

Cardiovascular

Questions

EMBRYOLOGY

1. In the embryonic heart, the right common cardinal vein and the right anterior cardinal vein jointly give rise to which vein in the adult? (p 278) _____
2. Which embryonic shunt diverts oxygenated blood from the inferior vena cava into the left atrium, and what is its postnatal derivative? (p 280) _____
3. Which embryonic shunt directs oxygenated blood into the IVC, bypassing hepatic circulation, and what is its postnatal derivative? (p 280) _____
4. Which embryonic shunt bypasses the high-resistance pulmonary circulation, and what is its postnatal derivative? (p 280) _____
5. What is the approximate oxygen saturation (%) of the blood returning from the placenta in the umbilical vein? (p 280) _____
6. Which drug is commonly used to close the ductus arteriosus? What can be used to keep it open? (p 280) _____

ANATOMY

7. If the right coronary artery supplies the inferior portion of the left ventricle via the posterior descending artery, is the heart right- or left-dominant? (p 281) _____

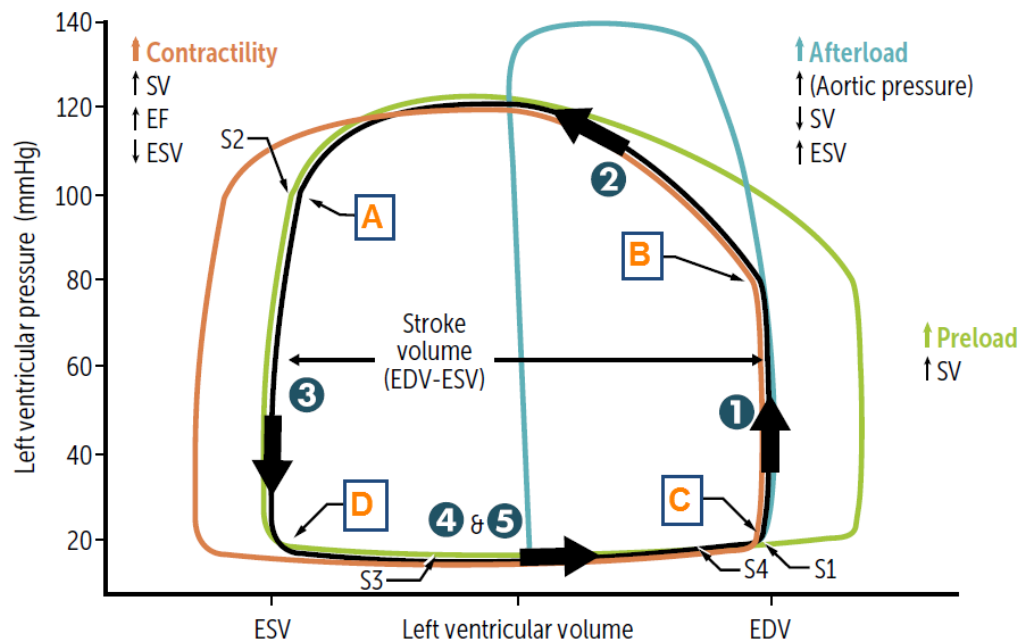
8. A patient has a myocardial infarction that damages the anterior interventricular septum. Which coronary artery is occluded? (p 281) _____
9. The left anterior descending artery and its branches supply _____ papillary muscle, while the posterior descending artery supplies _____ papillary muscle. (p 281)
10. Enlargement of the left atrium can compress the recurrent laryngeal nerve, causing _____, or compress the esophagus, causing _____. (p 281)

PHYSIOLOGY

11. With an increase in stroke volume, the heart would be expected to _____ (decrease/increase) in preload, to _____ (decrease/increase) in afterload, and to _____ (decrease/increase) in contractility. (p 282)
12. A 25-year-old athlete begins training for the Olympics. As she runs her standard 3 miles, is the increased oxygen demand of the heart met by increased coronary blood flow or by increased extraction of oxygen? (p 282-283) _____

