1.The transverse colon

A.is a retroperitoneal organ.
B.receives blood supply mainly from the superior mesenteric artery.
C.separates the greater and lesser sacs of peritoneum.
D.continues as the sigmoid colon.
E.develops from the junction of the foregut and the midgut.

2.The fundus of the stomach

A.is functionally a non-acid secreting part of the stomach.
B.is located under the left dome of the diaphragm.
C.has the greater omentum attached to it.
D.A and C are true.
E.B and C are true.

3.Structures which receive blood from the lateral branches of the abdominal aorta include the

A.kidneys.
B.duodenum.
C.ascending colon.
D.descending colon.
E.A, C and D.

Short-answer questions.

1. Draw and label a simple line diagram to show the parts of the stomach. (2)

2. What are factors which maintain sphincteric action between the oesophagus and the stomach? (2)

3. Which artery supplies blood to the stomach? (1)

4. Name the peritoneal folds attached to the stomach and the border to which each one is attached. (2)

5. Explain in brief the basis for functional division of the liver into lobes. (2)

6. Describe in brief, gross anatomical terms, the blood circulation in the liver. (3)

7. Explain in brief the functional importance of portal circulation with reference to the liver. (2)

8. What are portasystemic anastomoses? State three such sites. (2)

9. Draw a simple line diagram to show the parts of the biliary apparatus. (2)

10. Describe the internal features of the duodenum. (2)

11. State three features which distinguish the jejunum from the ileum. (3)

12. State two characteristic gross anatomical features of the colon. (2)

13. Explain the term "secondarily retroperitoneal organ". (1)

14. Correlate the development and blood supply of the colon. (2)

15. List the structures which develop from the abdominal foregut, the midgut and the hindgut. (5)

16. Describe in brief the overall pattern of branches of the abdominal aorta. (4)

17. What is Meckel's diverticulum? (2)

ANSWERS TO MCQs:

Topic - Abdominal viscera

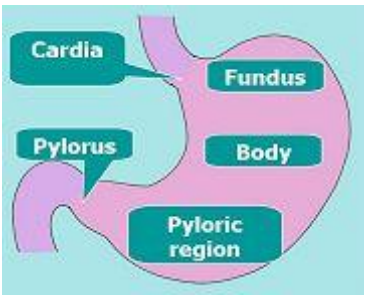
1.The transverse colon

A.is a retroperitoneal organ.
B.receives blood supply mainly from the superior mesenteric artery.
C.separates the greater and lesser sacs of peritoneum.
D.continues as the sigmoid colon.
E.develops from the junction of the foregut and the midgut.

The transverse colon has a mesentery (called transverse mesocolon). It is *not* retroperitoneal.
A matter of correlation : the transverse colon develops mainly from the midgut. The *left* end does develop from the hindgut, but it is a small part.
The transverse colon, with its mesocolon, forms a kind of shelf in the *abdomen*, dividing it into the *supra- and infracolic compartments*. Greater and lesser sacs are divisions of the *peritoneal cavity*, the lesser sac is behind the stomach, the greater sac being the rest of the cavity.
The transverse colon continues as the descending colon, not sigmoid colon.

2.The fundus of the stomach

A.is functionally a non-acid secreting part of the stomach.
B.is located under the left dome of the diaphragm.
C.has the greater omentum attached to it.
D.A and C are true.
E.B and C are true.



The diagram above shows the anatomical (topographical) parts of the stomach. Functionally, the fundus and the body are the acid secreting parts, the *pyloric part is the non-acid secreting* part.
The fundus *is* located under the left dome of the diaphragm. (Air in the fundus is usually seen as a dark area under the left dome in a plain x-ray of the abdomen).
The greater omentum hangs down from the greater curvature of the stomach, it is not attached at the fundus.

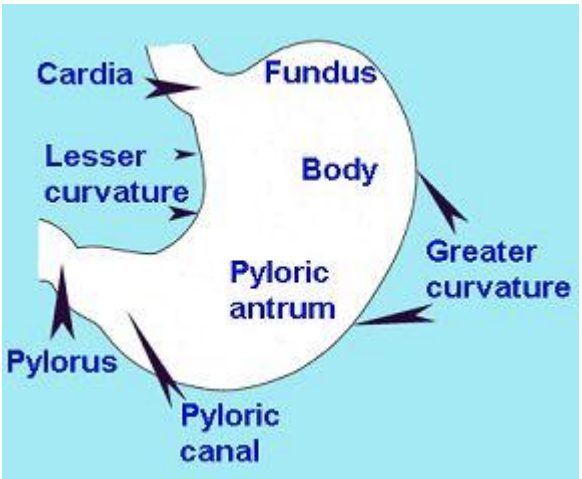
3.Structures which receive blood from the lateral branches of the abdominal aorta include the

A.kidneys.
B.duodenum.
C.ascending colon.
D.descending colon.
E.A, C and D.

