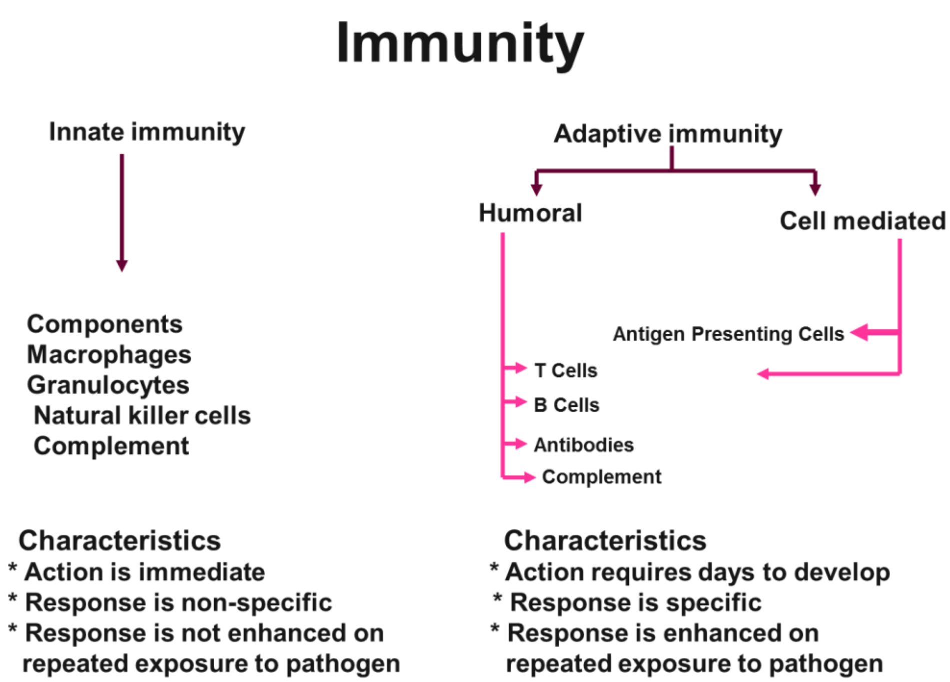
Section A

1. MCQ Correct Option

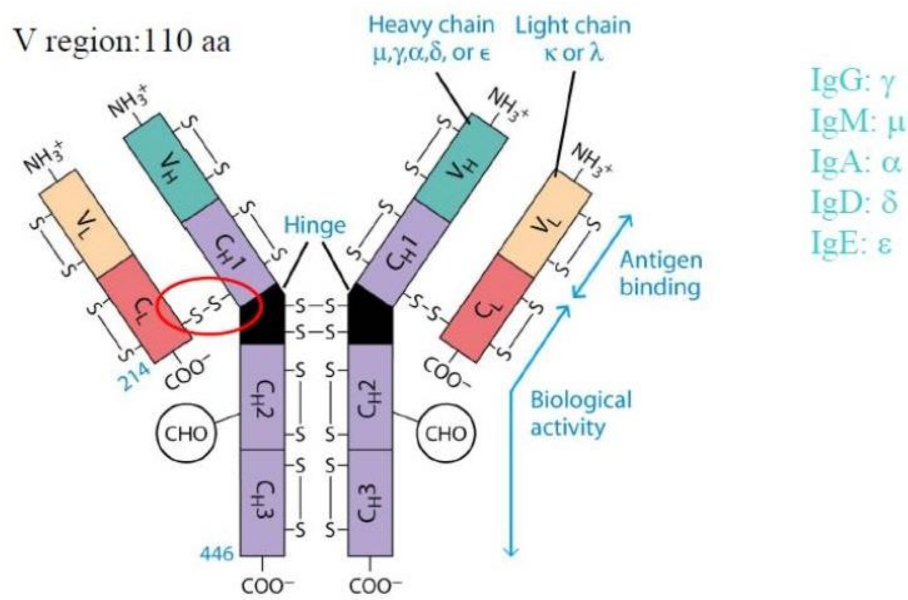
i-c; ii- c; iii-c; iv-b; v- c; vi- d; vii- a; viii- c; ix- a ; x- d

