Question No. 1 of 10

**Instructions:** (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

**1. Which complement binds to the Fc region of antibodies?**

(A) C1q  
(B) C4a  
(C) C1r  
(D) C1s

**Feedback**

A. Correct!  
Binds to Fc region of IgM & IgG antibodies.

B. Incorrect!  
Peptide mediator of inflammation.

C. Incorrect!  
Enzymatically activates complement component C1s.

D. Incorrect!  
Enzymatically activates complement component C4 & C2.

**Solution**

The classical pathway is initiated by binding of C1 to antigen-antibody complexes. C1 is a macromolecular complex present in the serum, it consist of C1q & two molecules each of C1r & C1s, held together in a complex (C1q2r2s2). Each C1 molecule must bind by its C1q globular heads, to at least two Fc sites of an antibody for a stable C1-antibody interaction to occur, which then activates C1r, which subsequently activates C1s which have two substrates C4 & C2.
**Question No. 2 of 10**

**Instructions:** (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

**Question #2**

2. MAC is composed of following complement components:

   (A) MBL
   (B) C1qr₂s₂
   (C) C5b, C6, C7, C8 & C9
   (D) C3, factor B, factor D, & properdin

**Feedback**

A. Incorrect!
The lectin pathway is initiated by binding of the serum protein, mannose-binding lectin (MBL) to the surface of a pathogen.

B. Incorrect!
The classical pathway is initiated by binding of C1 to antigen-antibody complexes. C1 is a macromolecular complex present in the serum, it consist of C1q & two molecules each of C1r & C1s, held together in a complex (C1qr₂s₂).

C. Correct!
C5b, C6, C7, C8, & C9, which interacts sequentially to form a macromolecular structure called as membrane attack complex (MAC).

D. Incorrect!
Alternative pathway involves four serum proteins: C3, factor B, factor D, & properdin for complement activation.

**Solution**

C5b, C6, C7, C8, & C9, which interacts sequentially to form a macromolecular structure called as membrane attack complex (MAC). This complex displaces the membrane phospholipids, forming a large transmembrane channel that disrupts the membrane of the target cells and enables the ions & small molecules to diffuse through in & out of the cell freely. Since ions and small molecules can diffuse freely through the central channel of the MAC, the cell can not maintain its osmotic stability and is killed by an influx of water & loss of electrolytes.
### Question No. 3 of 10

**Instructions:** (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

<table>
<thead>
<tr>
<th>Question #3</th>
</tr>
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<tbody>
<tr>
<td><strong>3. The term complement was coined by _____</strong>.</td>
</tr>
<tr>
<td>(A) Pfieffer</td>
</tr>
<tr>
<td>(B) Jules Bordet</td>
</tr>
<tr>
<td>(C) Ferrata</td>
</tr>
<tr>
<td>(D) Paul Ehrlich</td>
</tr>
</tbody>
</table>

**Feedback**

<table>
<thead>
<tr>
<th>A. Incorrect!</th>
</tr>
</thead>
<tbody>
<tr>
<td>In 1894 Pfieffer discovered that cholera vibrios were lysed when injected intraperitoneally into specifically immunized guinea pigs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Incorrect!</th>
</tr>
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<tbody>
<tr>
<td>In 1895 Jules Bordet established that the immune bacteriolysis &amp; hemolysis required two factors: the heat stable antibody &amp; a heat liable factor, named alexine (which is now called as complement).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Incorrect!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrated that the complement could be separated into two components by dialysis of serum against acidified water, which he called C1 &amp; C2.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Correct!</th>
</tr>
</thead>
<tbody>
<tr>
<td>The term “Complement” was coined by Paul Ehrlich.</td>
</tr>
</tbody>
</table>

**Solution**

In 1890s the term "Complement" was coined by Paul Ehrlich, defining it as "the activity of blood serum that complements the ability of specific antibody to cause lysis of bacteria".
Question No. 4 of 10

Instructions: (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

Question #4

4. Which regulatory protein blocks the conversion of C3 convertase by binding with C3b?

(A) C1 inhibitor
(B) Factor H
(C) C4b binding protein
(D) DAF

Feedback

A. Incorrect!
It affects the classical pathway, causes the C1r\textsubscript{2}s\textsubscript{2} to dissociate from C1q.

