Q.P. Code : 01239

[Time: $2\frac{1}{2}$ Hours] **[Marks:75]**

Please check whether you have got the right question paper.

N.B:
1. All Question are compulsory.
2. Figures to the right indicate full marks.
3. Draw neat labelled diagrams wherever necessary.

Q.1 a) Explain the term: (**any one**) (02)

i) Agglutinins
Ii) Flocculation

b) Give one example of: (**any one)** (01)

i) Fluorescent compounds used in immunoassay
Ii) Precipitation reactions

c) Answer the following (**any two**) (12)

i) Outline the general features of antigen-antibody reaction
ii) Describe complement fixation test
iii) Explain the steps involved in sandwich ELISA
iv) Explain the working of Fluorescence-activated cell sorter and its application

Q.2 a) Answer in one word: (**any three**) (03)

i) Active form of androgen
ii) Gland on which TSH act
iii) Hormone that is secreted by zona glomerulosa
iv) Cells of the testes that produce androgen
v) Transport protein of T_3 and T_4
vi) Hormone associated with Cushing's syndrome

b) Discuss the following: (**any two**) (12)

i) Biochemical functions of calcitriol
ii) Mechanism of action of group I hormones
iii) Physiological and biochemical function of estrogen
iv) Release, transport and any two biochemical function of thyroid hormone

Q.3 a. Name the pathway to which the following molecules belong (**any three**) (03)

i) Acyl carrier protein
ii) PS synthase
iii) Malonyl ACP Transferase
iv) Prenyl transferase
v) Acetone
vi) Squalene

(P.T.O)

b) Attempt the following (**any two**) (12)

i) Discuss the role of acetyl CoA carboxylase in lipid metabolism
ii) Schematically represent synthesis of TAG from glycerol
iii) Write the flow-sheet for formation of activated isoprene on cholesterol biosynthesis
iv) Describe the formation of ketone bodies in the liver

Q.4 a) Explain the term: (**any one**) (02)

i) Curie
Ii) Secondary electron

b) Give one example of: (**any one**) (01)

i) Detector used in IR spectroscopy
Ii) Sources of radiation in fluorescent spectroscopy

c) Describe and give two applications of the following techniques (**any two**) (12)

i) Geiger-Muller counter
ii) Working of confocal microscope
iii) Monochromators used in fluorescent spectroscopy
iv) IR spectrophotometer

Q.5 Write short note on (**any three)** (15)

a. Coomb's test
b. RIA-Principle and application
c. Menstrual cycle
d. Abnormalities of thyroid function
e. Types of radioactive decay
f. Transcriptional regulation of cholesterol biosynthesis

XXXXXXXXXXXXX

T.Y.B.Sc SEM VI – CBSGS revised 75M) Date :19th April 2017
Paper II –Immunology, Biochemistry and Instrumentation
Model Answer Key – QP code 01239

1 a Explain the term: **(any one)** **2**

i. Agglutinins: The antibody involved in bringing about agglutination reaction.

ii. Flocculation: Instead of sedimenting, the antigen-antibody complex remains suspended as floccules

b. Give one example of: **(any one)** **1**

i. Fluorescent compounds used in immunoassay: Fluorescein / Rhodamine / Phycoerythrin

ii. Precipitation reactions: Immunodiffusion/Single diffusion (Oudin)/ Double diffusion (Ouchterlony Radial immunodiffusion/ immunoelectrophoresis/rocket electrophoresis **(any one)**

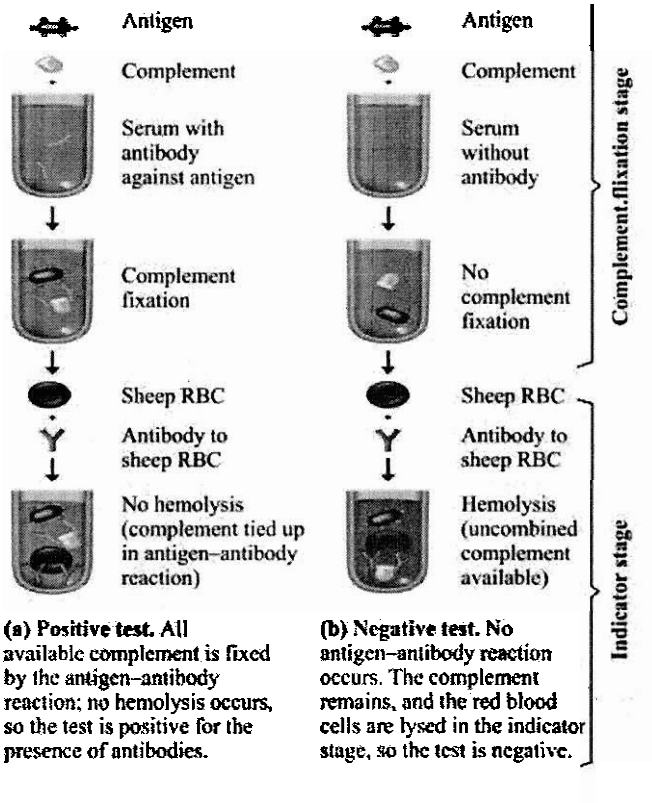
c. Answer the following: (any two) **12**

i. General features of antigen-antibody reaction **(any six points 6M)** **6**

- The reaction is specific.
- Entire molecules react and not fragments
- There is no denaturation of the antigen or the antibody during the reaction
- The combination occurs at the surface
- Strength of antigen-antibody complex depends on affinity and avidity
- Both the antigen and antibody participates in the formation of agglutination or precipitation.
- Both antigen and antibodies are multivalent.
-

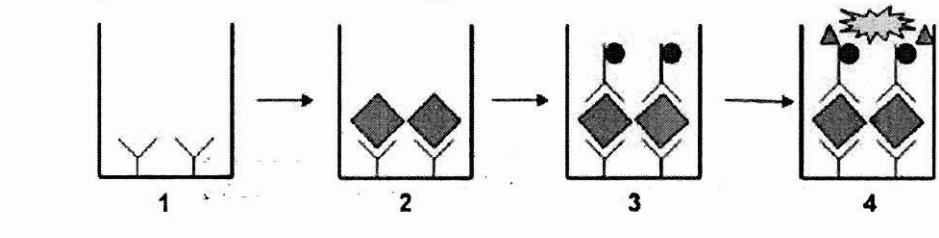
ii. Describe complement fixation test

The complement fixation test is one of the major traditional tests for the demonstration of presence of specific antigens or antibodies. **(1M)**



iii Explain steps involved in sandwich ELISA 6

The Sandwich ELISA measures the amount of antigen between two layers of antibodies (i.e. capture and detection antibody).

