Chapter 5: The Complement System

1. Which of the following complement fixation pathways can be initiated by a soluble C3 convertase?

A) Alternative
B) Classical
C) Lectin
D) All of the answers are correct.
E) None of the answers are correct.

Answer: A
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy
Hint: Two of the three pathways require a protein to recognize a specific antigen or other molecular complex on the surface of the pathogen to form the C3 convertase.
Source: Test Bank
Sequence: 5001

2. On a holistic scale, the complement system plays a role in

A) specific pathogen defenses.
B) nonspecific pathogen defenses.
C) both specific and nonspecific pathogen defenses.
D) All of the answers are correct.
E) None of the answers are correct.

Answer: C
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.0

Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: Complement can be activated by antibodies or PRRs.
Source: Test Bank
Sequence: 5002

3. A common denominator among the three complement pathways is antigen recognition. Can you name three molecules that act as antigen recognition molecules for the classical, lectin, and alternative pathways?

Answer:
Feedback: Antibodies for classical, lectins for the lectin pathway, and C3b for the alternative pathway. For the alternative pathway, properdin can also act as an antigen recognition molecule.
Question Type: Essay
Chapter Name: 5
Section: 5.0
Cognitive Level: HOC
Blooms Level: Analyzing
Level of Difficulty: Moderate
Hint: Some forms of C3 protein can act as opsonins.
Source: Test Bank
Sequence: 5003

4. Complement components can be classified into seven functional categories, including

A) Enzymatic mediators.
B) Inflammatory mediators.
C) Membrane attack proteins.
D) Regulatory complement components.
E) All the answers are correct.

Answer: E
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.0
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: Many complement parts or components are activated via enzymatic alteration.

Source: Test Bank
Sequence: 5004

5. Of the molecules listed, which can be considered the key molecule in complement pathways?

A) C1
B) IgM
C) MBL
D) C5 convertase
E) None of the answers are correct.

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: All three pathways can lead to the formation of MACs.
Source: Test Bank
Sequence: 5005

6. In considering the following list of molecules, which can act as a bridge to connect complement labeled pathogens to effector immune cells?

A) IgM
B) C1
C) C1R
D) C3aR
E) Both C1R and C3aR are correct.

Answer: E
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: In complement nomenclature, R stands for “receptor.”
Source: Test Bank

Sequence: 5006

7. Which of the following provides serine protease activity in the classical complement activation pathway?

A) MASP-2
B) C1r
C) C1s
D) Both C1r and C1s act in the classical pathway.
E) None of the answers acts in the classical pathway.

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: The serine protease that acts on the classical pathway components that will ultimately be deposited into the surface of the pathogen need to be activated, which consists of proteolytic cleavage.
Source: Test Bank
Sequence: 5007

8. You suspect that you have identified a mouse line that lacks a functional complement system. A friend suggests collecting serum and looking for hemolytic activity as a first screen in determining complement activity in the line. Do you agree or disagree with your friend, and why?

Answer:
Feedback: Agree. Although the hemolytic screen will not specifically identify which components of complement are missing in the line; the screen is a good functional test as intact complement pathways typically lead to hemolysis.
Question Type: Essay
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Evaluating
Level of Difficulty: Difficult
Hint: Hemolysis means lysis of red blood cells.

Source: Test Bank
Sequence: 5008

9. In your own words, and using no more than two sentences, explain how DAF regulates complement to inhibit MAC-mediated lysis.

Answer:
Feedback: DAF is a membrane-bound regulator of complement. DAF accelerates the destabilization of C3 convertases.
Question Type: Essay
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Analyzing
Level of Difficulty: Moderate
Hint: DAF stands for decay-accelerating factor.
Source: Test Bank
Sequence: 5009

10. Which of the following is the MOST potent anaphylatoxin produced during the complement cascade?

A) C3a
B) C3b
C) C5a
D) C5b
E) Ba

Answer: C
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: Anaphylatoxins produced during complement activation are not inserted into the surface of the pathogen.
Source: Test Bank
Sequence: 5010

11. To which of the following is MBL MOST structurally similar?

A) C3b
B) C1q
C) Bb
D) C5b
E) None of the answers are correct.

