**Pocket Guide to Neonatal ECG Interpretation, 3rd Edition**

**Test Directions**

1. Please fill out the answer form and provide all requested information. We are unable to issue a certificate without complete information.
2. All questions and answers are developed from the information provided in the book. Select the one best answer and fill in the corresponding circle on the answer form.
3. Mail the answer form to NICU Ink, 1425 N. McDowell Blvd., Ste. 105, CA 94954-6513 with a check for $30 (processing fee) made payable to NICU Ink. This fee is nonrefundable.
4. You will be notified of your test results within 4–6 weeks. Please retain a copy of the completed test for your records.
5. An answer key is available upon request with completion of the exam.
6. If you pass the test (80%) you will earn 5 contact hours* for the course (0.5 hour pharmacology credit).

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the American Nurses Credentialing Center (ANCC) through the joint providership of the Academy of Neonatal Nursing and NICU Ink Book Publishers.

The Academy of Neonatal Nursing is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

Provider, Academy of Neonatal Nursing, approved by the California Board of Registered Nursing, Provider #CEP 6261; and Florida Board of Nursing, Provider #FBN 3218, content code 2505.

No relevant financial interest or affiliation with any commercial interests was disclosed by members of planning committee or the activity test panel.

*Contact hours based on a 60-minute hour.
Neonatal ECG Interpretation

NATIONAL CERTIFICATION CORPORATION (NCC)
COMPETENCY CATEGORIES BY SPECIALTY AND CODES

<table>
<thead>
<tr>
<th>NIC/NNP (NCC Code)</th>
<th>Total 5 Contact Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Assessment (1)</td>
<td>2.5</td>
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<tr>
<td>Pharmacology (3)</td>
<td>0.5</td>
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<tr>
<td>Physiology &amp; Pathophysiology (2)</td>
<td>2.0</td>
</tr>
</tbody>
</table>

| Professional Practice (4/5)              |                        |
| Pharmacology (4)                         | 0.5                   |
| Physical Assessment (1)                  | 2.5                   |
| Physiology & Pathophysiology (2)         | 2.0                   |

NCC competency categories are provided for your information. The category breakdown is an estimate. The final decision regarding competency categories is at the discretion of NCC.

Before you begin...

This course is subject to periodic review and update. It is reviewed three years after it is published. Please visit Continuing Education at nicuink.net, if necessary, for the latest update.

Current course release date: September 1, 2015

COURSE OBJECTIVES

1. Outline the components of the cardiac electrical cycle.
2. Correctly position three ECG leads.
3. Identify artifact on an ECG strip.
4. Measure the components of the cardiac cycle.
5. Illustrate five basic types of cardiac rhythms.
6. Describe the ECG features of 18 neonatal arrhythmias.
7. Discuss the ECG findings associated with electrolyte imbalances.
8. Delineate the basic principles of 12-lead ECG interpretation.
1. During the heart’s resting state, which of the following ions would be found inside the cell?  
   a. chloride  
   b. potassium  
   c. sodium

2. During depolarization, nerve impulses travel through the ventricle along:  
   a. Keith’s bundle  
   b. the Purkinje system  
   c. the sinoatrial (SA) node

3. Atrial depolarization is represented by which wave of the ECG?  
   a. P  
   b. S  
   c. T

4. The pause in electrical impulse transmission at the atrioventricular (AV) node allows time for blood to:  
   a. enter the atria  
   b. enter the ventricles  
   c. leave the ventricles

5. What does the QRS complex (Q wave, R wave, S wave) represent?  
   a. atrial repolarization  
   b. firing of the SA node  
   c. ventricular depolarization

6. Abnormalities of the ST segment (the isoelectric section following the S wave and merging into the T wave) can result from:  
   a. hypocalcemia  
   b. myocardial ischemia  
   c. prostaglandin administration