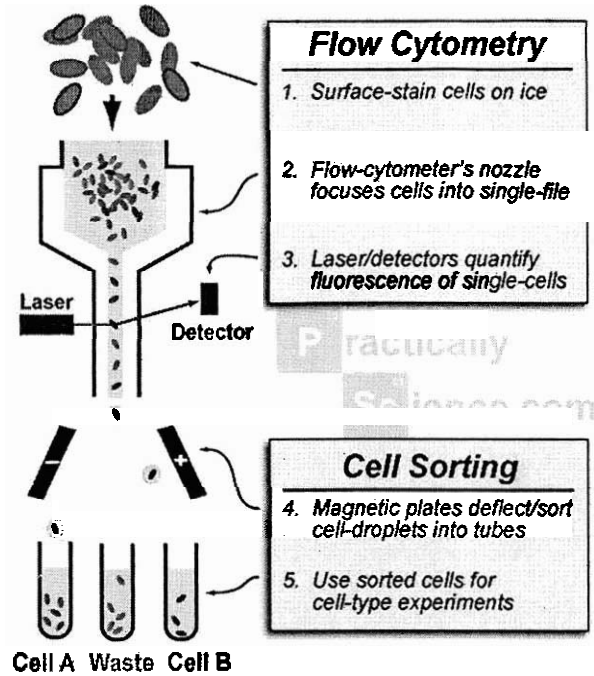


1. Immobilization of the antigen-specific antibody on the well.
2. Addition of the antigen.
3. Addition of the enzyme-labelled antibody.
4. Introduction of the enzyme's substrate and apparition of the colored product.

Y : **Antigen specific antibody.**
◆ : **Antigen (bacteria).**
: **Enzyme labelled antibody.**
▲ **Enzymatic substrate.**
: **Coloured product.**

iv Explain working of Fluorescent activated cell sorter and its application. 6

The flow cytometer uses a laser beam and light detector to count single intact cells in suspension. instrument counts each cell as it passes the laser beam and records the level of fluorescence the ce emits; an attached computer generates plots of the number of cells as the ordinate and their fluorescence intensity as the abscissa. More sophisticated versions of the instrument are capable o sorting populations of cells into different containers according to their fluorescence profile. (4M)



Applications (any two): (2M)

- Used to determine the kind and number of WBC in blood.
- Analysis of leukemia's.
- Determination of HIV infection.

2 a Answer in one word: **(any three)**

i. Active form of androgen - Dihydrotestosterone

ii Gland on which TSH acts - Thyroid gland

iii Hormone that is secreted by Zona glomerulosa - Mineralocorticoid

iv **Cells of the testesthat produce androgen - Leydig cells**

v Transport protein of T_3 and T_4 - Thyroid binding globulin (TBG) / Thyroid binding prealbumin.

vi Hormone associated with Cushing's syndrome – Adrenocortical hormone/ cortisol/ adrenocorticoid hormone/ glucocorticoid.

b Discuss the following **(any two)** **12**

i Biochemical functions of calcitriol **6**

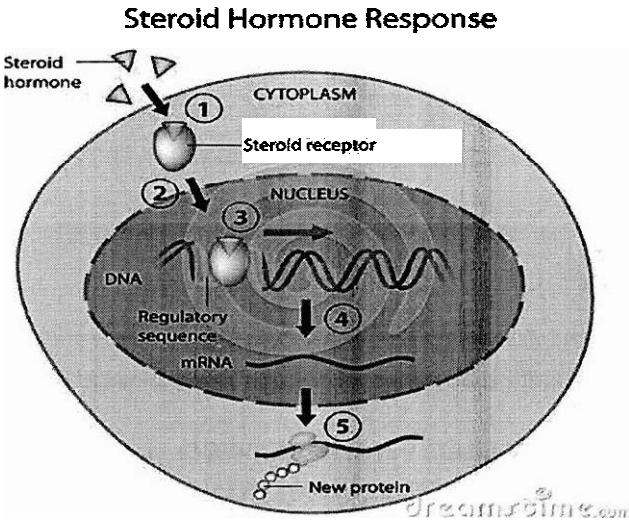
Calcitriol is the biologically active form of vitamin D. It regulates the plasma levels of calcium and phosphate.

1) Action of calcitriol on the intestine: In the intestine cells, calcitriol binds with a cytosolic receptor to form a calcitrol-receptor complex. This complex interacts with specific DNA sequence leading to synthesis of calcium binding protein. This protein increases calcium uptake by the intestine.

2) Action of calcitriol on the bone: **In the osteoblasts of bone, calcitriol stimulates calcium** uptake for deposition as calcium phosphate. Thus calcitriol is essential for bone formation. Calcitriol along with parathyroid hormone increases the mobilization of calcium and phosphate from bone. This causes elevation in plasma calcium and phosphate levels.

