EnterMedSchool.org

Enzyme Kinetics & Inhibition (Km, Vmax, Inhibitors)

Exam — Enzymology

Pre-med/IB-level conceptual practice on enzyme kinetics: meaning of Km and Vmax, saturation, enzyme concentration vs substrate concentration, catalytic efficiency, and how different inhibitor types (competitive, noncompetitive, uncompetitive, mixed, irreversible, allosteric) change kinetics and graphs. Built to teach the concepts through tricky, realistic scenarios (no heavy calculations).

60 items — Printable Exam

Free & Open-Source

Generated February 20, 2026

Scan to visit online

1 **Which statement best defines Vmax for an enzyme-catalyzed reaction?**

- A The fastest speed possible at any temperature
- B The reaction rate when [S] = Km
- C The reaction rate when all enzyme active sites are effectively saturated with substrate
- D The substrate concentration at which the enzyme is half saturated
- E The maximum amount of product that can ever be formed

2 **Which statement best defines Km (Michaelis constant) for a simple Michaelis–Menten enzyme?**

- A The substrate concentration at which v = Vmax/2
- B The maximum rate of the reaction
- C The enzyme concentration at which v = Vmax/2
- D The substrate concentration at which v = Vmax
- E The number of active sites on the enzyme

3 **If the substrate concentration equals Km, what fraction of Vmax is the reaction rate (v) approximately?**

- A 1/4 of Vmax
- B 1/2 of Vmax
- C 3/4 of Vmax
- D Equal to Vmax
- E Cannot be predicted without kcat

4 **A student says: 'Km is the substrate concentration where the enzyme is fully saturated.' Which is the best correction?**

- A Correct: Km is where the enzyme is saturated
- B Incorrect: Km is where the reaction stops
- C Incorrect: Km is where $v = Vmax/2$, not full saturation
- D Incorrect: Km equals Vmax always
- E Correct, but only at high temperature

5 **Which change most directly increases Vmax (without changing the enzyme's intrinsic chemistry)?**

- A Decreasing substrate concentration
- B Increasing enzyme concentration
- C Adding a competitive inhibitor
- D Lowering temperature slightly below optimum
- E Lowering pH far from optimum

6 **If you double the enzyme concentration while keeping substrate concentration fixed at a very high level (saturating), what happens to the initial rate?**

- A It stays the same because substrate is saturating
- B It approximately doubles
- C It halves because the enzyme is diluted
- D It becomes independent of enzyme concentration

E It becomes zero because the enzyme competes with itself

7 At very low substrate concentration compared with Km, what mainly controls the reaction rate?

A Only the pH of the solution

B Only the temperature of the solution

C Primarily the substrate concentration (rate rises roughly proportionally with [S])

D Only Vmax (rate is flat and saturated)

E Only the amount of product already formed

8 At very high substrate concentration compared with Km, what mainly limits the reaction rate?

A Substrate diffusion into the enzyme is always limiting

B The enzyme's catalytic capacity (approaching Vmax)

C The substrate concentration, which continues to increase rate linearly

D The reaction must stop because enzyme is saturated

E Only Km

9 Which statement about Km is most accurate for students at this level?

A Lower Km usually corresponds to higher apparent substrate affinity (enzyme reaches half Vmax at lower [S])

- B Lower Km always means higher Vmax
- C Km is the same as enzyme concentration
- D Km is the maximum possible rate
- E Km has units of time

10 A student measures a lower Vmax after accidentally using half as much enzyme as intended. What happens to Km (assuming conditions are otherwise identical)?

- A Km increases
- B Km decreases
- C Km stays the same
- D Km becomes zero
- E Km becomes infinite

11 Which statement correctly describes a competitive inhibitor?

- A It binds only to the enzyme–substrate complex
- B It binds the active site and competes with substrate, so high [S] can reduce its effect
- C It decreases Km and decreases Vmax
- D It decreases Vmax but does not affect Km
- E It permanently destroys the enzyme by covalent bonding (always)

12 **In classic competitive inhibition, which kinetic change is expected?**

- A Vmax decreases; Km decreases
- B Vmax decreases; Km unchanged
- C Vmax unchanged; Km increases (apparent)
- D Vmax increases; Km increases
- E Vmax unchanged; Km decreases

13 **A drug decreases the reaction rate at low substrate concentration, but at very high substrate concentration the reaction still reaches the same Vmax as without the drug. The drug is most likely a:**