SECTION- B

Q2. Cell types of innate immunity



Q3. Structure and function of IgG antibody

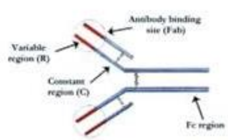


- Most abundant antibody in internal body fluids
- Made in lymph nodes, spleen and bone marrow
- Circulates in lymph and blood
- Smaller and more flexible than IgM so can cross into extracellular spaces of damaged or infected tissues

Can cross the placental barrier and protect fetus

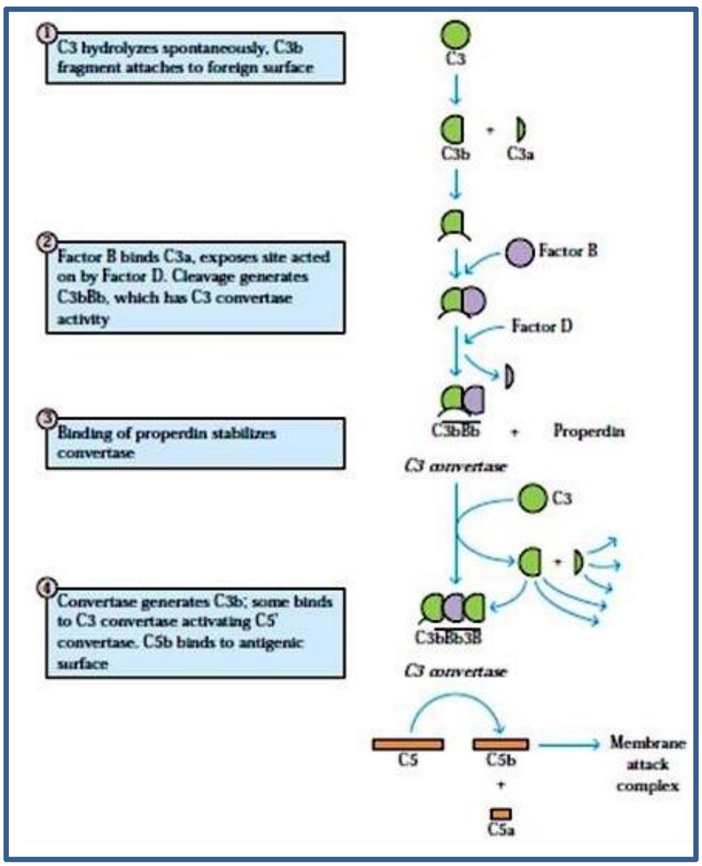
- Flexibility of hinge region in IgG allows the two Fab arms to move relative to each other so both antigen recognition sites may bind repetitive sites on an antigen
- More effector functions than IgM

IgG1 and IgG3 can directly recruit phagocytic cells to ingest antigen:antibody complexes and can also strongly activate complement

Type	binding sites	Target site	major function
IgG 	2	•Blood •Tissue fluid •CAN CROSS PLACENTA	•Increase macrophage activity •Antitoxins •Agglutination

Q4: Membrane attack complex- (MAC)

The terminal sequence of complement activation involves C5b, C6, C7 , C8 and C9 which interact sequentially to form a macromolecular structure called Membrane attack complex (MAC). This complex forms a large channel through the membrane of target cell enabling ions & small molecules to diffuse freely across the membrane. This constitutes a chain of sequence of series reactions



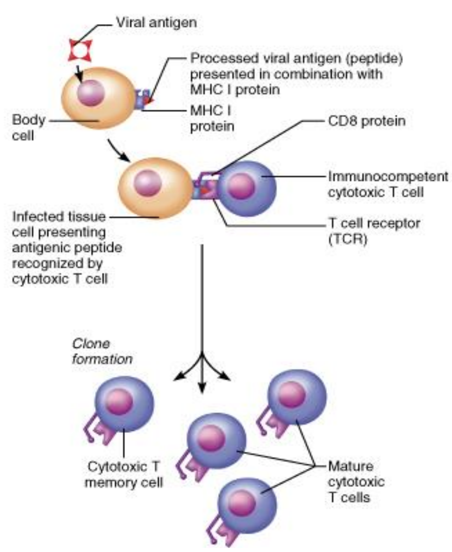
Regulation of Complement System- series of regulatory proteins interact with the various complement component and regulates the complement system