Answer: B
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: Two of the complement activation pathways are initiated by the binding of proteins to the pathogens that, in spite of the differences in primary structure, have remarkable similarities in their higher order structure.
Source: Test Bank
Sequence: 5011

12. Which of the following is TRUE about the C5 convertase?

A) C5 convertase can consist of the membrane-bound components $C3b_2Bb$.
B) C5 convertase cleaves C5 into C5a and C5b, with the b chain attached to the pathogen surface and the α chain dissociating away to serve as a potent proinflammatory chemotactic factor.
C) C5 convertase is an important player in the production of the MAC.
D) All of the answers are true.
E) None of the answers are true.

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: Of what does the C5 consist, and what does it do?
Source: Test Bank

Sequence: 5012

13. Name two complement proteins whose primary functions are promoting anaphylatoxin activity. What common structural feature of the two named proteins allows for their inactivation by way of serum carboxypeptidases?

Answer:
Feedback: C3a and C5a. Both act as anaphylatoxins when formed during complement activation. C3a and C5a contain C-terminal arginine residues that are targets of carboxypeptidases. Removal of such residues leads to C5a and C3a inactivation.
Question Type: Essay
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Evaluating
Level of Difficulty: Difficult
Hint: Carboxypeptidases are enzymes that remove amino acids from the C-termini of proteins.
Source: Test Bank
Sequence: 5013

14. Can you imagine how a blood-borne bacterial pathogen might activate all three arms of the complement system? How can this occur?

Answer:
Feedback: Yes. The classical pathway can be activated by antibodies produced in response to the bacterial pathogen, or by previously synthesized circulating antibodies. The lectin pathway can be activated via recognition of lectins by MBL. The alternative pathway can be activated via circulating properdin acting as a PRR.
Question Type: Essay
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Evaluating
Level of Difficulty: Difficult
Hint: The blood contains components of all three complement pathways.
Source: Test Bank
Sequence: 5014

15. Complement activation is implicated in the pathogenesis of SLE. However, the incidence of SLE is highly correlated to C4 deficiency. Can you explain this paradox?

Answer:
Feedback: Deficiencies in C4 contribute to a reduction of C3b levels, that is, less C3b is now available to bind to immune complexes and contribute to immune response contraction. The inhibition of C3b-mediated opsonization allows for activation of the later stages of the complement system.
Question Type: Essay
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Evaluating
Level of Difficulty: Difficult
Hint: C3b production is dependent on the early events of complement activation.
Source: Test Bank
Sequence: 5015

16. Which of the following BEST explains the timing of the classical pathway of complement fixation, relative to the other pathways of complement fixation, against a pathogen in an individual who has never been exposed to said pathogen?

A) No target for C1qrs exists on the surface of the pathogen in the earliest stages of the response to it.
B) The chemical environment of the pathogen's surface favors the spontaneous activation of soluble C3 immediately upon exposure to the pathogen.
C) C1qrs immediately recognizes carbohydrate antigens on the surface of the pathogen, allowing for rapid formation of the C4b2a C3 convertase.
D) The pathogen expresses one or more factors on its surface that act as negative regulators of C3 convertase formation.
E) None of the answers are correct.

Answer: A
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: What complement protein(s) recognize(s) which antigens to initiate C3 convertase formation?
Source: Test Bank

Sequence: 5016

17. Which of the following binds to surface-bound C3b during formation of the alternative C3 convertase?

A) Factor Bb
B) Factor B
C) C2a
D) C4b
E) Factor D

Answer: B
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: When does cleavage of the factor that binds to C3 occur in relation to that factor's binding to C3b?
Source: Test Bank
Sequence: 5017

18. Which of the following can be directly activated as a soluble protein in the microenvironment surrounding a pathogenic cell?

A) C2
B) C3
C) Factor B
D) Factor D
E) C4

Answer: B
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy

Hint: What complement factors are involved in which activation pathways, and how does each participate?
Source: Test Bank
Sequence: 5018

19. Which of the following acts as a protease that is required to generate the alternative pathway C3 convertase?

A) C2
B) C3
C) Factor B
D) Factor D
E) C4

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy
Hint: What complement factors are involved in which activation pathways, and how does each participate?
Source: Test Bank
Sequence: 5019

20. Which of the following is the first complement factor to be activated, resulting in insertion of one of its subunits into the pathogen surface in two of the three complement fixation pathways?

A) C2
B) C3
C) Factor B
D) Factor D
E) C4

Answer: E
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC

Blooms Level: Remembering
Level of Difficulty: Easy
Hint: What complement factors are involved in which activation pathways, and how does each participate?
Source: Test Bank
Sequence: 5020

21. Which of the following, when activated itself, acts as a protease that converts soluble C3 into C3a and C3b in the alternative pathway?

