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Kinematics Basics

Exam — Kinematics

Pre-med/IB-style conceptual questions on 1D/2D kinematics: distance vs displacement, speed vs velocity, acceleration, sign conventions, motion graphs (slope/area), constant-acceleration reasoning, free fall, projectiles, and relative motion.

70 items — Printable Exam

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1 A student walks 3 m east, then 4 m west along a straight line. Which statement is correct?



- A Distance = 1 m, displacement = 7 m east
- B Distance = 7 m, displacement = 1 m west
- C Distance = 7 m, displacement = 1 m east
- D Distance = 0 m, displacement = 0 m
- E Distance = 4 m, displacement = 3 m east

2 A runner completes one full lap of a circular track and returns to the starting point. Which is true for the entire lap?



- A Average speed = 0, average velocity = 0
- B Average speed > 0, average velocity = 0
- C Average speed = average velocity
- D Average speed = 0 and average velocity = 0
- E Average velocity is larger than average speed

3 Which of the following is a vector quantity?



- A Speed
- B Distance
- C Displacement
- D Time
- E Mass





4 Which statement about speed and velocity is correct?



- A** Speed includes direction; velocity does not.
- B** Velocity can never be negative.
- C** Speed is the magnitude of velocity and has no direction.
- D** Velocity is always larger than speed.
- E** Speed equals displacement divided by time.

5 A car travels 60 km east in 1 hour, then 60 km west in 1 hour. Which statement is correct for the whole 2-hour trip?



- A** Average speed = 0 km/h, average velocity = 0 km/h
- B** Average speed = 30 km/h, average velocity = 30 km/h east
- C** Average speed = 120 km/h, average velocity = 0 km/h
- D** Average speed = 60 km/h, average velocity = 0 km/h
- E** Average speed = 0 km/h, average velocity = 60 km/h

6 In 1D motion, which statement about a negative velocity is correct?



- A** Negative velocity means the object is slowing down.
- B** Negative velocity means the object is speeding up.
- C** Negative velocity means motion is opposite the chosen positive direction.
- D** Negative velocity means the speed is negative.
- E** Negative velocity is impossible in physics.





7 Acceleration is best defined as:



- A** Distance traveled per unit time
- B** Displacement per unit time
- C** Change in velocity per unit time
- D** Change in distance per unit time
- E** Velocity divided by displacement

8 Which situation shows zero velocity but nonzero acceleration?



- A** A car moving straight at constant 20 m/s
- B** A ball at the highest point of its vertical throw (ignoring air)
- C** A book resting on a table
- D** A cart moving straight with constant speed and constant direction
- E** A train moving on a straight track with constant velocity

9 Which situation shows nonzero velocity but zero acceleration?



- A** A car increasing speed on a straight road
- B** A cyclist turning a corner at constant speed
- C** A train moving straight at constant velocity
- D** A ball falling freely (ignoring air)
- E** A rocket changing direction in space





10 An object moves in a circle at constant speed. Which statement is correct?



- A** Acceleration is zero because speed is constant.
- B** Velocity is constant because speed is constant.
- C** The object accelerates because velocity direction changes.
- D** Displacement after any time must be zero.
- E** Distance traveled must be zero because it returns to the start each second.

11 On a displacement–time graph, the slope (gradient) represents:



- A** Acceleration
- B** Velocity
- C** Displacement
- D** Distance
- E** Momentum

12 On a velocity–time graph, the slope (gradient) represents:



- A** Displacement
- B** Speed
- C** Acceleration
- D** Distance
- E** Kinetic energy





13 On a velocity–time graph, the area under the curve between two times represents:



- A** Acceleration
- B** Displacement
- C** Speed
- D** Force
- E** Momentum

14 On an acceleration–time graph, the area under the curve between two times represents:



- A** Change in velocity
- B** Displacement
- C** Average speed
- D** Kinetic energy
- E** Mass

