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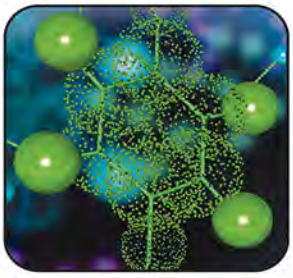

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QUESTIONS

Neurons & Types of Nerve Fibres

1. **Dorsal root ganglia have-** *(NBE P 13)*
   - A. Unipolar ☐
   - B. Multipolar ☐
   - C. Bipolar ☐
   - D. Pseudounipolar ☐
2. **Neurons in sympathetic ganglia are-** *(NBE P 13)*
   - A. Unipolar ☐
   - B. Bipolar ☐
   - C. Pseudounipolar ☐
   - D. Multipolar ☐
3. **In which type of nerve fibres is conduction blocked maximally by pressure OR If one of your nerves is compressed and this leads to paresthesia for sometime, the type of nerve fiber affected is probably OR Person wakes up with pain, parasthesia, tingling of the arms, he had slept with arm below the head. Which fibres are involved?:** *(NBE P 15,14,13; PGI 01, SGPGI 06)*
   - A. Aa ☐
   - B. Ab ☐
   - C. Ag ☐
   - D. C ☐
4. **A man slept with head over forearm, next morning he complains of tingling, numbness over forearm. It is caused by-** *(NBE P 13)*
   - A. Sensitivity to hypoxia is A>B>C ☐
   - B. Sensitivity to pressure is A>B>C ☐
   - C. Sensitivity to hypoxia is C>B>A ☐
   - D. Sensitivity to pressure is B>A>C ☐
5. **True about Nerve fibre 'C' is** *(TN 08, AP 01, UP 02)*
   - A. Most susceptible to Hypoxia *(BHU 03)* ☐
   - B. Unmyelinated ☐
   - C. Preganglionic autonomic ☐
   - D. Not for temp. & pain senses ☐
6. **Nociception from abdomen is transmitted by-**
   - A. A gamma *(NBE P 13)* ☐
   - B. Aα ☐
   - C. C fibres ☐
   - D. B ☐
7. **Burning pain is carried by which type of fibres-**
   - A. A alpha *(NBE P 13)* ☐
   - B. A delta ☐
   - C. A beta ☐
   - D. C ☐
8. **Maximum conduction occurs in which fibres**
   - A. B-fibres *(UP 09, Bihar 03, Delhi 04)* ☐
   - B. Aa fibre ☐
   - C. Sympathetic fibre ☐
   - D. C-fibre ☐
9. **Nerve Conduction is slowest in-** *(NBE P 13)*
   - A. C ☐
   - B. A alpha ☐
   - C. A beta ☐
   - D. A delta ☐
10. **Group B Nerve fibres are situated in:** *(AIIMS 02)*
    - A. Muscle spindles ☐
    - B. Fibres carrying pain sensation ☐
    - C. Preganglionic autonomic fibres ☐
    - D. Post ganglionic autonomic fibres. ☐
11. **In Intersegmental reflex, the afferents come from:**
    - A. Golgi tendon *(AIIMS 09)* ☐
    - B. Ia fibres ☐
    - C. IIb fibres ☐
    - D. Muscle spindles ☐
12. **Nerve fibers involved in proprioception:**
    - A. Type Aα fiber *(NBE P 15,14; PGI 15,13,08)* ☐
    - B. Type B fiber ☐
    - C. Type C fiber ☐
    - D. Type Aβ fiber ☐
13. **Most sensitive nerve fiber to hypoxia-** *(NBE P 13)*
    - A. A ☐
    - B. B ☐
    - C. C ☐
    - D. All are equally sensitive ☐
14. **Group A nerve fibers most susceptible to:**
    - A. Pressure *(AIIMS 05)* ☐
    - B. Hypoxia ☐
    - C. Local anesthetics ☐
    - D. Temperature ☐
15. **The afferent fibers which are most sensitive to local anesthetic belong to Group OR Post ganglionic sympathetic fibres are:** *(AIIMS 04; NBE P 15,13)*
    - A. A ☐
    - B. B ☐
    - C. C ☐
    - D. D ☐
16. **The correct order of susceptibility of the different types of nerve fibres to local anesthetics is:**
    - A. B > C > A *(AIIMS 08)* ☐
    - B. A > B > C ☐
    - C. C > A > B ☐
    - D. C > B > A ☐
17. **A gamma nerve diameter is-** *(NBE P 13)*
    - A. 13-20 ☐
    - B. 4-13 ☐
    - C. 3-6 ☐
    - D. 0.2-1.0 ☐
18. **Thickening of axon leads to-** *(NBE P 13)*
    - A. Increased speed of conduction ☐
    - B. Decreased speed of conduction ☐

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C. Increased absolute refractory period ☐
D. Unmyelination ☐

19. **Increased velocity of conduction in a nerve is favored by:** *(PGI 08)*
A. Increased capacitance ☐
B. Decreased capacitance ☐
C. Increased resistance ☐
D. Decreased resistance ☐
E. Increased velocity ☐

20. **Which of the following is an amineneuro-transmitter** *(AIIMS 03)*
A. Acetylcholine ☐
B. GABA ☐
C. Glutamate ☐
D. Epinephrine ☐

Muscle Spindle

21. **Which of the following is true regarding alpha and gamma motor neurons during initiation of voluntary movements?** *(AIIMS 15)*
A. Alpha motor neurons are activated first followed by gamma motor neurons ☐
B. Gamma motor neurons are activated first followed by alpha motor neurons ☐
C. Both are activated together ☐
D. Only alpha motor neurons get activated ☐

22. **The intrafusal fibers of the striated skeletal muscles are innervated by one of the following type of motor neurons. Choose the correct answer:** *(AIIMS 04)*
A. Alpha ☐
B. Beta ☐
C. Gamma ☐
D. Delta ☐

23. **You are testing knee jerk reflex in a patient. The afferents in deep tendon reflexes are carried by:**
A. Dynamic intrafusal fibers *(AIIMS 14)* ☐
B. Golgi tendon organ ☐
C. Nuclear bag and static chain fibers ☐
D. Both Golgi tendon and muscle spindle ☐

24. **Lowest most level of integration of stretch reflex is at**
A. Cerebral cortex ☐
B. Medulla ☐
C. Lower medulla ☐
D. Spinal cord ☐

25. **What is true regarding the gamma efferent neuron?**
A. An 'A' group *(Jipmer 05)* ☐
B. Motor neuron with a smaller diameter than that of alpha efferent neurons ☐
C. Innervates intrafusal fibres ☐
D. Innervates muscle fibres that stretch annulospiral endings ☐
E. All of the above ☐

26. **Muscle spindle is -** *(AI 2K)*
A. Receptor for a variety of multisynaptic reflexes ☐
B. Receptor for myotatic or stretch receptor reflex ☐
C. Occurs only in antigravity extensor muscles ☐
D. Excited by both stretch and contraction of the muscles in which it is located. ☐

27. **Find faulty statement regarding muscle spindle** *(SGPGI-02, Jipmer-01, UP-04, Bihar 05)*
A. Central zone has no active & myosin ☐
B. Peripheral zone has no actin & myosin ☐
C. Type 1 nuclear bag fibers has low myosin ATP ase activity ☐
D. Type 2 nuclear bag fiber has has high level of myosin ATPase activity ☐

28. **Contractile part of intrafusal fiber**
A. Ends *(WB-01, Assam-03)* ☐
B. Center *(SGPGI 09, UP-03)* ☐
C. Both ☐
D. None ☐

29. **Find false statement regarding sensory endings**
A. Flower spray is secondary *(Jhar-04, Jipmer 08)* ☐
B. Primary ending is annulospiral ☐
C. Primary ending conduct Ia fibers ☐
D. Annulospiral wrap the ends ☐

