I. Name each labeled part. (10 points)

II. Multiple Choice. Circle ALL correct answers. There may be one, more than one or no correct completion for a given question. Think of these as multiple true-false; points are lost if a correct completion is not circled or an incorrect completion is circled. (110 points)

I. The perception of slow pain following injury to the feet depends on normally functioning
   (a) Group IV afferent fibers
   (b) anterolateral systems
   (c) proprioceptors Ia, Ib, II
   (d) dorsal columns
   (e) ventromedial brainstem pathway

   AVAIL NOTED
2. Horner's syndrome
(a) may result from a lesion in the medulla (✓)
(b) may result from a lesion in the hypothalamus
(c) cannot be distinguished from a lesion of cranial nerve III (✗)
(d) includes ptosis, miosis, enophthalmos and facial anhidrosis
(e) occurs only with a lesion of the cervical sympathetic chain

3. A normal subject lies face up with his head tilted forward 30 degrees (neck flexed). When the left external auditory canal is irrigated with WARM water, nystagmus occurs and
(a) the slow component elevates the eyes. (✓)
(b) the slow component adducts the right eye and abducts the left eye
(c) the quick component occurs only in the left eye. (✗)
(d) the slow component is to the patient's right.
(e) the quick component is to the right

4. REM sleep
(a) is a period of poor thermoregulation
(b) is characterized by relatively low voltage (amplitude), high frequency waves in the EEG
(c) is accompanied by complete paralysis of all skeletal muscles (not respiratory)
(d) normally occurs following an episode of slow-wave sleep
(e) is the stage of sleep most common when there is a drop in brainstem activity

5. Which of the following oculomotor mechanisms have the purpose of displacing an image from one place on the retina to another (as distinct from rendering the images stationary on the retina)?
(a) the VOR (✓)
(b) smooth pursuit (✗)
(c) optokinetic movements (✗)
(d) physiological nystagmus
(e) saccades

6. Unilateral damage to the vestibular component of cranial nerve VIII can cause
(a) Instability of the trunk
(b) clonus (✗)
(c) nystagmus (✓)
(d) falling
(e) vertigo

7. Signs of damage to the long motor tracts may occur in a patient following occlusion of branches of the
(a) anterior cerebral artery
(b) posterior cerebral artery
(c) anterior spinal artery
(d) basilar artery
(e) middle cerebral artery

8. Loss of dopaminergic neurons in the substantia nigra, pars compacta leads to a clinical syndrome characterized by
(a) cogwheel rigidity
(b) hemiballismus (✓)
(c) tremor at rest
(d) bradykinesia
(e) dysdiadokokinesis
9. Neurons (or their axons) making monosynaptic contact with alpha motor neurons include
   a. gamma motor neurons
   b. intrafusal fibers
   c. certain neurons with cell bodies in the cerebral cortex
   d. cerebellar Purkinje cells
   e. la axons of cells in the dorsal root ganglia

10. A single motor unit may incorporate
    a. several alpha motor neurons
    b. muscle fibers in antagonistic muscles
    c. fewer than 10 muscle fibers
    d. more than one neuromuscular junction
    e. both fast and slow muscle fibers

11. Clinical deficits or signs on the left side of the body could arise from lesions of
    a. the subthalamic nucleus on the left
    b. cortical area 4 on the right
    c. the cerebellar hemisphere on the left
    d. the posterior parietal lobe on the right
    e. the cerebral peduncle on the right

12. Damage to the cerebellar cortex around the midline
    a. results in resting tremor
    b. could destroy fibers carrying proprioceptive information from the ipsilateral spinal cord
    c. would disrupt processing of information destined for the ventromedial motor pathways
    d. could produce pendular reflexes and hypotonia in the leg muscles
    e. can produce hyperreflexia

13. Signs of damage to the MLF in the rostral pons on the left include
    a. slow or absent adduction of o.d. on gaze to the left
    b. spontaneous horizontal nystagmus, o.u.
    c. nystagmus in o.s. on gaze to the left
    d. impaired adduction o.u. during convergence
    e. mydriasis o.d.

