BIOMEDICAL TECHNOLOGIES

A modern hospital can make use of variety of sophisticated instruments and equipment of accurate diagnosis and treatment of diseases. Three main categories of instruments and equipment used are **diagnostic**, **imaging**, and **therapeutic.**

3.6.1 Diagnostic Instruments

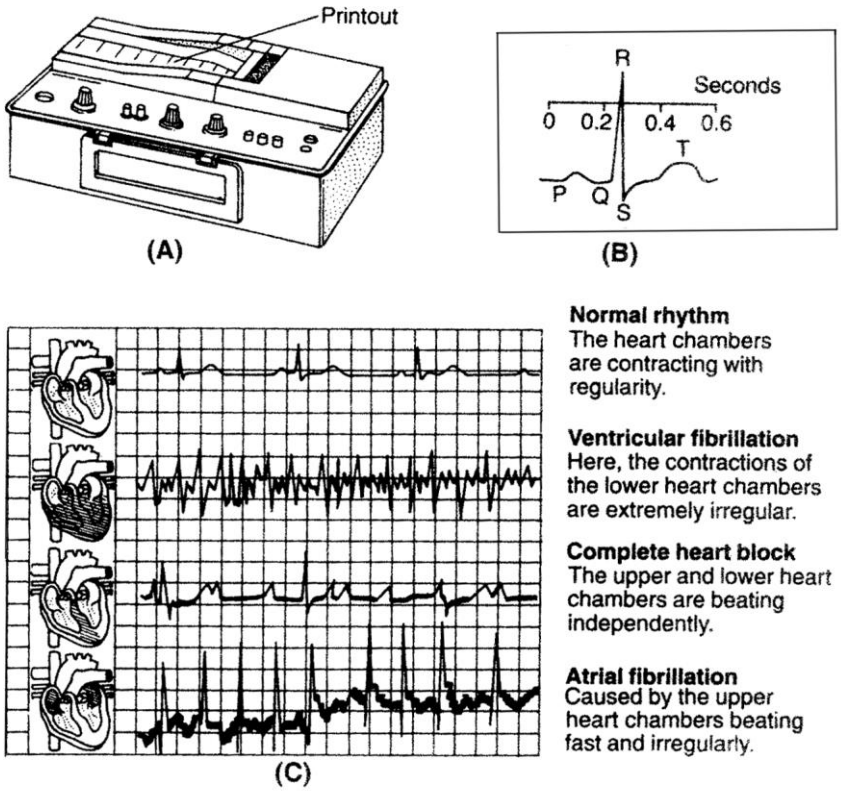
(i) **Sphygmomanometer**

- Sphygmomanometer, commonly called B.P. Apparatus, is an instrument for measuring blood pressure.
- This instrument consists of a rubber cuff attached by a rubber tube to a compressible hand pump or bulb.
- Another tube attaches to the cuff and to a column of mercury or pressure dial marked off in millimeters.
- Blood pressure is usually taken in the left brachial artery.
- Blood pressure is recorded by giving the systolic pressure and diastolic pressure expressed as millimeters of mercury (*mm Hg*).
- A healthy young adult male has blood pressure reading of about 120/80 (*i.e.* 120 *mm Hg* systolic and 80 *mm Hg* diastolic).
- The difference between systolic and diastolic pressure is called Pulse pressure.
- Blood pressure often rises normally with age to about 130/90 at age 60.
- Abnormally high blood pressure is known medically as hypertension; abnormally low blood pressure is termed hypotension.

(ii) **Electrocardiograph**

- The abbreviation ECG stands for electrocardiogram, a record of myoelectrical changes that immediately precede contraction of heart muscle.
- Electrocardiograph is the instrument used to record ECG.
- Leads from this instrument are attached to the chest, wrists and ankles using conducting jelly.
- The waves produced in ECG are known as P, Q, R, S and T.
- An ECG is helpful for diagnosing pathological disorders of the heart like coronary artery disease, coronary thrombosis, pericarditis, cardiomyopathy and myocarditis.
- **Multi-channel monitors** measure and display the ECG, blood pressure in various heart chambers and other physiological data.
- **Echocardiography** is a method of obtaining an image of the structure of heart using ultrasound.

