I. In the space provided, match the number identifying a particular structure or feature on the figure to its name or description. If the structure or feature is not on the figure, enter an X.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pons</td>
</tr>
<tr>
<td>2</td>
<td>Hypothalamus</td>
</tr>
<tr>
<td>3</td>
<td>Thalamus</td>
</tr>
<tr>
<td>4</td>
<td>Cingulate Gyrus</td>
</tr>
<tr>
<td>5</td>
<td>Medial longitudinal fasciculus</td>
</tr>
<tr>
<td>6</td>
<td>Septum pellucidum</td>
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<tr>
<td>7</td>
<td>Interpeduncular fossa</td>
</tr>
<tr>
<td>8</td>
<td>Mamillary body</td>
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<tr>
<td>9</td>
<td>Optic chiasm</td>
</tr>
<tr>
<td>10</td>
<td>Medulla oblongata</td>
</tr>
<tr>
<td>11</td>
<td>Cerebellum</td>
</tr>
<tr>
<td>12</td>
<td>Fornix</td>
</tr>
<tr>
<td>13</td>
<td>Midbrain tegmentum</td>
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<tr>
<td>14</td>
<td>Temporal lobe</td>
</tr>
<tr>
<td>15</td>
<td>Foramen of Monro</td>
</tr>
<tr>
<td>16</td>
<td>Visual cortex</td>
</tr>
<tr>
<td>17</td>
<td>Splenium of the corpus callosum</td>
</tr>
<tr>
<td>18</td>
<td>Fourth ventricle</td>
</tr>
<tr>
<td>19</td>
<td>Pecial body</td>
</tr>
</tbody>
</table>

Diagram showing various brain structures and their corresponding numbers.
II. Place the letter from the figure next to the name of the artery or other structure indicated. If the structure is not on the figure, enter an X. (Note that the right cerebellum and the tip of the right temporal lobe have been removed) (20 points)

- **F** anterior inferior cerebellar a.
- **L** superior cerebellar a.
- **A** olfactory bulb.
- **N** oculomotor nerve
- **S** anterior communicating a.
- **H** anterior spinal a.
- **D** trigeminal nerve
- **T** anterior cerebral a.
- **X** dorsal column
- **B** optic nerve

- **E** basilar a.
- **P** internal carotid a.
- **G** posterior inferior cerebellar a.
- **O** posterior communicating a.
- **K** abducens nerve
- **C** mammillary body
- **J** vertebral a.
- **R** middle cerebral a.
III. Circle the correct answer (1 point each)

- Plane of section: (coronal) horizontal sagittal

- What are stained (darker areas): (cell bodies) fibers

At the end of each pointer, write the name of the structure it designates. (1 point each)
IV. For each clinical deficit indicated, name the cranial nerve (I-XII) whose function has been impaired or lost. (15 points)

- pupil dilated and fixed (i.e. unresponsive to light in either eye)
- loss of taste on the anterior 2/3 of the tongue
- hoarseness due to paralysis of the vocal cords
- hyperacusis and paralysis of the orbicularis oculi
- paralysis of the sternocleidomastoid muscle
- deviation of the tongue to the one side on protrusion
- inability to Abduct one eye
- afferent pupillary defect—direct response is weaker than consensual
- absent corneal reflex (one possibility)
- absent corneal reflex (other possibility)
- impaired acoustic reflex (one possibility)
- impaired acoustic reflex (another possibility)
- impaired acoustic reflex (still another possibility)

V. TRUE or FALSE. Circle the T if the statement is True, the F if the statement is False. (10 points)

- T F Secondary hyperalgesia is caused by an axon reflex at the site of injury.
- T F Slow pain is attributable to activity in group II axons.
- F F Central control or regulation of pain would be impaired by damage to the nucleus raphé magnus of the medulla.
- T F Nociceptors are among the most rapidly adapting receptors of the body.
- F F A patient may experience pain in a region of denervated skin.
- T F Activity in group II axons can modulate the flow of nociceptive signals in central pain pathways.
- T F Opiate derivatives such as morphine reduce pain by their actions on receptors in the dorsal horn, medulla and periaqueductal gray.
- T F Nociceptive impulses from the viscera travel in part of the fasciculus gracilis.
- T F Antidromic activation of group IV axons can cause swelling and vasodilatation in the region of their cutaneous terminals.
- T F Nociceptor activation contributes to the sensation of "hot".
VI. MULTIPLE CHOICE. Circle ALL correct answers or completions. There may be one, more than one or no correct completion for a given question. (Think of these questions as multiple true-false; points are lost if a correct completion is not circled or an incorrect completion is circled.) (75 points)

