# PHYS 105 · Chapter 2: Motion Along a Straight Line

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

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

## Part 1: Multiple-Choice Questions (45)

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

### 2.1 Position, Displacement and Average Velocity

**Q1.** *The total distance traveled divided by the total time elapsed is:* **[Final 232]**

**A** *The average speed*
**B** *The acceleration*
**C** *The average force*
**D** *The mass*

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**Q2.** *A car moves 53 m to the right and then 98 m to the left. The whole trip takes 5 s. What is its average velocity? (take right as positive)* **[Midterm 201]**

**A** *9 m/s*
**B** *30.2 m/s*
**C** *−9 m/s*
**D** *−30.2 m/s*

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**Q3.** *Refer to the figure. If you start from the Bakery, travel to the Cafe, and then to the Art Gallery, what is your displacement?* **[Final 202]**




**A** *6.5 km South*
**B** *10.5 km North*
**C** *2.5 km South*
**D** *9.0 km North*

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**Q4.** *A car starts from rest and accelerates at 2 m/s² for 3 s, then moves at constant velocity for another 3 s. What is its average velocity during the 6 s?* **[Final 182]**

**A** *4.5 m/s*
**B** *18 m/s*
**C** *9 m/s*
**D** *27 m/s*

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### 2.2 Instantaneous Velocity and Speed

**Q5.** *You received a ticket for driving too fast. If the radar measured your speed as 133 km/h, what physical quantity did the radar measure?* **[Midterm 251]**

**A** *Average velocity*
**B** *Velocity*
**C** *Instantaneous speed*
**D** *All of the above*

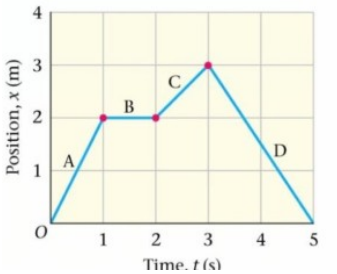
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**Q6.** *The position of an object is $x = 7t - 3t^2$ (x in m, t in s). What is its instantaneous velocity at t = 3.0 s?* **[Midterm 252]**

**A** *−11 m/s*
**B** *−21 m/s*
**C** *−6.0 m/s*
**D** *9.0 m/s*

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**Q7.** *The figure shows position versus time for an object. Which of the following statements is correct?* **[Final 182]**




**A** *The object moves at constant velocity during segment B*
**B** *The object moves at constant velocity during segment D*
**C** *The object decelerates during segment B*
**D** *The object speeds up during segment A*

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## 2.3 Acceleration

**Q8.** *The direction of the average acceleration vector is:* **[Midterm 202]**

**A** *the same as the change in velocity*
**B** *opposite to the velocity*
**C** *the same as the velocity*
**D** *opposite to the change in velocity*

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**Q9.** *Can an object have a positive acceleration while its speed is decreasing?* **[Midterm 252]**

**A** *No, this is not possible.*
**B** *No, positive acceleration always increases speed.*
**C** *Yes, if the initial velocity is negative.*
**D** *Yes, if the initial velocity is zero.*

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**Q10.** *Which of the following conditions will cause an object to slow down (decelerate)?* **[Midterm 242]**

**A** *Positive velocity, positive acceleration*
**B** *Negative velocity, negative acceleration*
**C** *Negative velocity, positive acceleration*
**D** *None of the above*

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**Q11.** *A car traveling west (the –x direction) begins to slow down as it approaches a traffic light. Which statement about its acceleration in the x direction is correct?* **[Final 222]**

**A** *Its acceleration and velocity are both positive.*
**B** *Its acceleration and velocity are both negative.*
**C** *Its acceleration is positive; its velocity is negative.*
**D** *Its acceleration is negative; its velocity is positive.*

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**Q12.** *Which of the following situations is impossible?* **[Final 242]**

**A** *Velocity directed east and acceleration directed west*
**B** *Velocity directed east and acceleration directed east*
**C** *Constant non-zero acceleration and changing velocity*
**D** *Constant non-zero velocity and changing acceleration*

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**Q13.** *What is the acceleration of a bus that keeps a constant velocity of 70 km/h west for 13 minutes?* **[Midterm 211]**

**A** *1.5 $m/s^2$*
**B** *19.4 $m/s^2$*
**C** *5.38 $m/s^2$*
**D** *0 $m/s^2$*

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## 2.4 Constant Acceleration

**Q14.** *A bicycle starts from rest with a constant acceleration of 3.5 $m/s^2$ for 0.2 min. What is its final speed?* **[Midterm 241]**

**A** *21 m/s*
**B** *42 m/s*
**C** *7 m/s*
**D** *210 m/s*

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**Q15.** *A golf ball is initially at rest. If its acceleration is 3.5 $m/s^2$ during a time interval of 0.07 min, what is its final velocity?* **[Midterm 232]**