13. A 60-year-old man receives an intravenous injection of epinephrine. Would his contractility increase or decrease? (p 282) _____
14. Cardiac output (CO) = heart rate (HR) × _____. (p 283)
15. Write the equation for calculating ejection fraction (p 283) _____
16. Which blood vessels account for most of total peripheral resistance? (p 284) _____
17. Which parameter does the viscosity of blood mostly depend on? (p 284) _____
18. A 23-year-old man has significant blood loss after a motor vehicle accident. A decrease in blood volume leads to _____ (increased/decreased) right atrial pressure and to _____ (increased/decreased) cardiac output. (p 284)

19. A 76-year-old man with congestive heart failure is given digoxin as a positive inotrope. An increase in inotropy leads to _____ (increased/decreased) cardiac output and to _____ (increased/decreased) right atrial pressure. (p 284)
20. A 10-year-old boy presents with dehydration following acute diarrhea. He receives 2 liters of normal saline. An increase in blood volume leads to _____ (increased/decreased) right atrial pressure and to _____ (increased/decreased) cardiac output. (p 284)
21. Fill in the blanks A–D with the correct valvular event that occurs at each stage of the left ventricular cardiac cycle. Then fill in the blanks 1–5 with the correct phase of the left ventricular cardiac cycle. (p 285)



A. _____

1. _____

B. _____

2. _____

C. _____

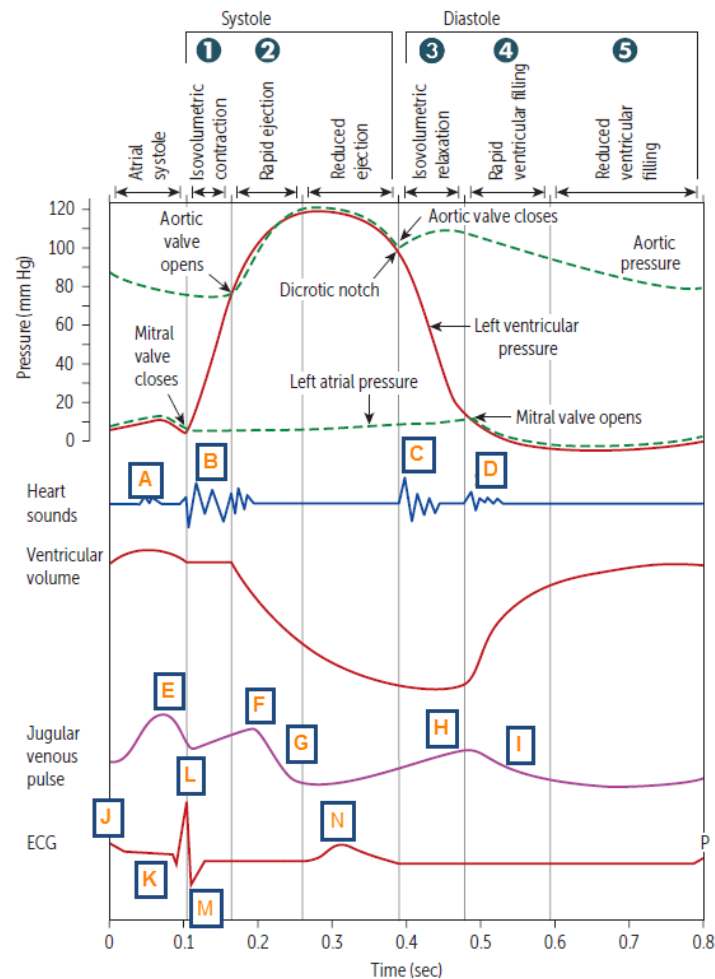
3. _____

D. _____

4. _____

5. _____

22. Fill in the blanks A–N with the correct heart sound, jugular venous pulse waveform, or ECG waveform. (Numbers refer to numbers in image in question 21.) (p 285, 291)



