CHAPTER 61
Medical parasitology

QUESTIONS

Q 1

The optimal blood specimen is not often provided for malaria smears. State what this specimen is and also what the second choice is in terms of anticoagulant. *(p. 1121)*

Q 2

What is the only stain that allows visualization of erythrocyte stippling in malaria smears? *(p. 1121)*

Q 3

Which two fecal matter fixatives contain mercury and are thus difficult to dispose of safely in the laboratory? *(p. 1122)*

Q 4

What are the three types of microscopic examination routinely performed on stool specimens? *(p. 1123)*

Q 5

What three organisms may be better visualized with either a modified iron hematoxylin or modified acid-fast stain? Discuss the sensitivity and specificity of the acid-fast stain for these organisms. *(p. 1123)*

Q 6

Several human cells and types of organic material resemble parasites and can make diagnosis challenging. What do *Entamoeba histolytica* trophozoites look like? *(Table 61–4, p. 1124)*

Q 7

Review the lifecycle of Plasmodium species by stating whether the following events or parasite forms are found in the mosquito or in humans. *(Fig. 61–1, pp. 1128–1130)*

Fertilization of macrogamete: _____

Immature schizont: _____

Release of merezoites: _____

Liberation of sporozoites: _____

Mature schizont: _____

Q 8

Differentiate between true disease relapse and recrudescence in malaria and state which Plasmodium species exhibit each. *(pp. 1128–1129)*

Q 9

Clinical Consultation: A 23-year-old female returned from a 1-week trip to West Africa 3 months ago and has complained of fevers and chills for the past week. She is now hospitalized and is noted to have fevers to 102.5°F every other day at about 2:00pm. The clinician suspects malaria. Based on her history and fever curve, what two species are now unlikely or at least less likely? *(Table 61–8, pp. 1130–1133)*

Using what you learned from question 1 in this chapter and the guidance on *page 1121*, what do you recommend for collection of a blood sample?

What age of red blood cells (RBCs) will you pay particular attention to in your microscopic examination?

You find several intracellular parasites on the thick smear, and note ameboid forms, Shüffner's dots, and 13–16 merozoites in the few mature schizonts you find. You diagnose:

The woman then reveals to the clinician that her brother had an episode of hemolytic anemia when he was treated for vivax malaria last year. She wonders if she is at risk for hemolysis. Is she? Explain your answer.

Q 10

Are both trophozoites and gametocytes seen in humans with babesiosis? *(p. 1134)*

Q 11

Review the morphologic forms of the two important genera of hemoflagellates, stating which form is found in which vector or host. *(pp. 1134–1135)*

Leishmania spp. in humans: _____

Trypanosoma cruzi tissue in humans: _____

Leishmania spp. in insect vector: _____

Trypanosoma in insect vector: _____

Trypanosoma in bloodstream in humans: _____

Q 12

Compare and contrast the trypanosomiases. *(p. 1135)*

	East African	West African	American
Hemoflagellate			
Vector			
Illness severity (describe)			
Length of parasite (blood)			

Q 13

Review the major hemoflagellates causing the various forms of leishmaniasis. *(pp. 1135–1136)*

L. donovani causes _____

L. braziliensis causes the aggressive _____

L. mexicana and *L. braziliensis* cause the less severe New World _____

L. tropica and *L. major* cause Old World _____

Q 14

How will you distinguish *Leishmania* spp. from *Histoplasma capsulatum* in a tissue biopsy? *(p. 1136)*

Q 15

What three types of serologic tests are employed to diagnose toxoplasmosis? *(p. 1137)*

Q 16

What is the etiologic agent of primary amebic meningoencephalitis? *(p. 1137)*

Q 17

What genus causes granulomatous amebic meningoencephalitis, and keratitis in contact lens wearers? *(p. 1138)*

Q 18

List the three genera of ameba that inhabit the intestinal tract of humans. *(p. 1138)*

Q 19

The only amebic species that is invasive and causes disease in humans is *Entamoeba histolytica*. What nonpathogenic species looks identical to *E. histolytica* in stool specimens? *(p. 1139)*

What commercially available test will discriminate between the two?