30. **Central wraping is done by** *(PGI 08, DNB 12)*
A. Flower spray endings ☐
B. Annulospiral ending ☐
C. Golgitendon ☐
D. Type II fiber ☐

31. **Dynamic response is due to**
A. Primary ending *(AMU-04, WB-03, UP-06)* ☐
B. Secondary ending ☐
C. Tertiary ending ☐
D. All ☐

32. **True is all except regarding intrafusal fibers** *(UP-01)*
A. Nuclear chain fibers are shorter & thinner ☐
B. Nuclear bag fibers are lesser *(PGI 06, WB 09)* ☐
C. Primary endings excited by bag fibers only ☐
D. Secondary endings excited by chain fibers only ☐

33. **Group II sensory fibers are attached to**
A. Annulospiral ending *(AIIMS 04)* ☐
B. Flower spray ending ☐
C. Golgi tendon ☐
D. Pacinian corpsucle ☐

34. **Plate endings are feature of** *(PGI 14,12, SGPGI-03)*
A. Nuclear chain fibers *(NBE P 14, 13; UP 05)* ☐
B. Nuclear bag fibers ☐
C. Extrafusal ☐
D. Golgi tendon ☐

35. **Leksell efferents go to** *(Bihar 03, MP 04)*
A. Interneurons ☐
B. Golgi bottle cells ☐
C. Golgi tendon organ ☐
D. Spindle ☐

36. **Nuclear bag fibres are related to:** *(AIIMS 14)*
A. Force ☐
B. Length ☐
C. Tone ☐
D. Length and velocity ☐

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37. **Muscle spindle (stretch reflex) detects:**
   A. Tension *(AIIMS 09,15,13; NBE P 15,14)* ☐
   B. Length ☐
   C. Proprioception ☐
   D. Stretch Length ☐

Golgi Tendon

38. **In stretch reflex, the stimulus is-** *(NBE P 13)*
   A. Change in muscle length ☐
   B. Change in muscle tension ☐
   C. Pain in muscle ☐
   D. Cessation of blood supply ☐
39. **Golgi tendon organs detect** *(AIIMS 08,15,13,14)*
   A. Static muscle length *(NBE P 15,14,13)* ☐
   B. Dynamic muscle length ☐
   C. Muscle tension ☐
   D. Muscle action ☐
40. **Regarding Golgi tendon organ true is** *(AIIMS 11, 06)*
   A. Senses dynamic length of muscle ☐
   B. Involved in reciprocal innervation ☐
   C. α-motor neuron stimulation ☐
   D. Senses muscle tension ☐
41. **True statement about golgi tendon organ is**
   A. High threshold *(PGI 08, WB-03, KA-05)* ☐
   B. Dynamic response only ☐
   C. Detects length change ☐
   D. 3-25 muscle fibers. ☐
42. **Number of golgi tendon organs per 100 muscle fibres-** *(NBE P 13)*
   A. 1-20 ☐
   B. 200-400 ☐
   C. 50-60 ☐
   D. 80-100 ☐
43. **Golgi tendon organ true is A/E** *(Jipmer 04, TN 05)*
   A. Static & dynamic response *(Assam-06)* ☐
   B. Activated by both stretch and contraction of muscle ☐
   C. Responsible for stretch reflex ☐
   D. Transmit to Ib fibers. ☐
44. **Tendon organ , correct is A/E** *(Raj 05)*
   A. Ramified nobby nerve endings ☐
   B. Regulates tension *(SGPGI 06, Andhra 04)* ☐
   C. Weak stretch activates inverse stretch reflex ☐
   D. Myelinated Ib fibers ☐
45. **Autogenic inhibition is function of** *(PGI 02)*
   A. Intrafusal fiber *(AIIMS-03, UP 05)* ☐
   B. Extrafusal fiber ☐
   C. Golgi tendon organ ☐
   D. Muscle spindle ☐
46. **Crossed extensor reflex is a -** *(AIIMS 02, JIPMER 09)*
   A. Withdrawal reflex ☐
   B. Postural reflex ☐
   C. Monosynaptic reflex ☐
   D. Sympathetic ☐

Nerve Injury

47. **Most susceptible tissue to hypoxia-**
   A. Muscle *(NBE P 15,14; AIIMS 15,13)* ☐
   B. Neurons ☐
   C. Hepatocytes ☐
   D. Myocytes ☐
48. **Neuronal degeneration is seen in all of the following *except* OR Best prognosis in nerve injury:** *(AI 05; NBE P 15,14)*
   A. Crush nerve injury & Neurotemesis ☐
   B. Axontemesis ☐
   C. Senescence. ☐
   D. Neuropraxia. ☐
49. **Axonotmesis includes discontinuity in:** *(NBE P 14)*
   A. Perineurium *(PGI 06)* ☐
   B. Epineurium ☐
   C. Endoneurium ☐
   D. Axon & Myelin sheath ☐
50. **Motor march is seen in-** *(NBE P 13)*
   A. Axontemesis ☐
   B. Neurotemesis ☐
   C. Neuropraxia ☐
   D. Nerve regeneration ☐
51. **Difference between neuropraxia and neuronotomesis is:** *(PGI 10)*
   A. EMG finding ☐
   B. Sensory loss ☐
   C. Motor loss ☐
   D. Nerve conduction studies in distal fragment ☐
   E. Axon integrity ☐
52. **First change observed in distal part, of a cut nerve is:** *(AI 04; AIIMS 02)*
   A. Axonal degeneration f/b myelin degeneration ☐
   B. Chromatolysis ☐
   C. Degeneration of neurilema ☐
   D. Schawn cells proliferation & Sprouting ☐

Nerve Conduction & N.M. Junction

53. **If a supramaximal stimulus is applied to an excitable tissue like a nerve or a muscle and it elicits a response, then the tissue is said to be in:**
   A. Absolute refractory period *(NBE P 13)* ☐
   B. Relative refractory period ☐
   C. Latent period ☐
   D. After-depolarization ☐
54. **If a supramaximal stimulus is applied to an excitable tissue like a nerve or a muscle and it elicits a response, then the tissue is said to be in:**
   A. Absolute refractory period *(NBE P 13)* ☐
   B. Relative refractory period *(AIIMS 14)* ☐
   C. Latent period ☐
   D. After-depolarization ☐
55. **Action potential is generated in excitable cells. These cells are:** *(PGI 11)*
   A. Nerves ☐

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B. Muscle ☐
C. Glands ☐
D. Contractile tissue ☐
E. Neuroglial cells ☐

56. **"Nerve terminals release chemicals was discovered by:** *(PGI 10)*
A. Dale ☐
B. Withering ☐
C. Domagk ☐
D. Langley ☐
E. Loewi ☐

57. **Na+ channel concentration is highest at-** *(NBE P 13)*
A. Dendrites ☐
B. Soma ☐
C. Axon hillock ☐
D. Axon ☐

58. **True regarding Na+ ion-** *(NBE P 13)*
A. Responsible for Donnan effect ☐
B. Responsible for Resting membrane potential ☐
C. Responsible for Depolarization ☐
D. Does not help other ions in transport ☐

59. **Initiation of nerve impulse occurs at the axon hillock because :** *(AI 04, 02)*
A. It has a lower threshold than the rest of axon ☐
B. It is unmyelinated ☐
C. Neurotransmitter release occurs here ☐
D. None of the above ☐

60. **Nerve depolarization is due to-** *(NBE P 13)*
A. Opening of sodium channels ☐
B. Opening of chloride channels ☐
C. Opening of potassium channels ☐
D. Opening of calcium channels ☐

61. **Which is TRUE regarding nerve conduction:**
A. All or none phenomenon *(AIIMS 04)* ☐
B. Conduction independent of amplitude ☐
C. Propagated action potential is generated in dendrites ☐
D. Faster in unmyelinated fibres ☐

62. **Action potential is:** *(Raj 09, AMU 04, MAHE 02)*
A. Decremental phenomenon ☐
B. Doesn't obey all or none phenomenon ☐
C. K+ goes from ECF to ICF ☐
D. Threshold stimulus is required ☐