B. Correct!
It affects the alternative pathway, blocks the formation of C3 convertase by binding C3b.

C. Incorrect!
It affects both Classical & Lectin pathways, blocks the formation of C3 convertase by binding C4b.

D. Incorrect!
It affects all the three pathways, accelerates dissociation of C4b2a & C3bBb.

Solution

Unchecked complement activity can cause not only exhaustion of the complement system but also serious damage to tissues. Several inbuilt control mechanisms regulate the complement cascade at different steps. The complement system includes a series of regulatory proteins that inactivate various complement components e.g. Factor H: It affects the alternative pathway, blocks the formation of C3 convertase by binding C3b.
**Question No. 5 of 10**

**Instructions:** (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

<table>
<thead>
<tr>
<th><strong>5.</strong> Deficiency of C1, C2, &amp; C4 complement components of classical pathway causes which disease?</th>
</tr>
</thead>
</table>
| (A) Collagen vascular diseases  
  (B) Bacteremia  
  (C) Recurrent pyogenic infection  
  (D) None of the above |

**Feedback**

- **A. Correct!**  
  Right answer, as deficiency of C1, C2, & C4 complement components causes collagen vascular diseases.

- **B. Incorrect!**  
  Deficiency of C5 to C8 complement component causes Bacteremia, mainly with Gram negative diplococci, & toxoplasmosis.

- **C. Incorrect!**  
  C3 & its regulatory protein C3b inactivator deficiency cause recurrent pyogenic infections.

- **D. Incorrect!**  
  Wrong answer, as deficiency of C1, C2, & C4 complement components causes collagen vascular diseases.

**Solution**

Complement deficiencies result in the host being unable to efficiently eliminate the microbial antigens or circulating immune complexes. Recurrent bacterial & fungal infections & collagen diseases also occur. Genetic deficiency of C1, C2, & C4 complement components cause's collagen vascular diseases.
### Question No. 6 of 10

**Instructions:**  (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

<table>
<thead>
<tr>
<th>Question #6</th>
<th>6. Complement promotes phagocytosis of particulate antigens, this process is known as:</th>
</tr>
</thead>
</table>
|             | (A) Agglutination  
                  (B) Clonal anergy  
                  (C) Opsonization  
                  (D) Virulence       |

**Feedback**

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Incorrect!</td>
<td>Antibodies combine with the surfaces of microorganisms or soluble antigens and cause them to agglutinate or precipitate.</td>
</tr>
<tr>
<td>B. Incorrect!</td>
<td>A physiological state in which cells are unable to be activated by antigen.</td>
</tr>
<tr>
<td>C. Correct!</td>
<td>Opsonization is the process by which macromolecules contained within the extracellular tissue fluid are internalized by cells.</td>
</tr>
<tr>
<td>D. Incorrect!</td>
<td>A measure of the infectious ability of a pathogen.</td>
</tr>
</tbody>
</table>

**Solution**

The complement includes more than 30 soluble & cell bound proteins. Biological activities of this system impact both innate & acquired immunity. After activation, the complement components interact in a highly regulated cascade & carries out the various functions, one of this function is “Opsonization”, which promotes phagocytosis of particulate antigens.
Question No. 7 of 10

Instructions: (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

Question #7
7. Which subclass of IgG can not activate the classical pathway?

(A) IgG1  
(B) IgG2  
(C) IgG3  
(D) IgG4

Feedback
A. Incorrect!  
IgG1 can activate the classical pathway.

B. Incorrect!  
IgG2 can activate the classical pathway.

C. Incorrect!  
IgG3 can activate the classical pathway.

D. Correct!  
Right answer, IgG4 cannot activate the classical pathway.

Solution
Complement activation by the classical pathway begins with the formation of immune complexes or binding of antibody to an antigen on a suitable target like bacterial cell. IgM & certain subclasses of IgG (IgG1, IgG2 & IgG3) can activate the classical pathway.
<table>
<thead>
<tr>
<th>Question No. 8 of 10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructions:</strong> (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.</td>
</tr>
</tbody>
</table>