• **Doppler echocardiography** is a technique which allows the indirect measurement of the flow of velocity as it passes through the heart.



A. A modern portable ECG machine, **B.** Normal ECG,
C. Different abnormal patterns of ECG

(iii) **Electroencephalograph**

• The electrical activity of the exposed animal brain was discovered by **Satton** in 1875.

• **Hans Berger** (1929) was the first to record Electro-Encephalo-Gram (EEG).

• Electroencephalography is done by attaching a number of small electrodes to the scalp.

• The electrodes are connected to an instrument that measures the brain's impulses in microvolts and amplifies them for recording purposes.

• Electroencephalography is painless, produces no side-effects and to record it takes about 45 minutes.

• An EEG records the minute electrical impulses produced by the activity of brain.

• EEG is useful to find out whether the person is alert, awake or asleep.

• EEG can help in diagnosing certain conditions such as epilepsy, encephalitis, dementia and brain tumour.

• Electroencephalography can also be used to monitor the condition of patients during surgery and to assess the depth of anaesthesia.

• EEG is also used as a test for brain death.

- The weaker magnetic fields from the brain can be studied with the help of SQUID (Super conducting Quantum Interference Device).
- Magnetoencephalography (MET) is useful for studying the disease associated with the brain and spinal cord.

3.6.2 Imaging Instruments

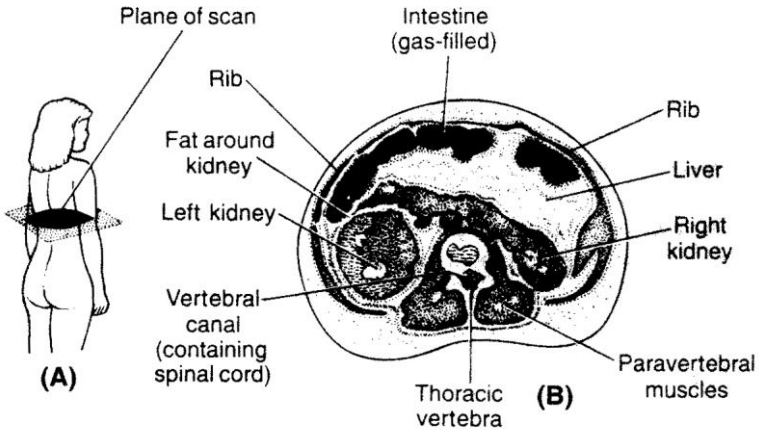
Major advancements in the medical sciences have been the development of new imaging techniques that provide detailed pictures of internal organs.

(i) **X-rays**

- Following their discovery by **Wilhelm Roentgen,** a German physicist in 1895, X-ray became an important tool for medical diagnosis.
- X-ray are a form of electromagnetic radiation of extremely short wavelength.
- When a beam of X-rays is directed at a part of the body such as chest, the rays are absorbed more by dense structures such as the ribs or heart muscles than by less dense structures such as the skin or lungs.
- This causes shadows of variable intensity to be cast on a photographic film.
- X-rays cause no sensation when passed through body tissues.
- Large or frequent radiation doses may damage the skin and internal organs and may cause cancer in later life.
- The study of X-rays for detection and treatment of disease is called radiology.
- X-ray imaging in the simplest form is commonly employed for diagnosing diseases of the heart, lungs and detection of bone and joint injuries.
- Nowadays, the risk involved in having X-rays is extremely small; radiation doses are kept to a minimum.

(ii) **Computed Tomographic Scanning (CT)**

- CT scanning was developed by **Godfrey Hounsfield** of Britain in 1968 (Nobel Prize in 1979).
- This technique combines the use of X-rays with computer technology to produce a two or three-dimensional clear cross-sectioned image of an area.
- Computed tomographic scanning is also known as CAT (Computed Axial Tomography).
- CT scanning provides clearer and more detailed information than X-rays.
- Another advantage of CT scanning is that it tends to minimize the amount of radiation exposure.
- CT scanning can be used to obtain images of any part of the body.
- CT scanning helps in the diagnosis of diseases of brain, spinal cord, chest and abdomen.
- This technique is also extremely useful in detecting tumour and monitoring the extent of their spread to surrounding tissues and organs.