63. **Which ion causes repolarization –** *(NBE P 13)*
A. Magnesium ☐
B. Calcium ☐
C. Potassium ☐
D. Sodium ☐

64. **Resting membrane potential of neuron is close to the isoelectrical (equilibrium) potential of -**
A. Na *(NBE P 14; (AIIMS 08)* ☐
B. CI ☐
C. K+ ☐
D. Mg ++ ☐

65. **Most diffusable ion in excitable tissue is :**
A. Na^+ *(AI 08)* ☐
B. K^+ ☐
C. PO_4^- ☐
D. Cl^- ☐

66. **Excitable tissue at rest is least permeable to:**
A. Na^+ *(AI 06, AIIMS 13)* ☐
B. K^+ ☐
C. Ca^{++} ☐
D. Cl^- ☐

67. **Resting membrane potential in nerve fibre**
A. Is equal to the potential of ventricular muscle fibre *(UP 2K, SGPGI 04)* ☐
B. Can be measured by surface electrodes ☐
C. Increases as extra cellular K+ increases ☐
D. Depends upon K+ equilibrium ☐

68. **A travelling nerve impulse does not depolarize the area immediately behind it, because :** *(AIIMS 02)*
A. It is hyperpolarized ☐
B. It is refractory ☐
C. It is not self propagating ☐
D. The condition is always orthodromic ☐

69. **True about nerve impulse is:** *(AIIMS 94)*
A. Travels in one direction along axon ☐
B. If current is increased too slow nerve respond fast ☐
C. Travels in one direction at synapse ☐
D. Travels with the speed of electric current ☐

70. **Unidirectional flow of a nerve impulse is at:**
A. Synapse *(AI 06)* ☐
B. Axon ☐
C. Dendrites ☐
D. All of the above ☐

71. **Orthodromic conduction is** *(AMU 04, SGPGI 04;(NBE P 15,14,13; AIIMS 14)*
A. An axon can conduct impulse in one direction only ☐
B. An axon can conduct impulse in both direction ☐
C. The jumping of depolarization from node to node ☐
D. The point at which a runaway spike potential ☐

72. **Synaptic conduction is mostly orthodromic because:**
A. Dendrities cannot be depolarized *(AI 03)* ☐
B. Once repolarized, an area cannot be depolarized ☐
C. The strength of antidromic impulse is less ☐
D. Chemical mediator is localised only in the presynaptic terminal. ☐

73. **Function of Dendrites:** *(PGI 03, 12)*
A. It generates the action potential ☐
B. Wave activity in E.E.G. ☐
C. $\downarrow_{ed}$ Retrograde firing ☐
D. $\uparrow_{ed}$ Retrograde firing ☐
E. Involved in memory ☐

74. **In a neuron, graded electrogenesis occurs at-**
A. Soma-dendritic zone *(NBE P 13)* ☐
B. Initial segment ☐
C. Axon ☐
D. Nerve ending ☐

75. **Most permeable to pure phospholipid bi layer is-**
A. Oxygen *(NBE P 13)* ☐

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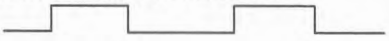
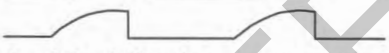
B. Na ☐
C. Cl ☐
D. Water ☐

76. True about Nissl granule: *(PGI 10, 14)*
A. Involves in RNA synthesis ☐
B. Present in axon ☐
C. Present in dendrite ☐
D. Involves in protein synthesis ☐
E. Structurally they are endoplasmic reticulum ☐

77. Node of Ranvier is seen in- *(NBE P 13)*
A. Cell body ☐
B. Dendrites ☐
C. Axons ☐
D. Terminal butons ☐

78. Which of the following statements is true for excitatory postsynaptic potentials (EPSP): *(AI 03)*
A. Are self propagating ☐
B. Show all or none response ☐
C. Are proportional to the amount of transmitter released by the presynaptic neuron ☐
D. Are inhibitory at presynaptic terminal ☐

79. Simulation of post ganglion sympathetic neurons leads to: *(PGI 02)*
A. Fast EPSP ☐
B. Slow EPSP ☐
C. Fast IPSP ☐
D. Slow IPSP ☐
E. Very slow EPSP ☐

80. Equal strength stimulus of which type is least likely to produce a nerve stimulation: *(AIIMS 02)*
A.  ☐
B.  ☐
C.  ☐
D.  ☐

81. Which of the following statements is true about presynaptic inhibition? *(AIIMS 08)*
A. It results due to failure of the action potential to reach the synapse. ☐
B. It occurs due to hyperpolarisation of presynaptic membrane. ☐
C. It occurs due to inhibition of release of neurotransmitter from presynaptic terminal. ☐
D. It occurs due to blockade of neurotransmitter receptors ☐

82. Regarding presynaptic inhibition which of the following combination is true: *(AIIMS 01)*
a) Affected by axo-axonic transmission.
b) Not affected by pharmacologic agent
c) Prolonged by anaesthetic agents
d) Not prolonged by strychnine.
e) Inhibited by picrotoxin
f) It will increase EPSP
A. a, c and f are true. ☐
B. a, d, e are true. ☐
C. d, c and b are true. ☐
D. a, d and b are true. ☐

83. TRUE about Renshaw cell inhibition is:
A. Add on collateral sensation *(AIIMS 2K)* ☐
B. Increases by local anaesthetics. ☐
C. Has memory for spinal cord. ☐
D. Inhibition of feedback propogation. ☐

84. Renshaw inhibition- *(NBE P 13)*
A. Feedback facilitation ☐
B. Feedforward inhibhition ☐
C. Feedforward facilitation ☐
D. Feedback inhibhition ☐

85. Presynaptic facilitation is caused by- *(NBE P 13)*
A. Prolonged opening of calcium channels ☐
B. Prolonged opening of chloride channels ☐
C. Prolonged opening of sodium channels ☐
D. Prolonged closure of potassium channels ☐

86. Synaptic potentials can be recorded by: *(AIIMS 05)*
A. Patch clamp technique ☐
B. Voltage clamp technique ☐
C. Microelectrode ☐
D. EEG ☐

87. Type principle that is the spinal cord dorsal roots are sensory and the ventral roots are motor is known as– *(NBE P 13)*
A. Laplace's law ☐
B. Bell-Magendle's law ☐
C. Frank Starling's law ☐
D. Weber-Fechner's law ☐

88. Phantom limb sensations are best described by:
A. Weber Fechner law *(AIIMS 05)* ☐
B. Power law ☐
C. Bell-Magendie law ☐
D. Law of projection ☐

89. Weber Fechner law is related with : *(AI 03)*
A. Amplitude ☐
B. Surface area ☐
C. Number of sensory fibre involvement ☐
D. Stimulus discrimination ☐

90. Weber fechner law is: *(AIIMS 08)*
A. Magnitude of stimulus strength perceived is approximately proportionate to the log of the intensity of stimulus strength ☐
B. Magnitude of stimulus strength perceived is directly proportional to the intensity of stimulus strength ☐
C. Threshold of receptor is directly proportional to stimulus strength ☐
D. Threshold of receptor is inversely proportional to stimulus strength ☐

91. Intensity of sensory stimulation is directly related to: *(AIIMS 02)*
A. Duration of action potential (AP) ☐
B. Frequency of AP ☐
C. Amplitude of AP ☐
D. All of the above. ☐

92. Spontaneous release of acetylcholine at the neuro-muscular junction produces: *(AI 05)*

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A. Miniature end-plate potential ☐
B. Action potential ☐
C. Post-tetanic potential ☐
D. Resting membrane potential ☐

Neuromuscular Junction

93. A short duration high frequency stimulation with 5 Hz of perforating substance pathway in hippocampus leads to: *(AIIMS 14)*
A. Long term potentiation ☐
B. Post tetanic potentiation ☐
C. Long term depression ☐
D. Habituation ☐