A. _____

H. _____

B. _____

I. _____

C. _____

J. _____

D. _____

K. _____

E. _____

L. _____

F. _____

M. _____

G. _____

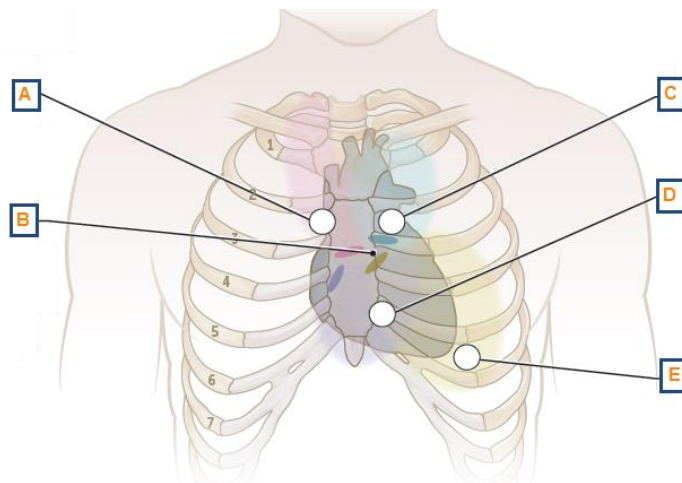
N. _____

23. Describe the pressures in the left ventricle and aorta for a patient with aortic stenosis. (p 286)

24. In normal splitting of the S₁ heart sound, the pulmonic valve closes later during inspiration due to _____ (increased/decreased) blood flow over the pulmonic valve. (p 287)

25. On auscultation of a patient with an atrial septal defect during inspiration, does the time between pulmonic and aortic valvular closure increase, decrease, or stay the same? (p 287)

26. Fill in the blanks A-E with the correct auscultation site. (p 288)



A. _____

D. _____

B. _____

E. _____

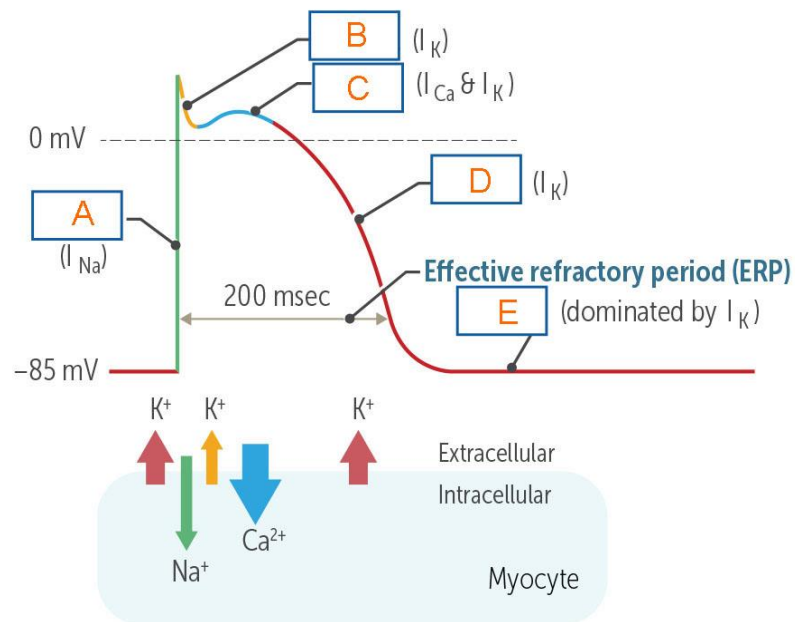
C. _____

27. Name three pathological processes that can cause mitral regurgitation. (p 289) _____

28. Name four pathological processes that can cause aortic regurgitation. (p 289) _____

29. When listening to a patient's heart, you hear a high-pitched holosystolic murmur loudest at the apex that does not increase in intensity with inspiration. You also notice that it radiates toward axilla. What is the most likely cause of this murmur? (p 289) _____
30. Which murmur is often caused by age-related calcification? (p 289) _____
31. How is cardiac myocyte physiology different from that in skeletal muscle? (p 290) _____

32. Fill in the blanks (A–E) with the correct phase of the myocardial action potential and the ionic current responsible for each phase. (p 290)