A. Plane of CT scan of a patient, **B.** Axial section of CT scan of abdomen showing vertebra, kidneys, liver and intestine

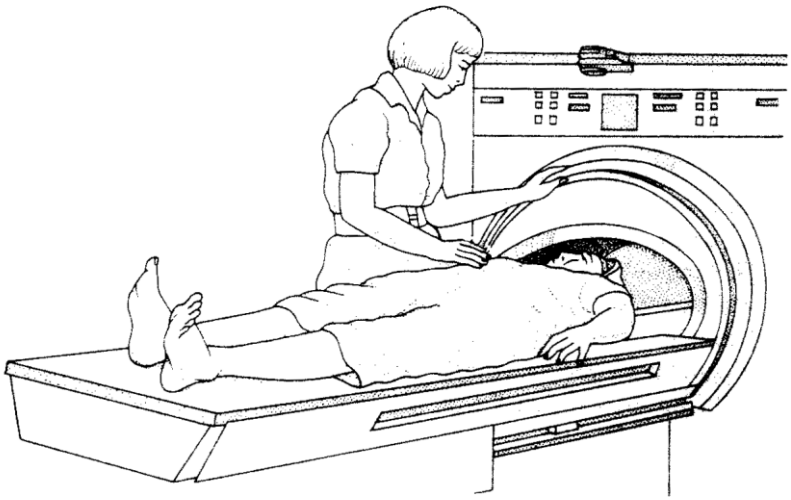
(iii) **Positron Emission Tomographic Scanning (PET)**

- PET scanning was developed by **Louis Sokoloff** of USA in 1985.
- PET is a diagnostic technique based on detection of positrons (positively charged electrons) emitted by radio isotopes such as carbon ^{11}, nitrogen ^{13} or oxygen ^{15} generated by the cyclotron.
- These radio isotopes are then incorporated by chemical methods into biological molecules such as glucose, amino acids, carbon dioxide and ammonia.
- These positron emitting compounds are injected into the blood-stream and are taken up in greater concentration by areas of tissues that are more metabolically active.
- PET scanning provides three- dimensional images that reflect the metabolic and chemical activity of tissues beings studied.
- PET scanning is particularly valuable for measurement of regional cerebral blood volume, blood flow, metabolic rates of glucose and oxygen in humans.
- PET scanning is used for detecting tumours, for locating the origin of epileptic activity within brain and for examining brain function in various mental illnesses.
- Recently PET scanning has been used to locate colour-processing centers in human visual cortex.

(iv) **Magnetic Resonance Imaging (MRI)**

- MRI was originally discovered in 1946 independently by **Felix Bloch** and **Purcell** in USA.
- MRI is a diagnostic technique that provides high-quality cross-sectioned or three-dimensional images of organs and structures without using X-rays or other radiation.
- This technique exploits the natural behaviour of the protons (nuclei) of hydrogen atoms when they are subjected to a very strong magnetic field and radio waves.
- The most abundant source of protons in the body are hydrogen atoms in water molecules.

- An MRI scan reflects differences in the water content of tissues.
- A newer application of MRI known as Nuclear Magnetic Resonance spectroscopy (NMR) relies on the detection of other chemical elements such as phosphorus and calcium.
- The patient lies down surrounded by massive electromagnets and is exposed to short bursts of powerful magnetic field and waves.
- The bursts stimulate protons (hydrogen nuclei) in the patient's tissues to emit radio signals.
- The signals are detected and analyzed by a computer to create an image of a “slice” of the patient's body.
- In imaging NMR is superior to CT scanning; it generally gives much greater contrast between normal and abnormal tissues, it is free from radiation hazards and images can be obtained in any plane unlike CT, which is restricted to cross-sectional imaging.
- There are no known risks or side effects of MRI.
- MRI is a costly test that is not yet widely available.
- MRI is especially useful in studying brain and spinal cord. It can clearly differentiate between white and gray ma