15 A displacement–time graph is a horizontal line. What does this indicate?



- A** Constant nonzero velocity
- B** Increasing acceleration
- C** The object is at rest (velocity = 0)
- D** The object is speeding up





- E The object must be moving in a circle

16 A displacement–time graph is a straight line with constant positive slope. What does this indicate?



- A Constant positive velocity (and zero acceleration)
- B Constant positive acceleration
- C Constant negative velocity
- D Velocity increasing with time
- E Displacement must be zero

17 A displacement–time graph curves upward (its slope increases with time). Which statement is correct?



- A Velocity is constant and positive
- B Velocity is decreasing but still positive
- C Velocity is increasing (positive acceleration)
- D Acceleration must be zero because displacement increases
- E The object must be moving with constant speed

18 A displacement–time graph increases but curves downward (its slope decreases with time while remaining positive). Which statement is correct?



- A Velocity is positive but decreasing (negative acceleration)





- B Velocity is negative
- C Acceleration must be positive
- D The object is at rest
- E Displacement must be decreasing

19 A velocity–time graph is a horizontal line at $v = +5$ m/s. Which is true?



- A Acceleration is $+5$ m/s²
- B Acceleration is zero
- C Velocity is increasing
- D Displacement is zero
- E The object must be slowing down

20 A velocity–time graph is a straight line with positive slope. Which statement is correct?



- A Acceleration is constant and positive
- B Acceleration is zero
- C Acceleration is constant and negative
- D Velocity must be constant
- E Displacement must be zero





21 A velocity–time graph crosses from positive velocity to negative velocity. What must be true at the crossing point?



- A Acceleration is zero
- B Displacement is zero
- C Velocity is zero (instantaneous stop/change of direction)
- D Speed is negative
- E The object is at equilibrium

22 Which statement is guaranteed for 1D motion with constant acceleration?



- A The displacement–time graph is a straight line
- B The velocity–time graph is a straight line
- C The acceleration–time graph must cross zero
- D The speed must be constant
- E The object must return to its starting point

23 A velocity–time graph has equal positive area above the time axis and equal negative area below the time axis over the same time interval. What can you conclude?



- A Displacement is zero, distance traveled is zero
- B Displacement is zero, but distance traveled is greater than zero
- C Displacement is greater than zero
- D Distance traveled is negative
- E Acceleration must be zero the whole time





24 If acceleration is zero in 1D motion, which statement is always true?



- A Velocity is constant (could be zero)
- B Speed must be increasing
- C The object must be at rest
- D Displacement must be zero
- E The object must be moving in a circle

25 If velocity is constant in 1D motion, what must be true about acceleration?



- A Acceleration is constant and nonzero
- B Acceleration is zero
- C Acceleration equals velocity
- D Acceleration must be positive
- E Acceleration must be negative

26 For 1D motion with constant acceleration, what is the average velocity over a time interval in terms of initial velocity u and final velocity v ?



- A $v_{avg} = u + v$
- B $v_{avg} = (u + v)/2$
- C $v_{avg} = (v - u)/2$
- D $v_{avg} = uv$
- E $v_{avg} = u/v$





27 An object starts from rest and moves with constant acceleration. If the time of motion is doubled, the displacement becomes:



- A 2 times larger
- B 3 times larger
- C 4 times larger
- D 8 times larger
- E Unchanged

28 An object starts from rest with constant acceleration. The distances traveled in successive equal time intervals are in which ratio?



- A 1 : 1 : 1 : 1
- B 1 : 2 : 3 : 4
- C 1 : 3 : 5 : 7
- D 1 : 4 : 9 : 16
- E 2 : 4 : 6 : 8

29 A ball is thrown straight up. Ignoring air resistance, which statement about the acceleration is correct during the entire flight?



