1. Consider a hypothetical congenital disease in which the foregut undergoes normal differential growth and buddings (formation of diverticula), but fails to undergo any rotations. Given this lack of rotation, describe the final orientations of the greater and lesser curvatures of the stomach, and the positions of the liver, pancreas and spleen relative to the stomach. Your description of the abnormal positions should include a description of the normal positions of the curvatures and indicated organs. (10 points)

In the beginning of foregut development, the anterior aspect grows more slowly than the posterior, giving rise to the lesser (anterior) and greater (posterior) curvatures of the stomach. Normally, two 90° rotations leave the lesser curvature facing cranially and the greater facing caudally. In this situation, however, with a patient in anatomical position, the lesser curvature will remain facing the ventral body wall and the greater curvature will face the patient’s back.

Since the liver forms as an outpouching from the anterior surface of the early stomach and the pancreas from the posterior (plus some from the anterior before fusion), they normally end up above and below the stomach, respectively. That is, liver above, pancreas below. In this case, they will remain where they begin, on the anterior (liver) and posterior (pancreas) surfaces of the non-rotating stomach.

The spleen is not a derivative of the GI tract and should develop in its normal position, between

2. During surgery for a double lung transplant, a cystic fibrosis patient suffered bilateral transection of the thoracic splanchnic nerves.

A. Name the abdominal organs that will be most affected by the nerve damage. (4 points)

   - the foregut: (Esophagus), Stomach, Pancreas, Liver, Gall bladder, and “Proximal” Duodenum (up to major papilla of Vater)

B. Will this affect sympathetic innervation, parasympathetic innervation, or both? (2 points)

   Sympathetic, parasympathetic innervation is from the Vagus Nerve (C.N.).

3. Some cancers mainly affect the Müllerian (paramesonephric) ductal system. Which organs are likely to be affected by these types of cancer? (5 points)

   The Müllerian ducts ultimately become the Cervix, Upper Vagina, Uterine/Fallopian tubes, and ovaries. Therefore, these structures will most likely be affected.

Nice try on the stomach question. Correct answer: The stomach's greater curvature and the lateral body wall.
4. Flaccid paralysis of the bladder is caused by loss of parasympathetic innervation to the smooth muscle in the bladder wall. The flaccid bladder overfills and stretches, sometimes to the point that it may hold several liters of urine.

A. Damage to ventral rami at which spinal levels will lead to flaccid paralysis of the bladder? (2 points)
   S2, S3, S4

B. Given a diagnosis of flaccid paralysis of the bladder, what region of the gut tube would you suspect has also lost its parasympathetic innervation? (2 points)
   The Hindgut

C. What change in sexual function will likely co-occur with flaccid paralysis of the bladder? (2 points)
   Erectile dysfunction and/or decreased (possibly lost) sensation to most of the perineal region (via pudendal Nerve)

5. Examples of two degrees of bifid (doubled) ureter are shown in the picture to the right.

A. What specific structure in the developing fetus has undergone abnormal bifurcation to produce the bifid ureter? (2 points)
   Ureteric Bud

B. Circle the single correct answer in each set of parentheses:
   Early in normal development, the structure named in part A is connected at one end to the (pronephric/mesonephric/metanephric) kidney, and at the other end to the (mesonephric/paramesonephric) duct. (4 points)

C. Normal bifurcations of the structure named in part "A" leads to the development of what specific parts of the urinary system? (4 points)
   Ureteric Bud Becomes all of the collecting parts of the Urinary System:
   Collecting Tubules, Major/Minor Calyces, Renal Pelvis, Ureter

Points missed: 0
6. The arteries to the gut have extensive anastomoses. These are of considerable clinical importance, as they allow alternate pathways of blood flow to the different regions of the gut tube.

A. Describe the path of an anastomosis between the superior mesenteric artery and the inferior mesenteric artery. (3 points)

Superior Mesenteric Artery → Middle colic Artery → Marginal artery → Left colic Artery → Inferior Mesenteric Artery

B. Describe the path of an anastomosis between two branches of the celiac trunk. (3 points)

Celiac Trunk → Splenic Artery

Common Hepatic Artery → Right Gastroepiploic Artery

Gastrroduodenal Artery → Left Gastroepiploic Artery

7A. Describe the path of sperm from the seminiferous tubules to their exit out the penile urethra. The first and last steps have been done for you: (4 points)

Seminiferous tubules → Efferent ductules → Epididymis → ductus deferens → Ejaculatory duct

→ Prostatic Urethra → spongy (penile) urethra (Missing umbilical vesicles)

7B. Name two locations along the pathway above where accessory fluids are added to the sperm. Include the organ or structure that contributes the fluid. (2 points)
(1) Ejaculatory duct - Fluid contributed by Seminal vesicles
(2) Prostatic urethra - Fluid contributed by Prostate gland

8. Name the structure with the described spatial relationship. Be sure to specify if something is an artery, vein, nerve, ligament, etc. (6 points total).