A. _____

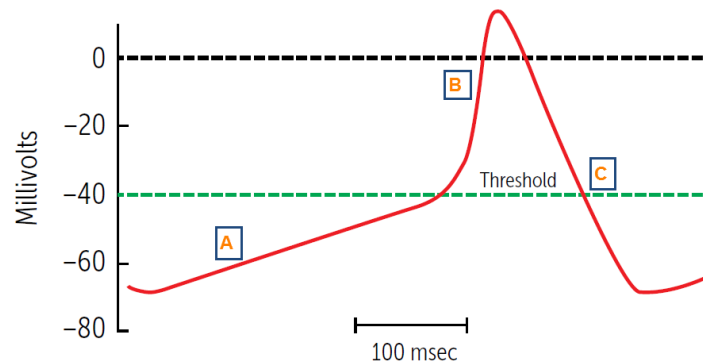
D. _____

B. _____

E. _____

C. _____

33. Fill in the blanks A–C with the correct phase of the pacemaker action potential and the ionic current responsible for each phase. (p 290)



A. _____ C. _____

B. _____

34. As compared with the myocardial action potential, which phases are absent from the pacemaker potential? (p 290) _____
35. Describe the ECG of patient with torsades de pointes. What is a potentially dangerous sequelae of this arrhythmia? (p 292) _____
36. A 67-year-old man has an irregularly irregular ECG tracing during a routine visit to his doctor. What is his most likely diagnosis and what does the treatment regimen include? (p 293) _____
37. The ECG tracing of a 73-year-old woman shows a "sawtooth" pattern. What is her diagnosis and what can be done to treat her condition? (p 293) _____
38. Progressive lengthening of the PR interval takes place in _____ (Mobitz type I/Mobitz type II/both Mobitz type I and type II) heart block. (p 293)

39. An ECG shows an erratic rhythm with no identifiable waveform. What is the most likely diagnosis? (p 293) _____
40. A 65-year-old man presents with an ECG tracing displaying P waves and QRS complexes that are not rhythmically associated. Which therapeutic intervention would be most appropriate? (p 293) _____
41. Which infectious disease can cause third-degree (complete) AV block? (p 293) _____
42. What chemical changes of blood elicit a response from peripheral chemoreceptors? How do central chemoreceptors differ? (p 294) _____
43. In the lungs, what is the physiologic advantage of vasoconstriction in response to hypoxia? (p 295) _____
44. An 80-year-old man with a history of right-sided heart failure presents with bilateral ankle edema. In terms of capillary fluid exchange, what is the mechanism by which his edema developed? (p 295, 306) _____
45. A 55-year-old man with longstanding alcoholic cirrhosis presents with bilateral pedal edema and ascites. In terms of capillary fluid exchange, what is the mechanism by which his edema developed? (p 295) _____
46. A 43-year-old woman presents with bilateral pitting leg edema. Laboratory results are remarkable for high low-density lipoprotein, low albumin, and proteinuria (nephrotic syndrome). In terms of capillary fluid exchange, what is the mechanism by which her edema developed? (p 295) _____

47. A 50-year-old Ethiopian man presents with severe bilateral leg and scrotal edema due to elephantiasis. In terms of capillary fluid exchange, what is the mechanism by which his edema developed? (p 295) _____
- _____

PATHOLOGY

48. How do neonates with tricuspid atresia remain viable given their severely compromised circulation? (p 296) _____
49. What are the four clinical features of tetralogy of Fallot? (p 296) _____
- _____
50. What must be present for a fetus with D-transposition of great vessels to remain viable? (p 296)
- _____
- _____
51. What physical exam findings are associated with coarctation of the aorta? (p 297) _____
- _____
- _____
52. Describe the murmur of patent ductus arteriosus. (p 297) _____
53. Which three cardiac defects are associated with Down syndrome? (p 298) _____
- _____
54. List the risk factors for primary hypertension. (p 298) _____
- _____
55. An 80-year-old veteran is told by his physician that he has calcification of medium-sized arteries and that the condition is relatively benign as it does not obstruct blood flow. What disease does he have? (p 299) _____

56. List six complications of atherosclerosis. (p 300) _____

57. A patient presents to the emergency department with tearing chest pain radiating to the back and dies soon after presentation. What would most likely be seen on x-ray of the chest? What vascular pathology would most likely be seen at autopsy? (p 301) _____

58. At what point is ischemic heart disease given the term "myocardial infarction"? (p 301)

59. ST-segment elevation MI on an ECG indicates _____ (subendocardial/transmural) infarction of the myocardium, but Non-ST-segment elevation MI indicates _____ (subendocardial/transmural) infarction. (p 301)
60. List eight symptoms of a myocardial infarction. (p 302) _____