**A** *14.7 m/s*
**B** *3.5 m/s*
**C** *7.75 m/s*
**D** *0.13 m/s*

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**Q16.** *A car traveling at 60 km/h accelerates at a constant 2.0 $m/s^2$. How much time is needed to reach 90 km/h?* **[Midterm 251]**

**A** *4.2 s*
**B** *45 s*
**C** *30 s*
**D** *15 s*

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**Q17.** *An airplane increases its speed at an average rate of 15 $m/s^2$. How much time does it take to go from 100 m/s to 160 m/s?* **[Final 222]**

**A** *17 s*
**B** *7 s*
**C** *4 s*
**D** *11 s*

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**Q18.** *An airplane has an average acceleration of 5.6 $m/s^2$. Starting from rest, how long does it take to reach 150 km/h?* **[Final 231]**

**A** *12.5 s*
**B** *2.87 s*
**C** *7.4 s*
**D** *0.64 s*

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**Q19.** *A student driving at 18 km/h brakes, and the car slows down at a constant 3.5 m/s² until it stops. How long does it take to stop?* **[Final 242]**

**A** *0.5 s*
**B** *1.4 s*
**C** *2.5 s*
**D** *3.6 s*

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**Q20.** *A car starts from rest with a constant acceleration of 4 m/s². What distance does it cover in 3 seconds?* **[Final 241]**

**A** *16 m*
**B** *18 m*
**C** *12 m*
**D** *9 m*

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**Q21.** *A car accelerates uniformly from 7.2 km/h at 2.0 m/s². How far does it travel in 6.0 s?* **[Midterm 252]**

**A** *12 m*
**B** *24 m*
**C** *36 m*
**D** *48 m*

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**Q22.** *An airplane flying at 100.0 m/s accelerates at 3.60 m/s² for 5.00 s. How far does it travel during this time?* **[Midterm 242]**

**A** *545 m*
**B** *826 m*
**C** *455 m*
**D** *620 m*

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**Q23.** *A bicycle accelerates in a straight line from 2 m/s to 10 m/s in 2 s. What is its displacement during this time?* **[Midterm 243]**

**A** *4 m*
**B** *8 m*
**C** *12 m*
**D** *16 m*

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**Q24.** *A car moving at 90 km/h brakes suddenly and stops in 2.5 s. What is its stopping distance?* **[Midterm 241]**

**A** *31.25 m*
**B** *36 m*
**C** *10 m*
**D** *62.5 m*

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**Q25.** *A car accelerates from 10 m/s to 30 m/s at a rate of 3 m/s². What distance does it travel while accelerating?* **[Final 221]**

**A** *80.0 m*
**B** *133 m*
**C** *399 m*
**D** *226 m*

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**Q26.** *A race car can reach an acceleration of 26 m/s². If it accelerates from rest at this rate over 200 m, how fast is it moving at the end?* **[Midterm 211]**

**A** *17 m/s*
**B** *52 m/s*
**C** *102 m/s*
**D** *83 m/s*

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**Q27.** *A car moving in a straight line at 3 m/s starts to accelerate uniformly at 0.8 m/s$^2$ for 100 m. What is its final speed?* **[Final 202]**

**A** *9 m/s*
**B** *83 m/s*
**C** *3.8 m/s*
**D** *13 m/s*

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**Q28.** *A jet traveling due north comes to rest in 949 m. If it slows with a constant acceleration of magnitude 3.53 m/s$^2$, what was its initial speed?* **[Final 232]**

**A** *949 m/s*
**B** *81.9 m/s*
**C** *18619 m/s*
**D** *269 m/s*

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**Q29.** *A plane needs a takeoff speed of 88.3 m/s and a runway of 1351 m, starting from rest. How long does it take to reach this speed? (uniform acceleration)* **[Midterm 211]**

**A** *30.6 s*
**B** *61.2 s*
**C** *9.7 s*
**D** *44.15 s*

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## 2.5 Free-Fall Acceleration

**Q30.** *An object is in free fall if it moves:* **[Midterm 202]**

**A** *under the influence of gravity only*
**B** *under the influence of air resistance only*
**C** *under both gravity and air resistance*
**D** *under neither gravity nor air resistance*

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**Q31.** *For free-falling objects:* **[Final 231]**

**A** *The acceleration is constant*
**B** *The distance is constant*
**C** *All of the above*
**D** *None of the above*

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**Q32.** *An object is released from rest and falls with no air resistance. Which of the following is true about its motion?* **[Final 202]**

**A** *Only its acceleration is constant.*
**B** *Only its velocity is constant.*
**C** *Neither is constant.*
**D** *Both are constant.*

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**Q33.** *What is the velocity of a ball at the highest point when it is thrown vertically upward?* **[Midterm 202]**