Q 20

How useful is the serologic test for diagnosing amebic liver abscess if stool samples are negative? *(p. 1139)*

Q 21

Differentiating between Entamoeba histolytica and the nonpathogenic Entamoeba coli is challenging. Erythrophagocytosis by a trophozoite, if present, is diagnostic for E. histolytica. Otherwise, cyst forms may be compared and contrasted. Review these. *(Table 61–10, p. 1142)*

	E. histolytica	*E. coli*
Usual size		
No. of nuclei (mature cyst)		
Appearance of chromatid bodies		

Q 22

Dientamoeba fragilis is an ameboid flagellate which causes diarrhea, often in young children. Trophozoites are roughly 10 μm, with binucleation being the predominant form. A positive specimen should raise suspicion for what other intestinal parasite? *(p. 1142)*

Q 23

Describe in the box below how you can differentiate between *Giardia lamblia* and *Chilomastix mesnili*. *(Figs. 61–13 and 61–14, pp. 1143–1144)*

	G. lamblia	*C. mesnili*
Nuclei in trophs		
Nuclei in cysts		
Patient symptoms		

Q 24

Clinical Consultation: A 48-year-old male pig farmer has had diarrhea for 1 week. Colonoscopy showed ulcerations, and a biopsy was performed. List some of the morphologic features that will help you diagnose *Balantidium coli*. *(p. 1144)*

Q 25

List the four coccidian parasite genera that infect humans. *(p. 1144)*

Q 26

State how the size of the organism will distinguish oocysts of *Cryptosporidium parvum* from those of *Cyclospora cayetanensis* on an acid-fast preparation of a stool specimen. *(pp. 1145–1146)*

Q 27

Describe the appearance of microsporidia on a modified trichrome stain. *(p. 1146)*

Color: _____

Size: _____

Shape: _____

Q 28

The Cellophane test is the method of choice for diagnosing *Enterobius vermicularis*. Adult females measuring up to _____ in length and colorless ovoid eggs _____ long are easily identified. *(Fig. 61–16, p. 1147)*

Q 29

How does pneumonitis occur in ascariasis if ova are ingested orally, and the adults live in the duodenum and jejunum? *(p. 1148)*

Q 30

Describe how the buccal chamber morphology can be used to distinguish between rhabditoid larvae of hookworms and *Strongyloides stercoralis*. *(Fig. 61–19, pp. 1149–1150)*

Q 31

Like *Ascaris lumbricoides*, *Strongyloides stercoralis* adults live in the duodenum and may cause Löffler syndrome/pneumonitis in the migration stage. They differ from *A. lumbricoides* in several ways. Outline these by reviewing the life cycle of *S. stercoralis*. *(pp. 1149–1150)*

How parasite enters host (human): _____

Form found in stool specimens: _____

Variant of life cycle in immunosuppressed host: _____

Q 32

How may the number of lateral branches of a gravid uterus differentiate between *Taenia saginata* and *T. solium*? *(Fig. 61–21, p. 1150)*

Q 33

Infection with the pork tapeworm and cysticercosis are not acquired in the same way and are not interchangeable terms. Distinguish between the two. *(pp. 1150–1151, 1157)*

Q 34

The common first intermediate host of all trematodes is: *(p. 1152)*

Q 35

Differentiation between the ova of *Fasciolopsis buski* and those of *Fasciola hepatica* is not usually possible. What clinical symptoms or laboratory tests would suggest one fluke over the other? *(pp. 1152–1153)*

Q 36

Longstanding infection with *Clonorchis sinensis* is linked to what malignancy? *(p. 1153)*

Q 37

Both *Fasciola hepatica* and the lung fluke *Paragonimus westermani* have unembryonated, operculated ova. Describe the size difference that distinguishes the two. *(Fig. 61–16, pp. 1147, 1153)*

Q 38

What form/stage of the schistosome penetrates the skin of humans? *(p. 1154)*

Q 39

Which two species of *Schistosoma* have a lateral spine? *(p. 1154)*

Q 40

Review the periodicity of the common filarial worms by stating the optimal time to draw blood for examination. *(p. 1155)*

Wuchereria bancrofti: _____

Brugia malayi: _____

Loa loa: _____

Mansonella spp: _____

Q 41

Differentiation of the filarial worm is based on morphology, but there may be other clues to their identity on an exam question, such as the insect vector. Review both of these features. *(Figure 61 –25, pp. 1155–1156)*

	Sheath	Nuclei in tail tip	Vector(s)
Wuchereria bancrofti			
Brugia malayi			
Loa loa			
Onchocerca volvulus			
Mansonella spp.			