A. Coursing to the left along the superior edge of the pancreas
Splenatic Artery → Common Fibular N.

B. Runs over the lateral aspect of the fibular neck
Superior Extensor Retractor Tendon

C. Runs from the head of the femur to the acetabulum
Ligamentum Teres

D. Lies in the free inferior edge of the falciform ligament
Unbilical Vein

E. Attached to the greater curvature of the stomach and inferior aspect of the transverse colon
Greater Omentum

F. In the male, drains from the pelvis into the left renal vein
Left Testicular Vein

Page 3

Points missed: 1.5
9. On the image below, **draw in or label** the following: (4 points)

A. The abdominal aorta and its split into the left and right common iliac arteries.

B. On the body's left side, **circle** the nerve roots that form the sciatic nerve. Sciatic: L4, 5, S1, 2

C. **Label** the obturator nerve on the body's left side. L7, 8, 9

D. On the right side of the body, **draw a solid arrow** indicating the direction of the fascicles of the external oblique, and a **dotted arrow** indicating the direction of the fascicles of the internal oblique, as they course along the anterior body wall.

10. For each of the following terms, **provide 2 examples** of viscera to which each term applies. (6 points)

   Intraperitoneal
   - Stomach
   - Transverse Colon

   Retroperitoneal
   - Esophagus
   - Kidney

   Secondarily retroperitoneal
   - Ascending Colon
   - Descending Colon

Page 4

Points missed: __0__
11. In 1997, an episiotomy was performed in 31% of childbirths in the U.S. An episiotomy is an incision through the perineum made to enlarge the vagina and prevent uncontrolled perineal tears during childbirth. A posterior episiotomy is most common, though mediolateral episiotomies are sometimes performed. The path of the incisions made for both types of episiotomies are shown in the figure to the right.

A. A nerve block may be used for local anesthesia in this procedure. Which nerve would be blocked, and which bony landmark would a physician use to guide the injection? (2 points)

The pudendal nerve would be blocked, using the ischial spine as a bony landmark.

B. What structures may be damaged during a posterior episiotomy that normally resist uncontrolled defection? (2 points)

The inferior rectal nerve coming off of the pudendal nerve.

No. midline ext. and sphincter - 2

C. What erectile tissue could be damaged by a mediolateral episiotomy? (2 points)

Corpus Spongiosum

12. Complete the following table. (10 pts.)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal attachment</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adductor longus</td>
<td>Pubic ramus</td>
<td>Obturator nerve</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>Anterior inferior iliac spine</td>
<td>Femoral nerve</td>
</tr>
<tr>
<td>Gluteus minimus</td>
<td>Posterior side of iliac crest - 1/2</td>
<td>Superior gluteal N.</td>
</tr>
<tr>
<td>Semimembranosus</td>
<td>Ischial tuberosity</td>
<td>Sciatic nerve</td>
</tr>
<tr>
<td>Sartorius</td>
<td>Anterior superior iliac spine - 1/2</td>
<td>Femoral nerve</td>
</tr>
<tr>
<td>Piriformis</td>
<td>Anterolateral sacrum</td>
<td>Ventral rami of S1 &amp; S2</td>
</tr>
</tbody>
</table>
13. Fill in the blanks to complete the paragraph below. (6 points)

Orchipexy is a surgical procedure used to treat undescended testis, or cryptorchidism, when the testis is located in the inguinal canal. A transverse incision is made in the midinguinal canal, cutting through Camper's and Scarpa's fascia. The aponeurosis of the external oblique is opened by dissecting through the superficial inguinal ring, with care taken not to sever the ilioinguinal nerve that runs through the inguinal canal. Cremaster muscle fascicles, derived from the internal oblique muscle, are dissected from the spermatic cord, which completely frees the testis from its inguinal attachments. In most cases of cryptorchidism, the processus vaginalis is still patent and must be severed and ligated to avoid indirect inguinal hernias. Finally the testis is placed in a scrotal pouch where it is permanently secured by its adherence to fibers of the Dracos muscle, which is derived from the Scarpa's fascia.