94. Release of synaptic vesicles from the presynaptic terminals is inhibited by? *(AIIMS 13)*
A. Preventing depolarization of nerve terminal ☐
B. Inhibition of conduction of nerve implse ☐
C. Prevention of Ca^{2+} influx ☐
D. Prevention of Na^{+} influx ☐

95. Contraction of muscle can be caused by- *(NBE P 13)*
A. Release of noradrenaline ☐
B. Release of acetylcholine ☐
C. Release of serotonin ☐
D. Release of histamine ☐

96. Which of the following events happens when a nerve impulse arrives at the Neuromuscular Junction: *(AI 12)*
A. Release of Calcium from the Sarcoplasmic Reticulum ☐
B. Acetylcholine binds to receptors on the postsynaptic sarcolemmal membrane ☐
C. Initiation of formation of cross bridges to allow muscle contraction ☐
D. Efflux of calcium through synaptic vesicles into the synaptic cleft ☐

97. Skeletal muscle contraction ends when- *(NBE P 13)*
A. Ions move out of cytoplasm ☐
B. Ach is absorbed from the NMJ ☐
C. Closure and indrawing of receptors ☐
D. Decreased calcium outside reticulum ☐

98. Myasthenia gravis is a disorder of: *(AI 05)*
A. Motor neuron ☐
B. Neuromuscular junction ☐
C. Peripheral nerve ☐
D. Spinal cord ☐

Muscle Contraction

99. Sarcomere extends between- *(NBE P 13)*
A. A band & I band ☐
B. Two Z lines ☐
C. Two I bands ☐
D. None ☐

100. In the following electron micrograph of the sarcomere, correctly identify the area labeled as "E".



A. band *(AIIMS 16)* ☐
B. I-band ☐
C. M-band ☐
D. H-zone ☐

101. Thin filament consists of all except- *(NBE P 13)*
A. Actin ☐
B. Troponin ☐
C. Myosin ☐
D. Tropomyosin ☐

102. Which of the following is not a Sarcolemmal Proteins? *(AI 08)*
A. Sarcoglycan ☐
B. Dystrophin ☐
C. Dystroglycan ☐
D. Perlecan ☐

103. Myosin filament has a fixed length of- *(NBE P 13)*
A. 0.16nm ☐
B. 1.6 microm ☐
C. 16nm ☐
D. .6mm ☐

104. The band which disappears on muscular contraction is *(AIIMS 14, PGI 15)*
A. A ☐
B. H ☐
C. I ☐
D. M or CM ☐

105. In Muscle contraction all are true except
A. A bond remains unchanged *[PGI 14,03]* ☐
B. H zone disappears ☐
C. I band becomes wider ☐
D. Two Z lines come closer ☐

106. Which protein prevents contraction by covering binding sites on actin and myosin : *(AI 08, NBE P 14)*
A. Troponin ☐
B. Calmodulin ☐
C. Thymosin ☐
D. Tropomyosin ☐

107. Tropomyosin: *(AI 02)*
A. Helps in the fusion of actin and myosin ☐
B. Covers myosin & prevents attachments of actin & myosin ☐
C. Slides over myosin ☐
D. Causes Ca^{2+} release ☐

108. The site where myosin heads bind to actin in skeletal muscles are covered by OR Actin's active site are covered by: *(AI 08; NBE P 15,13; AIIMS 15)*
A. Tropomyosin ☐
B. Troponin ☐
C. Calcium ☐
D. None of the above ☐

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109. All of the following are true about excitation contraction coupling except: *(AIIMS 13)*
- A. Accetylcholine is released at the nerve terminal ☐
- B. Calcium is pumped back into the sacroplasmic reticulum during relaxation ☐
- C. Calcium is released from sacroplasmic reticulum during contraction ☐
- D. Calcium binds to tropomyosin to initiate muscle contraction ☐

110. Which of the following triggers muscle contraction
- A. Ca binding tropomyosin *(AIIMS 15,13; AI 08)* ☐
- B. Ca binding troponin C ☐
- C. ATP breakdown ☐
- D. Ca binding troponin I ☐

111. Type I muscle fibers are- *(NBE P 13)*
- A. Red ☐
- B. Anerobic ☐
- C. Large ☐
- D. Glycolytic ☐

112. Features of slow twinching muscle is/are *(PGI 11)*
- A. Contain large amounts of myoglubin ☐
- B. Composed of smaller fibers ☐
- C. Contain larger amount of glycolytic enzyme ☐
- D. White in colour ☐
- E. It has high ATPase activity ☐

113. The properties of fast twitch muscle are: *(PGI 11,13)*
- A. Extensive sarcoplasmic reticulum ☐
- B. Extensive blood supply ☐
- C. Large glycolytic pathway ☐
- D. Abundant mitochondria ☐
- E. Made up of large so of small fibers with some long fibre muscles ☐

114. Fast fatigue fibres are recruited during walking:
- A. In the beginning *(AIIMS 14)* ☐
- B. In the end ☐
- C. Throughout the walking process ☐
- D. When small neurons are excited ☐

115. True for smooth muscle contraction is A/E *(PGI 09)*
- A. Latch bridge are less cycle less ATP bridges ☐
- B. Dephosphorylation causes definite relaxation ☐
- C. LC phosphatase is essential for binding ☐
- D. Slow & prolonged contractile response independent of nerve supply ☐
- E. Length tension relationship does not exist ☐

116. Increase in cytosolic calcium from intracellular storage, during smooth muscle contraction is/are due to: *(PGI 08)*
- A. CAMP ☐
- B. CGMP ☐
- C. CCMP ☐
- D. IP3- DAG ☐
- E. Ca $^{2+}$ channel ☐

117. Action of calmodulin is: *(PGI 02)*
- A. Ca^{2+} dependent ☐
- B. Through calmodulin dependent kinases ☐
- C. Through CAMP dependent kinases ☐
- D. Through CGMP dependent kinases ☐

118. The difference between skeletal an smooth muscle contraction and relaxation is/are:
- A. Troponin (+ve) *(NBE P 15,13;PGI 06)* ☐
- B. Myosin light chain kinase ☐
- C. Ca^{2+} ☐
- D. Actin & Myosin ☐

119. True regarding excitation contraction coupling in smooth muscles is : *(AIIMS 02)*
- A. Presence of troponin is essential ☐
- B. Sustained contraction occurs with high calcium concentration ☐
- C. Phosphorylation of actin is required for contraction ☐
- D. Presence of cellular calcium is essential to cause muscle contraction ☐

120. The force of muscle contraction can be increased by all of the following except : *(AI 04)*
- A. Increasing the frequency of activation of motor units ☐
- B. Increasing the number of motor units activated ☐
- C. Increasing the amplitude of action potentials in the motor neurons ☐
- D. Recruiting larger motor units ☐

121. Twitch of a single motor unit is called : *(AI 06)*
- A. Myoclonic-jerk ☐
- B. Fasciculation ☐
- C. Tremor ☐
- D. Chorea ☐

122. Tetanic contraction is due to accumulation of –
- A. Na^{+} *(NBE P 13)* ☐
- B. Ca^{+2} ☐
- C. K^{+} ☐
- D. Cl^{-} ☐

123. There is mutation of gene coding for the ryanodine receptors in malignant hyperthermia. Which of the following statements best explains the increased heat production in malignant hyperthermia?
- A. Increased muscle metabolism by excess of Ca ions *(AIIMS 05)* ☐
- B. Thermic effect of blood ☐
- C. Increased sympathetic discharge ☐
- D. Mitochondria thermogenesis ☐

124. When the tension in a muscle fibre is maximum, its length is called as- *(NBE P 13)*
- A. Equlibrium length ☐
- B. Optimum length ☐
- C. Initial length ☐
- D. None ☐