8. Hereditary angioneurotic edema is caused by the deficiency of which complement component?

- (A) C5 to C8 components
- (B) C1 inhibitor
- (C) C3 & C3b
- (D) None of the above

<table>
<thead>
<tr>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Incorrect! Deficiency of C5 to C8 complement component causes Bacteremia.</td>
</tr>
</tbody>
</table>

| B. Correct! Hereditary angioneurotic edema is caused by the deficiency of C1 inhibitor. |

| C. Incorrect! C3 & its regulatory protein C3b inactivator deficiency cause recurrent pyogenic infections. |

| D. Incorrect! Hereditary angioneurotic edema is caused by the deficiency of C1 inhibitor. |

<table>
<thead>
<tr>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited deficiencies of most of the complements components are known. Clinical syndromes associated with genetic deficiencies of complement components are many, one of the common examples is: “Hereditary angioneurotic edema”, is is caused by the deficiency of C1 inhibitor.</td>
</tr>
</tbody>
</table>
Question No. 9 of 10

**Instructions:** (1) Read the problem statement and answer choices carefully; (2) Work the problems on paper as needed; (3) Pick the correct answer; and (4) Go back to review the core concept tutorial as needed.

<table>
<thead>
<tr>
<th>Question #9</th>
<th>9. Which complement protein is involved in the polymerization reaction to complete the formation of membrane attack complex (MAC) pore?</th>
</tr>
</thead>
</table>
|             | (A) C6  
|             | (B) C7  
|             | (C) C8  
|             | (D) C9  |

**Feedback**

A. Incorrect!  
C5b attaches to C6 component and forms C5b6 which initiates the formation of membrane attack complex.

B. Incorrect!  
C5b6 attaches with the C7 component and forms C5b67 complex that inserts into the lipid bilayer.

C. Incorrect!  
C5b67 attaches with the C8 component to form C5b678 which binds to multiple C9 molecules initiating their polymerization.

D. Correct!  
C5b67 attaches with the C9 component to form C5b6789-MAC which polymerizes to complete the formation of MAC pore.

**Solution**

The classical pathway is initiated by binding of C1 to antigen-antibody complexes. The classical pathway results into formation of C3 & C5 convertase, which is converted into a membrane-attack complex (MAC) by a sequence of terminal reaction. C3 convertase splits the C3 component into C3a & C3b. Hydrolysis of C3 is the major amplification step, as it generates large amounts of C3b, which forms part of C5 convertase (C4b2a3b active complex). C3b can also diffuse away from the activating surface & bind to immune complexes or foreign cell surfaces, where it functions as an opsonin. C5 convertase cleaves the C5 component into C5a (which diffuses away) & C5b, which attaches to C6 component & initiates the formation of membrane attack complex in a terminal sequence manner in the order: C5b, C6, C7, C8, & C9, which interacts sequentially to form a macromolecular structure called as membrane attack complex (MAC). C9 complement protein is involved in the polymerization reaction to complete the formation of membrane attack complex (MAC) pore.
**Question #10**

**10. C5 convertase of alternative pathway is made of following complement components:**

(A) C4b2a3b  
(B) C3bBb3b  
(C) C4b2a  
(D) C3bBb

**Feedback**

A. Incorrect!  
It is C5 convertase (C4b2a3b), of classical & lectin pathway.

B. Correct!  
It is C5 convertase (C3bBb3b), of alternative pathway.

C. Incorrect!  
It is C3 convertase (C4b2a), of classical & lectin pathway.

D. Incorrect!  
It is C3 convertase (C3bBb), of alternative pathway.

**Solution**

Alternative Complement Pathway is initiated without requiring antibody, in most cases by binding of the C3b to activating cell surfaces such as microbial cell walls (both gram positive & negative bacteria). C3 convertase can hydrolyze C3 into C3a (diffuses away) & C3b auto-catalytically and then generates active C3bBb3b complex known as C5 convertase, analogous to C5 convertase activity of classical pathway. C5 convertase splits the C5 component into C5a & C5b, C5b with the antigenic surfaces. Conversion of C5b to the membrane –attack complex occurs by the same sequence of reactions as in the classical pathway. C5 convertase of alternative pathway is made of C3bBb3b and classical & lectin pathway by C4b2a3b.