3) Action of calcitriol on the Kidney: Calcitriol is also involved in minimizing the excretion of calcium and phosphate through the kidney, by decreasing their excretion and enhancing reabsorption.

ii Mechanism of action of group I hormone 6



iii **Physiological and Biochemical function of estrogen:** 6

a) Physiological functions: **(2M)**

- Growth, development and maintenance of female reproductive organs.
- Maintenance of menstrual cycle.
- Development of female sexual characteristics.

b) Biochemical functions: **(any four 4M)**

- Lipogenic effect: Estrogen increase lipogenesis in adipose tissue.
- Hypocholesterolemic effect: Estrogens lower the plasma total cholesterol. The LDL fraction of lipoproteins is decreased while the HDL fraction is increased.
- Anabolic effect: Estrogens promote transcription and translation. The synthesis of many proteins in liver is elevated.
- Effect on bone growth: Estrogen promotes calcification and bone growth. Decalcification of bone in the postmenopausal women leading to osteoporosis is due to lack of estrogens.
- Effect of transhydrogenase: Transhydrogenase is an enzyme, which is activated by estrogen. It is capable of reducing NADPH to NAD^+. The NADH so formed can be oxidized.

iv **Release, transport and any two biochemical function of thyroid hormone:** 6

Release: The thyroid hormones thyroxine (T_4) and triiodithyrinine (T_3) are produced in thyroglobulin. Thyroid hormone secretion is stimulated by TSH. **(1M)**

Transport: Two specific binding protiens- thyroxine binding globulin (TBG) and thyroxine binding prealbumin are responsible for the transport of thyroid hormones: **(1M)**

Biochemical function of thyroid hormones: (any two 4M)

- Influencing on metabolic rate: It stimulates the metabolic activities and increase in oxygen consumption. Na^+-K^+ ATPase activity is directly correlated to thyroid hormones and, this inturn, with ATP utilization.
- Effect on protein metabolism: It promotes protein synthesis by acting at the transcriptional level. Thyroid hormone, thus, function as anabolic hormone and cause positive nitrogen balance and promote growth and development.

- Influence of carbohydrate metabolism: It promotes intestinal absorption of glucose and its utilization. These hormone increases gluconeogenesis and glycogenolysis, with overall effect of enhancing blood glucose level.
- Effect of lipid metabolism: Lipid turnover and utilization is stimulated by thyroid hormone. Hypothyroidism is associated with elevated plasma cholesterol levels.

3 a. Name the pathway to which the following molecules belong (**any three**)

i Acyl Carrier Protein – Fatty acid biosynthesis / lipogenesis

ii PS synthase – phosphatidyl serine biosynthesis / membrane phospholipid synthesis

iii Malonyl ACP transferase - Fatty acid synthesis / lipogenesis

iv Prenyl transferasse – cholesterol biosynthesis

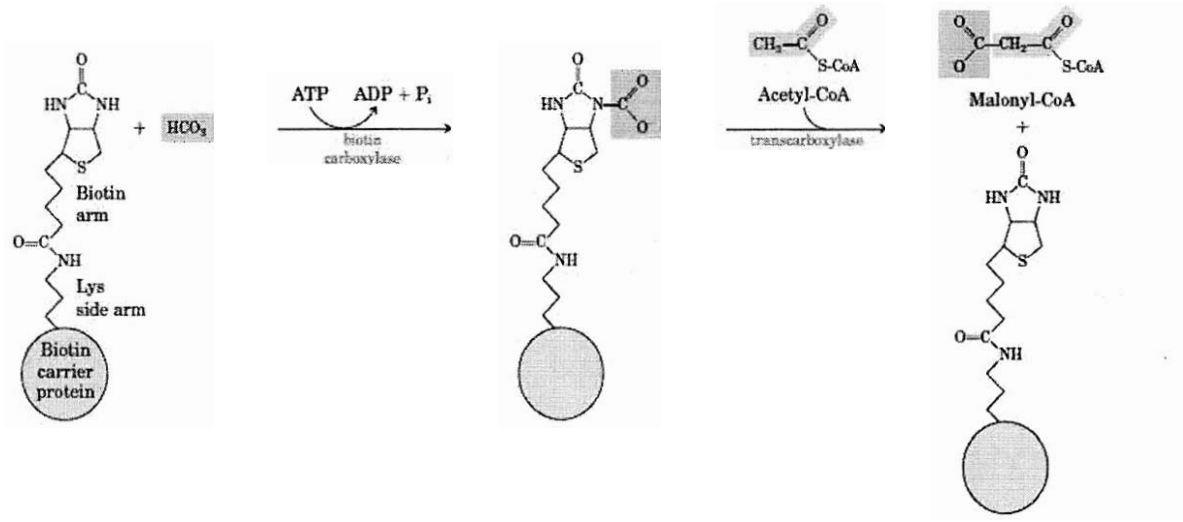
v Acetone – ketone body synthesis / ketogenesis

vi Squalene - cholesterol biosynthesis

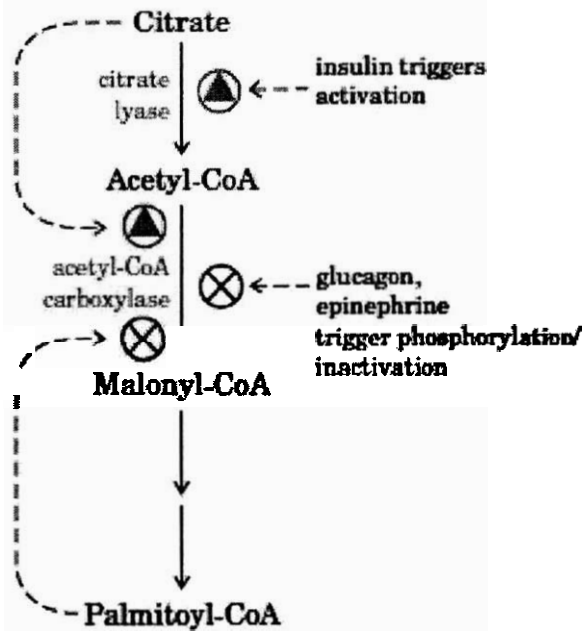
b Attempt the following (**any two**)

i. Discuss the role of acetyl CoA carboxylase in lipid metabolism

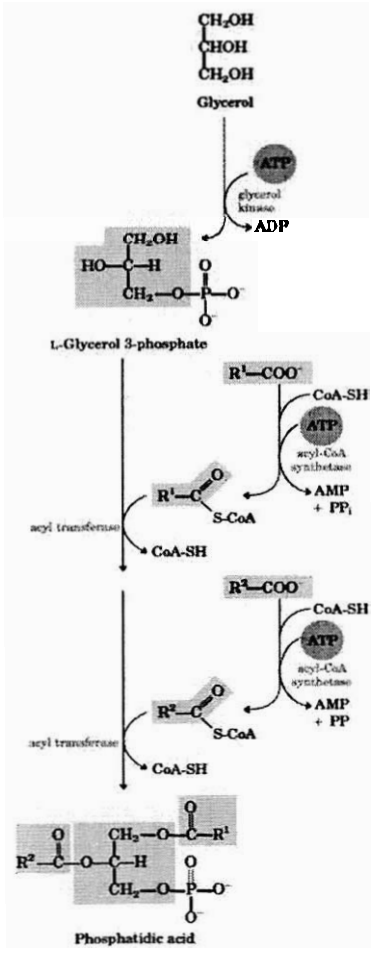
- Catalyses conversion of acetyl CoA to Malonyl CoA. **(3M)**