61. Describe the time frame for events after a myocardial infarction. (p 302)
- A. Early coagulative necrosis becomes apparent _____
 - B. Extensive coagulative necrosis. Tissue around infarct shows acute inflammation with neutrophils _____
 - C. Macrophages, then granulation tissue at margins appear _____
 - D. Contracted scar complete _____
62. After a myocardial infarction, when is the patient at the greatest risk for the development of an arrhythmia? When is the risk for free wall rupture or interventricular septal rupture the greatest? When is the risk for ventricular aneurysm the greatest? (p 302) _____

63. Which ECG leads are best for diagnosing an infarct of the left anterior descending artery? (p 303)

64. Six days after having a myocardial infarction, a patient presents with a new-onset murmur. Which type of murmur is the most likely? (p 304) _____

65. A 16-year-old boy presents for a school physical. Physical examination reveals a 3/6 systolic murmur at the left sternal border. Upon questioning, he mentions that he has had several fainting episodes. His father, a former soccer player, had similar episodes and died suddenly at the age of 25 years. What is this patient's most likely diagnosis? What would a cardiac biopsy specimen reveal? (p 305)

66. In heart failure, _____ (increased/decreased) cardiac output leads to _____ (increased/decreased) activity of renin-angiotensin-aldosterone, which leads to _____ (increased/decreased) systemic venous pressure, and ultimately the physical finding of _____ (peripheral/pulmonary) edema. (p 306)

67. In heart failure, _____ (increased/decreased) left ventricular contractility leads to _____ (increased/decreased) pulmonary venous pressure, ultimately leading to _____ (peripheral/pulmonary) edema. (p 306)

68. With respect to bacterial endocarditis, what symptoms and signs are represented by the mnemonic **FROM JANE**? (p 307) _____

69. Rheumatic fever is a secondary to infection by which organism? (p 308) _____

70. List the components of the **J♥NES** mnemonic for rheumatic heart disease. (p 308) _____

71. What symptoms might patients with myocarditis display? (p 309) _____

72. What physical exam findings are associated with cardiac tamponade? (p 309) _____

73. A 70-year-old former prostitute presents chest pain radiating to the back and worsening shortness of breath. Her cardiac enzymes are negative and she has no ST changes on ECG. Echocardiography shows aortic regurgitation and a dilated aortic root. Laboratory tests are significant for a positive rapid plasma reagin. What is the most likely cause of her pain and shortness of breath? (p 309)

74. Which three clinical findings are associated with Buerger disease? (p 310) _____

75. A 7-year-old Japanese child presents with a 1-week history of fever, erythema of the conjunctiva and tongue, and desquamation of the palms of the hands. What is the most likely diagnosis? What is the preferred treatment? (p 310) _____

76. Which infectious disease is strongly associated with polyarteritis nodosa? (p 310) _____

77. What are the arteriogram findings seen in polyarteritis nodosa? (p 310) _____

78. A 75-year-old woman presents with new-onset right jaw pain and headache at the right temple. What is the most likely diagnosis? (p 310) _____
79. Temporal arteritis is associated with what laboratory finding? (p 310) _____

80. List nine signs or symptoms of granulomatosis with polyangiitis (Wegener). (p 311) _____

81. In eosinophilic granulomatosis with polyangiitis (Churg-Strauss), the patient will test positively for _____ (MPO-ANCA/p-ANCA or PR3-ANCA/c-ANCA) in the serum. In granulomatosis with polyangiitis (Wegener), the patient will test positively for _____ (MPO-ANCA/p-ANCA or PR3-ANCA/c-ANCA). (p 311)
82. Patients with Churg-Strauss syndrome usually present with which signs and symptoms? (p 311)

83. A 7-year-old boy with a recent viral upper respiratory tract infection now presents with worsening abdominal pain. Purpura develops on his legs. What is the most likely diagnosis? (p 311)

84. Which cardiac tumor may present with multiple syncopal episodes? (p 312) _____

PHARMACOLOGY

85. Why are angiotensin-converting enzyme inhibitors especially important for patients with diabetes mellitus? (p 312) _____
86. What four agents are first-line therapy for hypertension in pregnancy? (p 312) _____