125. Considering the latent period of a muscle twitch to be 10 ms, contraction time 40 ms and relaxation time 50 ms, what will be the tetanizing frequency for this muscle? *(AIIMS 15)*
- A. 25 Hz ☐
- B. 50 Hz ☐
- C. 100 Hz ☐
- D. 75 Hz ☐

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ANSWERS AND EXPLANATIONS:

Neurons & Types of Nerve Fibres

1. D i.e. Pseudounipolar 2. D i.e. Multipolar *[Ref: BRS Anatomy p 18]*

Unipolar Neurons	Pseudounipolar N	Bipolar N	Multipolar Neuron
Invertebrates	**Dorsal root ganglion**Q	**Bipolar cells (retina)**	**Purkinje** (cerebellar) cells **pyramidal cells** of hyppocampus, **sympathetic ganglion & chain, motor neuron** Mn="PMS"

3. B i.e. Ab 4. B i.e. i.e. Sensitivity to pressure is A>B>C 5. B i.e. Unmyelinated 6. C i.e. C fibres
7. D i.e. C 8. B i.e. Aa fibre 9. A i.e. C 10. C i.e. Preganglionic autonomic fibres
11. D i.e. Muscle spindle 12. A i.e. Aα fibers 13. B i.e. B 14. A i.e. Pressure
15. C i.e. 'C' 16. D i.e. C > B > A 17. C i.e. 3-6 *[Ref: Ganong 24/e p. 92-94; Berbe 6/e p. 77; Guyton 12 SAE p. 73]*

- *A (Aα, Aβ, Aγ, Aδ) and B* fibers are *myelinated* but *C fibers are unmyelinated.*
- **Fiber diameter and hence conduction velocity** in decreasing order is ***A (Aα > Aβ > Aγ) > B > C.***
- Relative **decreasing order of susceptibility of nerve fibers to conduction block** produced by various agents is: **pressure (ABC = A > B > C); hypoxia (BAC = B > A > C);** and **local anesthetics (CBA = C > B > A).** That means **A fibers are most susceptible to pressure, B to hypoxia and C to LA.**
- **Pressure on a nerve** (eg Saturday night or Sunday morning palsy) can cause loss of conduction in **large diameter motor (Aα), touch and pressure (Aβ) fibers**Q while pain sensation (Aδ) remains relatively intact.
- **Type Aα fibers** are involved in **proprioception**Q; group **B** are ***preganglionic autonomic***Q and **group C** are **post ganglionic autonomic** (sympathetic) & dorsal root fibersQ. **Visceral pain (nociception) e.g. from abdomen is carried by c fibers**Q.
- **Thermo receptors** for cold are **A delta (Aδ) fibers for hot (heat/warmth/burn)** are on **C fibers**Q. **Visceral pain (nociception) eg from abdomen is carried by C fibers.**

- **Thermoreceptors** for cold are **A delta (Aδ) fibers** and for **hot (heat/warmth/burn)** are on **C fibers**Q.

Mammalian Nerve Fibers: Types & Function

Numerical (N) & Erlanger – Gasser (EG) Fiber Type Classification of Sensory Neurons

N Type	EG Type	Origin	Function	Myelinated	Fiber Diameter (μm)	Velocity (m/s)	Spike Duration (ms)	Absolute Refractory period
Ia	A α	*Annulospiral ending of muscle spindle*Q (primary muscle spindle receptor a/w extrafusal muscle fiber)	**Proprioception, somatic motor**	**Yes**	12-20	70-120		
Ib	A α	*Golgi-tendon organ*Q						
II	A β	- *Flower spray ending of muscle spindle*Q *(Secondary muscle spindle receptor)* - Fibers from most cutaneous **mechano receptor** (i.e. **discrete cutaneous tactile,** receptor)	**Touch, pressure,** motor	**Yes**	5-12	30-70	0. 4-0.5	0.4-1

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III	A δ	Nociceptors of **neospinothalamic tract, cold thermoreceptor**, free nerve endings of crude touch & pressure (skin mechanoreceptors)	**Pricking pain, cold (temperature), crude touch**	**Thin**	2-5	12-30		
IV	**C (dorsal root)**	**Nociceptors** of **paleospinothalamic tract, warmth** receptor	**Slow pain, temperature (hot)**, crude touch, itch & tickle	**Unmyeli-nated**	0.4-1.2	0.5-2	2	2

Classification of Motor Fibers (Neurons)

Motor type	EG type							
α	A α	*Annulospiral ending of muscle spindle*Q (**primary receptor a/w extrafusal muscle fiber**)	**Proprioception, somatic motor**	**Yes**	12-20	70-120		
γ	A γ	Associated with **intrafusal muscle fiber**	**Motor to muscle spindle**	**Yes**	**3-6**Q	15-30		

Classification of Autonomic (Motor) Neurons

Preganglionic	**B**	*Preganglionic autonomic*Q	**Yes**	*<3*	*3-15*	*1.2*	*1.2*
Post ganglionic	**C**	*Postganglionic sympathetic*Q	**No**	0.3-1.3	0.7-2.3	2	2

☆ Features

- Greater the diameter of a given nerve fibre, ***greater is the speed of conduction***Q. **Diameter** & hence the **velocity of conduction** in decreasing order is

  Aα > Aβ > Aγ > Aδ > B > C
- Large axons are primarily concerned with:
  - Proprioceptive sensation
  - Somatic motor function
  - Conscious touch & pressure
- Small axons are primarily concerned with
  - Pain
  - Temperature
  - Autonomic function
- Refractory period & spike duration

  Minimum – Aα

  Maximum – C fibres

Relative susceptibility of mammalian A, B and C nerve fibres to conduction block produced by various agents:

Suscepti-bility to	Most Susceptible	Inter-mediate	Least Susceptible
Hypoxia	B	A	C
Pressure	A	B	C
Local anesthetics	C	B	A

- Touch is carried by — AB, Aδ
- Pain by — **Aδ**, **C** fibres **[PA DC]**
- **A (A_α, A_β, A_γ A_δ) and B** fibers are **myelinated** but **C fibers are unmyelinated.**

18. A i.e. Increased speed of conduction **19. A & D i.e. Increased capacitance & decreased resistance**

[Ref: Gabriel C Ezeilo p. 33; Mathews- cellular physiology of nerve and muscle 4/ed pg-50; Ganong 23rd/e p.89-83]

Velocity of conduction in a nerve is increased by ***myelination, increase in diameter (thick nerve) and capacitance and decrease in resistance***Q.

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Factors Affecting Nerve Conduction Velocity

Fiber Diameter

Ability of an action potential to spread is proportional to amount of cytosol.

Small diameter fibers **have less cytosol (& more membrane)** which means **less capacitance** (and **more resistance**) causing **slower** conduction velocity

Large diameter fiber offers **lesser resistance and higher capacitance** through its **thick axoplasmic core** and so the conduction velocity is **faster.**

Degree of Myelination

- Nerve conduction velocity is directly proportional to *degree of myelination*
- Degree of myelination and so the conduction velocity decrease from A (α β γ δ) to B to C (eg Aα fibers are heavily myelinated where C fibers are unmyelinated)

20. **D i.e. Epinephrine** *[Ref: Ganong 24/e p. 136-53; Berne 6/e p. 95-103]*

Histamine, epinephrine, norepinephrine, serotonin and dopamine are **biogenic mono-amine neurotransmitters. (Mn" HENS do are monoamine NTs").**

Muscle Spindle

21. **C i.e. Both are activated together** 22. **C i.e. Gamma** *[Ref: Ganong 24/ep 232, Guyton 13/ep 694]*

- **The main motor** supply **of intrafusal fibres is *Y* (gamma) neurons.**Q ***Y*** motor neuron exclusively supply intrafusal fibresQ. Intrafusal fibres are also supplied by β fibres. β fibres also supply the extrafusal fibres [β for both]. **The main motor supply of extrafusal fibres are α neurons.**

- **During initiation of voluntary movements,** in response to descending excitatory inputs to spinal motor circuits i.e. whenever signals are transmitted from motor cortex etc, **both gamma (γ) and alpha (α) motor neurons are stimulated simultaneously. This co activation effect of α and γ neurons causes simultaneous contraction of both extrafusal skeletal muscle fibers and intrafusal muscle spindle fibers**Q

23. **A i.e. Dynamic intrafusal fibers**

Afferent in deep tendon reflex (eg knee jerk) is carried by **dynamic intrafusal fibers (nuclear bag fibers type 1)**Q.