- Rate limiting enzyme and thus the is a site for regulation of fatty acid biosynthesis **(3M)**



ii Schematically represent synthesis of TAG from glycerol



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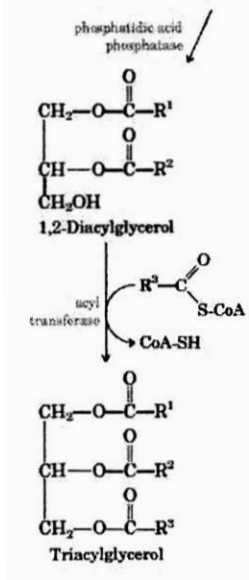
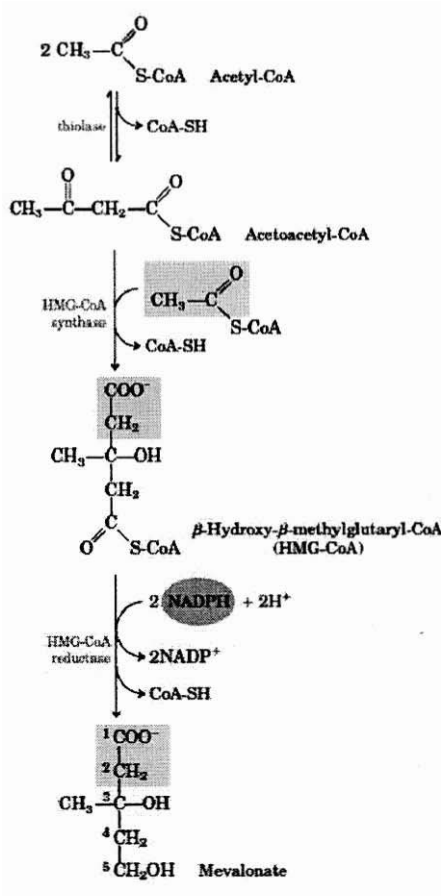
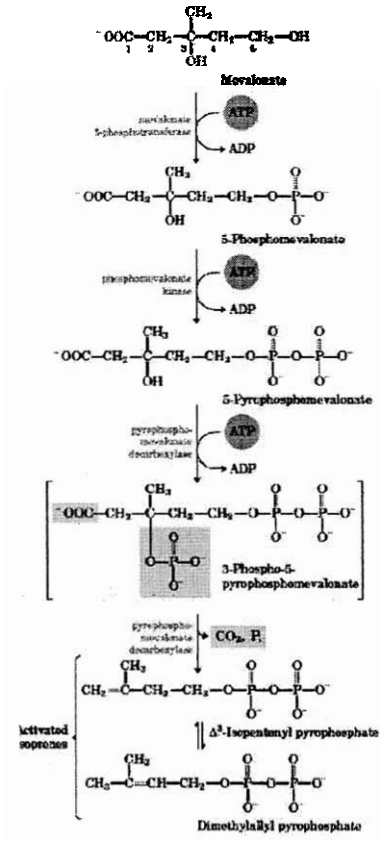
Phosphatidic acid



iii Write the flow-sheet for formation of activated isoprene in cholesterol biosynthesis (3M stage I +3M stage II)





iv Describe the formation of ketone bodies in the liver **(5M eacg step)**

The synthesis of ketone bodies occurs in the ***liver.*** The enzymes for ketone body synthesis are located in the ***mitochondrial matrix.*** Acetyl CoA, formed by oxidation of fatty acids, pyruvate or some amino acids, is the precursor for ketone bodies. Ketogenesis occurs through the following reactions (***Fig.14.11***).

1. Two moles of **acetyl CoA condense** to form acetoacetyl CoA. **This reaction is catalysed** by thiolase, an enzyme involved in the final step of β-oxidation. Hence, acetoacetate synthesis is appropriately regarded as the reversal of thiolase reaction of fatty acid oxidation.

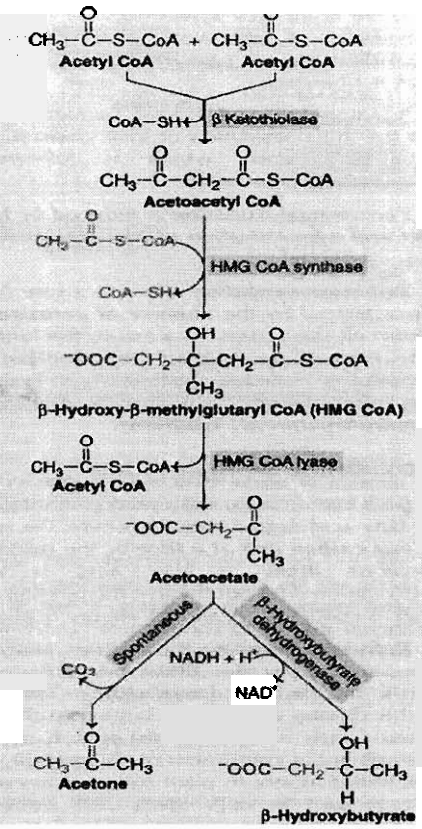
2. Acetoacetyl CoA combines with another molecule of acetyl CoA to produce β-hydroxy β-methyl glutaryl CoA (HMG CoA). ***HMG CoA synthase,*** catalysing this reaction, ***regulates the synthesis of ketone bodies.***

3. HMG CoA lyase cleaves HMG CoA to produce acetoacetate and acetyl CoA.

4. Acetoacetate can undergo spontaneous decarboxylation to form acetone.

5. Acetoacetate can be reduced by a dehydrogenease to β-hydroxybutyrate.

The carbon skeleton of **some amino** acids (ketogenic) is degraded to acetoacetate or acetyl CoA and, therefore, to ketone bodies, e.g. leucine, lysine, phenylalanine etc.