Protein	Type of protein	Pathway affected	Immunologic function
C1 inhibitor (C1Inh)	Soluble	Classical	Serine protease inhibitor: causes $C\overline{1r_2s_2}$ to dissociate from C1q
C4b-binding protein (C4bBP)*	Soluble	Classical and lectin	Blocks formation of C3 convertase by binding C4b; cofactor for cleavage of C4b by factor I
Factor H*	Soluble	Alternative	Blocks formation of C3 convertase by binding C3b; cofactor for cleavage of C3b by factor I
Complement-receptor type 1 (CR1)* / Membrane-cofactor protein (MCP)*	Membrane bound	Classical, alternative, and lectin	Block formation of C3 convertase by binding C4b or C3b; cofactor for factor I-catalyzed cleavage of C4b or C3b C3bBb
Decay-accelerating factor (DAE or CD55)*	Membrane bound	Classical, alternative, and lectin	Accelerates dissociation of $C\overline{4b2a}$ and $C\overline{3bBb}$ (classical and alternative C3 convertases)
Factor-I	Soluble	Classical, alternative, and lectin	Serine protease: cleaves C4b or C3b using C4bBP, CR1, factor H, DAE, or MCP as cofactor
S protein	Soluble	Terminal	Binds soluble C5b67 and prevents its insertion into cell membrane
Homologous restriction factor (HRF) / Membrane inhibitor of reactive lysis (MIRL or CD59)*	Membrane bound	Terminal	Bind to C5b678 on autologous cells, blocking binding of C9
Anaphylatoxin inactivator	Soluble	Effector	Inactivates anaphylatoxin activity of C3a, C4a, and C5a by carboxypeptidase N removal of C-terminal Arg

Q5: Differences of T and B lymphocytes

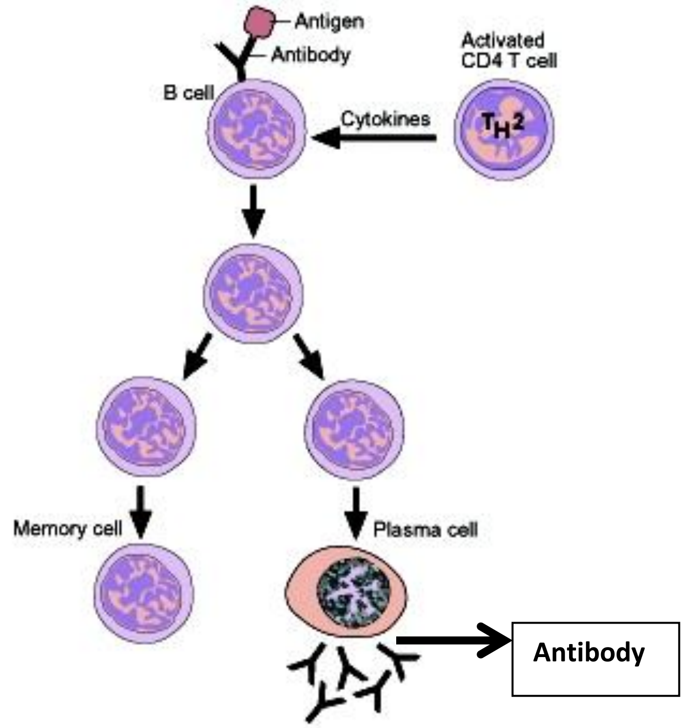
Functioning of T lymphocyte

- Mature T-cells have T cell receptors which have a very similar structure to antibodies and are specific to 1 antigen.
- They are activated when the receptor comes into contact with the Ag with another host cell (e.g. on a macrophage membrane or an invaded body cell)
- After activation the cell divides to form:
- T-helper cells – secrete CYTOKINES
  - → help B cells divide
  - → stimulate macrophages
- Cytotoxic T cells (killer T cells)
  - → Kill body cells displaying antigen
- Memory T cells
  - → remain in body