24. **D i.e. Spinal cord** 25. **E i.e. All** 26. **B i.e. Receptor for stretch receptor reflex**
27. **B i.e. Peripheral zone has no action & myosin** 28. **A i.e. Ends** 29. **D i.e. Annulospiral wrap the ends**
30. **B i.e. Anulospiral ending** 31. **A i.e. Primary ending** 32. **C i.e. Primary endings excited by bag fibers only**
33. **B i.e. Flower spray ending** 34. **B i.e. Nuclear bag fibers** 35. **D i.e. Spindle**
36. **D i.e. Length and velocity**
37. **B i.e. Length** *[Ref: Guyton 12/SAE p.686,770-72; Ganong 24/e p. 229-33]*

Golgi tendon organ function as a transducer in feedback circuit that regulate ***muscle force (or tension)***Q in a fashion analogus to the **muscle spindle (dynamic nuclear bag fibers)** feed back circuit that regulates ***muscle length and velocity***Q. Mn – "T for T & L for L"

Muscle Spindle

Each muscle spindle is 3-10mm long structure consisting of 3 elements (1) tiny **intrafusal muscle fibers =ifmf** (3-12 in number) with *contractile polar ends and noncontractile center;* (2) large diameter myelinated **type Ia and II afferent nerves** originating in *the central portion of* ifmf and (3) small diameter myelinated **γ motor efferent nerves** supplying the *polar contractile region of ifmf.* Muscle spindle is a sense organ which sends information about **muscle length**Q and **rate of change of length** (i.e. **speed of movement**Q. Because the change in muscle length is associated with **change in joint angle,** therefore muscle spindle also provide information on **joint position (proprioception).** Muscle spindle acts through **monosynaptic muscle stretch (myotatic) reflex**Q.

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Intrafusal Muscle Fibers (IFMF)

- *Central (mid) part of fibers has few or no actin & myosin filaments, so the ends of intrafusal fibers are contractile whereas central portions are not*Q. It's central portion functions as sensory receptor.
- IFMFs **lie parallel to** regular contractile units of muscle ie *extrafusal fibers* attached to its tendons. But it *does not contribute to the overall contractile force of muscle.* Two types of intrafusal fibers are

Nuclear bag fibers

- Several nuclei are *congregated in expanded central bag.* Typically 2 (1-3) bag fibers occurs per spindle.
- There are 2 subtypes of nuclear bag fibers: static and dynamic. ***Nuclear bag fiber 1 with low level of myosin ATPase activity and nuclear bag fiber 2 with high level of myosin ATPase activity***Q.

Nuclear chain fibers

- ***Shorter & thinner***Q (about half) as compared to bag fibers and lacks a definite bag. Nuclei are arranged in a chain throughout receptor area.
- 3-9 fibers per spindle

Afferent (Sensory) Nerve Endings

- Central sensory receptor portion of muscle spindle is stimulated by stretching of midportion either by lengthening of whole muscle or even by contraction of end portion of intrafusal fibers.
- Two type of **sensory nerve endings are**

Group Ia: Primary (Annulospiral) Endings

- Are terminations of rapidly conducting (70-120 m/s) 17μ diameter ***group Ia afferent fibers***Q***. It wraps (encircles) the central position of nuclear bag (dynamic and static) & nuclear chain fibers***Q.
- So **annulospiral endings are innervated (excited) by both nuclear bag (dynamic & static) and nuclear chain fibers.**
- Ia fibers are very sensitive to **velocity (speed) of change in muscle length** during stretch **(dynamic response).**
- When the length of spindle receptor increases suddenly (i.e., **dynamic response to rate of change of receptor length),** ***only primary endings are stimulated***Q

Group II: Secondary (Flower spray) Endings

- Are terminations of ***group II sensory fibers***Q (8μ diameter)
- May encircle fiber but usually it spreads like *branches on a bush.*
- ***Located near the ends but only on nuclear chain fibers***Q ***&static nuclear bag fibers. These do not innervate dynamic nuclear bag fibers***Q.
- ***There are upto 8 group II secondary endings in each muscle spindle.***
- Static response **d/t slow stretching of muscle spindle stimulate** ***both primary & secondary ending***Q

Efferent (Motor) Nerves

- **Main motor supply of muscle spindle** is through 3-6μ diameter ***gamma motor neuron (type A- γ motor fibers)***Q. Because of their characteristic smaller size they are called **γ-efferent of LeKell or small motor nerve system.** It has 2 histological types of motor end plates.

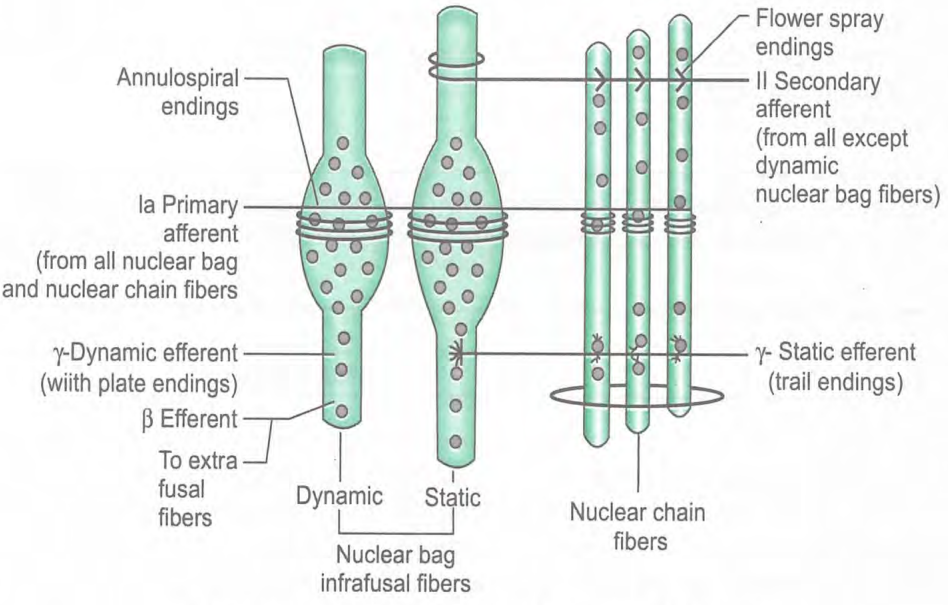
Gamma-Dynamic (γ-d)

Plate endings on **nuclear bag dynamic fibers**

Gamma-Static (γ-S)

Trail network endings on **nuclear chain fibers and static nuclear bag fibers**

- **Alpha motor neurons** (type **Aα-fibers**) are other type of anterior motor neuron of 14μdiameter mainly supplying *extrafusal fibers* and causing contraction of muscle fibers.
- So the muscle can be made to contract by stimulation of *α motor neuron* (innervating extrafusal fiber) or *γ motor neuron* (indirectly via stretch reflex). Intrafusal fibers are less strong & lesser in number to cause muscle contraction. However, their contraction by γ neuron deforms annulspiral endings & initiate stretch reflex.