- A Competitive inhibitor
- B Pure noncompetitive inhibitor
- C Uncompetitive inhibitor
- D Irreversible inhibitor
- E Denaturing agent that unfolds the enzyme

14 **Which statement best describes a pure noncompetitive inhibitor (classic model)?**

- A It binds only at the active site
- B It binds only to the enzyme–substrate complex
- C It reduces Vmax without changing Km (apparent)
- D It increases Vmax and decreases Km
- E It is always irreversible

15 **A student adds an inhibitor and finds that no matter how much substrate is added, the reaction cannot reach the original Vmax. Which inhibitor type best fits?**

- A Competitive inhibition
- B Noncompetitive (or irreversible) inhibition
- C Competitive inhibition only at low temperature
- D No inhibition is occurring
- E Increased enzyme concentration

16 **Uncompetitive inhibitors are defined by which binding behavior?**

- A Bind only to free enzyme (E)
- B Bind only to the enzyme–substrate complex (ES)
- C Bind only to the active site and mimic substrate
- D Bind covalently and permanently
- E Bind DNA instead of the enzyme

17 **In classic uncompetitive inhibition, the typical kinetic changes are:**

- A Vmax unchanged; Km increases
- B Vmax decreases; Km unchanged
- C Vmax decreases; Km increases
- D Vmax decreases; Km decreases

E Vmax increases; Km decreases

18 A student notices that adding more substrate does NOT overcome an inhibitor, but increasing enzyme concentration partially restores the maximal rate. Which inhibitor type is most consistent with this observation (conceptually)?

A Competitive inhibition

B Noncompetitive inhibition

C Uncompetitive inhibition

D No inhibition

E Substrate activation

19 Mixed inhibition is best recognized by which general pattern?

A Km always decreases and Vmax always increases

B Vmax decreases, and Km changes (can increase or decrease depending on inhibitor preference for E vs ES)

C Vmax unchanged and Km unchanged

D Vmax increases while Km stays the same

E Only Km increases while Vmax decreases to zero always

20 Which feature most strongly suggests an inhibitor is irreversible (at this level)?

A Its effect disappears when substrate concentration is raised high enough

B It binds the enzyme through weak, easily reversible interactions only

C Enzyme activity does not recover after removing free inhibitor, because the enzyme has been permanently inactivated

D It increases Km but not Vmax

E It binds only to the ES complex

21 An irreversible inhibitor reduces the number of active enzyme molecules. What kinetic change is most expected (qualitatively)?

A Vmax decreases; Km (of the remaining active enzyme) is usually unchanged

B Vmax increases; Km decreases

C Only Km increases; Vmax unchanged

D Only Km decreases; Vmax unchanged

E Both Vmax and Km always increase

22 A teacher says: 'Competitive inhibitors always look like the substrate.' Which response is best?

A Always true: competitive inhibitors must be identical to the substrate

B Mostly true at this level: competitive inhibitors often resemble the substrate enough to bind the active site, but they don't have to be identical

C False: competitive inhibitors always bind to an allosteric site

D False: competitive inhibitors bind only to ES

E True only for enzymes in mitochondria

23 **Which statement best captures why a competitive inhibitor increases the apparent Km?**

- A It permanently destroys half the enzyme molecules
- B It makes the enzyme bind substrate more tightly
- C It makes it harder for substrate to occupy the active site, so more substrate is needed to reach half-maximal rate
- D It makes the enzyme faster at turning substrate into product
- E It changes temperature of the reaction mixture

24 **A noncompetitive inhibitor reduces Vmax. Conceptually, the best reason is that it:**

- A Prevents substrate from ever binding to the enzyme
- B Reduces the fraction of enzyme molecules that can successfully catalyze product formation (even if substrate can bind)
- C Makes substrate concentration lower
- D Turns the enzyme into a substrate
- E Increases the enzyme's affinity so much that the reaction stops

25 **You compare two enzymes acting on the same substrate. Enzyme A has a lower Km than enzyme B, but both have the same Vmax at the same enzyme concentration. Which conclusion is most reasonable?**

- A Enzyme A reaches half-maximal rate at lower substrate concentration
- B Enzyme A always makes more product per second at saturating substrate
- C Enzyme A must have a higher Vmax
- D Enzyme B has higher substrate affinity than enzyme A

E Enzyme A cannot be inhibited

26 Which statement best explains why Vmax depends on enzyme concentration?

A More enzyme means more active sites available, increasing total catalytic capacity