Function of B lymphocytes

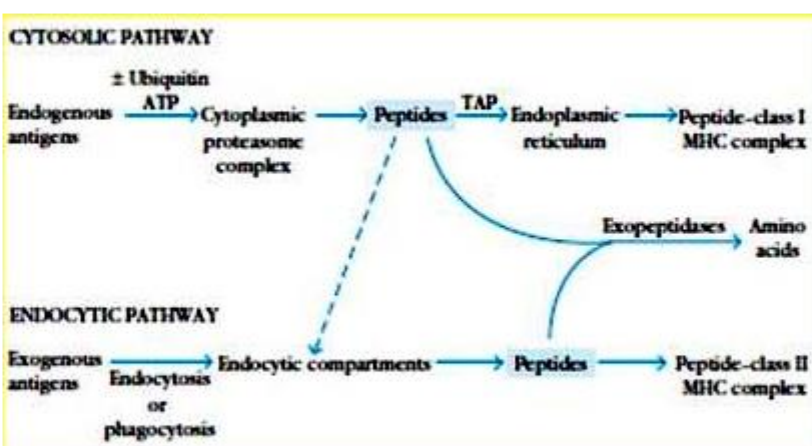
- B-lymphocytes, each of which make a different antibody.
- The huge variety is caused by genes coding for abs changing slightly during development.
- There are a small group of clones of each type of B-lymphocyte
- At the clone stage antibodies do not leave the B-cells.
- The (antibodies) abs are embedded in the plasma membrane of the cell and are called antibody receptors.
- When the receptors in the membrane recognise and antigen on the surface of the pathogen the B-cell divides rapidly.
- The antigens are presented to the B-cells by macrophages

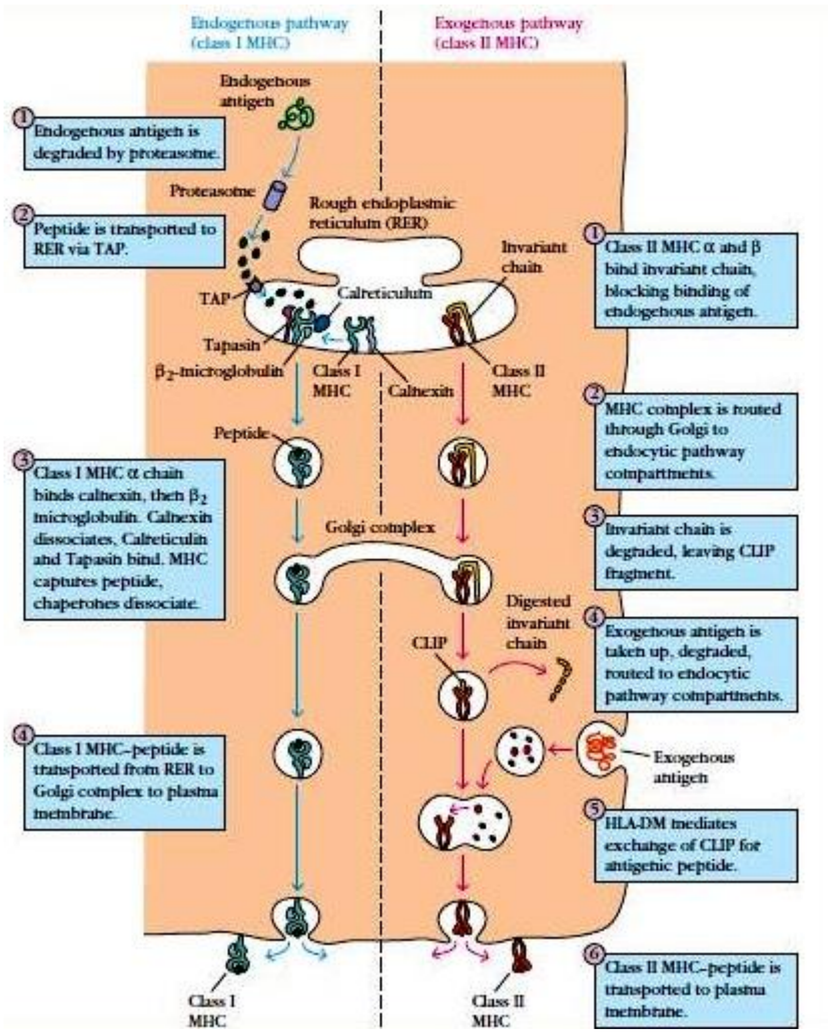


Q 6. Endocytic pathway And Antigen processing and presentation

The immune system uses two diferent pathways to eliminate intracellular and extracellular antigens

1. Endogenous antigen - those generate with in the cell are processed in cytosolic pathway and presented on membrane with class I MHC molecule;
2. Exogenous antigens- those taken up by the endocytosis are processed in the endocytic pathway and presented on the membrane with class II MHC molecules





Q7. Merits and demerits of mean

5·4·3. Merits and Demerits of Arithmetic Mean

Question No 7

Merits. In the light of the properties laid down by Prof. Yule for an ideal measure of central tendency, arithmetic mean possesses the following merits :

(*i*) It is rigidly defined.