- A Acceleration is upward on the way up and downward on the way down
- B Acceleration is zero at the top and nonzero elsewhere
- C Acceleration is constant downward throughout (approximately g)
- D Acceleration is constant upward throughout





E Acceleration depends on the speed, so it continuously changes

30 At the highest point of a vertical throw (ignoring air), which combination is correct?



- A $v = 0, a = 0$
- B $v > 0, a < 0$
- C $v = 0, a < 0$
- D $v < 0, a = 0$
- E $v < 0, a > 0$

31 A stone is dropped from rest (ignore air). After 1 s its speed is v . After 2 s, its speed is closest to:



- A $v/2$
- B v
- C $2v$
- D $4v$
- E v^2

32 Ignoring air resistance, which statement about free fall near Earth is correct?



- A Heavier objects fall faster because they have more weight
- B All objects fall with the same constant acceleration g , independent of mass





- C Acceleration increases with time because objects speed up
- D Acceleration is zero because gravity is constant
- E Objects fall at constant speed

33 In projectile motion without air resistance, which statement is correct?



- A Horizontal acceleration equals g
- B Horizontal velocity is constant; vertical acceleration is constant downward
- C Vertical velocity is constant; horizontal acceleration is downward
- D Both horizontal and vertical accelerations are zero
- E Horizontal and vertical motions are not independent

34 A projectile is launched and lands back at the same vertical level (ignore air). Which statement is correct?



- A Time going up is greater than time coming down
- B Time going up equals time coming down
- C Time coming down is zero at maximum height
- D Time depends only on horizontal speed
- E Time depends only on mass

35 Two projectiles are launched from the same point with the same speed, one at angle θ and one at angle $(90^\circ - \theta)$ (ignore air). Their ranges are:





- A Equal
- B The projectile always goes farther
- C The $(90^\circ -)$ projectile always goes farther
- D Both have zero range
- E Range depends only on mass, so cannot compare

36 Two cars move east at 20 m/s and 15 m/s. What is the speed of the faster car relative to the slower car?



- A 5 m/s
- B 15 m/s
- C 20 m/s
- D 35 m/s
- E 0 m/s

37 Car A moves east at 20 m/s while car B moves west at 15 m/s. What is the speed of A relative to B?



- A 5 m/s
- B 15 m/s
- C 20 m/s
- D 35 m/s
- E 0 m/s





38 A train moves 10 m/s east. A person walks 2 m/s west relative to the train. The person's velocity relative to the ground is:



- A 12 m/s east
- B 10 m/s east
- C 8 m/s east
- D 2 m/s west
- E 8 m/s west

39 Which situation can have zero average velocity but nonzero average speed?



- A Moving in a straight line without ever turning around
- B Returning to the starting point after moving away (out-and-back trip)
- C Standing still for the entire time
- D Moving at constant velocity in one direction
- E Having constant acceleration in one direction without reversing

40 Which situation can have zero average speed but nonzero average velocity over a time interval?



- A Moving out and coming back
- B Moving with constant velocity
- C Oscillating about a point and ending elsewhere
- D This is impossible
- E Falling freely under gravity





41 A car travels 100 km at 50 km/h, then returns 100 km at 100 km/h. What is the average speed for the whole trip?



- A 50 km/h
- B 75 km/h
- C $200/3$ km/h
- D 100 km/h
- E 150 km/h

42 For the same out-and-back trip (100 km out, 100 km back), what is the average velocity for the whole trip?



- A 50 km/h
- B $200/3$ km/h
- C 75 km/h
- D 0 km/h
- E 100 km/h

43 A car drives in the same direction for equal times: 1 hour at 50 km/h, then 1 hour at 100 km/h. What is the average speed?