4 a Explain the term **(any one)** **2**

i Curie - the quantity of radioactive material in which the no of nuclear disintegration per second is same as that in one gram of radium (3.7×10^{10} BQ)

ii Secondary electron – an electron belonging to a beam of secondary radiation or emission (as an electron emitted from a metal surface when the surface is bombarded by high speed electrons)

b. Give one example of **(any one)** **1**

i Detector used in IR spectroscopy – Thermal detector **or** Golay cells **or** thermocouples

ii Sources of radiation in fluorescent spectroscopy – mercury lamp **or** xenon arc **or** Deuterium lamp **or** hydrogen lamp

Describe and give two applications of the following techniques **(any two)** **12**

Geiger-Muller counter (**4M for description +2M for application)**

(ii) COUNTER TUBES A broad range of Geiger-Müller tubes is available, some of which are illustrated in Fig. 6.3. The *end window tube* is the most widely used type. Window density can vary according to the isotope being detected. Thus, thick end window (glass) tubes which are quite robust can be used with high energy β-emitters such as ^{32}P while more delicate thin end window tubes (mica or mylar) are necessary for detection of weak β-emitters such as ^{14}C. The *thin wall tubular* type of tube is frequently used in laboratory monitoring, particularly for location of spillages. The *annular well, thin wall dipping* and *liquid flow types* of tube are all for use with liquid samples and generally, because they are constructed of glass, are only suitable for strong β-emitters. The *needle probe* type is used for locating implants or concentrations of radioisotopes in several types of diagnostic tests used in clinical biochemistry.

With very soft β-emitters (e.g. ^{3}H) and α-emitters, even very thin end windows will absorb most, if not all, of the particles before they enter the sensitive volume of the tube. This can be overcome by using a *windowless* tube through which a gas mixture such as 2% butane in helium is continually passed. This is known as *gas flow counting* but it should be

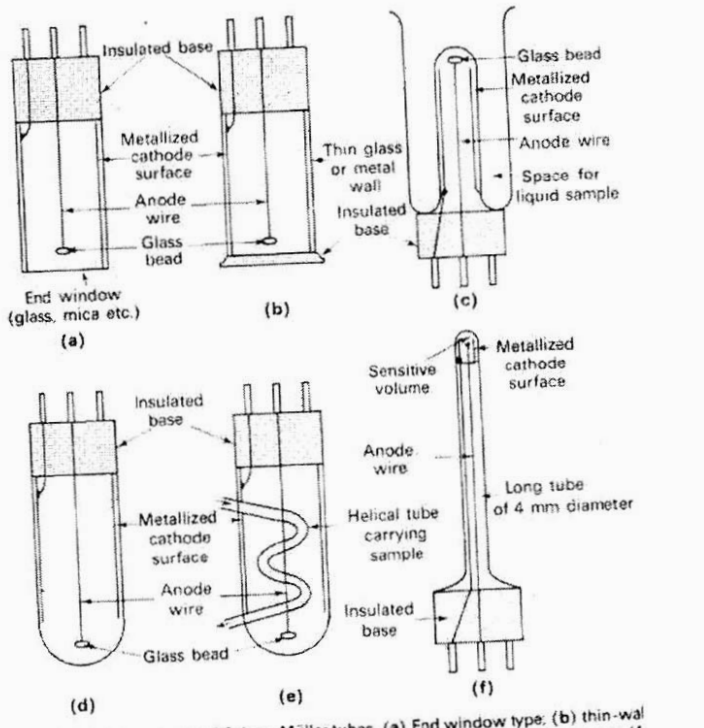


Fig. 6.3 Various types of Geiger-Müller tubes. (a) End window type; (b) thin-wal type; (c) annular-well type; (d) thin-wall dipping type; (e) liquid flow type; (f needle probe type.

(any one diagram)

Applications:

End-window ionisation counters are used for routine monitoring of the radioactive laboratory to check for contamination. They are also useful in experimental situations where the presence or absence of radioactivity needs to be known rather than the absolute quantity, for example quick screening of radioactive gels prior to autoradiography or checking of chromatographic fractions for labelled components.

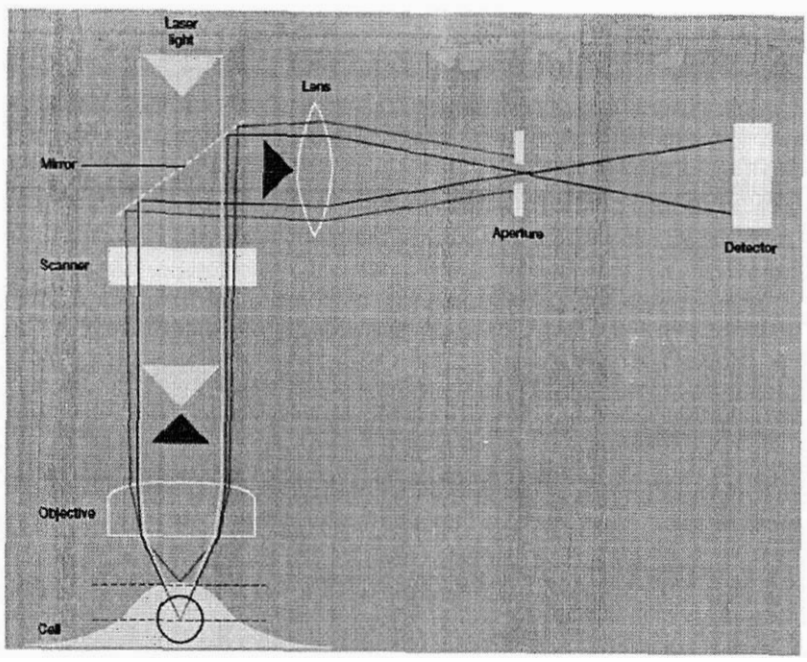
ii Working of confocal microscope **4M for description +2M for application)**

Confocal Microscopy

A conventional light microscope, which uses a mixed wavelength light source and illuminates a large area of the specimen, will have a relatively great depth of field. Even if not in focus, images of bacteria from all levels within the field will be visible. These will include cells above, in, and below the plane of focus
As a result the image can be murky, fuzzy, and crowded.