14. At some point in its development, a syrinx (cavitation) extending from the spinal canal in the cervical cord may cause the following signs:
    a. bilateral hypesthesia (diminished sensitivity in all modalities) with sacral sparing
    b. bilateral loss of pain and temperature in a cape and glove pattern
    c. atrophy and fibrillation of the arm and shoulder muscles bilaterally
    d. Babinski signs bilaterally
    e. spasticity in arms and legs bilaterally

15. Complete section of one trigeminal nerve as it exits the brainstem could result in
    a. hypeacusis ipsilaterally
    b. loss of pain and temperature sensation on the back of the neck ipsilaterally
    c. dysarthric speech
    d. loss of taste sensation on the anterior 2/3 of the tongue ipsilaterally
    e. paralysis of the ipsilateral masseter and temporalis muscles
16. Difficulty hearing the ticking of a watch held next to the one ear
   a. destruction of the middle ear ossicles on that side
   b. activation of the ipsilateral olivocochlear bundle
   c. a lesion in the ipsilateral inferior colliculus
   d. destruction of the outer hair cells by an ototoxic
   e. tonic contraction of the tensor tympani of that ear

17. Which of the following is/are true of a hyperope?
   a. when she views the North Star, her ciliary muscle must contract harder than that of a
      myope
   b. they cannot focus near objects because of the stiffness of the lens
   c. the appropriate corrective lens for this condition converges light rays
   d. viewing through a pinhole will improve image quality
   e. the eye's optics form the image of a distant object in front of the retina

18. The force developed by a muscle
   a. depends in part on the number of innervating motoneurons that are discharging
   b. is converted to a neural signal by the Golgi tendon organ
   c. decreases with continued contraction in myasthenia gravis
   d. varies with the amplitude of the action potentials in the innervating motoneurons
   e. is signaled to the central nervous system by Ia afferent fibers

19. Spasticity
   a. never occurs in conjunction with clonus
   b. may occur after damage of the long descending motor pathways
   c. may be diminished by dorsal root sections
   d. includes hyperreflexia and hypotonia
   e. is characteristic of basal ganglia disease

20. The caudate and putamen
   a. receive dopamine inputs from the red nucleus
   b. are separated by the anterior limb of the internal capsule
   c. provide inhibitory input to the globus pallidus
   d. are part of a motor loop that includes the cerebral cortex and thalamus
   e. are involved directly or indirectly in conditions producing hyperkinesia, bradykinesia or
dystonia

21. Joe Botz complains of poor hearing in his right ear. A tuning fork held against his forehead
    sounds louder on the left than on the right. This observation could indicate
   a. damage to the right superior colliculus
   b. middle ear disease on the right (conduction)
   c. damage to his right auditory nerve
   d. paralysis of the right stapedius muscle
   e. damage to Heschl's gyrus on the left

22. Horizontal eye movements
   a. depend on muscles innervated by the third and sixth cranial nerves
   b. when conjugate are coordinated by the medial longitudinal fasciculus
   c. can be voluntary or involuntary
   d. are impaired in Parinaud's syndrome
   e. can be slow or quick
III. Write the number of the correct structure (5 points)

- Contains fibers from contralateral pons ___
- Receives input from cortex of a cerebellar hemisphere ___
- Lesion here would cause paralysis of face on same side (two possibilities; list one) ___
- Lesion here would cause long tract signs ___
- Part of cerebellum most related to axial muscles ___

IV. In the space provided contrast fluent and non-fluent aphasia with respect to the features indicated. Short answers (one or a few words) will suffice. (10 points)