**A** *−10 m/s*
**B** *10 m/s*
**C** *8 m/s*
**D** *Zero*

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**Q34.** *A ball is thrown straight up with a speed of 12 m/s. What is the maximum height it reaches?* **[Midterm 241 · Midterm 232]**

**A** *1.22 m*
**B** *6.88 m*
**C** *8.50 m*
**D** *7.34 m*

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**Q35.** *A ball is thrown straight up with an initial speed of 18 m/s. Neglecting air resistance, what is the maximum height it reaches?* **[Midterm 233]**

**A** *18 m*
**B** *36 m*
**C** *12.2 m*
**D** *16.5 m*

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**Q36.** *A ball is thrown vertically upward from the ground with an initial speed of 30 m/s. How long does it take to return to the ground?* **[Final 241]**

**A** *29.4 s*
**B** *6.12 s*
**C** *19.6 s*
**D** *30 s*

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**Q37.** *An object is thrown upward from the ground at 16 m/s. Neglecting air resistance, how long does it take to reach the ground again?* **[Final 211]**

**A** *1.63 s*
**B** *3.27 s*
**C** *1.22 s*
**D** *5.29 s*

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**Q38.** *A ball is dropped from rest from the top of a building and strikes the ground after 2.00 s. What is the height of the building?* **[Final 242]**

**A** *19.6 m*
**B** *39.3 m*
**C** *51.1 m*
**D** *9.81 m*

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**Q39.** *From what height should an object be dropped from rest to hit the ground 4 seconds later? (neglect air resistance)* **[Midterm 211]**

**A** *40 m*
**B** *78.4 m*
**C** *19.6 m*
**D** *156.8 m*

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**Q40.** *A stone is dropped from rest from a height of 15 m. Neglecting air resistance, what is its speed just before it hits the ground?* **[Midterm 233]**

**A** *12.1 m/s*
**B** *17.1 m/s*
**C** *15 m/s*
**D** *150 m/s*

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**Q41.** *A stone is dropped from rest from the top of a high cliff. It falls 4.9 m in the first second. How much farther does it fall in the next second?* **[Midterm 201]**

**A** *39.2 m*
**B** *4.9 m*
**C** *9.8 m*
**D** *14.7 m*

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**Q42.** *A stone is dropped from rest 60 m above the ground. Assuming no air resistance, what is its height above the ground when its speed is 29 m/s?* **[Final 202]**

**A** *51.2 m*
**B** *17.1 m*
**C** *42.9 m*
**D** *35.7 m*

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**Q43.** *A ball is thrown downward from the top of a building with an initial speed of 25 m/s. It strikes the ground after 2.0 s. How high is the building?* **[Midterm 251]**

**A** *90 m*
**B** *70 m*
**C** *50 m*
**D** *30 m*

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**Q44.** *A bag is dropped from a hot-air balloon that is moving vertically upward at 2 m/s. It takes the bag 3 s to reach the ground. What was its height when it was dropped?* **[Final 182]**

**A** *50.1 m*
**B** *44.1 m*
**C** *38.1 m*
**D** *6 m*

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**Q45.** *A cannonball is fired straight up from the ground at 225 m/s. At what time is it 620 m above the ground and moving downward?* **[Midterm 201]**

**A** *42.97 s*
**B** *2.94 s*
**C** *33.62 s*
**D** *25.41 s*

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## ***Part 2: Problems (5)***

*Solve the following problems and show your work in detail.*

**Problem 1.** *A car initially moving at 5 m/s accelerates at 3 m/s² for 5 s, then decelerates at 2 m/s² until it stops. Determine:* **[Midterm 201]**

**a)** *The velocity of the car at the end of the first 5 s.*

**b)** *The total displacement of the car.*

**c)** *The average velocity of the car during the whole trip.*

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**Problem 2.** *A car moving at 90 km/h starts to decelerate at a constant rate until it stops after 50 m.* **[Midterm 233]**

**a)** *What is the acceleration of the car?*

**b)** *What distance does the car travel in the first 2 s after it starts to decelerate?*

**c)** *How long does it take the car to stop?*

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**Problem 3.** *A car moving at 30 m/s stops after covering a distance of 50 m (constant acceleration).* **[Midterm 202]**

**a)** *Find the acceleration of the car.*

**b)** *Find the average velocity.*

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**Problem 4.** *A Cessna plane starts from rest and needs to reach a speed of 120 km/h to take off.* **[Midterm 232]**

**a)** *What constant acceleration is needed for a takeoff run of 240 m?*

**b)** *How much time does the takeoff run take?*

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**Problem 5.** *A boy drops a ball from the roof of a house. It takes 3 s to hit the ground.* **[Midterm 202]**

**a)** *What distance does the ball cover before it reaches the ground?*

**b)** *Calculate the speed of the ball just before it hits the ground.*

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