The solution to this problem is the **confocal scanning laser microscope** (CSLM) or confocal microscope. Fluorescently stained specimens are usually examined. A focused laser beam strikes a point in the specimen , . Light from the illuminated spot is focused by an objective lens onto a plane above the objective. An aperture above the objective lens blocks out stray light from parts of the specimen that lie above and below the plane of focus. The laser is scanned over a plane in the specimen (beam scanning) or the stage is moved (stage scanning) and a detector measures the illumination from each point to produce an image of the optical section. When many optical sections are scanned, a computer can combine them to form a three-dimensional image from the digitized signals. This image can be measured and analyzed quantitatively.

The confocal microscope improves images in two ways. First, illumination of one spot at a time reduces interference from light scattering by the rest of the specimen. Second, the aperture above the objective lens blocks out stray light as previously mentioned. Consequently the image has excellent contrast and resolution. A depth of 1 μm or less in a thick preparation can be directly observed. Special computer software is used to create high-resolution, three-dimensional images of cell structures and complex specimens such as biofilms



Applications (any two)

- 3D images of entire cell, cellular components and complex specimens like biofilms.
- Colocalisation is used to determine if two or more different molecules reside at the same physical location in a specimen.
- Used to evaluate cellular physiology.

iii **Monochromators used in fluorescent spectroscopy 4M for description +2M for application)**

Two monochromators may be employed, the first (M_1) for selecting the excitation wavelength. Fluorescence emission occurs in all possible directions and one direction (90°) is chosen and the second monochromator (M_2) is used for determination of the fluorescence spectrum. The radiation source is generally either a mercury lamp or a xenon arc, excitation wavelengths frequently being selected in the ultraviolet region and the emission wavelengths in the visible region. The detector is usually a sensitive photocell, for example a red-sensitive photomultiplier for wavelengths greater than 500 nm. Temperature control is required for accurate work as the intensity of fluorescence may vary between 10% and 50% for a 10 deg.C change at approximately 25 °C.

Two approaches are possible for the illumination of the sample: the simplest is the basic 90° illumination (Fig. 9.10), the alternative approach being front-face illumination (FFI; Fig. 9.11) which obviates pre- and postfilter effects. These latter effects arise owing to the absorption of radiation prior to it reaching the fluorescent molecules (prefilter absorption) and the reduction in the amount of emitted radiation escaping from the cuvette (postfilter effects). Such effects are more evident in concentrated solutions, and the use of microcuvettes (containing less material) can be of value (Fig. 9.11a). FFI is essential for examining suspensions, and cuvettes with only one optical face are required. Excitation and emission occur at the same face but generally the technique is somewhat less sensitive than 90° illumination.

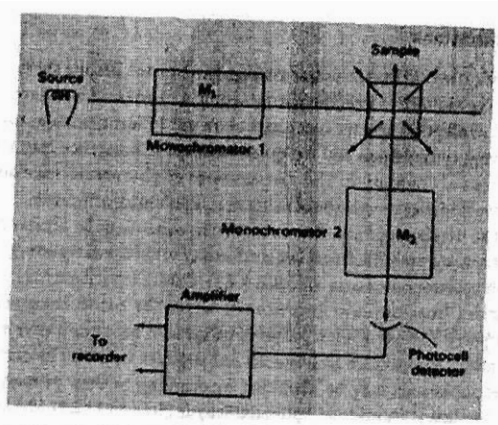


Fig. 9.10. The basic component of a spectrofluorimeter set up for 90° illumination.

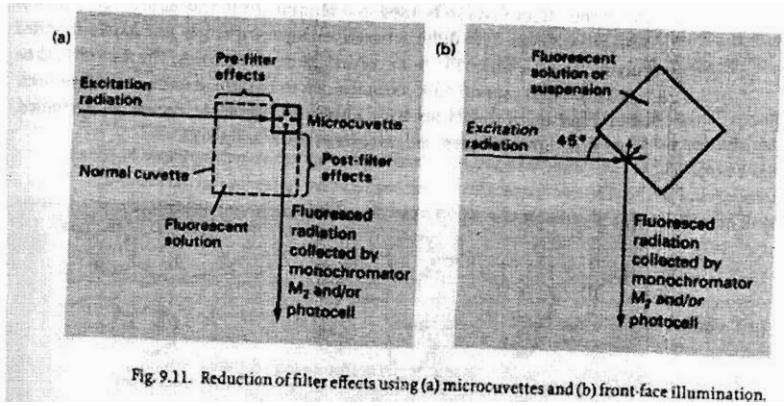


Fig. 9.11. Reduction of filter effects using (a) microcuvettes and (b) front-face illumination.

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iv IR spectrophotometer **4M for description +2M for application)**

Instrumentation

The most common source is a Nichrome alloy coil heated to incandescence. This region of the electromagnetic spectrum contains the heat waves. Samples of solids are either prepared in mulls such as nujol and held as layers between salt planes such as NaCl or pressed into KBr discs. Non-covalent materials must be used for sample containment and also in the optics, as these materials are transparent to infrared.

Detectors are of the heat recognition type. The Golay cell contains gas or liquid whose expansion is registered when the energy is absorbed. Thermal detectors

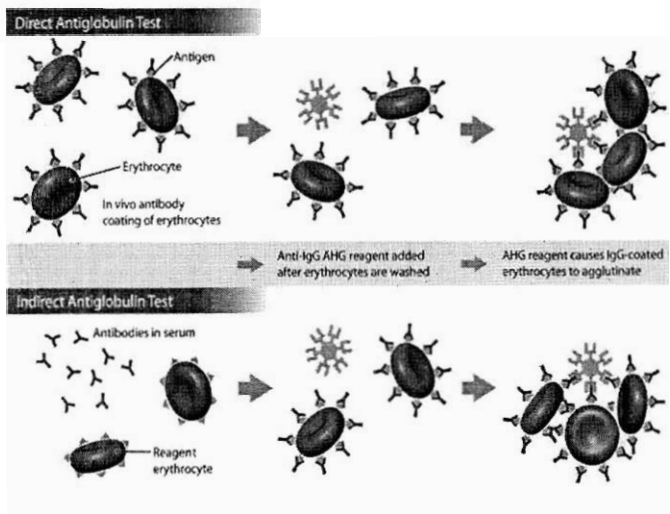
such as thermocouples can also be employed. Analysis using a Michelson interferometer allows Fourier transform infrared spectroscopy (FT–IR) to be performed. This instrument involves fixed and rotating mirrors that split the incident beam into two. The beams are recombined after passage through the sample but as the two pathlengths are different, interfence patterns arise that may be analysed by Fourier transform methods (see Section 10.4.1 for consideration of FT methods). The Beer–Lambert law applies in all cases except complex mixtures, where more complicated mathematical procedures are required.