Magnetic resonance imaging. The patient is positioned to undergo MRI

(v) **Ultrasound Scanning**

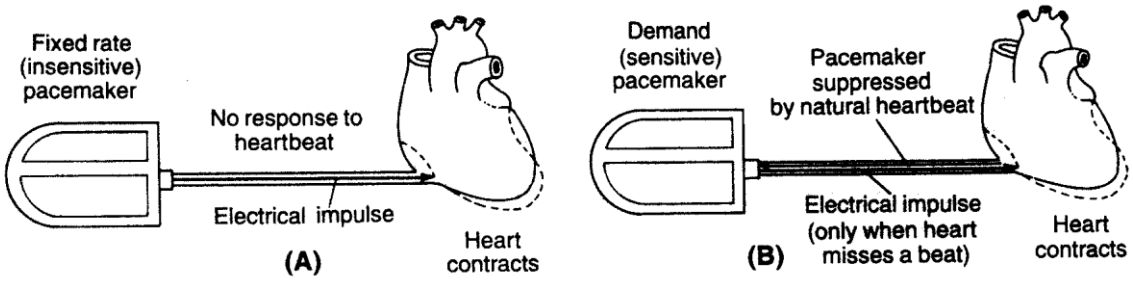
- This is also known as echography or sonography and uses inaudible high-frequency sound waves in the range of 1-15 million hertz.
- Ultrasound waves are produced by the piezoelectric effect when an electric potential is applied to crystals of lead zirconate.
- Ultrasound waves are emitted by a device called a transducer which is placed on the skin over the part of body to be viewed.
- The transducer contains the crystals of lead zirconate that converts an electric current into sound waves.

- The transducer crystal is made to oscillate back and forth.
- Some of the waves are reflected at tissue boundaries, so a series of echoes are returned.
- The transducer also acts as a receiver, converting these echoes into electrical signals, which are processed and displayed on a screen of a monitor to give a two-dimensional image.
- Ultrasound imaging is useful in diagnosing the diseases of the brain, kidney stones, gallstones, cirrhosis, intestinal obstruction, fallopian tubes, uterus etc.
- Ultrasound has wide applications in medicine and is especially useful in obstetrics.
- This technique offers no known risk to the baby and is often performed at about 16 to 18 weeks to reveal multiple pregnancy and foetal abnormalities like anencephaly and spina bifida.

3.6.3 Therapeutic Instruments

(i) **Pacemakers**

- Pacemaker is a device that supplies electrical impulses to the heart to maintain the heartbeat at a regular rate.
- The artificial pacemaker was introduced by **Chardack** in 1960.
- Pacemakers are life saving when the normal heart rate 72-80 drops to abnormally low levels like 30-40 due to diseases.
- Pacemaker consists of a pulse generator and an electrode.
- The pulse generator is hermetically sealed box; it contain lithium halide cells to provide power for over 10 years.
- The electrode is a fine metallic spring ensheathed in a thin layer of biocompatible plastic; the special tip remains in contact with the interior of right ventricle.
- An artificial pacemaker is implanted when a person's sinu-atrial node is not functioning properly.
- Two basic types of pacemakers are fixed-rate and demand type.
- Fixed-rate pacemaker discharges impulses at a steady rate, irrespective of the heart's activity.
- Demand pace maker discharges impulses only when the heart-rate slows or a beat is missed. A normal heart-rate and beat suppresses the pacemaker.
- A pacemaker may be external (worn on belt) or internal (implanted in the chest).
- There are two main types of implantation, **transvenous implantation** and **epicardial implantation**.
- Modern pacemakers are comparatively insensitive to interference, but may be affected by powerful electromagnetic pulses.
- Anyone fitted with a pacemaker should avoid powerful radio or radar transmitters and should not pass through security screens at airports.
- Pacemakers are likely to be influenced by microwave ovens, electric shavers, automobile ignition and cellular phones.