Q 42

Clinical Consultation: A 10-year-old boy whose parents are sheep farmers develops abdominal pain and is found to have a single, unilocular, 9 cm cyst filled with clear fluid in his liver. His primary chore at home is to clean up after the family's Australian shepherd dog. Give three species of cestode, from two genera, that are diagnostic possibilities. *(pp. 1158–1159)*

ANSWERS

A1. A drop of fresh blood, directly from a finger stick or syringe, is preferred because it does not distort the parasite. If anticoagulant must be used, then ethylenediaminetetraacetic acid (EDTA) is preferred.

A2. Giemsa stain will allow for visualization of the Shüffner's dots.

A3. Schaudinn's and polyvinyl alcohol (PVA) both contain mercury. The modified PVA fixatives replace mercury with either zinc sulfate or copper sulfate.

A4. The three basic examinations are the direct wet mount with a drop of saline or iodine, the wet mount of a concentrate, and the permanent stain. The direct mount is best for identifying motility, the concentration method is more sensitive if few organisms are present, and the stains can bring out small organisms such as amebae.

A5. The oocysts of *Cryptosporidium*, *Cyclospora*, and *Isospora* are better visualized with these stains than with Wheatley's trichrome, so this is a more sensitive method. It is not, however, specific, and careful attention must be paid to size and comparison with positive controls.

A6. *E. histolytica* trophozoites resemble macrophages, which are likely to be present in the specimen along with parasites.

A7. Fertilization of the macrogamete and liberation of sporozoites occur in the mosquito. Both schizont forms and the release of merozoites occur in humans.

A8. True disease relapse occurs when there is a renewal of exoerythrocytic schizony by latent hepatic sporozoites, called hypnozoites. This occurs with *P. vivax* and *P. ovale*.

Recrudescence does not involve the liver. It is a rise in parasitemia from undetectable to clinically detectable levels. It occurs with *P. falciparum* and *P. malariae*.

A9. *P. falciparum* usually presents within 1 month, and *P. malariae* has quartan periodicity, so these are less likely.

Collect blood by syringe or fingerstick near 2:00 pm on a 'febrile' day.
Examine the smear for younger red blood cells (reticulocytes).
Diagnosis: *P. vivax*.

If this woman is a heterozygote with a dual population of red blood cells, she may experience some degree of hemolysis, but not as severe as her brother's.

A10. No, just trophozoites. As *P. falciparum* often shows only the ring forms, distinguishing between the two with no travel history can be tough.

A11. *Leishmania* and *T. cruzi* in humans are in the amastigote form.
The promastigote is found in the insect vector for *Leishmania*.
The epimastigote form is in the insect vector for *Trypanosoma*.
The trypomastigote is found in the bloodstream of humans.

A12. East African trypanosomiasis is caused by *Trypanosoma brucei rhodesiense*, 30 μm long, carried by the tsetse fly, *Glossina* spp. It is rapidly fatal.

West African trypanosomiasis is caused by *T. brucei gambiense*, 30 μm long, also carried by *Glossina* spp. flies. It is more chronic, but can be fatal.

American trypanosomiasis (Chagas disease) is caused by *Trypanosoma cruzi*, 20 μm long, carried by the reduviid bug. It may have an acute or chronic course.

A13. *L. donovani* – visceral form.
L. braziliensis – mucocutaneous.
L. mexicana and *L. braziliensis* – New World cutaneous.
L. tropica and *L. major* – Old World cutaneous.

A14. *Leishmania* have a kinetoplast but lack a cell wall. *H. capsulatum* lacks the kinetoplast but its cell wall may stain with Gomori's methenamine silver or periodic-acid–Schiff.

A15. Sabin–Feldman (an antibody titer), indirect fluorescent antibody (IFA), and enzyme immunoassay (EIA).

A16. *Naegleria fowleri*. This is nearly always fatal.

A17. *Acanthamoeba* spp. are classically associated with keratitis in contact lens wearers.

A18. These are *Entamoeba*, *Endolimax*, and *Iodamoeba*.

A19. *E. dispar* is the nonpathogen. EIA antigen detection can help distinguish the two.

A20. Very useful. It has a 95% sensitivity if one has a liver abscess. By contrast, serologies are much less often positive (10%) in asymptomatic carriers.

A21. *E. histolytica* and *E. coli* cysts are nearly the same size, with *E. coli* a little larger (15–25 μm vs 12–15 μm). *E. histolytica* cysts have four nuclei and blunt or rounded chromatoidal bodies. E. coli cysts have eight nuclei and splintered or pointed chromatoidal bodies.