(*ii*) It is easy to calculate and understand

(*iii*) It is based on all the observations.

(*iv*) It is suitable for further mathematical treatment. The mean of the combined series is given by (5·8) or (5·8*a*). Moreover, it possesses many important mathematical properties (Properties 1 to 4 as discussed earlier) because of which it has very wide applications in statistical theory.

(*v*) Of all the averages, arithmetic mean is affected least by fluctuations of sampling. This property is explained by saying that arithmetic mean is a *stable* average.

Demerits. (*i*) The strongest drawback of arithmetic mean is that it is very much affected by extreme observations. Two or three very large values of the variable may unduly affect the value of the arithmetic mean. Let us consider an industrial complex which houses the workers and some big officials like general manager, chief engineer, architect etc. The average salary of the workers (skilled and unskilled) is, say, Rs. 8,000 per month. If the salaries of the few big bosses (who draw very high salaries) are also included, the average wage per worker comes out to be Rs. 12,000 say. Thus, if we say that the average salary of the workers in the factory is Rs. 12,000 p.m. it gives a very good impression and one is tempted to think that the workers are well paid and their standard of living is good. But the real picture is entirely different. Thus, in the case of extreme observations, the arithmetic mean gives a distorted picture and is no longer representative of the distribution and quite often leads to very misleading conclusions. Thus, while dealing with extreme observations, arithmetic mean should be used with caution.

(*ii*) Arithmetic mean cannot be used in the case of open end classes such as less than 10, more than 70, etc., since for such classes we cannot determine the mid-value X of the class intervals unless (*i*) we estimate the end intervals or (*ii*) we are given the total value of the variable in the open end classes. In such cases mode or median (discussed latter) may be used.

(*iii*) It cannot be determined by inspection nor can it be located graphically.

(*iv*) Arithmetic mean cannot be used if we are dealing with qualitative characteristics which cannot be measured quantitatively such as intelligence, honesty, beauty, etc. In such cases median (discussed later) is the only average to be used.

(*v*) Arithmetic mean cannot be obtained if a single observation is missing or lost or is illegible unless we drop it out and compute the arithmetic mean of the remaining values.

(*vi*) In extremely asymmetrical (skewed) distribution, usually arithmetic mean is not representative of the distribution and hence is not a suitable measure of location.

(*vii*) Arithmetic mean may lead to wrong conclusions if the details of the data from which it is obtained are not available. In this connection it is worthwhile to quote the words of H. Secrist :

"*If an average is taken as a substitute for the details, then the arithmetic mean, in spite of the simplicity and ease of calculation, has little to recommand when series are non-homogeneous.*"

The following example will illustrate this view point.

Let us consider the following marks obtained by two students *A* and *B* in three tests, *viz.*, terminal test, half-yearly examination and annual examination respectively.

Marks in :	I Test	II Test	III Test	Average marks
Student *A*	55%	60%	65%	60%
Student *B*	65%	60%	55%	60%

The average marks obtained by each of the two students at the end of year are 60%. If we are given the average marks alone we conclude that the level of intelligence of both the students at the end of the year is same. This is a fallacious conclusion since we find from the data that student *A* has improved consistently while student *B* has deteriorated consistently.

(*viii*) Arithmetic mean may not be one of the values which the variable actually takes and is termed as a *fictitious* average. Sometimes, it may give meaningless results. In this context it is interesting to quote the remarks of the 'Punch' journal :

"*The figure of 2·2 children per adult female was felt to be in some respects absurd, and a Royal Commission suggested that middle classes be paid money to increase the average to a sounder and more convenient number*".

Example 5·4. *The numbers 3·2, 5·8, 7·9 and 4·5, have frequencies x, (x + 2), (x − 3) and (x + 6) respectively. If the arithmetic mean is 4·876, find the value of x.*

Solution.