A) C2
B) C3
C) Factor B
D) Factor D
E) C4

Answer: C
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy
Hint: What complement factors are involved in which activation pathways, and how does each participate?
Source: Test Bank
Sequence: 5021

22. Which of the following, when activated, utilizes its “a” component instead of the “b” component in the formation of the C3 convertase?

A) C2
B) C3
C) Factor B
D) Factor D
E) C4

Answer: A
Question Type: Multiple Choice
Chapter Name: 5

Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy
Hint: What complement factors are involved in which activation pathways, and how does each participate?
Source: Test Bank
Sequence: 5022

23. Which of the following immunoglobulin isotypes is the MOST efficient at initiating a complement fixation cascade?

A) IgG
B) IgE
C) IgM
D) IgD
E) None of the answers are correct.

Answer: C
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy
Hint: Which of the isotypes named in the answer choices presents the most binding sites for C1q to recognize?
Source: Test Bank
Sequence: 5023

24. Addition of which of the following components to any C3 convertase leads to the formation of the C5 convertase?

A) C3b
B) C2a
C) C4b
D) C5b
E) C3a

Answer: A

Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy
Hint: An additional copy of one of the membrane-bound components of C3 convertase is required to generate the C5 convertase.
Source: Test Bank
Sequence: 5024

25. Which form of IgM is MOST readily recognized by C1q?

A) Monomeric IgM
B) Planar pentameric IgM
C) "Staple-form" pentameric IgM
D) All of the answers are recognized equally by C1q.
E) None of the answers are recognized by C1q.

Answer: C
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Remembering
Level of Difficulty: Easy
Hint: Which form allows for C1q greatest accessibility to its binding sites on the IgH_{μ}?
Source: Test Bank
Sequence: 5025

26. Which of the following acts as a positive regulator of complement fixation via stabilization of C3bBb?

A) DAF (CD55)
B) Properdin
C) Factor H
D) Factor I
E) MCP (CD46)

Answer: B

Question Type: Multiple Choice
Chapter Name: 5
Section: 5.2
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: Differentiate between positive and negative regulation of complement fixation and understand the mechanisms by which each occurs.
Source: Test Bank
Sequence: 5026

27. Which of the following acts as a serine protease that, with cofactors, cleaves C3b and C4b?

A) DAF (CD55)
B) Properdin
C) Factor H
D) Factor I
E) MCP (CD46)

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.2
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: Differentiate between positive and negative regulation of complement fixation and understand the mechanisms by which each occurs.
Source: Test Bank
Sequence: 5027

28. Which of the following facilitates dissociation of both the C4b2a and C3bBb C3 convertases?

A) DAF (CD55)
B) Properdin
C) Factor H
D) Factor I
E) MCP (CD46)

Answer: A
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.2
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: Differentiate between positive and negative regulation of complement fixation and understand the mechanisms by which each occurs.
Source: Test Bank
Sequence: 5028

29. Which of the following is capable of initiating the alternative pathway of complement fixation by directly binding to the surfaces of certain cell types?

A) DAF (CD55)
B) Properdin
C) Factor H
D) Factor I
E) MCP (CD46)

Answer: B
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.2
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: Differentiate between positive and negative regulation of complement fixation and understand the mechanisms by which each occurs.
Source: Test Bank
Sequence: 5029

30. The MAC consists of a multimeric complex of which of the following proteins that, by their association, forms a pore in the surface of the attacked cell?

A) C3b
B) C5b
C) C6
D) C9

E) C4b

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: Which spans the cell surface instead of merely being inserted into the extracellular face of it?
Source: Test Bank
Sequence: 5030

31. How does binding of complement-opsonized microbes to CR1 facilitate clearing of the microbe from the host?

A) Promotion of phagocytosis of opsonized microbes by leukocytes
B) Secretion of proinflammatory cytokines
C) Mediating phagocytosis of C3b-opsonized pathogen by B cells
D) All of the answers occur as a result of CR1 binding of complement-opsonized microbes.
E) None of the answers occur.

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.2
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: CR1 facilitates clearance in multiple ways.
Source: Test Bank
Sequence: 5031

32. Which of the following is TRUE about the binding of C5b to the pathogen surface?

A) C5b binds to the pathogen surface the same way C4b and C3b do.
B) C5b requires C6 binding to stabilize it before it dissociates away.
C) C5b, when complexed to C6 and C7, is capable of forming the MAC on any cell membrane, pathogen, or host.

