the acceleration (in m/s/s) of the projectile is:

A 9.8 down
B 0
C 9.8 up
D 19.6 up
E None of the above

Answer: A
An elevator is moving upward with constant acceleration. The dashed curve shows the position, \( y \), of the ceiling of the elevator as a function of the time, \( t \). At the instant indicated by the dot, a bolt breaks loose and drops from the ceiling. Which curve best represents the position of the bolt as a function of time?

\[ y \]

\[ t \]

Answer: B
Question 6

An elevator is moving upward with constant acceleration. The dashed curve shows the position, \( y \), of the ceiling of the elevator as a function of the time, \( t \). At the instant indicated by the dot, a bolt breaks loose and drops from the ceiling. Which curve best represents the position of the bolt as a function of time?

Answer: B
Chapter 3: VECTORS
Question 1

A vector has a magnitude of 12. When its tail is at the origin it lies between the positive $x$ axis and the negative $y$ axis and makes an angle of $30^\circ$ with the $x$ axis. Its $y$ component is:

A  $6/\sqrt{3}$
B  $-6\sqrt{3}$
C  6
D  $-6$
E  12

Answer: D
Question 1

A vector has a magnitude of 12. When its tail is at the origin it lies between the positive $x$ axis and the negative $y$ axis and makes an angle of $30^\circ$ with the $x$ axis. Its $y$ component is:

A $6/\sqrt{3}$
B $-6\sqrt{3}$
C 6
D $-6$
E 12

Answer: D
Question 2

The value of $\hat{i} \cdot (\hat{j} \times \hat{k})$?

A  zero
B  +1
C  -1
D  3
E  $\sqrt{3}$

Answer: B
Question 2

The value of $\hat{i} \cdot (\hat{j} \times \hat{k})$?

A  zero
B  +1
C  -1
D  3
E  $\sqrt{3}$

Answer: B
Chapter 4: MOTION IN TWO AND THREE DIMENSIONS
Question 1

Two bodies are falling with negligible air resistance, side by side, above a horizontal plane. If one of the bodies is given an additional horizontal acceleration during its descent, it:

A strikes the plane at the same time as the other body
B strikes the plane earlier than the other body
C has the vertical component of its velocity altered
D has the vertical component of its acceleration altered
E follows a straight line path along the resultant acceleration vector

Answer: A
Question 1

Two bodies are falling with negligible air resistance, side by side, above a horizontal plane. If one of the bodies is given an additional horizontal acceleration during its descent, it:

A strikes the plane at the same time as the other body
B strikes the plane earlier than the other body
C has the vertical component of its velocity altered
D has the vertical component of its acceleration altered
E follows a straight line path along the resultant acceleration vector

Answer: A
Question 2

A stone thrown from the top of a tall building follows a path that is:

A  circular
B  made of two straight line segments
C  hyperbolic
D  parabolic
E  a straight line

Answer: D
Question 2

A stone thrown from the top of a tall building follows a path that is:

A circular  
B made of two straight line segments  
C hyperbolic  
D parabolic  
E a straight line

Answer: D
Question 3

A stone is thrown horizontally and follows the path XYZ shown. The direction of the acceleration of the stone at point Y is:

Answer: A
Question 3

A stone is thrown horizontally and follows the path XYZ shown. The direction of the acceleration of the stone at point Y is:

Answer: A
Question 4

Which of the curves on the graph below best represents the vertical component $v_y$ of the velocity versus the time $t$ for a projectile red at an angle of $45^\circ$ above the horizontal?

![Graph with curves A, B, C, D, and E representing $v_y$ vs. $t$.]

A  OC  
B  DE  
C  AB  
D  AE  
E  AF
Question 4

Which of the curves on the graph below best represents the vertical component $v_y$ of the velocity versus the time $t$ for a projectile red at an angle of 45° above the horizontal?

![Diagram showing curves on a graph with $v_y$ on the y-axis and $t$ on the x-axis.]