Mammalian Muscle Spindle: Afferents & Efferents

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Golgi Tendon

38. **A i.e. Change in muscle length** 39. **C i.e. Muscle tension** 40. **D i.e. Senses muscle tension**
41. **D i.e. 3-25 muscle fibers.** 42. **A i.e. 1-20** 43. **C i.e. Responsible for stretch reflex**
44. **C i.e. Weak stretch activates reflex** 45. **C i.e. Golgi tendon organ**

[Ref: Ganong 24/e p. 230-233; Guyton 12/SAE p. 770-74; Oxford physiology 3/e p.254]

- **Muscle spindle** (responsible for **stretch reflex**) located in muscle belly send information about **muscle length** and **rate (speed** or **velocity) of change of length**. Whereas **golgi tedon organs** located in muscle tendons transmit information about **muscle tendon tension or rate of change of tension**Q.
- Golgi tendon organ has **low threshold** and **strong stretch is required to produce relaxation** (i.e. **inverse stretch reflex** or **autogenic protective inhibitory negative feedback lengthening reaction).**
- **Golgi tendon (or ramified net like knobby nerve endings)** are both **activated by passive stretch and active contraction of muscle**Q and has both **dynamic as well as static response.**
- Each goligi tendon is attached to **3-25 muscle fibers.**

46. **A i.e. Withdrawal reflex** *[Ref: Guyton & Hall 11/e p.681 – 82; Ganong 22/e p.135]*

Crossed extensor reflex is withdrawl reflexQ.

Nerve Injury

47. **B i.e. Neurons**

Hypoxic Susceptibility of Cells

Type	High susceptibility	Intermediate	Low susceptibility
Damage time	3-5 minutes	20-120 minutes	**Hours**
Cells	**Neurons (nerve cell)**Q	**Myocardium (Myocyte), Hepatocyte, Renal epithelial cell**	Fibroblast, epidermis, **skeletal muscle**

48. **D i.e. Neuropraxia** 49. **D i.e. Axon & Myelin Sheath** 50. **A i.e. Axontemesis**
51. **A, D, E i.e. EMG finding, Nerve conduction studies.., Axon integrity** 52. **A i.e. Axonal degeneration**

[Ref: Guyton 12/SAE p. 74-76; Samson Wright 13/e p. 288; Chaudhari 5/e p. 46; Apley's 8/e P-231; Sembulingam 4/e p. 687; CSDT 11/e p. 128, 913; Maheshwari 3/e p. 50-51]

- **Neuropraxia** refers to physiological disruption of conduction only, no structural changes or degeneration occur. **Neuronal degeneration is seen in**Q - Crush nerve injury, Fetal development, Senescence.
- **No neuronal degeneration (anatomical disruption or axonal disintegrity) is seen in neuroprexia. Axontemesis** includes **discontinuity in axons and myelin sheaths**Q. Whereas, in **neurontemesis** there is **complete discontinuation** of nerve (ie axon with myelin sheath & neural tube or perineurium, epineurium & endoneurium).
- Type of nerve injury can be differentiated by **EMG & nerve conduction studies**.
- **1st change** occurring in distal part of cut nerve is **axonal degeneration followed by** (2nd change) **myelin degeneration**Q.

Seddon's Classification of Nerve Injury

Features	Neuropraxia	Axontemesis	Neurontemesis
Pathology	- No anatomical disruption - Both axon & sheath intact - Physiological disruption of conduction only	**Axons & myelin sheath disrupted but endoneural perineurium and epineurium sheath (neural tube) is intact**Q	- Complete division of nerve - Axon & neural tube (i.e. perineurium, epineurium, & endoneural sheath) both are divided.
Degeneration	**No degeneration** Q	Degeneration present proximal + distal (Wallerian)	Degeneration present proximal + Distal (Wallerian)
Neuroma	No	In continuity	**End or side neuroma**
Tinel's signQ **/ Motor march**	Absent	**Advancing (present)**Q	Static
Prognosis	- Excellent - Recovery is complete usually **with in 6 weeks**	- Good /fair /poor - Occurs as regenerating axons grow into intact sheath	Poor

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- **Electrodiagnostic studies** (like **nerve conduction study & EMG**) are used to **distinguish between partial & complete lesion**Q **and to establish a baseline for monitoring subsequent functional recovery**Q. However, these are not helpful until 2-3 weeks after an acute injury.
- If a muscle lose its nerve supply (d/t nerve injury), **EMG** shows **denervation potential** at 3rd week; which exludes neuropraxia but however does not differentiate between axontmesis and neurontemesis.
- All types of injuries may cause sensory, motor or both loss depending on type of nerve damaged.

★ Each **axon** is covered by **myelin sheath** (in myelinated nerve only) &/or **neurilemma (Schwann sheath)**. Each *nerve fiber* (containing many axons) is covered by **endoneurium**. Each *fasciculus* (containing many nerve fibres) is covered by **perineurium**. And each nerve (containing mamy fasciculus) is covered by **epineurium**.

Nerve Conduction & N.M. Junction

53. **B i.e. Relative refractory period** 54. **B i.e. Relative refractory period**
55. **A i.e. Nerves; B i.e. Muscle; C i.e. Glands; D i.e. Contractile tissue**
[Ref: Ganong 24/e p. 88; Guyton 12/e p. 64-65, 666; Chaudhary 6/e p. 17; Best & Taylor 13/e p.155-62]

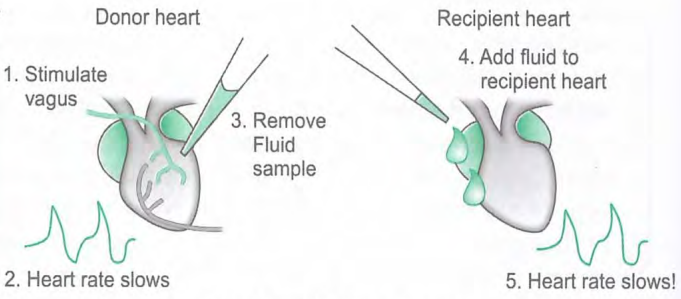
Action potential develops in excitable cells such as **nerves (neurons), muscle (skeletal, smooth and cardiac),** and other **contractile tissues** such as **few glands**Q. Glial cells such as neuroglial cells do not generate action potential.

Refractory Period (RP)

Absolute RP	Relative RP
- It correspond to period from time the firing level is reached until repolarization is 1/3rd complete - **No stimulus no matter how strong, will excite the nerve.**	- **From the end of absolute R.P to start of after depolarization.** - **In this period only very strong stimulus can cause excitation**Q

56. **E i.e. Loewi**

Otto Loewi ***discovered that nerve terminals or synapse release chemicals.*** In his most famous experiment, Loewi took fluid from one frog heart (**vagus stoff** or later found to be **acetylcholine**) and applied it to another, slowing the second heart and showing that synaptic signaling used chemical messengers.



Otto Loewi's Experiment

57. **C i.e. Axon hillock** 58. **C i.e. Responsible for Depolarization** 59. **A i.e. It has lower threshold than rest of axon**
60. **A i.e. Opening of sodium channels** 61. **A i.e. All or none phenomenon** 62. **D i.e. Threshold stimulus is required**
63. **C i.e. Potassium** 64. **C i.e. K^+** 65. **B i.e. K^+ potassium ion is most diffusible ion.**
66. **A i.e. Na^+** 67. **D i.e. Depends on potassium ion equilibrium** 68. **B i.e. It is refractory**
69. **C i.e. Travels in one direction at synapse** 70. **A i.e. Synapse** 71. **A i.e. An Axon can conduct impulse in ...**
72. **D i.e. Chemical mediator is located only in the presynaptic terminal**
[Ref: Ganong 24/e p. 86-92; Guyton 12/SAE p. 71-73; Berne 6/e p. 65-76; Chaudhari 5/e p. 469-70]