- A 50 km/h
- B 75 km/h
- C $200/3$ km/h
- D 100 km/h





E 150 km/h

44 A cyclist rides 10 km north then 10 km east. Which statement is correct?



- A Distance = 20 km and displacement magnitude = 20 km
- B Distance = 20 km and displacement magnitude = 10 km
- C Distance = 20 km and displacement magnitude = $10\sqrt{2}$ km
- D Distance = $10\sqrt{2}$ km and displacement magnitude = 20 km
- E Distance = 0 km and displacement magnitude = 0 km

45 Which pair must have the same SI units?



- A Velocity and acceleration
- B Displacement and distance
- C Speed and time
- D Acceleration and force
- E Velocity and energy

46 Which equation is dimensionally consistent (units work out correctly)?



- A $v = u + at$
- B $v = u + a/t$
- C $s = ut + a$





D $a = v + u$

E $t = u + v$

47 Which constant-acceleration equation relates v , u , a , and s but does NOT include time t ?



A $v = u + at$

B $s = ut + (1/2)at^2$

C $v^2 = u^2 + 2as$

D $s = (u + v)t/2$

E $a = (v - u)/t$

48 Which constant-acceleration equation relates s , u , v , and t but does NOT include acceleration a ?



A $s = (u + v)t/2$

B $v = u + at$

C $s = ut + (1/2)at^2$

D $v^2 = u^2 + 2as$

E $a = (v - u)/t$

49 A velocity–time graph is a rectangle of height v and width t (constant velocity v for time t). What is the displacement?





- A $v + t$
- B v/t
- C vt
- D v^2t
- E t/v

50 A velocity–time graph is a triangle: velocity increases linearly from 0 to v over time t . What is the displacement over this time?



- A vt
- B $(1/2)vt$
- C v/t
- D $2vt$
- E v^2t

51 Velocity changes linearly from $+v$ to $-v$ over time t . What is the displacement over that time interval?



- A vt
- B $(1/2)vt$
- C 0
- D $-vt$
- E Cannot be determined without mass





52 Velocity changes linearly from $+v$ to $-v$ over time t . What is the total distance traveled in that time interval?



- A 0
- B vt
- C $(1/2)vt$
- D $(1/4)vt$
- E $2vt$

53 A car's speedometer reads 0 at an instant. Which statement could still be true at that instant?



- A Acceleration must be zero
- B The car must be at the top of a hill
- C The car could have nonzero acceleration
- D The car must be moving backward
- E The car must have zero displacement

54 If an object has constant nonzero acceleration in 1D, which statement about its velocity is correct?



- A Velocity is constant
- B Velocity changes linearly with time
- C Velocity changes exponentially with time
- D Velocity must be zero
- E Velocity cannot change sign





55 If an object has constant nonzero velocity in 1D, which statement about its displacement is correct?



- A** Displacement changes quadratically with time
- B** Displacement changes linearly with time
- C** Displacement stays constant
- D** Displacement must be negative
- E** Displacement depends on acceleration, not velocity

56 An object moves in the $+x$ direction but slows down. What are the signs of velocity and acceleration?



- A** $v > 0, a > 0$
- B** $v > 0, a < 0$
- C** $v < 0, a > 0$
- D** $v < 0, a < 0$
- E** $v = 0, a = 0$

57 An object moves in the $-x$ direction and speeds up (its speed increases while moving more negative). What are the signs of velocity and acceleration?



- A** $v > 0, a > 0$
- B** $v > 0, a < 0$
- C** $v < 0, a < 0$
- D** $v < 0, a > 0$





E $v = 0, a < 0$

58 An object moves in the $-x$ direction but slows down (its velocity is negative but increases toward zero). What are the signs of velocity and acceleration?



A $v < 0, a > 0$

B $v < 0, a < 0$

C $v > 0, a < 0$

D $v > 0, a > 0$

E $v = 0, a = 0$

59 At a turning point in continuous 1D motion (the moment an object reverses direction), what must be true at that instant?