Applications

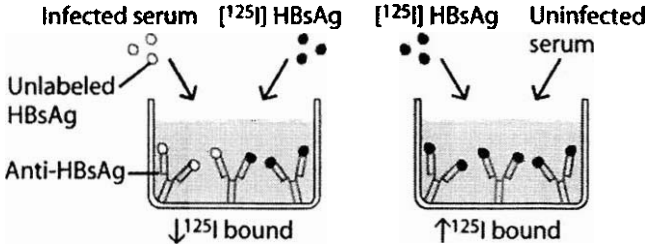
The use of infrared and Raman spectroscopy is mainly in biochemical research for intermediate-sized molecules such as drugs, metabolic intermediates and substrates. Examples are the identification of substances such as penicillin and its derivatives, small peptides and environmental pollutants. It is an ideal and rapid method for measuring certain contaminants in foodstuffs and can be coupled to a gas–liquid chromatograph (GC–IR) when it is also frequently used for the analysis of drug metabolites. Figure 10.2 shows the major bands of an FT-IR spectrum of the drug phenacetin. Gas analysis is rapid, particularly for measuring different concentrations of gases such as CO_2, CO and CH = CH (acetylene) in biological samples. Use in the study of photosynthesis and respiration in plants is valuable, particularly for CO_2 metabolism.

5 Write short note on **(any three)**

a. **Coombs test:** Coombs test is also known as antiglobulin test. The Coombs' test was first described in 1945 by Cambridge immunologists Robin Coombs. Coombs reagent (antiglobulin) is used to detect the presence of antigen and incomplete antibody complex. (2M)



b **RIA – Principle and application:** Principle of RIA involves competitive binding of radiolabeled Ag and unlabeled Ag to a high affinity Ab.
The increase in the concentration of the Ag in the unlabeled test sample, the more radiolabeled Ag will be displaced from the Ag binding sites
Therefore the concentration of the test sample Ag is a measure of the decrease in the amount of radiolabeled Ag bound to the Ab. (3M)



Application: (2M)

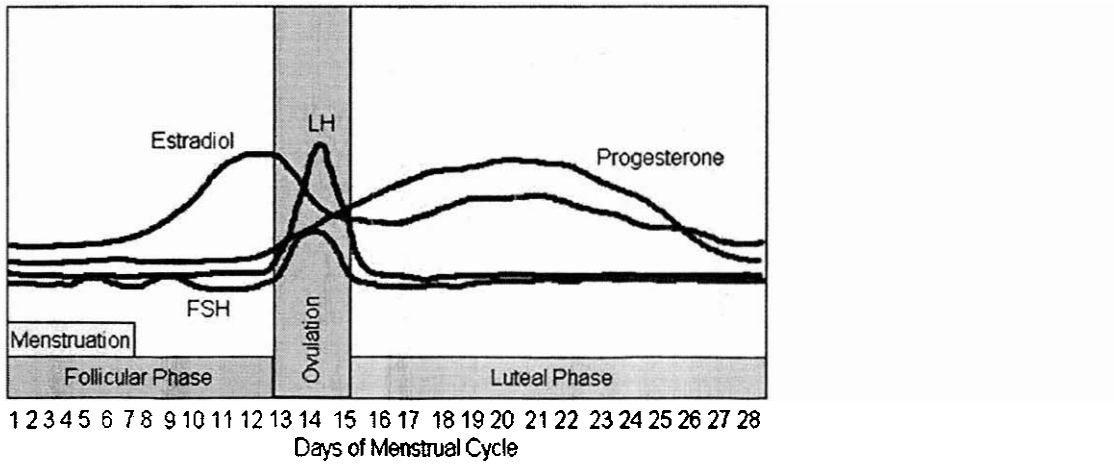
- To determine the concentration of a particular antigen in a given sample.
- Used to detect the presence of Hepatitis B virus in blood.
- Used in quantification of hormones, drugs, tumour markers, IgE and viral antigen etc.

c **Menstrual cycle**

The **Menstrual Cycle** begins at **puberty** and ends at **menopause.** Menopause is the permanent cessation of the menstrual cycle. The Menstrual Cycle lasts an average of 28 days, but many women have shorter or longer cycles. Pregnancy, medications, illness, and other factors can interrupt the menstrual cycle.

There are 4 stages to the Menstrual Cycle:

1. **Follicle Stage** – This involves the maturation of an egg in the ovary and the secretion of estrogen. The estrogen causes the thickening of the uterine lining (the blood volume builds up).
2. **Ovulation** – One egg is released from the follicle in the ovary.
3. **Corpus Luteum** – The follicle breaks down and forms a yellow mass of cells which secrete progesterone and enhance the thickening of the uterine lining.
4. **Menstruation** - This is when the uterine lining (blood) is shed and released through the vagina. This lasts for up to a week and happens when egg fertilization does not take place.



d **Abnormalities of thyroid function:**

Goiter: Abnormal increase in the size of thyroid gland. Goiter is primarily due to failure in the autoregulation of T_3 and T_4 synthesis. This may also cause due to deficiency or excess of

iodine.
It can be associated with over-function of the thyroid gland **hyperthyroidism** or with under-function of the gland **hypothyroidism**. (2M)
Hyperthyroidism: also known as thyrotoxicosis and is associated with overproduction of thyroid hormones. It is characterized by increased BMR, nervousness, irritability, anxiety, rapid heart rate, loss of weight, weakness, diarrhea, sweating and protrusion of eyeballs.
Graves disease: it is de to elevated thyroid stimulating IgG also known as long acting thyroid stimulator which activates TSH, and, thereby increases thyroid hormonal production.
Hyperthyroidsm: this is due to impairment in the function of thyroid gland. Disorder of pituitary or hypothalamus also contributes to hypothyroidism. Hypothyroidism is characterized by reduced BMR, slow heart rate, weight gain, sluggish behavior, constipation, dry skin etc.
Hypothyroidism in children is associated with physical and mental retardation, collectively known as cretinism. Hypothyroidism in adult causes myxoedema, characterized by bagginess under the eyes, puffiness of face, slowness in physical and mental activities. (3M)

e Types of radioactive decay

Types of radioactive decay

There are several types of radioactive decay; only those most relevant to bio chemists are considered below.