B More enzyme automatically increases substrate concentration

C Vmax is fixed by temperature only and cannot change

D More enzyme reduces reaction rate by crowding out substrate

E Enzyme concentration affects Km but not Vmax

27 A student measures Vmax and Km for an enzyme. Then they add more enzyme and repeat. What changes?

A Vmax increases; Km stays the same

B Vmax stays the same; Km increases

C Vmax decreases; Km decreases

D Both Vmax and Km increase

E Both Vmax and Km decrease

28 A classic Michaelis–Menten curve (v vs [S]) approaches a plateau at high [S]. The best explanation is:

A Substrate is destroyed at high concentration

B The enzyme becomes saturated, so adding substrate doesn't significantly increase the fraction of occupied active sites

- C The enzyme begins producing substrate instead of product
- D The reaction becomes endothermic
- E The buffer runs out of ions

29 Which experimental change would help you distinguish a competitive inhibitor from a noncompetitive inhibitor without doing any calculations?

- A Change the color of the test tube
- B Increase substrate concentration to very high levels and see whether the same Vmax can still be reached
- C Measure pH once at the beginning only
- D Measure the mass of the enzyme protein
- E Use a different brand of pipette

30 A reaction shows the same Km but a smaller Vmax after adding an inhibitor. Which inhibitor type is the best match (classic patterns)?

- A Competitive
- B Pure noncompetitive
- C Uncompetitive
- D Competitive irreversible
- E Substrate

31 **A reaction shows both a smaller Vmax and a smaller Km after adding an inhibitor. Which inhibitor type is the best match (classic patterns)?**

- A Competitive
- B Pure noncompetitive
- C Uncompetitive
- D Competitive irreversible
- E Activator

32 **An inhibitor decreases Vmax and increases Km. Which label best fits?**

- A Competitive inhibition
- B Pure noncompetitive inhibition
- C Uncompetitive inhibition
- D Mixed inhibition with preference for free enzyme (E)
- E No inhibition is happening

33 **An inhibitor decreases Vmax and decreases Km. Which label best fits?**

- A Competitive inhibition
- B Pure noncompetitive inhibition
- C Mixed inhibition with preference for ES
- D Competitive inhibition only at low [S]
- E Enzyme activation

34 **A student claims: 'If an inhibitor lowers Km, it must be an activator because lower Km means better.' Which is the best correction?**

- A Correct: lower Km always means faster reaction at all substrate concentrations
- B Incorrect: Km can decrease even when the inhibitor makes Vmax smaller, so overall catalysis can still be worse
- C Correct: lower Km always increases Vmax
- D Incorrect: Km cannot change with inhibitors
- E Correct only in the presence of oxygen

35 **Which statement best distinguishes an allosteric inhibitor from a competitive inhibitor?**

- A Allosteric inhibitors always bind covalently
- B Allosteric inhibitors bind at a site other than the active site and change enzyme activity by altering conformation
- C Competitive inhibitors bind only to ES
- D Allosteric inhibitors increase Vmax by definition
- E Competitive inhibitors can never be overcome by high substrate

36 **Feedback inhibition in a metabolic pathway is best described as:**

- A An enzyme in the pathway inhibiting the next enzyme in line by cutting it
- B The final product inhibits an early enzyme, slowing the pathway when product is abundant
- C A substrate inhibiting itself by becoming toxic
- D Only competitive inhibition by the substrate
- E A process found only in bacteria

37 A student adds a competitive inhibitor and then doubles enzyme concentration (keeping inhibitor concentration the same). Which outcome is most likely?

A Competitive inhibition disappears completely at all substrate concentrations

B Vmax increases (more enzyme), but a higher substrate concentration is still needed to reach half of that Vmax

C Km must return exactly to its original value

D Vmax decreases because more enzyme binds more inhibitor

E The reaction becomes zero because inhibitor is amplified

38 Two experiments use the same enzyme and conditions. In experiment 2, the enzyme is partially denatured by heat (some enzymes lose proper shape). What is the most likely kinetic effect?