A22. *Enterobius vermicularis*, the agent of pinworms.

A23. *G. lamblia* has two nuclei in the trophozoite and four in the cyst stage. It also causes diarrhea. *C. mesnili*, in contrast, has just one nucleus in either stage and is nonpathogenic. If a person is symptomatic, and one finds only *C. mesnili*, one must continue to search for a cause.

A24. *B. coli* is the largest parasite one will see under the microscope. The trophozoite is 50–100 μm, and the cyst is 50–70 μm. It is ciliated, another feature that makes it unique among pathogens. It has a large macronucleus and many cytoplasmic food vacuoles.

A25. *Isospora*, *Sarcocystis*, *Cryptosporidium*, and *Cyclospora* are the four coccidians that infect humans.

A26. *C. parvum* is just 4–6 μm in diameter, while *C. cayetanensis* is 8–10 μm.

A27. Microsporidia are extremely small, but the modified trichrome stain helps bring them out. They are elliptical in shape, just 1.5–3 μm in size, and red with this stain.

A28. Adults are up to 13 µmm long, and ova are 50–60 µm in length.

A29. Ingested eggs hatch in the intestine and migrate through the wall of the bowel as larvae to enter the bloodstream. They travel to the lungs and mature briefly in the alveolar capillaries before being coughed up, swallowed, and returning to the intestines, where they mature into adults. A large load of larvae in a person previously sensitized to *Ascaris lumbricoides* can lead to an allergic reaction.

A30. *Strongyloides* has a short buccal cavity, about as long as the (narrowed) anterior tip is wide. Hookworms have a longer buccal cavity, about as long as the body is wide.

A31. Humans are infected by penetration of the skin by infective (third-stage) larvae. They pass first-stage larvae in their stool, and rarely pass ova. Autoinfection can occur in the debilitated host.

A32. *T. saginata* has 15–20 branches, while *T. solium* has 7–13.

A33. Ingestion of undercooked pork containing cysticerci results in the tapeworm developing in the gut and passage of *T. solium* ova in the feces. This is mildly debilitating. Ingestion of *T. solium* eggs, from one's own tapeworm or from poor hygiene, with spreading of the ova to others, causes cysticercosis. This is a serious, often fatal illness.

A34. The snail is the common intermediate host. Many trematodes have a second intermediate host, such as a fish or crab.

A35. *F. buski* causes diarrhea and nausea. The geographic range is south-east Asia, China, and India and is found in people who eat water chestnuts (and possibly have contact with pigs). Peripheral blood eosinophilia may be seen even in asymptomatic persons. *F. hepatica*, with a wider geographic distribution and acquired by ingestion of watercress, causes biliary colic and obstructive jaundice, so an elevated direct bilirubin or alkaline phosphatase might be helpful. Eosinophilia would be seen with *F. hepatica* as well, so this would not be a useful discriminator.

A36. Cholangiocarcinoma is an adverse outcome associated with chronic *Clonorchis* infestations.

A37. *F. hepatica* is about 140 µm long, while *P. westermani* is about 90 µm.

A38. The cercaria stage penetrates the intact skin of humans.

A39. Both *S. mansoni* and *S. japonicum* have lateral spines, but they are often poorly visible in *S. japonicum*.

A40. Both *W. bancrofti* and *B. malayi* are nocturnal, so 10:00 pm to 2:00 am is the recommended time to draw blood. *L. loa* is best harvested at noon. *Mansonella* spp. lack periodicity and can be found any time.

A41. *W. bancrofti* have a sheath, have no nuclei in the tail, and are transmitted by several mosquito vectors – *Culex*, *Aedes*, and *Anopheles*.

B. malayi have a sheath, have two nuclei in the tail, and are transmitted by *Aedes*, *Anopheles*, and *Mansoni* spp. mosquitos.

L. loa has a sheath, has some nuclei in the tail, and is transmitted by the *Chrysops* deer fly.

O. volvulus lacks a sheath, has no nuclei in the tail, and is transmitted by the *Simulium* black fly.

Mansonella spp. lack a sheath, have nuclei in the tail, and are transmitted by *Culicoides* gnats.

A42. *Echinococcus granulosus* is associated with sheep and is probably the first choice. Also consider the dog or cat tapeworms *Taenia multiceps* or *Taenia serialis* in this case.