14. When necessary, a feeding tube can be inserted directly into the stomach through the anterior body wall. Consider an insertion site lateral to the rectus sheath. List, in proper sequence, all the tissue layers that the feeding tube will pass through. The first and last steps are done for you. (8 points)

Skin \(\rightarrow\) Camper's Fascia \(\rightarrow\) Scarpa's Fascia \(\rightarrow\) External oblique \(\rightarrow\) Internal Oblique

\(\rightarrow\) Transversus Abdominis \(\rightarrow\) Transversalis Fascia \(\rightarrow\) Parietal Peritoneum

\(\rightarrow\) Visceral Peritoneum \(\rightarrow\) Muscular wall of the stomach

15. Circle the single best answer. During exploratory surgery of the abdomen, an incidental finding was a herniation of bowel between the lateral edge of the rectus abdominis muscle, the inguinal ligament and the inferior epigastric vessels. These boundaries defined the hernia as a(n): (2 points)

- a) Congenital inguinal hernia
- b) Direct inguinal hernia
- c) Femoral hernia
- d) Indirect inguinal hernia
- e) Umbilical hernia

Boundaries: Inguinal Triangle

16. Circle the single best answer. The internal thoracic artery is sometimes surgically cut near the inferior border of the sternum and used to supply blood to a region of the heart. In these cases, maintenance of adequate blood flow to the rectus abdominis may be dependent on increased flow through which artery? (2 points)

- a) Superficial epigastric
- b) Inferior epigastric
- c) Umbilical
- d) Superficial circumflex iliac
- e) Deep circumflex iliac

Page 6

Points missed: 0
17. Below is a superior view of a female pelvis with the hip in a flexed position. **Draw and label** the following structures. For muscles show both the proximal and distal attachments, for nerves show nerve roots. When structures pass behind bony structures, be sure to show this by interrupting the lines and labeling the structure in every space that it can be seen from this view. (8 pts)

- vagina
- rectum
- urethra
- right piriformis
- right iliacus
- left ischiococcygeus (=coccygeus)
- left tendinous arch of levator ani
- left inguinal ligament

![Diagram of pelvic structures](image)

18. On the first day of anatomy lab, an enthusiastic, slippery-gloved student drops a scalpel. Unfortunately, her lab partner’s foot, protected only by a brightly-colored foam slipper, is directly below the dropped scalpel.

A. In an attempt to avoid the speeding blade, the student rapidly **flexes** his knee. **Name two muscles** that contribute to this motion, and give their innervation. (4 points)

  - **Semitendinosus** and **Semitendinosus**
  - Innervations = **Sciatic Nerve**

B. Unfortunately, the leg movement is not rapid enough, and the scalpel pierces the dorsum of the foot just lateral to the second metatarsal, causing pain. **Name 3 nerves** through which this afferent pain signal passes. Which spinal level is associated with this dermatome? (4 points)

  - **Medial dorsal cutaneous nerve** → **Superficial peroneal nerve** → **Sciatic nerve**

  ![Spinal level diagram](image)

Page 7 (5) Points missed: 2
19. Weakness of the quadriceps muscle group can lead to compensatory changes in gait. Several possible gait changes are listed below. Some of them will act to compensate for quadriceps weakness, while others will actually increase the demand on the quadriceps group. **Circle** any gait alterations below that you would **expect to compensate** for quadriceps weakness, and **briefly explain** how they would compensate for the weakened quadriceps. (6 points)

A. Hyperextension of the knee during stance phase.

Locking the knee (hyperextension) will place the downward force of gravity, which originates at the center of gravity, more directly in line with the point of rotation at the knee joint, thus shortening the lever arm and decreasing the load on the quadriceps.

B. Increased knee flexion during stance phase.

C. A forward tilt of the trunk during stance phase.

Forward tilting, like knee hyperextension, will tend to align the center of gravity with the point of rotation at the knee. In this case, the increased load will be placed on hip extensors (hamstrings) to compensate for quadriceps weakness.

D. A rearward tilt of the trunk during stance phase.

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20. **Circle the single best answer.** The spleen is derived from the: (2 points)

- embryonic foregut
- embryonic midgut
- embryonic hindgut
- mesoderm of the posterior body wall
- a & d

21. **Circle the single best answer.** Derivatives of the intermediate mesoderm include all of the following except the: (2 points)

- collecting system of the kidneys
- fundus of the uterus
- ovaries
- genital tubercle
- seminal vesicles (or seminal glands)

\[-10 = \frac{115}{125} = 0.92\]

\[\bar{X} = 92\%\]

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Page 8

Points missed: 2