A Vmax increases because heat adds energy

B Vmax decreases because fewer functional enzymes remain active

C Km always decreases because heat increases collisions

D Km always increases and Vmax always increases

E Km becomes undefined and the reaction becomes photosynthesis

39 A student thinks Vmax is a 'fixed property of the enzyme molecule' and cannot change. Which is the best correction?

A Correct: Vmax cannot change in any experiment

B Incorrect: Vmax depends on enzyme concentration and conditions; changing the amount of enzyme changes Vmax

C Incorrect: Vmax is defined as Km/2

D Correct, unless substrate concentration is low

E Correct, unless you change the pH of the substrate only

40 Which scenario best demonstrates that competitive inhibition can be overcome?

A Adding more inhibitor restores normal activity

B Raising substrate concentration restores the same Vmax as without inhibitor

C Lowering substrate concentration restores Vmax

D Heating the enzyme restores Vmax permanently

E Removing enzyme from the solution restores activity

41 Which scenario best demonstrates that noncompetitive inhibition cannot be overcome by substrate?

A Increasing substrate concentration makes the inhibitor more effective

B Increasing substrate concentration restores the original Vmax

C Even at very high substrate concentration, the maximum rate stays lower than before inhibitor was added

D The inhibitor effect disappears when substrate is removed

E The inhibitor increases Vmax

42 **A student sees two Michaelis–Menten curves. Curve 2 is shifted to the right compared to curve 1 but reaches the same plateau. What is the best interpretation?**

- A Vmax decreased; Km decreased
- B Vmax unchanged; Km increased
- C Vmax increased; Km decreased
- D Vmax decreased; Km unchanged
- E Both Vmax and Km are unchanged

43 **A student sees two Michaelis–Menten curves. Curve 2 plateaus at a lower rate than curve 1 but reaches half-max at the same substrate concentration. Best interpretation?**

- A Vmax decreased; Km unchanged
- B Vmax unchanged; Km increased
- C Vmax increased; Km unchanged
- D Vmax decreased; Km decreased
- E Vmax unchanged; Km decreased

44 **Which statement about the relationship between Km and enzyme–substrate binding is most accurate?**

- A Km is always exactly equal to the dissociation constant (Kd) of ES
- B Km has no relationship at all to binding
- C Km often correlates with binding/affinity in simple models, but it is not always identical to Kd because it also reflects catalytic steps
- D Km is determined only by temperature, not by enzyme structure

E Km is the same for all enzymes

45 **Which change would most likely increase the reaction rate at a fixed substrate concentration that is far below Km?**

A Increasing enzyme concentration

B Decreasing enzyme concentration

C Adding a noncompetitive inhibitor

D Decreasing substrate concentration further

E Denaturing half the enzyme

46 **Which statement about enzyme saturation is correct?**

A At saturation, the enzyme is permanently bound to substrate and cannot release product

B At saturation, most active sites are occupied most of the time, so adding more substrate has little effect on rate

C At saturation, Km becomes zero

D At saturation, competitive inhibitors become more effective

E At saturation, the reaction must stop immediately

47 **A student plots 1/v vs 1/[S] (Lineweaver–Burk) and sees that with an inhibitor, the y-intercept increases but the x-intercept stays the same. Which classic inhibitor pattern does this suggest?**

A Competitive inhibition

B Pure noncompetitive inhibition

C Uncompetitive inhibition

D No inhibition

E Activation

48 On a Lineweaver–Burk plot, competitive inhibition typically causes lines to intersect at the:

A x-axis (same x-intercept)

B y-axis (same y-intercept)

C origin (0,0)

D They are parallel and never intersect

E random points depending on temperature only

49 On a Lineweaver–Burk plot, uncompetitive inhibition is classically recognized because the inhibitor and no-inhibitor lines are:

A Parallel (same slope) with different intercepts

B Intersecting at the y-axis

C Intersecting at the x-axis

D Always overlapping exactly

E Only vertical

50 **A student adds an inhibitor and finds the Michaelis–Menten curve shifts DOWN (lower plateau) and also shifts LEFT (half-max reached at lower [S]). What is the best match?**

- A Competitive inhibition
- B Pure noncompetitive inhibition
- C Uncompetitive inhibition
- D Enzyme concentration doubled
- E Substrate concentration decreased

51 **Which explanation best fits why competitive inhibition does not change Vmax?**

- A Because competitive inhibitors speed up catalysis at high [S]
- B Because at saturating substrate, substrate outcompetes inhibitor for the active site, so the enzyme can still achieve its full catalytic capacity
- C Because competitive inhibitors bind covalently
- D Because Vmax depends only on Km
- E Because inhibitors cannot bind enzymes at all