Types of pacemakers
A. Fixed rate pacemaker, **B.** Demand pacemaker

3.6.4 DEVICES

Three types of medical devices used nowadays are implants, disposables and external prosthesis.

(i) **Implants**

- Implants are devices used for replacing a diseased organ or tissue within the body.
- Implants must be non-toxic and biocompatible and are used for replacing joint, arteries, heart valves, etc., and occasionally helpful in cosmetic surgery.

(a) **Artificial Heart Valve**

- Artificial heart valves may be either mechanical or made of human or animal tissues.
- Mechanical valves are made from special biocompatible plastics, metal alloys and ceramics.
- Tissue valves are taken from cadavers of pigs or made from the pericardium of animals.
- Mechanical valves develop tendency of clotting of blood, so the patient must have regular medication of anticoagulants.
- Tissue valves do not require anticoagulants, but they tend to calcify, particularly in young.

(ii) **Disposables**

(a) **Oxygenator**

- The first open heart surgery was performed by **Walton Lillehel** (USA) in 1953 by meant of a procedure, called heart-lung bypass.
- Oxygenator is used in open-heart surgery to oxygenate the blood passing through the heart-lung machine.
- Oxygenator can be called as an artificial lung. Two common types of oxygenators currently used are bubble oxygenator and membrane oxygenator.
- Bubble oxygenators are used for shorter operation whereas membrane oxygenators are more suitable for longer operations and for operation of infants.

Landmarks in Medicine : Diagnosis and Surgery

Invention/ Development	Year	Inventor/Scientist	Country
Thermometer	1593	Galileo Galilei	Italy
Medical thermometer	1612	Sanctorius	Italy
Stethoscope	1810	Rene Laennec	France

Ophthalmoscope	1851	Hermann Von Helmhotz	Germany
Antiseptic surgery	1870	Joseph Lister	Britain
X-rays	1895	Wilhelm Roentgen	Germany
Electrocardiograph (ECG)	1906	Willem Einthoven	Netherland
Electroencephalograph (EEG)	1929	Hans Berger	Germany
Cardiac pacemaker	1932	A.S. Hyman	USA
Kidney dialysis machine	1945	Willem Kolff	Netherland
Coronary artery bypass graft	1951	Arthur Vineberg	Canada
Open heart surgery	1953	Walton Lillehel	USA
Kidney transplant	1955	Joseph Murray	USA
Artificial heart	1957	Willem Kolff	Netherland
Fibre-optic endoscopy	1957	Basil Hirschowitz	USA
Laser	1960	T.H. Maimah	USA
Heart transplant surgery	1967	Christiaan Barnard	South Africa
NMR imaging	1971	Raymond Damadian	USA
CAT scanner	1972	Godfrey Hounsfield, Alan Cormack	Britain USA
Coronary angioplasty	1976	Andrease Gruntzig	Switzerland
"Test-tube baby'	1978	Patrick Steptoe Robert Edwards	Britain Britain
PET scanner	1985	Louis Sokoloff	USA
Two-hand transplant	2000	Jean-Michel Dubernard	France

(b) **Blood Bag**

- Blood transfusion is required during surgery, following delivery, for bleeding diseases and after injury.
- Improper transfusion can cause reactions or transmit dangerous diseases such as hepatitis B and AIDS.
- Disposable blood bags reduce chances of spreading diseases.
- Though not prescribed for general use, perfluorocarbons can be used as blood substitute; they dissolve and release oxygen.

(c) **Blood Dialyser (Artificial Kidney)**

- Kidney dialysis machine was invented by **Willem Kolff,** a dutch scientist in 1945.
- A person requires artificial kidney when both of his kidneys fail.
- An artificial kidney can only reproduce the passive filtration process.
- The blood of the patient is passed through the disposable dialyser and is then returned to the body by the intravenous route.
- Haemodialysis means a technique used to remove waste products from the blood.
- The working of blood dialyser is based on the physical laws of diffusion and osmosis.