Lateral branches of the aorta supply the "three paired structures", namely kidneys, adrenals and gonads. The ascending and descending colon may well be laterally located, but they develop as single midline structures and their arteries, superior and inferior mesenteric, are *anterior* branches of the aorta.

Short-answer questions.

1. Draw and label a simple line diagram to show the parts of the stomach. (2)



Well, a hand-drawn diagram may not look like this, but then it is *not* a test of artistic

skills!

The distinction between pyloric antrum and canal is not important here. The two can be described as the "pyloric part". In fact the boundaries between these regions are more functional and histological rather than gross anatomical. The body and the fundus are the "acid secreting" parts of the stomach.

Note that the last label is "pylorus". The pyloric sphincter is seen on the interior.

The features of the interior are not shown here. The mucosa of the stomach is thrown into folds called rugae, seen when the stomach is opened.

2. What are factors which maintain sphincteric action between the oesophagus and the stomach? (2)

There is *no* anatomical sphincter between the oesophagus and the stomach. The three factors said to responsible for sphincteric action are : Tone of smooth muscle, angulation between the oesophagus and the stomach and the right crus of the diaphragm.

Of these, the muscle tone is perhaps the most important physiological factor, governed by the vagus nerve. The other two factors are debatable. The angle (see the diagram above) is a likely mechanical factor - when the fundus is distended the angle becomes more acute and a flap of stomach wall presses against the oesophagus. The fibres of the right crus of the diaphragm are external and loop around the oesophagus. (See a diagram of the diaphragm).

3. Which artery supplies blood to the stomach? (1)

Coeliac artery.

The principle stressed here is that the stomach is a part of the abdominal foregut. For this unit, *the names of the branches of the coeliac artery need not be memorised*. Those are of surgical significance.

The only further detail that is significant at this level is that the arteries of the stomach form anastomotic channels along the curvatures of the stomach.

4. Name the peritoneal folds attached to the stomach and the border to which each one is attached. (2)

Greater and lesser omentum, attached to greater and lesser curvatures respectively.

This may be thought of as an anatomical, trivial detail. However, it illustrates the embryological fact that the lesser omentum is a part of the ventral mesogastrium and the greater omentum, of the dorsal mesogastrium. The curvatures represent the original ventral and dorsal borders of the stomach.

5. Explain in brief the basis for functional division of the liver into lobes. (2)

The portal vein, hepatic artery and the bile duct have right and left branches. All the right branches serve the same part of the liver which is the functional right lobe. The remaining part, served by the left branches, is the left lobe.

Anatomically we see well marked smaller regions, the quadrate and the caudate lobes, on the visceral surface of the liver. Both belong to the left lobe as described above.

(For those who care for details - well, not exactly, most of the caudate lobe! Also, to be on the correct side of the law, the bile duct has tributaries, not branches!!)

6. Describe in brief, gross anatomical terms, the blood circulation in the liver. (3)

The liver receives blood from the hepatic artery and the portal vein. The portal vein brings blood from the abdominal part of the digestive system. Blood from the liver is drained by the hepatic veins which join the inferior vena cava.

Blood from the two sources flows through the capillaries (called sinusoids) of the liver. The histological details are a part of the cell and tissue biology unit, and therefore need not feature here.

The functional importance is discussed in the next answer.

It is important not to confuse the portal vein with the hepatic veins - a very common mistake!

7. Explain in brief the functional importance of portal circulation with reference to the liver. (2)

The portal vein takes most of the absorbed food (and some unwanted substances!) from the abdominal gut to the liver. The liver stores or alters some of these depending on the needs of the body and redistributes them. The liver also destroys most poisonous substances ("detoxification") which are absorbed. For these reasons portal circulation is of great importance.

This answer, while satisfactory from a functional, gross anatomical viewpoint, is an oversimplification. Those who have studied the physiology and/or biochemistry pertaining to the liver know better! To give two examples :
a. Glucose which is not immediately needed by the body is converted to glycogen and stored in the liver.
b. The amino acids (building blocks for proteins) in our food are often not in the proportions required by the body. The liver alters some of these, and converts some into other amino acids ("deamination" and "transamination").