1. Two-point cutaneous discrimination thresholds are lower (discriminable points closer together) on the hand than on the back in part because
   a. receptive fields of cutaneous afferents are larger on the back than on the hand
   b. the hand, but not the back, is innervated by group II afferent axons
   c. cutaneous innervation densities are higher on the back than on the hand
   d. the hand has a larger representation than the back in cortical area S1
   e. a given hand is represented in both left and right primary somatic sensory cortices

2. Loss of position sense in the right leg might occur following
   a. damage to the thoracic spinal cord on the left
   b. damage to the upper medulla oblongata on the left
   c. occlusion of certain branches of the basilar artery
   d. a disease selectively affecting large diameter peripheral axons
   e. occlusion of the left middle cerebral artery

3. As a probe is pushed against the skin with increasing pressure, the change in intensity is signaled to the central nervous system in part as an increase in the
   a. number of afferent fibers responding to the stimulus
   b. amplitude (in mV) of the action potentials in the discharging axons
   c. discharge frequency of the active axons
   d. conduction velocities of the active axons
   e. sensitivity of the low-threshold cutaneous mechanoreceptors

4. Lesions that would interfere with pain perception but not with low-threshold cutaneous touch perception include those damaging
   a. a dorsal column nucleus
   b. the main sensory nucleus of V
   c. the anterior white commissure
   d. the intralaminar nuclei of the thalamus
   e. the antero-lateral column of the spinal cord

5. The hemi-neglect syndrome
   a. is invariably accompanied by defective cutaneous sensation
   b. affects somatic sensation, but not vision or audition
   c. may be accompanied by a constructional apraxia
   d. may be accompanied by astereognosis
   e. occurs following damage to the posterior parietal cortex
6. Corneal transparency
   a. is due to the presence of crystalline in the keratocytes
   b. is aided by evaporation of the tear film
   c. can be diminished by damage to the corneal epithelium or endothelium
   d. requires the active removal of water from the stroma
   e. requires the normal circulation of oxygenated aqueous humor
   f. need O2 to make ATP to remove water

7. Hyperopia (hypermetropia)
   a. exists when the eye's optics always form images of very distant objects in front of the retina
   b. requires the ciliary muscle to be constantly active to focus images on the retina
   c. can be corrected by a converging lens placed before the eye
   d. is analogous to the situation arising when the eye is submerged in water
   e. and astigmatism occurring together can be corrected by a toric lens

8. Pupillary constriction
   a. can result from damage to the cervical spinal cord
   b. beneath a pustular eye lid suggests the presence of Horner's syndrome
   c. occurs as the component of the 'near response'
   d. can occur in a blind eye
   e. following retinal illumination involves a direct retinal projection to the midbrain

9. Left homonymous hemianopia
    a. can occur following occlusion of the posterior cerebral artery on the right
    b. can occur following occlusion of the middle cerebral artery on the left
    c. will occur following interruption of axons from both the right temporal retina and left nasal retina
    d. is always associated with loss of the direct pupillary light response from the left eye
    e. may occur in a patient who is paralyzed on the left side

10. In retinal detachment
    a. the retina separates from the pigment epithelium
    b. there follows intense hyperpolarization of the photoreceptors
    c. regeneration of the bleached photopigment of the receptors is interrupted
    d. normal shedding of outer segment discs is interrupted
    e. the photoreceptors are deprived of their normal blood supply

11. High-acuity vision of the human fovea is correlated with
    a. an abundance of arterial vessels from the central retinal artery
    b. a high concentration of low-threshold rods in the central fovea
    c. displacement of the overlying retinal layers to the side with a reduction of light scattering
    d. the presence of midget ganglion cells receiving input from only one cone
    e. expanded representation in striate cortex of the fovea (relative to peripheral retina)
12. Decreased sensitivity to sound in one ear might result from damage to the ipsilateral
   a. cochlear nucleus of the medulla
   b. primary auditory cortex
   c. middle ear ossicles
   d. outer hair cells of the organ of Corti
   e. stria vascularis

13. Traveling waves on the basilar membrane
   a. move in different directions for low and high frequency sounds
   b. induced by bone conduction move from the apical to the basal turns of the cochlea
   c. peak in amplitude at different distances along the membrane depending on the frequency
      of the sound input.
   d. are not generated by the sounds of one's own voice
   e. may be set in motion by the action of the outer hair cells in certain pathological conditions

14. Neural signals arising from the organ of Corti reach the primary auditory cortex via a pathway
    that has synaptic relay located in the
    a. medulla
    b. pons
    c. midbrain
    d. thalamus
    e. spiral ganglion

15. Joe Botz complains of decreased hearing in his left ear. During the Weber test (tuning fork
    against the forehead), the sound is loudest in his right ear. Joe's problem may include
    a. buildup of wax in his left ear
    b. damage to the olivocochlear bundle to the left ear
    c. cerebellar-pontine angle tumor on the left
    d. damage to the stria vascularis in the left ear
    e. paralysis of the tensor tympani of the left ear