7. The T wave represents:  
   a. ventricular depolarization  
   b. atrial repolarization  
   c. ventricular repolarization
<table>
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<tr>
<th>8. What electrical event is said to be lost in the QRS complex?</th>
<th>a. atrial repolarization</th>
<th>b. firing of the AV node</th>
<th>c. repolarization of the ventricles</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. What structure is referred to as the heart’s pacemaker?</td>
<td>a. AV node</td>
<td>b. bundle of His</td>
<td>c. SA node</td>
</tr>
<tr>
<td>10. The normal heart rate (HR) of a neonate would be ____ beats per minute (bpm).</td>
<td>a. 50–120</td>
<td>b. 90–180</td>
<td>c. 120–190</td>
</tr>
<tr>
<td>11. The most common recording speed for ECG printouts is ____ mm/minute.</td>
<td>a. 20</td>
<td>b. 25</td>
<td>c. 30</td>
</tr>
<tr>
<td>12. When assessing an ECG printout, start by identifying the:</td>
<td>a. P wave</td>
<td>b. isoelectric line</td>
<td>c. T wave</td>
</tr>
<tr>
<td>13. Causes of ECG artifact include:</td>
<td>a. deep respirations</td>
<td>b. inotrope administration</td>
<td>c. phototherapy lights</td>
</tr>
<tr>
<td>14. A normal QRS interval for a newborn is ____ second.</td>
<td>a. 0.02–0.04</td>
<td>b. 0.04–0.08</td>
<td>c. 0.08–0.12</td>
</tr>
</tbody>
</table>
15. The time interval represented by the periodic marks on the ECG paper is _____ seconds.
   a. 3  
   b. 6  
   c. 10

16. Determining heart rate from the ECG can be accomplished by taking ten times the number of:
   a. P waves between 2 periodic marks  
   b. QRS complexes in 6 seconds  
   c. T waves in 10 seconds

17. Junctional rhythms originate from the:
   a. AV node  
   b. conduction pathway  
   c. SA node

18. The most common rhythm disturbance in premature infants is:
   a. atrial tachycardia  
   b. premature atrial contractions  
   c. sinus bradycardia

19. The etiology of the most common preterm infant arrhythmia includes:
   a. anemia  
   b. hypoglycemia  
   c. increased blood pressure

20. Causes of sinus tachycardia include:
   a. electrolyte imbalances  
   b. hypovolemia  
   c. vagal stimulation

21. Which of the following is true of sinus arrhythmia?
   a. ECG shows missed P waves  
   b. heart rate increases during inspiration  
   c. it occurs most commonly in preterm infants
22. **Sinus arrest may result from:**
   a. congenital heart disease  
   b. hyperthermia  
   c. injury to the SA node

23. **Parameters of a premature atrial contraction include:**
   a. abnormal P waves  
   b. inverted T waves  
   c. prolonged QRS intervals

24. **Premature atrial contractions (PACs) should not be considered benign when they are associated with:**
   a. apnea  
   b. oliguria  
   c. sepsis

25. **The etiology of paroxysmal atrial tachycardia (PAT) includes:**
   a. cor pulmonale  
   b. irritation from invasive catheters  
   c. myocarditis

26. **The ECG pattern in atrial flutter is described as:**
   a. inverted  
   b. Mobitz  
   c. “sawtooth”

27. **Causes of atrial flutter include elevated levels of _____ in the blood.**
   a. digoxin  
   b. dopamine  
   c. nitroprusside

28. **Which of the following cardiac anomalies is associated with supraventricular tachycardia?**
   a. coarctation of the aorta  
   b. tetralogy of Fallot  
   c. transposition of the great vessels
29. An ECG pattern in which the P wave appears after the QRS complex is referred to as a/an _____ rhythm.
   a. atrial   b. nodal   c. ventricular

30. Premature ventricular contractions occur at what point in the electrical conduction pattern of the heart? The:
   a. beginning, before the SA node fires   b. midpoint, the stimulus moves from the SA to AV node   c. end, during transfer of the stimulus to the bundle branches

31. On the ECG, premature ventricular contractions (PVCs) appear as a:
   a. peaked T wave   b. short PR interval   c. widened QRS complex

32. A PVC occurring with every second heart beat is referred to as:
   a. bigeminy   b. junctional block   c. ventricular tachycardia

33. The etiology of PVCs includes:
   a. acidosis   b. hypertension   c. hypoxia

34. Pharmacologic treatment of PVCs includes the use of:
   a. adenosine   b. lidocaine   c. propranolol

35. Prolonged QT syndrome is characterized by a QT interval of greater than _____ seconds.
   a. 0.22   b. 0.33   c. 0.44
36. Which of the following medications is the initial treatment for prolonged QT syndrome?
   a. amiodarone   b. digoxin   c. propranolol

37. An ECG finding for an infant with ventricular tachycardia is:
   a. absent QRS complexes   b. three or more sequential PVCs   c. “sawtooth” P waves

38. Ventricular tachycardia may be precipitated by:
   a. irritation by a central catheter   b. mitral valve prolapse   c. pericardial effusions

39. A medication used to prevent recurrence of ventricular tachycardia is:
   a. atenolol   b. flecainide   c. digoxin

40. Tachycardia should be assumed to be ventricular tachycardia if the:
   a. infant is hypotensive   b. QRS is wide   c. heart rate slows in response to vagal stimulation