COMPUTATION OF MEAN

Number (X)	*Frequency (f)*	*fX*
3·2	x	$3{\cdot}2x$
5·8	$x+2$	$5{\cdot}8\,(x+2)$
7·9	$x-3$	$7{\cdot}9\,(x-3)$
4·5	$x+6$	$4{\cdot}5\,(x+6)$

we have :

$$\Sigma f = x + (x+2) + (x-3) + (x+6) = 4x + 5$$

$$\Sigma fX = 3{\cdot}2x + 5{\cdot}8(x+2) + 7{\cdot}9(x-3) + 4{\cdot}5(x+6)$$

$$= (3{\cdot}2 + 5{\cdot}8 + 7{\cdot}9 + 4{\cdot}5)x + 11{\cdot}6 - 23{\cdot}7 + 27{\cdot}0$$

$$= 21{\cdot}4x + 14{\cdot}9$$

$$\therefore \quad \text{Mean} = \frac{\Sigma fX}{\Sigma f} = \frac{21{\cdot}4x + 14{\cdot}9}{4x+5} = 4{\cdot}876 \text{ (Given)}$$

$$\Rightarrow \quad 21{\cdot}4x + 14{\cdot}9 = 4{\cdot}876\,(4x+5)$$

$$\Rightarrow \quad 21{\cdot}4x + 14{\cdot}9 = 19{\cdot}504x + 24{\cdot}380$$

$$\Rightarrow \quad (21{\cdot}400 - 19{\cdot}504)x = 24{\cdot}380 - 14{\cdot}900$$

$$\Rightarrow \quad 1{\cdot}896x = 9{\cdot}480 \quad \Rightarrow \quad x = \frac{9{\cdot}480}{1{\cdot}896} = 5$$

Example 5·5. *Marks secured by 50 students in a test paper are given below :*

30	45	48	55	39	25	31	12	18	21	54	59	51	33	43	44	10
38	19	26	41	35	37	41	46	33	51	37	58	58	17	19	23	26
29	38	57	36	35	44	43	27	19	43	22	31	47	24	21	15	

SECTION B

Q No - 8 -

$$\text{Probability} = \frac{\text{Favourable no of cases}}{\text{Exhaustive no of cases}}$$

(1) Exhaustive no of cases = $^nC_r = {}^{13}C_2$

$$\frac{\lfloor 13}{\lfloor 2 \times \lfloor 11} = 78$$

(2) Favourable no of cases for white balls -

$$^nC_r = {}^5C_1$$

$$\frac{\lfloor 5}{\lfloor 1 \times \lfloor 4} = 5$$

(3) Favourable no of cases for red balls -

$$^nC_r = {}^8C_1$$

$$\frac{\lfloor 8}{\lfloor 1 \times \lfloor 7} = 8$$

$$\text{Probability} = \frac{{}^5C_1 \times {}^8C_1}{{}^{13}C_2} = \frac{5 \times 8}{78}$$

Ans $\boxed{= \frac{20}{39}}$

Que. No. 9:

Calculate mode from the following frequency distribution

Solution –

Class Interval	Frequency	
0 – 5	5	
5 – 10	10	f_0
10 – 15	15	f_1
15 – 20	8	f_2
20 – 25	7	
25 – 30	5	

Formula – $\text{Mode} = l + \frac{h\,(f_1 - f_0)}{(f_1 - f_0) - (f_2 - f_1)}$

Given – $l = 10$, $h = 5$,
$f_0 = 10$, $f_1 = 15$, $f_2 = 8$

$$\text{Mode} = 10 + \frac{5\,(15-10)}{(15-10) - (8-15)}$$

$$= 10 + \frac{25}{12}$$

$$= 10 + 2.08$$

Ans. = 12.08

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Section A

(viii) Step deviation method is used for calculation of —

(a) Mean

(viii) The mean of the given data is

$$\bar{X} = \frac{\Sigma X}{n} = \frac{12+13+11+9+8+7+15+5+17+3}{10}$$

$$= 100/10 \quad \boxed{=10}$$

(c) 10

(ix) A uniform die is thrown at random. Find the probability that the number on it is 4 –

Favourable no of case = 1

Exhaustive no of cases = 6

Probability $= \frac{1}{6}$ (a)

(x) Karl pearson suggested

(d) Correlation.