ASSIGNMENT

BIOMEDICAL TECHNOLOGIES

Basic Level

1. Stethoscope was invented by
   (a) Rene Laennec (b) Wilhelm Roentgen (c) Edward Jenner (d) Joseph Lister
2. First heart transplant was performed by
   (a) William Harvey (b) Christiaan Barnard (c) Har Govind Khorana (d)Walton Lillehel
3. Sphygmomanometer measures
   (a) Heartbeat rate (b) Pulse rate (c) Blood pressure (d) All of these
4. Electrocardiograph was developed by
   (a) Hans Berger (b) Willem Kolff (c) Willem Einthoven (d) Wilhelm Roentgen
5. The ECG is used to detect
   (a) Heart attack (b) Heart Block (c) Coronary thrombosis (d) All of the above
6. QRS is related to
   (a) Ventricular contraction (b)Auricular contraction (c)Cardiac cycle (d) Auricular relaxation
7. An ECG gives information of
   (a) Brain (b) Ventricle (c) Auricle (d) Both (b) and (c)
8. Which of the following reveals the muscle disorders
   (a) ECG (b) EEG (c) EMG (d) All of these
9. Who was first to record EEG of man
   (a) Hans Berger (b) Galileo Galilei (c) Willem Einthoven (d) Sanctorius
10. EEG can help in diagnosing certain conditions like
    (a) Elpilepsy (b) Encephalitis (c) Dementia (d) All of these
11. MET helps in investigating
    (a) Brain disease (b) Brain health (c) Heart disease (d) Both (a) and (b)
12. MET is
    (a) Magnetoencephalography (b) Magnetoelectron transport
    (c) Metallic emission tantrum (d) Mixed electronic tachycardia
13. Autoanalyser estimates the various
    (a) Heart defects (b) Nucleic acids in the body
    (c) Biochemical substances in the body fluids (d) None of these
14. Who discovered X-rays
    (a) William Stockers (b) Wilhelm Roentgen (c) Hans Berger (d) Rene Laennec
15. X-rays were discovered in the year
    (a) 1870 (b) 1895 (c) 1906 (d) 1929
16. Radiology deals with the study of
    (a) UV- rays (b) Gamma rays (c) Cosmic rays (d) X-rays

17. X-ray imaging is commonly employed for diagnosing diseases of
(a) Heart (b) Lungs (c) Bones (d) All of these

18. Barium X-ray examination is useful to investigate the
(a) Digestive tract (b) Reproductive system (c) Circulatory system (d) Excretory system

19. Which of the following is used to diagnose diseases related with blood vessels
(a) Radiology (b) Urography (c) Angiography (d) Dialysis

20. Which of the following statements is correct
(a) Computed tomography scanning is also knows as CAT
(b) CT scanning provides clearer and more detailed information than X-rays
(c) CT scanning can be used to obtain images of any part of the body
(d) All of these

21. CT scanning helps in the diagnosis of diseases of
(a) Brain (b) Spinal cord (c) Chest (d) All of these

22. PET (Positron emission tomography) scanning was developed by
(a) Raymond Damadian (b) Louis Sokoloff (c) Willem Kolff (d) Joseph Murray

23. PET is a diagnostic technique based on
(a) Medical lasers (b) X-ray radiations
(c) Positively charged electrons (d)All of these

24. A positron emitting isotope is
(a) Nitrogen 13 (b) Carbon 14 (c) Oxygen 16 (d) None of these

25. Which of the following can study the metabolic and chemical activity of tissues
(a) PET imaging (b) MRI (c) NMR (d) None of these

26. MRI was originally discovered in 1946 by
(a) Steptoe and Edwards (b) Godfrey Hounsfield and Alan Cormack
(c) Bloch and Purcell (d) Louis Sokoloff

27. The medical use of NMR was developed by
(a) Raymond Damadian (b) A.S. Hyman (c) T.R. Maimah (d) Basil Hirschowitz

28. The most abundant source of protons in the body are
(a) Hydrogen atoms (b) Oxygen atoms (c) Nitrogen atoms (d) All of these

29. In imaging, NMR is superior to CT scanning because
(a) It generally gives much greater contrast between normal and abnormal tissues
(b) It is free from radiation hazards
(c) Image can be obtained in any plane
(d) All of these