The detoxification function of the liver is usually uneventful, but the liver faces a great "occupational hazard" in doing this. Some of the toxins can seriously and / or irreversibly damage the liver.

Also bear in mind that these are just a few of the numerous functions of the liver! The (average) 1400 grammes of liver pack a chemical laboratory that, if constructed using our technology, would occupy a few buildings.

8. What are portasystemic anastomoses? State three such sites. (2)

The veins of the digestive tube form a continuous plexus (network) in the submucosal layer. Parts of the tube outside the abdomen drain into 'systemic' veins, leading to the heart. At the junctional regions therefore, there are communications between veins leading to the portal circulation and the systemic veins. These are portasystemic anastomoses. They can be present in nearby locations also.

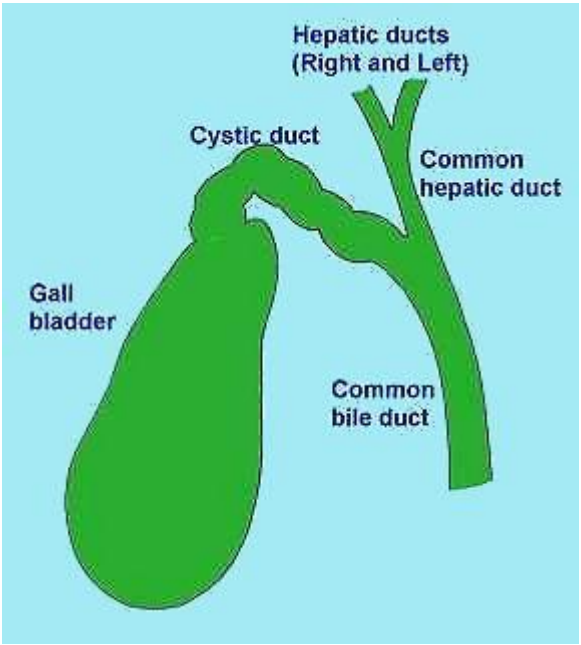
Three examples : Lower end of the oesophagus, Anal canal, Around the umbilicus.

The first two are clearly junctional areas. Blood in the oesophagus goes to the superior vena cava via the azygos vein, that in the stomach to the portal vein. At the other end, blood from the upper part of the anal canal goes to the portal vein, that from the lower part, to the inferior vena cava via the iliac veins. The case of the umbilicus is slightly different. Fine veins running along the ligamentum teres join the portal vein at one end, and veins of the skin around the umbilicus.

The term "portacaval" anastomoses. While this term may be used for portasystemic anastomoses and is in fact used sometimes, it creates an impression that the anastomoses are direct channels between the portal vein and one of the venae cavae. This is not accurate. There is only one channel, the ductus venosus, between the portal vein and the IVC. This channel functions only during foetal life.

The importance of portasystemic anastomoses : These delicate veins enlarge to allow drainage of blood from the gut if there is obstruction to portal flow as in some liver diseases. The umbilical anastomoses, when enlarged, are visible through the skin. The oesophageal anastomoses cannot be seen, but distension of these fine walled veins may cause them to burst, leading to massive, often fatal bleeding into the stomach.

9. Draw a simple line diagram to show the parts of the biliary apparatus. (2)



Again, a *simple line diagram*! No, you do *not* have to colour it!

It is just a matter of understanding the terminology. Bile is taken from the lobes of the liver by the two hepatic ducts (R and L), so the common duct is called the common hepatic duct. The duct of the gall bladder is the cystic duct. The final common duct is therefore the common bile duct. This opens in the duodenum. (The CBD is much longer than shown here, it passes behind the duodenum before opening in it - but that is a matter of surgical detail again.

10. Describe the internal features of the duodenum. (2)

Like the rest of the small intestine, the mucosa of the duodenum is thrown into incomplete circular folds (plicae circulares), except in the first one inch. The middle of the duodenum (the vertical part) has an elevation, the major papilla, on which the combined bile-pancreatic duct opens.

The 'traditional' division of the duodenum into four parts is of topographical importance only.

The first inch lacks the circular folds, and is seen as a caplike area with smooth outline in a barium X-ray image.

In addition to the major papilla the middle of the duodenum shows a smaller papilla with the opening of the accessory duct of the pancreas.