41. “Rabbit ear” R waves are characteristic of:
   a. bundle branch block   b. first degree heart block   c. ventricular fibrillation

42. First degree heart block may be caused by:
   a. Ebstein’s anomaly   b. tetralogy of Fallot   c. VSD
43. A cyclic pattern of “dropped” QRS complexes is characteristic of which of the following heart blocks?
   a. Mobitz I  b. Mobitz II  c. third degree

44. Which of the following maternal disorders results in third degree heart block in the neonate?
   a. HELLP syndrome  b. rheumatic heart disease  c. systemic lupus erythematosus

45. A drug that may be useful in treating third degree heart block is:
   a. atropine  b. lidocaine  c. nifedipine

46. What is the most common ECG change seen with hyperkalemia?
   a. flattened QRS complex  b. inverted P wave  c. peaked T wave

47. A shortened QT interval is characteristic of which electrolyte imbalance?
   a. hypercalcemia  b. hypomagnesemia  c. hyponatremia

48. During defibrillation, what electrode position is preferred for small infants?
   a. anterior-anterior  b. anterior-lateral  c. anterior-posterior

49. Cardioversion is indicated in the treatment of:
   a. congenital heart block  b. supraventricular tachycardia  c. premature ventricular contractions
50. The goal of cardioversion is to deliver an electrical impulse at any point of the cardiac cycle except that represented by the _____ wave.
   a. P  
   b. S  
   c. T

51. Improper timing of cardioversion can result in what complication?
   a. atrial arrest  
   b. heart block  
   c. ventricular fibrillation

52. Defibrillation is used to treat:
   a. atrial flutter  
   b. organized ventricular tachycardia  
   c. ventricular fibrillation

53. The recommended energy level for initial defibrillation of an infant is _____ joules/kg.
   a. 2  
   b. 4  
   c. 6

54. The ECG records electrical current as it passes from a _____ electrode.
   a. negative to positive  
   b. neutral (ground) to negative  
   c. positive to negative

55. Which lead is positioned on the fourth intercostal space at the left sternal border?
   a. V₁  
   b. V₂  
   c. V₃

56. The normal direction of the cardiac axis in the newborn is best described as:
   a. downward and to the left  
   b. downward and to the right  
   c. upward and to the left
<table>
<thead>
<tr>
<th>Question</th>
<th>Choice a</th>
<th>Choice b</th>
<th>Choice c</th>
</tr>
</thead>
<tbody>
<tr>
<td>57. The direction of the cardiac axis is determined by assessing the ____ wave.</td>
<td>a. P</td>
<td>b. R</td>
<td>c. T</td>
</tr>
<tr>
<td>58. What ECG changes might you expect to find with hypoplastic left heart syndrome?</td>
<td>a. left atrial hypertrophy</td>
<td>b. right axis deviation</td>
<td>c. QRS axis deviation</td>
</tr>
<tr>
<td>59. What ECG changes accompany tricuspid atresia?</td>
<td>a. left ventricular hypertrophy</td>
<td>b. right axis deviation</td>
<td>c. right ventricular hypertrophy</td>
</tr>
<tr>
<td>60. A diphasic P wave accompanies:</td>
<td>a. atrial hypertrophy</td>
<td>b. ventricular atrophy</td>
<td>c. ventricular hypertrophy</td>
</tr>
<tr>
<td>61. An R wave that is large in V₁ and progressively smaller in V₂ through V₆ is diagnostic of ____ hypertrophy.</td>
<td>a. left ventricular</td>
<td>b. left atrial</td>
<td>c. right ventricular</td>
</tr>
<tr>
<td>62. ECG changes found with pericarditis include a/an:</td>
<td>a. concave T wave</td>
<td>b. elevated ST segment</td>
<td>c. flat R wave</td>
</tr>
<tr>
<td>63. Signs of digoxin toxicity include:</td>
<td>a. atrial fibrillation</td>
<td>b. PACs</td>
<td>c. sick sinus syndrome</td>
</tr>
</tbody>
</table>
64. What is the approximate HR (bpm) in this strip?

a. 120  

b. 140  

c. 160

65. Which wave is represented by the number one in this figure?

a. P  

b. Q  

c. T
For each of the next four ECG strips, identify the arrhythmia.