30. Which of these is based on magnetic resonance
(a) Sonography (b) NMR scanning (c) PET scanning (d) CT scanning

31. Which of the following does not use ionising radiations
(a) PET scanning (b) CT scanning (c) NMR (d) Contrast X-ray

32. Ultrasound imaging is also known as

(a) EEG (b) ECG (c) Echography (d) MRI

33. Sonography uses inaudible high frequency sound waves in the range of

(a) 20-2000 hertz (b) 1-15 million hertz (c) 2000-2 million hertz (d) None of these

34. In ultrasound, waves are produced by

(a) X-rays (b) Piezoelectric effect (c) Magnetic waves (d) Sound effect

35. Ultrasound waves are produced when an electric potential is applied to crystals of

(a) Lithium halide (b) Lead zirconate (c) Lithium chloride (d) None of these

36. Ultrasound imaging is useful in diagnosing the disease of

(a) Brain (b) Gallstones (c) Cirrhosis (d) All of these

37. Which of the following is an implant

(a) Pacemaker (b) Medical laser (c) Oxygenator (d) PET scanning

38. Which of the following is used to normalize low level heart beats

(a) Vascular grafts (b) Intra-aortic balloon pump (c)Pacemaker (d) All of these

39. The heart of a healthy man beats normally per minute

(a) 85-90 times (b) 80-90 times (c) 70-80 times (d) 60-70 times

40. Role of pacemaker is to

(a) Increase heartbeat (b) Decrease heartbeat

(c) Initiate heartbeat (d) Control blood supply to heart

41. In case of artificial pacemaker, the electrode is inserted into

(a) Right ventricle (b) Right auricle (c) Left ventricle (d) Left auricle

42. Cardiac pacemaker was invented by

(a) Walton Lillehel (b) A. S. Hyman (c) Joseph Murrey (d) Christiaan Bernard

43. The implantable pacemakers were first introduced by

(a) Chardack (b) T. H. Maimah (c) Purcell (d) Einthoven

44. The electrode of a pacemaker comprises a fine metallic spring ensheathed in a thin layer of

(a) Plastic (b) Copper (c) Silver (d) Granite

45. The cell used in a pacemaker are those of

(a) Cadmium chloride (b) Lead (c) Lithium halide (d) Zirconium

46. Which of the following is used by surgeons as a "light knife"

(a) X-rays (b) Lasers (c) Gamma rays (d) All of these

47. Which of the following is not a type of laser

(a) Hydrogen laser (b) CO_2 laser (c) Neon laser (d) Argon laser

48. Which of the following devices is used to help the heart in pumping blood

(a) Artificial valves (b) Lasers

(c) Intra-aortic balloon pump (d) Pacemaker

49. Intra-aortic balloon pump is deflated during

(a) Diastole (b) Systole (c) Both of these (d) None of these

50. Intra-aortic balloon pump is inflated by

(a) Hydrogen (b) Oxygen (c) Helium (d) Chlorine

51. Artificial heart valves may be

(a) Mechanical (b) Made of human tissue (c) Made of animal tissue (d)Any of these

52. Which type of the following heart valves are generally damaged

(a) Tricuspid valve (b) Eustachian valve

(c) Bicuspid valve (d) Aortic semilunar valves

53. The employing of artificial arteries is termed

(a) Autograft (b) Allograft (c) Vascular graft (d) Xenograft

54. Artificial arteries are made of

(a) Rubber (b) Dacron (c) Teflon (d) Both (b) and (c)