87. A patient is started on antihypertensive therapy. One week later he returns, complaining of swollen ankles. Which class of medication was he likely prescribed? (p 313) _____

88. List four adverse effects of nitroglycerin. (p 313) _____

89. What is the effect of nitrates on contractility? What is the effect of nitrates with β -blockers on contractility? (p 314) _____
90. By which mechanism can medications reduce angina? (p 314) _____

91. What are the adverse effects of Sacubitril? (p 314) _____

92. A 50-year-old man with hypercholesterolemia is deficient in vitamins A, D, E, and K. He also complains of gastrointestinal discomfort since starting a lipid-lowering agent. Which lipid-lowering agent is the most likely cause? (p 315) _____
93. Digoxin inhibits which mechanism of transport in the cell membrane? (p 316) _____
94. What are the mechanisms of action of cardiac glycosides? (p 316) _____

95. Facial rash, fever, and joint pain develop in a female patient who is taking procainamide for an arrhythmia. Anti-histone antibodies are present in her serum. What is the most likely diagnosis? (p 317) _____
96. Symptoms of headache and tinnitus related to quinidine use are collectively known as: (p 317) _____

97. What are the toxicities of β -blockers? (p 318) _____

98. What is the mechanism of action of β -blockers? (p 318) _____

99. What three types of testing must be performed periodically for patients who take amiodarone?
(p 318) _____
100. What is a potentially fatal adverse effect of Ibutilide? (p 318) _____
101. What are the adverse effects of calcium channel blockers (class IV)? (p 319) _____

102. Which antiarrhythmic is a first-line drug for diagnosing and terminating supraventricular tachycardia (SVT)? (p 319) _____
103. Name five toxicities of adenosine. (p 319) _____

104. Which ion is infused to treat torsades de pointes and digoxin toxicity? (p 319) _____

Answer

EMBRYOLOGY

1. Superior vena cava (SVC).
2. Foramen ovale and fossa ovalis.
3. Ductus venosus and ligamentum venosum.
4. Ductus arteriosus and ligamentum arteriosum.
5. 80%.
6. Indomethacin helps close PDA, whereas prostaglandins E₁ and E₂ can keep it open.

ANATOMY

7. Right-dominant.
8. The left anterior descending artery.
9. Anterolateral; posteromedial.
10. Hoarseness; dysphagia.

PHYSIOLOGY

11. Increase; decrease; increase.
12. Increased coronary blood flow (the heart always operates with maximal oxygen extraction).
13. Increase.
14. Stroke volume (SV).
15. $EF = SV/EDV = (EDV - ESV) / EDV$.
16. Arterioles.

17. Hematocrit.
18. Decreased; decreased.
19. Increased; increased.
20. Increased; increased.
21. A = Aortic valve closes; B = Aortic valve opens; C = Mitral valve closes; D = Mitral valve opens.
1 = Isovolumetric contraction; 2 = Systolic ejection; 3 = Isovolumetric relaxation; 4 = Rapid filling.
5 = Reduced filling.
22. A = S4; atrial kick, caused by high atrial pressure and associated with ventricular noncompliance (eg, hypertrophy).
B = S1; mitral and tricuspid valve closure.
C = S2; aortic and pulmonary valve closure.
D = S3; in early diastole during rapid ventricular filling phase. Associated with increased filling pressures, and more common in dilated ventricles.
E = a wave; atrial contraction.
F = c wave; RV contraction (closed tricuspid valve bulging into right atrium).
G = x descent; downward displacement of closed tricuspid valve during rapid ventricular ejection phase.
H = v wave; increased right atrial pressure due to filling against a closed tricuspid valve.
I = y descent; RA emptying into RV.
J = P wave; atrial depolarization.
K = QRS complex; ventricular depolarization.
L = QRS complex; ventricular depolarization.
M = QRS complex; ventricular depolarization.
N = T wave; ventricular repolarization.
23. In a patient with aortic stenosis, the stenotic valve causes increased afterload of the left ventricle. Thus, the left ventricular pressure is higher than the pressure after the valve (in the aorta).
24. Increased.