52 **An inhibitor binds equally well to free enzyme (E) and enzyme–substrate complex (ES) but does not affect substrate binding strength. Which label best describes it?**

- A Competitive inhibitor
- B Pure noncompetitive inhibitor
- C Uncompetitive inhibitor
- D Irreversible inhibitor
- E Substrate analog that binds only to the active site

53 **Which statement about 'enzyme efficiency' is most accurate at this level?**

- A An enzyme is more effective at low substrate if it has a low Km and/or high catalytic rate
- B Only Vmax matters, because Km is never used
- C Only Km matters, because Vmax is always the same
- D Efficiency increases when inhibitors are added
- E Efficiency is the same as the pH of the solution

54 **Two enzymes have the same Km. Enzyme X has a higher Vmax than enzyme Y in the same experiment. The best explanation is that enzyme X:**

- A Has higher substrate affinity
- B Is present at higher effective concentration and/or has a higher turnover rate (kcat)
- C Must have a higher Km
- D Is inhibited competitively
- E Has fewer active sites

55 **A student adds a noncompetitive inhibitor and then increases substrate concentration 100×. The rate increases somewhat but still plateaus below the original Vmax. Why can the rate still increase at first?**

- A Because noncompetitive inhibitors turn into competitive inhibitors at high substrate
- B Because some enzyme molecules remain uninhibited and can process more substrate as [S] rises, but total capacity is still lower
- C Because substrate destroys inhibitor molecules automatically

D Because Vmax is independent of inhibitors

E Because the enzyme becomes a transporter at high substrate

56 Which inhibitor type is MOST likely to show a stronger inhibitory effect at higher substrate concentrations (because it binds ES rather than E)?

A Competitive

B Uncompetitive

C Competitive irreversible

D No inhibitor

E A substrate

57 A student wants to reduce the effect of a competitive inhibitor without changing substrate concentration. Which change is most likely to help?

A Add more inhibitor

B Remove substrate entirely

C Decrease enzyme concentration

D Lower inhibitor concentration (dilution/removal)

E Add oxygen

58 Which statement about 'raising substrate concentration' is a common trap?

A It can overcome competitive inhibition

B It can restore Vmax in competitive inhibition

C It always restores Vmax no matter the inhibitor type

D It increases reaction rate when [S] is far below Km

E It has little effect when [S] is far above Km

59 Which real-world example is MOST consistent with an irreversible inhibitor conceptually (enzyme permanently inactivated)?

A A molecule that binds weakly to the active site and is easily washed away

B A molecule that covalently modifies the active site and permanently reduces active enzyme amount

C A substrate molecule that binds and becomes product

D A molecule that increases substrate concentration

E A molecule that changes the color of the buffer

60 A student compares two inhibitors. Inhibitor A increases Km but does not change Vmax. Inhibitor B decreases Vmax but does not change Km. Which pairing is correct?

A A = uncompetitive; B = competitive

B A = competitive; B = pure noncompetitive

C A = irreversible; B = competitive

D A = pure noncompetitive; B = competitive

E A = mixed; B = uncompetitive

#	Ans	Answer Text
	C	
2	A	The substrate concentration at which v = Vmax/2
	B	
4	C	Incorrect: Km is where v = Vmax/2, not full saturation
	B	
6	B	It approximately doubles
	C	
8	B	The enzyme's catalytic capacity (approaching Vmax)
	A	
10	C	Km stays the same
	B	
12	C	Vmax unchanged; Km increases (apparent)
	A	
14	C	It reduces Vmax without changing Km (apparent)
	B	
16	B	Bind only to the enzyme–substrate complex (ES)
	D	
18	B	Noncompetitive inhibition
	B	
20	C	Enzyme activity does not recover after removing free inhibitor, because ...
	A	
22	B	Mostly true at this level: competitive inhibitors often resemble the sub...
	C	
24	B	Reduces the fraction of enzyme molecules that can successfully catalyze ...
	A	
26	A	More enzyme means more active sites available, increasing total catalyti...
	A	
28	B	The enzyme becomes saturated, so adding substrate doesn't significantly ...
	B	
30	B	Pure noncompetitive
	C	
32	D	Mixed inhibition with preference for free enzyme (E)
	C	
34	B	Incorrect: Km can decrease even when the inhibitor makes Vmax smaller, s...
	B	
36	B	The final product inhibits an early enzyme, slowing the pathway when pro...
	B	
38	B	Vmax decreases because fewer functional enzymes remain active