Decay by negatron emission

In this case a neutron is converted to a proton by the ejection of a negatively charged beta (β) particle called a negatron (β^-):

neutron → proton + negatron

To all intents and purposes a negatron is an electron, but the term negatron is preferred, although not always used, since it serves to emphasise the nuclear origin of the particle. As a result of negatron emission, the nucleus loses a neutron but gains a proton. The *N*/*Z* ratio therefore decreases while *Z* increases by 1 and *A* remains constant. An isotope frequently used in biological work that decays by negatron emission is ^{14}C.

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + \beta^-$$

Negatron emission is very important to biochemists because many of the commonly used radionuclides decay by this mechanism. Examples are: ^{3}H and ^{14}C, which can be used to label any organic compound; ^{35}S used to label methionine, for example to study protein synthesis; and ^{32}P, a powerful tool in molecular biology when used as a nucleic acid label.

Decay by positron emission

Some isotopes decay by emitting positively charged β-particles referred to as positrons (β^+). This occurs when a proton is converted to a neutron:

proton → neutron + positron

Positrons are extremely unstable and have only a transient existence. Once they have dissipated their energy they interact with electrons and are annihilated. The mass and energy of the two particles are converted to two γ-rays emitted at 180° to each other. This phenomenon is frequently described as back-to-back emission.

As a result of positron emission the nucleus loses a proton and gains a neutron, the *N*/*Z* ratio increases, *Z* decreases by 1 and *A* remains constant. An example of an isotope decaying by positron emission is ^{22}Na:

$$^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + \beta^+$$

Positron emitters are detected by the same instruments used to detect γ-radiation. They are used in biological sciences to spectacular effect in brain scanning with the technique positron emission tomography (PET scanning) used to identify active and inactive areas of the brain.

Decay by alpha particle emission

Isotopes of elements with high atomic numbers frequently decay by emitting alpha (α) particles. An α-particle is a helium nucleus; it consists of two protons and two neutrons ($^4He^{2+}$). Emission of α-particles results in a considerable lightening of the nucleus, a decrease in atomic number of 2 and a decrease in the mass number of 4. Isotopes that decay by α-emission are not frequently encountered in biological work. Radium-226 (^{226}Ra) decays by α-emission to radon-222 (^{222}Rn), which is itself radioactive. Thus begins a complex decay series, which culminates in the formation of ^{206}Pb:

$$^{226}_{88}Ra \rightarrow {}^{4}_{2}He^{2+} + {}^{222}_{86}Rn \rightarrow \rightarrow \rightarrow {}^{206}_{82}Pb$$

Alpha emitters are extremely toxic if ingested, due to the large mass and the ionising power of the atomic particle.

Electron capture

In this form of decay a proton captures an electron orbiting in the innermost K shell:

proton + electron → neutron + X-ray

The proton becomes a neutron and electromagnetic radiation (X-rays) is given out.
Example:

$$^{125}_{53}I \rightarrow {}^{125}_{52}Te + \text{X-ray}$$

Decay by emission of γ-rays

In contrast to emission of α- and β-particles, γ-emission involves electromagnetic radiation similar to, but with a shorter wavelength than, X-rays. These γ-rays result from a transformation in the nucleus of an atom (in contrast to X-rays, which are emitted as a consequence of excitation involving the orbital electrons of an atom) and frequently accompany α- and β-particle emission. Emission of γ-radiation in itself leads to no change in atomic number or mass.

γ-Radiation has low ionising power but high penetration. For example, the γ-radiation from ^{60}Co will penetrate 15 cm of steel. The toxicity of γ-radiation is similar to that of X-rays.
Example:

$$^{131}_{53}I \rightarrow {}^{131}_{54}Xe + \beta^- + \gamma$$

f Transcriptional regulation of cholesterol biosynthesis.

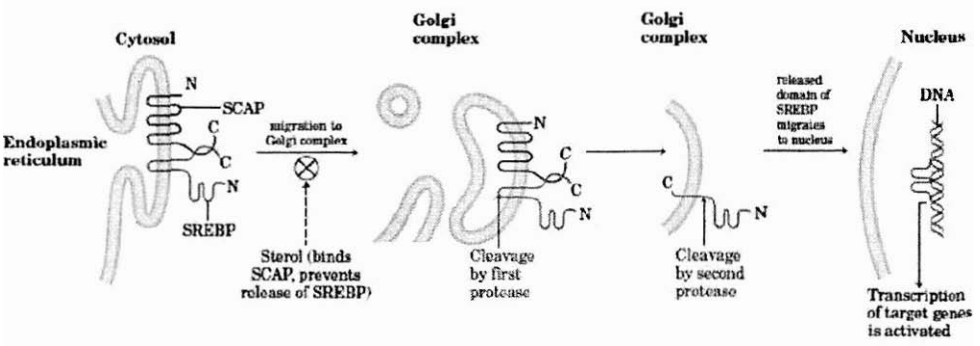


FIGURE 21-43 SREBP activation. Sterol regulatory element-binding proteins (SREBPs, shown in green) are embedded in the ER when first synthesized, in a complex with the protein SREBP cleavage-activating protein (SCAP, red). (N and C represent the amino and carboxyl terminals of the proteins.) When bound to SCAP, SREBPs are inactive. When sterol levels decline, the complex migrates to the Golgi complex, and SREBP is cleaved by two different proteases in succession. The liberated amino-terminal domain of SREBP migrates to the nucleus, where it activates transcription of sterol-regulated genes.