It is of embryological interest that the junction between the foregut and the midgut is in the middle of the duodenum.

The plicae circulares (*plica* = fold) increase the surface area of the duodenum.

11. State three features which distinguish the jejunum from the ileum. (3)

The jejunum has a thicker wall, larger plicae circulares and lacks Peyer's patches.

It is important to note that there no sharp anatomical boundary between the jejunum and the ileum. The transition is gradual.

Some more differences may be cited. At a microscopic level the villi (epithelial folds) are larger in the jejunum (this again is a matter of transition right from the duodenum to the terminal ileum). On the topic of blood vessels : the arteries of the jejunum branch fewer times, with fewer 'arcades' in the case of the jejunum.

Regarding Peyer's patches. Remember that aggregations of lymphoid tissue in the mucosa are present all throughout the small intestine. These are usually small. In the *ileum*, where they are called Peyer's patches, the aggregates are large enough to be seen through the wall, and are along the border opposite the attachment of the mesentery ("antimesenteric" border). Also note that with advancing age the patches become smaller and fewer and are rarely if at all seen in the elderly.

In a lean subject the mesentery of the jejunum is almost free of fat, the amount of fat increases as one inspects towards the ileum. Where the abdominal fat is in general

greater in amount, this difference is irrelevant.

12. State two characteristic gross anatomical features of the colon. (2)

Haustrations and taeniae coli.

Taeniae coli are three bands running longitudinally along the colon. These are condensations of the outer layer of the muscle in the wall. These bands "gather" the colonic wall into pouchlike areas called haustrations. Haustrations give rise to the characteristic appearance of the colon in a barium image.

13. Explain the term "secondarily retroperitoneal organ". (1)

An organ which has a mesentery during development but loses it later is a secondary retroperitoneal organ.

For example, duodenum, ascending and descending colon.

The kidneys are primarily retroperitoneal - they do not a mesentery to begin with, they develop in the tissues dorsal to the cavity.

14. Correlate the development and blood supply of the colon. (2)

The caecum, ascending colon and a large part of the transverse colon develop from the midgut and are therefore supplied by the superior mesenteric artery. The left end of the transverse colon, descending and sigmoid colon, rectum and the upper part of the anal canal develop from the hindgut and are supplied by the inferior mesenteric artery.

Correlation here refers to the explanation of gross anatomical features on the basis of embryonic development.

15. List the structures which develop from the abdominal foregut, the midgut and the hindgut. (5)

Foregut : Lower end of oesophagus, stomach and the upper (proximal) half of the duodenum.
Midgut : Distal half of duodenum, entire jejunum and ileum, caecum and appendix, ascending and a large part of transverse colon.
Hindgut : Left end of the transverse colon, descending and sigmoid colon, rectum and upper part of the anal canal.

The pancreas and the liver-biliary system develop from the junction of the foregut and the midgut.

This question can be split into three separate questions!

A little detail (*for those who may be interested*!) : The pancreas always receives blood supply from branches of both coeliac and superior mesenteric arteries. The liver receives arterial blood from the hepatic artery which is a branch of the coeliac. But the blood supply to a part of the liver (usually the right portion) and the gall bladder sometimes comes from the superior mesenteric artery.

16. Describe in brief the overall pattern of branches of the abdominal aorta. (4)

From the anterior side of the aorta arise the three unpaired branches to the gut (coeliac, sup. mesenteric and inf. mesenteric).
From its lateral side paired branches to the suprarenal (adrenal) glands, kidneys and the gonads (testes or ovaries) are given.
From its posterior/lateral side arise branches to the body wall - the vertebrae and the associated muscles.

This is easily explained by the development of these structures! The gut develops as an unpaired tube on the ventral side of the aorta. The kidneys, parts of the adrenals and the gonads develop as paired structures from the intermediate mesoderm.

Description of the branches to the remaining structures is a matter of topographic detail.

17. What is Meckel's diverticulum? (2)

It is a persistent vitellointestinal duct. This duct, which is a communication between the apex of the midgut loop and the yolk sac, normally disappears.

The diverticulum, which is present in approximately 2% of the population, is on an average 5 cm (2") in length and about 60 cm (2') *proximal* to the caecum.

This question simply stresses the embryological phenomenon of persistence of structures which otherwise should disappear. It is worth remembering that in such abnormally persistent structures, other abnormalities are not unexpected. In this case, for example, the histological structure of the lining may be that of the stomach or the pancreas.