25. Stays the same. (Because pressures can equalize across the atrial wall, there is no change in splitting during inspiration.)
26. A = Aortic area; B = left sternal border; C = pulmonic area; D = tricuspid area; E = mitral area (apex).
27. Ischemic heart disease (post-MI), mitral valve prolapse (MVP), or left ventricular (LV) dilatation.
28. Aortic root dilatation, bicuspid aortic valve, endocarditis, or rheumatic fever.
29. Mitral/tricuspid valve regurgitation.
30. Aortic stenosis.
31. The cardiac muscle action potential has a plateau due to calcium influx and potassium efflux. Cardiac muscle contraction requires calcium influx from ECF to induce CA release from sarcoplasmic reticulum and cardiac myocytes are electrically coupled to each other via gap junctions.
32. A = Phase 0; Na⁺ current.
B = Phase 1; K⁺ current.
C = Phase 2; Ca²⁺ and K⁺ current.
D = Phase 3; K⁺ current.
E = Phase 4; K⁺ current.
33. A = Phase 4; Na⁺ and K⁺ current.
B = Phase 0; Ca²⁺ current.
C = Phase 3; K⁺ current.
34. Phases 1 and 2.
35. ECG characterized by shifting sinusoidal waveforms. It can progress to ventricular fibrillation.
36. Atrial fibrillation. Treatment includes rate control, rhythm control, anticoagulation, and possible cardioversion.
37. Atrial flutter. Treated like atrial fibrillation. Catheter ablation is the definitive treatment.

- 38. Mobitz type I (Wenckebach). Type I involves progressive lengthening followed by a dropped beat. In type II, dropped beats are not preceded by progressive lengthening.
- 39. Ventricular fibrillation.
- 40. A pacemaker.
- 41. Lyme disease.
- 42. Low PO₂ (< 60 mm Hg), high PCO₂, and low pH of blood. Central chemoreceptors do not directly respond to PO₂.
- 43. This mechanism allows for only well-ventilated areas to remain perfused, optimizing gas exchange.
- 44. Heart failure results in increased capillary pressure, which causes fluid to move out of the capillaries and into the interstitium.
- 45. Liver failure results in decreased plasma proteins, which decreases plasma colloid oncotic pressure, and in turn causes fluid to move out of the capillaries and into the interstitium.
- 46. Nephrotic syndrome results in proteinuria and subsequent hypoalbuminemia, thus decreasing plasma colloid oncotic pressure, which in turn causes fluid to move out of the capillaries and into the interstitium.
- 47. Lymphatic obstruction results in increased interstitial fluid colloid osmotic pressure, which causes fluid to move out of the capillaries and into the interstitium.

PATHOLOGY

- 48. To maintain viability, both an ASD and a VSD are required for babies with tricuspid atresia.
- 49. **P**ulmonary infundibular stenosis, **R**ight ventricular hypertrophy, **O**verriding aorta, and **V**entricular septal defect (VSD). (Remember: **PROVe**).
- 50. A shunt must be present, which allows adequate mixing of blood (i.e., VSD, ASD, or patent foramen ovale).
- 51. Notched ribs (on CXR) due to increased collateral circulation, hypertension in the upper extremities, and weak, delayed pulse in the lower extremities.
- 52. Continuous "machine-like" murmur.