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- **Initiation of nerve impulse (depolarization) occurs at axon hillock** because **it has lower threshold for excitation than the rest of axon (neuron)**Q mainly because of **greater concentration of voltage gated Na+ channels.**
- **Development of AP (i.e. depolarization spike) occurs d/t Na^+ influx (from opening of Na^+ channels)**Q and **rapid return of membrane towards resting membrane potential/RMP (i.e. repolarization)** is d/t closing of Na^+ Channels and **opening of K^+ channel**Q.
- **Development of action potential (or nerve conduction)** is an **"all or none phenomenon"**Q ie neither AP occurs below threshold intensity nor does the further increase in intensity of stimulus produces increase in AP.
- **Because of more open K^+ channels and greater membrane permeability to K^+**(in comparison to Na^+) **at rest, the resting membrane potential in neurons** is usually about **-70 mV,** which is **close to equilibrium (isoelectric) potential for K^+**Q - Summary of Ganong 24/e p. 88
- **Order of permeability in excitable tissue at rest: $K^+ > Cl^- > Na^+$**Q
- **The nerve impulse is self propagating**Q due to circular current flow and succive electronic depolarization to the firing level of membrane ahead of action potential.
- **Once initiated moving impulse does not depolarize the area behind it to the firing level, because this area is refractory**Q.
- **Axons** can conduct nerve impulses **in either direction**Q **(anti-dromic conduction)** unlike **synapses**, which **permit conduction of nerve impulses in one direction (orthodromic) only because the neurotransmitter substance responsible for conduction is present in vesicles of presynaptic neurons only**Q**. The post synaptic neuron does not contain any neurotransmitter**Q. It has protein molecules embedded in it which serve as receptor for the neurotransmitter.
- **Orthodromic conduction means conduction in one direction only, from one neuron called the presynaptic neuron to another neuron called the postsynaptic neuron**Q.

PRESYNAPTIC NEURON (SYNAPTIC KNOB)	→ SYNAPTIC CLEFT →	POST SYNAPTIC NEURON
- *Neurotransmitter vesicles*		- *NO neurotransmitter vesicles* - Receptors present for them.

- **Electrical synapses can transmit signals in either direction.**Q

73. **B i.e. Wave activity in EEG (C) ↓ed retrograde firing (E) Involved in memory**
[Ref: Ganong 24/e P-125-26, 84-85; Guyton 12/SAE P-671-72, 676; Berne 6/e p. 53-54]

Functions of dendrites are learning & long term potentiation of memory, decreased retrograde firing and production of ware activity in EEGQ.

74. **B i.e. Initial segment** 75. **A i.e. Oxygen** 76. **C, D, E i.e. Present in dendrite; Involves in protein synthesis; Structurally they are endoplasmic reticulum**
77. **C i.e. Axons**

- From **Cell body (Soma)** of neuron arises 5-7 **Dendrites and Axon Hillock (initial thick segment of axon=Nerve impulse generator)**Q**. Nodes of Ranvier are periodic gaps in myelin sheath of axons**Q.
- Dendrites & soma are receptor zone. **Axon hillock is nerve impulse generator (graded electro genesis),** Axon is transmitter and nerve terminal is **neurotransmitter (NT) release zone.**

- **Nissl body (or granule) / tigroid body is large rough endoplasmic reticulum (i.e. containing ribosomes), seen in soma (or perikaryon , or cyton, or cell body, the bulbous end of a neuron, containing the cell nucleus)**Q **and dendrites**Q**, of neurons but not in axon or axon hillock**Q**. They are the site of protein synthesis**Q involved in for production of neurotransmitters such acetylcholine.

78. **C i.e. Are proportional to the amount of transmitter released by the presynaptic neuron**
[Ref: Ganong 24/e P-122-23, 161, 259; Berne 6/e p. 85, 89-90, 158, 222]

Excitatory post synaptic potential (EPSP) or **generator (receptor) potential** (which is EPSP in Pacinian corpuscles) is a **nonpropagating localized depolarizing potential, the magnitude of which is proportional to the intensity of stimulus (i.e. the amount of transmitters released by the pre synaptic neurons)**Q. So EPSP or GP(RP) are **graded potentials** rather than "all or none" action potential.

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79. **A i.e. Fast EPSP, B i.e. Slow EPSP, D i.e. Slow IPSP**

The response produced in post ganglionic sympathetic neurons by stimulation of their preganglionic innervations generates rapid depolarization ***(Fast EPSP)***Q, ***slow EPSP***Q, a ***late slow (prolonged) EPSP***Q, *and* ***prolonged inhibitory post synaptic potential (slow IPSP)***Q.

80. **B i.e.**  *[Ref: Ganong 24/e p. 90-91; Berne 6/e p. 65-67; Chaudhary 2/e p. 19]*

Only the ***current or stimulus which rises to its peak intensity rapidly causes the action potential to develop***Q. The **current which rises to its peak very slowly (as in graph B) does not produce AP**, although, at peak level, its strength may be adequate. This is called **accommodation**, & occurs because the **activation or opening up of Na^+ channels do not develop with slowly rising current strength**. In graphs A & C the rise to peak is rapid; where as the rise to peak is faster in D and slowest in B.

81. **C i.e. It occurs due to inhibition of release of neurotransmitter from presynaptic terminal.**
82. **B i.e. a, d, e**
83. **D i.e. Inhibition of feedback propogation**
84. **D i.e. Feedback inhibhition**
85. **A i.e. Prolonged opening of calcium channels**

[Ref: Ganong 24/e p134-36; Gabriel C Ezeilo p. 45-46; Guyton 11th/e p. 567-66; Sembulingum 3/e P- 642; Chaudhuri 5/e P- 472, 473]

- **Indirect preynaptic inhibition** occurs **due to decrease or inhibition of release of excitatory neurotransmitter from pre synaptic terminal**Q **(because of GABA mediated increased Cl- influx, increased K+ outflux, decreased size of action potential, decreased Ca++ entery, decreased NT release causing decrease in EPSP).** Whereas **direct reciprocal postsynaptic inhibition** occurs d/t release of inhibitory neurotransmitter (glycine / GABA) on post synaptic membrane producing **hyperpolarization & IPSP**.
- **Pricrotoxin (not LA) inhibits or antagonizes presynaptic inhibition whereas strychnine antagonizes postsynaptic inhibition**Q.
- **Presynaptic facilitation is caused by prolonged opening of Ca^{++} channels**Q **and early closing of K+ channels**Q.
- **Renshaw cell inhibition is negative feedback inhibition or inhibition of feedback propogation**Q.

86. **C i.e. Microelectrode** *[Ref: Ganong 24/e P-87-91]*

By electrical, chemical or mechanical stimulus, two types of physio chemical disturbances are produced in nerves- 1) **Local, non propagated potential – synaptic, electrotonic or generator potential,** 2) **Propogated disturbance – action potential (nerve impulse).** The electric events in neurons are rapid being measured in millisecond (ms) and the potential changes are small, measured in millivolts (mv). The electrical activity can be measured by (i) ***Microelectrode***Q with tip diameter of less than 1 micron (ii) Electronic amplifier (iii) Cathode ray oscilloscope

87. **B i.e. Bell-Magendle's law**
88. **D i.e. Law of projection**
89. **D i.e. Stimulus discrimation**
90. **A i.e. Magnitude of stimulus strength perceived is approximately proportionate to the log of the intensity of stimulus strength** *[Ref: Ganong 23rd/e p. 152-54; 22/ed pg-126; Guyton 11th/e p. 594-96; Gabriel C Ezeilo p. 452]*
91. **B i.e. Frequency of AP**

Weber Fechner law	"Magnitude of sensation felt is proportionate to the log of intensity of the stimulus". So **stimulus strength discrimination (gradation)** is dependent on **frequency of AP**Q, number of receptors activated and amount of receptor potential.
Bell Magentic law	In the spinal cord – **d**orsal roots are sensory and **v**entral roots are **m**otor **[DS VM]**
Law of projection	Describe ***phantom limb sensation***Q

92. **A i.e. Miniature end plate potential** *[Ref: Ganong 22/e P-117]*

Small quanta (packets) of *acetylcholine (Ach) are released* randomly from the nerve cell membrane at rest, each producing a minute depolarizing spike called a ***miniature end- plate potential.***Q

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