A  OC  
B  DE  
C  AB  
D  AE  
E  AF  

Answer: D
An object, tied to a string, moves in a circle at constant speed on a horizontal surface as shown. The direction of the displacement of this object, as it travels from W to X is:

A ↩
B ↓
C ↑
D ↘
E ↩
Question 5

An object, tied to a string, moves in a circle at constant speed on a horizontal surface as shown. The direction of the displacement of this object, as it travels from $W$ to $X$ is:

Answer: E
Question 6

An airplane is ying north at 500km/h. It makes a gradual 180° turn at constant speed, changing its direction of travel from north through east to south. The process takes 40s. The average acceleration of the plane for this turn (in km/h·s) is:

A 12.5km/h·s, north
B 12.5km/h·s, east
C 12.5km/h·s, south
D 25km/h·s, north
E 25km/h·s, south

Answer: E
Question 6

An airplane is ying north at 500km/h. It makes a gradual 180° turn at constant speed, changing its direction of travel from north through east to south. The process takes 40s. The average acceleration of the plane for this turn (in km/h·s) is:

A 12.5km/h·s, north
B 12.5km/h·s, east
C 12.5km/h·s, south
D 25km/h·s, north
E 25km/h·s, south

Answer: E
Question 7

A particle moves at constant speed in a circular path. The instantaneous velocity and instantaneous acceleration vectors are:

A both tangent to the circular path
B both perpendicular to the circular path
C perpendicular to each other
D opposite to each other
E none of the above

Answer: C
Question 7

A particle moves at constant speed in a circular path. The instantaneous velocity and instantaneous acceleration vectors are:

A both tangent to the circular path
B both perpendicular to the circular path
C perpendicular to each other
D opposite to each other
E none of the above

Answer: C
Question 8

A stone is tied to a string and whirled at constant speed in a horizontal circle. The speed is then doubled without changing the length of the string. Afterward the magnitude of the acceleration of the stone is:

A  the same
B  twice as great
C  four times as great
D  half as great
E  one-fourth as great

Answer: C
Question 8

A stone is tied to a string and whirled at constant speed in a horizontal circle. The speed is then doubled without changing the length of the string. Afterward the magnitude of the acceleration of the stone is:

A  the same  
B  twice as great  
C  four times as great  
D  half as great  
E  one-fourth as great

Answer: C
Problems
Problem 1

A car (A) speeds through town at a constant 20 m/s without noticing a police car (B) parked by the roadside. The police officer begins pursuit at the instant the car passes her, accelerating at a constant 2.0 m/s². Use the reference frame provided.

A How long does it take the officer to reach a speed of 30 m/s and how far behind the speeder is she at this time?

B At the instant described in part a), the speeder immediately slows down at a constant rate of \( \frac{4}{3} \) m/s². At what rate must the officer slow down so that both vehicles stop at exactly the same location and time?

C How far down the road are the vehicles when the "catch" is made?

D Sketch the position, velocity, and acceleration vs. time graphs for each car on the same plots. Be sure to label your graphs by including relevant times and values for each stage of motion.

E BONUS How long does it take for the vehicles to be 19 m apart?
Problem 2

A chemistry TA named Brodie is instructed to release a helium balloon ($B$) from rest at ground level at the same instant Dr. Jim launches a flaming arrow ($A$) from a horizontal distance of 300m and height of 20m above the ground at a speed of 60m/s and an initial angle of $60^\circ$ to the horizontal, as shown. Use appropriate vector notation and the reference frame provided.

A) Find the arrows distance from the origin and speed when it reaches maximum height.

B) At what time does the arrow intercept the balloon and at what constant rate is the balloon accelerating?

C) Find the average velocity of the arrow from launch to interception of the balloon.

D) BONUS: Unbeknown to the TA, a raw chicken egg is hidden inside the balloon. Assume the flaming arrow explodes the balloon but does not interrupt the motion of the egg (Dr. Jim is THAT GOOD!). How long does it take for the egg to strike the TA? Assume collision between egg and TA occurs at ground level.