D) C5b both requires C6 binding to stabilize it before it dissociates away and, when complexed to C6 and C7, is capable of forming the MAC on any cell membrane, pathogen, or host.
E) All of the answers are true.

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.1
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: How C5b binds is important to not only its normal function but also to potential abnormal function associated with it.
Source: Test Bank
Sequence: 5032

33. Which of the following is NOT an effect of C3a and C5a binding their receptors on leukocytes?

A) Increased vascular permeability via induction of TNF-α and IL-6 secretion
B) Induction of degranulation by granulocytes
C) Increased smooth muscle contraction to aid in delivering immune cells and molecules to the site of infection
D) All of the answers are effects of C3a and C5a binding their receptors.
E) None of the answers are effects of C3a and C5a binding their receptors.

Answer: D
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.2
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: Anaphylatoxins display more than one single activity upon their binding.
Source: Test Bank
Sequence: 5033

34. Which of the following regulates complement function by directly inhibiting formation of the MAC?

A) Protectin (CD59)
B) Factor I
C) DAF (CD55)
D) C1INH
E) Factor H

Answer: A
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.2
Cognitive Level: LOC
Blooms Level: Understanding
Level of Difficulty: Moderate
Hint: Not all complement regulatory factors act at the same stages in complement fixation; some act early in the process, others act later.
Source: Test Bank
Sequence: 5034

35. Based on your knowledge of complement activation pathways, predict which group of pathogens would be MOST susceptible to lysis by MACs.

A) Gram-negative pathogens
B) Eukaryotic pathogens
C) Enveloped viruses
D) Gram-positive pathogens
E) Gram-negative pathogens and enveloped viruses are equally susceptible.

Answer: E
Question Type: Multiple Choice
Chapter Name: 5
Section: 5.5
Cognitive Level: HOC
Blooms Level: Applying
Level of Difficulty: Difficult
Hint: Eukaryotic pathogens are composed of eukaryotic cells.
Source: Test Bank
Sequence: 5035

36. Some strains of staphylococcal bacteria express staphylokinase. Staphylokinase can degrade IgG. Based on this information, how will staphylokinase disrupt complement? Which pathway is

most impacted?

Answer:
Feedback: Staphylokinase will inhibit antibody-complement interactions. Antibody-complement interactions are critical for activation of the classical pathway.
Question Type: Essay
Chapter Name: 5
Section: 5.5
Cognitive Level: HOC
Blooms Level: Analyzing
Level of Difficulty: Moderate
Hint: Antibodies can act to label pathogens for immune recognition and response.
Source: Test Bank
Sequence: 5036

37. During an immune response, host damage from complement is generally limited to the area in which complement is activated. Explain one property of complement proteins that contribute to this observation.

Answer:
Feedback: Activated complement proteins generally have short half-lives, which favors a rapid inactivation state.
Question Type: Essay
Chapter Name: 5
Section: 5.3
Cognitive Level: HOC
Blooms Level: Analyzing
Level of Difficulty: Moderate
Hint: Consider protein turnover.
Source: Test Bank
Sequence: 5037

38. Complement is subject to rigorous regulatory mechanisms. C1INH can inhibit both the classical and lectin pathways. What function feature of C1INH allows for inhibition of both pathways?

Answer:
Feedback: C1INH is a serine protease inhibitor that inhibits serine proteases of the classical pathway and the MASP-2 protease of the alternative pathway. The ability of C1INH to target more than one serine protease allows for suppression of both pathways.

Question Type: Essay
Chapter Name: 5
Section: 5.3
Cognitive Level: HOC
Blooms Level: Analyzing
Level of Difficulty: Moderate
Hint: More than one pathway relies on the activity of proteases for full activation.
Source: Test Bank
Sequence: 5038

39. Initially the complement system was characterized by its capacity to covert antibody binding into pathogen lysis. Does the discovery of MAC-mediated lysis align with the evolutionary history of the complement system?

Answer:
Feedback: No, it does not. Studies of complement evolution, viewed as a timeline, indicate that the proteins making up the MAC appear as relative late additions to the animal genome. The opsonization activities of complement appear to predate the appearance of the MAC components. A functional MAC only appeared around the same time as the emergence of the adaptive immune response.
Question Type: Essay
Chapter Name: 5
Section: 5.6
Cognitive Level: HOC
Blooms Level: Evaluating
Level of Difficulty: Difficult
Hint: Innate immunity evolved prior to adaptive.
Source: Test Bank
Sequence: 5039