- 53. ASD, VSD, and atrioventricular (AV) septal defect.
- 54. Increased age, obesity, diabetes, physical inactivity, excess salt intake, excess alcohol intake, cigarette smoking, and family history.
- 55. Mönckeberg sclerosis (medial calcific sclerosis).
- 56. Infarcts, peripheral vascular disease, thrombi, emboli, aneurysms, and ischemia.
- 57. Mediastinal widening. Longitudinal intraluminal tear forming a false lumen, both of which are indicative of aortic dissection.
- 58. Most often due to rupture of coronary artery atherosclerotic plaque, resulting in acute thrombosis; elevation of cardiac biomarkers (troponins, CK-MB) are diagnostic.
- 59. Transmural infarct; subendocardial infarct.
- 60. Severe retrosternal pain, nausea, vomiting, pain in the left arm and/or jaw, diaphoresis, shortness of breath, and fatigue.
- 61. A = 0-24 hours; B = 1-3 days; C = 3-14 days; D = 2 weeks to several months.
- 62. First 0-24 hours; 3-14 days, 2 weeks to several months after MI.
- 63. Leads V₁ to V₆.
- 64. Holosystolic murmur of mitral regurgitation, best heard over the apex of the heart.
- 65. Hypertrophic obstructive cardiomyopathy; biopsy shows marked ventricular concentric hypertrophy, often septal predominance. Myofibrillar disarray and fibrosis.
- 66. Decreased; increased; increased; peripheral edema.
- 67. Decreased; increased; pulmonary edema.
- 68. **FROM JANE** = **F**ever, **R**oth spots, **O**sler nodes, **M**urmur, **J**aneway lesions, **A**nemia, **N**ail-bed hemorrhages, and **E**mboli.
- 69. Group A β -hemolytic streptococci.
- 70. **J♥NES** = **J**oint (migratory polyarthritides) ♥ **c**arditis; **N**odules in skin (subcutaneous); **E**rythema marginatum (evanescent rash with ring margin), **S**ydenham chorea.

- 71. Myocarditis presentation is highly variable, and can include dyspnea, chest pain, fever, and arrhythmias. Persistent tachycardia out of proportion to fever is characteristic.
- 72. Beck triad (Hypotension, distended neck veins, distant heart sounds), increased heart rate, and pulsus paradoxus.
- 73. Ascending aortic aneurysm due to syphilitic heart disease (tertiary syphilis).
- 74. Intermittent claudication, superficial nodular phlebitis, and Raynaud phenomenon. Additionally, autoamputation of digits and gangrene can be seen.
- 75. Kawasaki disease; treat with intravenous immunoglobulin and aspirin.
- 76. Hepatitis B.
- 77. Innumerable renal microaneurysms and spasm.
- 78. Giant cell (temporal arteritis).
- 79. Elevated (ESR) erythrocyte sedimentation rate.
- 80. Perforation of the nasal septum, chronic sinusitis, otitis media, mastoiditis, hemoptysis, cough, dyspnea, hematuria, and red cell casts.
- 81. MPO-ANCA/p-ANCA; PR3-ANCA/c-ANCA.
- 82. Asthma, sinusitis, skin lesions (nodule and purpura), and peripheral neuropathy (eg, wrist/foot drop).
- 83. Immunoglobulin A vasculitis, also known as Henoch-Schönlein purpura.
- 84. Myxoma; syncope can occur with “ball-valve” obstruction in the left atrium.

PHARMACOLOGY

- 85. ACE inhibitors are protective against diabetic nephropathy.
- 86. Hydralazine, labetalol, methyldopa, and nifedipine.
- 87. Calcium channel blockers.
- 88. Reflex tachycardia, hypotension, flushing, headache, “Monday disease” in industrial exposure.

- 89. Increased effect; little or no effect.
- 90. Reduction of myocardial oxygen consumption by decreasing one or more of the determinants of MVO₂: end-diastolic volume, blood pressure, heart rate, and contractility.
- 91. Hypotension and dizziness can be secondary to over-diuresis. Hyperkalemia, cough.
- 92. Bile acid resin.
- 93. Na⁺/K⁺/ATPase.
- 94. They increase intracellular calcium (thereby acting as a positive inotrope) and stimulate the vagus nerve.
- 95. Reversible SLE-like syndrome.
- 96. Cinchonism (which can occur with all quinine derivatives).
- 97. Impotence, exacerbation of COPD and asthma, cardiovascular effects (bradycardia, AV block, and HF), and CNS effects (sedation and sleep alterations). May mask signs of hypoglycemia.
- 98. β-Blockers decrease SA and AV nodal activity by decreasing cAMP and calcium ion currents; they suppress abnormal pacemakers by decreasing the slope of phase 4.
- 99. Pulmonary function (PFTs), liver function (LFTs), and thyroid function tests (TFTs).
- 100. Torsades de pointes.
- 101. Constipation, flushing, edema, and cardiovascular effects (HF, AV block, sinus node depression).
- 102. Adenosine.
- 103. Flushing, hypotension, chest pain, sense of impending doom, and bronchospasm.
- 104. Magnesium (Mg²⁺).