<table>
<thead>
<tr>
<th>Probable anatomical location of the lesion</th>
<th>Non-fluent Aphasia</th>
<th>Fluent Aphasia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broca's Area</td>
<td>Wernicke's Area</td>
<td></td>
</tr>
<tr>
<td>Frontal lobe - close to bottom of skull</td>
<td>Sup. Aspect of post. temporal lobe</td>
<td></td>
</tr>
<tr>
<td>Prosody</td>
<td>Prosody</td>
<td></td>
</tr>
<tr>
<td>dysprosodic</td>
<td>rhythm intonation</td>
<td></td>
</tr>
<tr>
<td>Patient's affective reaction to the disability</td>
<td>disturbed</td>
<td>undisturbed</td>
</tr>
<tr>
<td>Most likely associated neurological signs</td>
<td>R hemiplegia</td>
<td>loss of ability to locate sounds in space</td>
</tr>
<tr>
<td>Comprehension of speech</td>
<td>good</td>
<td>impaired</td>
</tr>
</tbody>
</table>
V. Write the number or name of the correct structure (7 points)
1. Name of #1 bump on the floor of the ventricle
2. Lesion here could produce ataxia (#)
3. Touch and pressure fibers are here (#)
4. Lesion around here could produce Babinski sign (#)
5. Ties together cranial nerves III, IV and VI (#)
6. This section is at the junction of (names) pons and the medulla

VI. True or False. Circle the T if the statement is true, the F if false. (10 points)

T F Motor neurons of the spinal cord arise from the alar plate of the neural tube.
T F Motoneurons of cranial nerve VII lie in the somatic motor column.
T F Some sensory neurons of cranial nerve VII synapse in the nucleus of the tractus solitarius.
T F Myelin of the CNS is formed by Schwann cells.
T F Otoliths are concentrated in the gelatinous cupula of the crista ampullaris.
T F Olfactory receptor cells, but not gustatory receptor cells, are derived from neural ectoderm.
T F Head rotation to the right excites neurons innervating the right lateral semicircular canal.
T F No neurons undergo mitosis in postnatal humans.
T F Neurons innervating the semicircular canals discharge during angular acceleration of the head.
T F Some neurons in Scarpa's ganglion synapse in the cerebellum.
VII. Clinical cases: answer the questions concisely (13 points)

Clinical Case 1: A 56 year old man appeared in the emergency room after being found unconscious on the street. After returning to consciousness, the patient reported weakness and difficulty in speaking. He also mentioned that he had a long-standing problem with alcohol abuse. Neurological exam revealed the following:

- During voluntary tongue protrusion, the tongue deviated to the left
- Reflexes in the right arm and leg were increased compared to the left, and the muscle tone on the right was also increased
- Great toe on the right was upgoing
- The patient could sense that he was being touched, but had poor two-point discrimination and position sense on the right
- Pain and temperature senses were normal on both sides
- The patient had a mild gate ataxia

Where is the lesion most likely to be? (3 points)

\[
\text{Left Medulla above pyramidal decussation + dorsal column nuclei.}
\]

How did you decide whether this lesion is inside or outside the CNS? (1 point)

\[
\text{Spasticity → inside}
\]

What structures are involved in the lesion to account for these symptoms? (3 points)

\[
\text{Cortico-spinal} \rightarrow \text{Spasticity} \qquad \text{DCML lesion} \rightarrow \text{poor touch + position}
\]

Clinical case 2: A 25 year-old woman noted the gradual onset of deafness in her right ear. Hearing in the left ear remained normal. She subsequently noted a "drooping" and numbness of the right side of her face and a tendency to drool from the right side of her mouth. Neurological examination revealed the following:

- Decreased hearing in the right ear (VIII)
- A right facial paralysis that included weakness of the orbicularis oculi and frontalis muscles (VII) (infraorbital nerve)
- When the left cornea was stimulated, the left eye blinked
- When the right cornea was stimulated, neither eye blinked

Failures of function in what neural structures are responsible for which signs and symptoms in this patient? (2 points)

\[
\text{CN V, VII}
\]

Is there any evidence of a lesion of the central nervous system in this patient and, if so, what is it? (2 points)

\[
\text{110 → 110 comm.}
\]

What is your best estimate of the location of the pathological process in this patient, and why? (2 points)

\[
\text{Stroke in the middle cerebral artery - at this point...}
\]