A Acceleration must be zero

B Velocity must be zero

C Speed must be maximum

D Displacement must be zero

E Distance traveled must be zero

60 Which statement about displacement is correct?



A Displacement equals distance traveled

B Displacement depends on the path taken





- C Displacement depends only on initial and final positions
- D Displacement can never be negative
- E Displacement is always greater than or equal to distance

61 A person walks 5 m east, then 5 m north, then 5 m west. What is the displacement from the start?



- A 0 m
- B 5 m east
- C 5 m north
- D 15 m
- E $5\sqrt{2}$ m northeast

62 An object moves in a straight line at 3 m/s for 4 s, then 1 m/s for 2 s (same direction). What is its average speed over the 6 s?



- A 2 m/s
- B $7/3$ m/s
- C $3/2$ m/s
- D $4/3$ m/s
- E 5 m/s





63 Two balls are released from the same height at the same time. One is dropped straight down, the other is thrown horizontally. Ignoring air resistance, which hits the ground first?

- A The dropped ball
- B The horizontally-thrown ball
- C They hit at the same time
- D It depends on their masses
- E It depends on the horizontal speed



64 Why do the dropped ball and the horizontally-thrown ball (from the same height, no air) hit the ground at the same time?

- A Because horizontal motion cancels gravity
- B Because the horizontally-thrown ball has a smaller weight
- C Because they have identical vertical motion: same initial vertical velocity and same vertical acceleration
- D Because the thrown ball has no acceleration
- E Because they travel the same distance in the same path



65 A ball is thrown straight up from the ground with speed u (ignore air). When it returns to the ground, its speed is:

- A 0
- B Less than u
- C Equal to u
- D Greater than u





- E Impossible to predict without mass

66 On a displacement–time graph, when is the object moving in the negative direction?



- A When the graph is above the time axis
- B When the graph is below the time axis
- C When the slope of the graph is negative
- D When the slope of the graph is zero
- E When the graph is curved

67 On a velocity–time graph, an object is speeding up (its speed is increasing) when:



- A Velocity is positive
- B Acceleration is zero
- C Velocity and acceleration have the same sign
- D Velocity and acceleration have opposite signs
- E Velocity crosses zero

68 An object has velocity $v > 0$ but acceleration $a < 0$. Which description is correct?



- A Moving forward and speeding up





- B Moving forward and slowing down
- C Moving backward and speeding up
- D Moving backward and slowing down
- E At rest with increasing speed

69 Which change increases the magnitude of acceleration for the same change in velocity Δv ?



- A Increase the time interval Δt
- B Decrease the time interval Δt
- C Reverse the direction of motion without changing Δt
- D Keep Δv and Δt the same
- E Increase mass

70 Which statement correctly distinguishes uniform speed from uniform velocity?



- A Uniform speed means constant direction; uniform velocity means changing direction
- B Uniform speed and uniform velocity mean the same thing
- C Uniform speed means constant speed; uniform velocity means constant speed and constant direction
- D Uniform speed requires zero acceleration; uniform velocity requires nonzero acceleration
- E Uniform velocity is always greater than uniform speed







#	Ans	Answer Text
	B	
2	B	Average speed > 0, average velocity = 0
	C	
4	C	Speed is the magnitude of velocity and has no direction.
	D	
6	C	Negative velocity means motion is opposite the chosen positive direction...
	C	
8	B	A ball at the highest point of its vertical throw (ignoring air)
	C	
10	C	The object accelerates because velocity direction changes.
	B	
12	C	Acceleration
	B	
14	A	Change in velocity
	C	
16	A	Constant positive velocity (and zero acceleration)
	C	
18	A	Velocity is positive but decreasing (negative acceleration)
	B	
20	A	Acceleration is constant and positive
	C	
22	B	The velocity–time graph is a straight line
	B	
24	A	Velocity is constant (could be zero)
	B	
26	B	$v_{avg} = (u + v)/2$
	C	
28	C	1 : 3 : 5 : 7
	C	
30	C	$v = 0, a < 0$
	C	
32	B	All objects fall with the same constant acceleration g , independent of m ...
	B	
34	B	Time going up equals time coming down
	A	
36	A	5 m/s
	D	
38	C	8 m/s east