55. The first open heart surgery was performed in

(a) 1945 (b) 1953 (c) 1967 (d) 1976

56. Oxygenator is used in the oxygenation of blood during

(a) Brain surgery (b) Kidney surgery

(c) Bypass surgery of heart (d)Open heart surgery

57. What is the percentage of carbon dioxide in the mixture of o_2 and co_2 used in oxygenators

(a) 15-20 (b) 10-15 (c) 5-10 (d) 2-5

58. Blood transfusion, if improperly carried out, can transmit serious diseases such as

(a) AIDS (b) Hepatitis B (c) Both (a) and (b) (d) None of these

59. Which of the following can be used as a blood substitute

(a) Haemoglobin dissolved in alcohol (b) Hydrocarbons

(c) Perfluorocarbons (d) Chlorofluorocarbons

60. Kidney dialysis machine was invented by

(a) Willem Kolff (b) Willem Einthoven (c) Willhelm Roentgen (d) Rene Laennac

61. Artificial kidney was invented in the year

(a) 1932 (b) 1945 (c) 1951 (d) 1955

62. An artificial kidney can do the

(a) Passive filtration process (b) Active filtration process

(c) Selective reabsorption (d) All of these

63. In what condition does a person require artificial kidney

(a) One kidney does not work properly (b) One kidney is completely damaged

(c) Both kidneys are damaged (d) All of these

64. Haemodialysis means

(a) A technique used to remove waste products from blood

(b) A method to increase the oxygen carrying capacity of blood

(c) A procedure to isolate defective RBCs (d) None of these

65. Who has designed Jaipur foot

(a) A. S. Hyman (b) P. K. Sethi (c) T. H. Maimah (d) H. Berger

66. Jaipur foot is made up of solid rubber and

(a) Aluminium (b) Plastics (c) Iron (d) Stainless steel

67. Scientists can pinpoint the location of colour processing perception centres in human visual cortex by

(a) PET scanning (b) NMR imaging (c) Ultra-sound imaging (d) CT scanning

68. Cross section image of internal body structure can be obtained by using this medical technique

(a) ECG- Electro Cardio Graph (b) EEC – Electro Encephalo Graph

(c) CAT – Computed Axial Tomography (d) PET- Positron emission Tomography

69. This technique uses the body's water molecules as the bases for its images

(a) MRI (b) Sonography (c) Thermography (d) Radio active traces

70. An X- ray of the lower abdomen shows a shadow in the region of the ureter suspected to be an ureteric calculus. A possible clinical symptom would be

(a) Motor aphasia (b) Anuria and haematuria

(c) Acute Renal Failure (ARF) (d) Chronic Renal Failure (CRF)

71. Which of the following diagnostic techniques uses X-rays

(a) PET (b) CT-scan (c) ECG (d) Sonography

72. In man artificial pace maker is implanted due to defects in

(a) SA- node (b) AV- node (c) Mitral valve (d) Purkinje fibres

73. The crystal of lead zirconate is a key component of

(a) Sonography (b) Electrocardiography

(c) Electroencephalography (d) Magnetoencephalography

74. The first open heart surgery was performed by

(a) Christiaan Barnard (b) Andreas Gruntzig (c) Willem Kolff (d) Walton Lillehel

75. Magnetic Resonance (MR) images are derived from the proton bearing species present principally from water and

(a) Long alkane chain protons of the fatty acid moieties

(b) Short alkane chain protons of the fatty acid moieties

(c) Long alkene chain protons of the fatty acid moieties

(d) Short alkene chain protons of the fatty acid moieties

76. Positron emission tomography (PET) is one of the best methods for functional imaging because

(a) Isotopes with long half –lives are used (b) Isotopes with short half –lives are used

(c) Positrons are directly involved used in imaging

(d)Isotopes of basic body elements are used for imaging

77. The cardiac pacemaker in a patient fails to function normally. The doctors find that an artificial pacemaker is to be grafted in him. It is likely that it will be grafted at the site of

(a) Purkinje system (b)Sinuatrial node

(c) Atrioventricular node (d)Atrioventricular bundle

ANSWER

ASSIGNMENT (BASIC LEVEL)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	b	c	c	d	a	d	c	a	d	d	a	c	b	b	d	c	a	c	d
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
d	b	c	a	a	a	a	a	d	b	c	c	b	b	b	d	a	c	c	c
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
a	b	a	a	c	b	a	c	b	c	d	d	c	d	b	d	d	c	c	a
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77			
b	a	c	a	b	a	a	c	a	b	b	a	a	d	c	d	b			

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