66.

a. complete heart block  b. sinus arrhythmia  c. sinus bradycardia

67.

a. atrial flutter  b. nodal rhythm  c. supraventricular tachycardia
68. a. sinus tachycardia  b. premature ventricular contractions  c. ventricular tachycardia

69. a. sick sinus syndrome  b. supraventricular tachycardia  c. ventricular fibrillation
Case Study Questions

Case #1
Use this case for the next 3 questions:
A previous 26 week gestational age infant is now 2 weeks old and was weaned off the ventilator yesterday. During an apnea episode you note that the infant has this rhythm:

70. What is this rhythm?
   a. sinus arrest   b. sinus bradycardia   c. junctional bradycardia

71. What is the heart rate?
   a. 40   b. 50   c. 60

72. What is your first action?
   a. check a pulse   b. place ice on the infant’s face   c. stimulate the baby
Case #2

Use this case for the next 3 questions:

You have been called to the delivery room for an emergent C-section delivery of a 38 week gestational age infant due to slow fetal heart rate. When the infant is delivered, she is noted to be alert, active, pink, and breathing immediately after delivery. Her heart rate is noted to be 50 beats per minute.

73. What maternal history do you ask for?
   a. Does the mother have a history of drug abuse?
   b. What medications did the mother receive prior to delivery?
   c. Is there a family history of a collagen vascular disease?
74. When the infant is placed on a cardiac monitor, the following rhythm is noted. What is the rhythm?

[ECG waveform]

a. complete heart block  

b. sick sinus syndrome  

c. sinus bradycardia

75. Which of the following treatment options is most appropriate for this situation?

a. begin CPR  

b. intravenous lidocaine  

c. monitor for tolerance
Case #3

Use the following case to answer the next 2 questions:

An infant born at 24 weeks gestation is now 5 months old and ventilator dependent. He has had a recent history of fluid and electrolyte imbalances. Today, he began having this EKG pattern.

76. What is the rhythm?
   a. bundle branch block  b. artifact  c. trigeminy

77. What is the most likely cause?
   a. cardiac tumor  b. myocarditis  c. elevated serum potassium
Case #4

Use the following case example to answer the next 3 questions:

An infant born at 32 weeks gestation is now 2 weeks old. He has experienced an increased number of episodes of apnea with bradycardia over the past 24 hours. He has also been noted to not be feeding as well as previously and has had some temperature instability. His ECG pattern is this:

![ECG pattern](image)

78. What is the heart rate (bpm)?
   a. 180  
   b. 200  
   c. 220

79. What is the rhythm?
   a. supraventricular tachycardia  
   b. sinus tachycardia  
   c. junctional tachycardia
80. What is the most likely cause?
   a. anemia                  b. pain                  c. infection
Please completely fill in the circle of the one best answer using a dark pen.
Complete name/address information below.

1. a. □ b. □ c. □
2. a. □ b. □ c. □
3. a. □ b. □ c. □
4. a. □ b. □ c. □
5. a. □ b. □ c. □
6. a. □ b. □ c. □
7. a. □ b. □ c. □
8. a. □ b. □ c. □
9. a. □ b. □ c. □
10. a. □ b. □ c. □
11. a. □ b. □ c. □
12. a. □ b. □ c. □
13. a. □ b. □ c. □
14. a. □ b. □ c. □
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16. a. □ b. □ c. □
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56. a. □ b. □ c. □
57. a. □ b. □ c. □
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79. a. □ b. □ c. □
80. a. □ b. □ c. □
POCKET GUIDE TO NEONATAL ECG INTERPRETATION, 3RD EDITION

Name ____________________________________________________________

Please Print

Address ______________________________________________________________________________________________________

City ___________________________________________________________________ State _______ Zip ____________________________

Nursing License # ___________________________ State(s) of License ______________________________________________________

Phone #______________________________ E-mail ________________________________ (optional)

Mail a $30.00 processing fee for 5 contact hours (0.5 hours pharmacology credit) payable to NICU Ink,® 1425 N. McDowell Blvd., Ste. 105, Petaluma, CA 94954-6513.

Include an additional $10.00 for rush processing.

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I have enclosed an additional $10 for rush processing.

Test expires August 31, 2018

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CHECK

GRADE

PASSED / FAILED

CERTIFICATE

ISSUED

MAIL DATE

IF DIFFERENT

REFERENCE #
Thank you for taking the time to assist us in evaluating the effectiveness of this course. Using the scale below, darken the circles corresponding to your responses. If an item is not applicable, leave it blank.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>5</th>
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</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
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**Objectives:** After reading the book, studying the content, and taking the test, the learner will be able to:

1. Outline the components of the cardiac electrical cycle.
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3. Identify artifact on an ECG strip.
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6. Describe the ECG features of 18 neonatal arrhythmias.
7. Discuss the ECG findings associated with electrolyte imbalances.
8. Delineate the basic principles of 12-lead ECG interpretation.
**Presentation**

1. The CNE activity is relevant to my practice.  
2. The content of this CNE activity is likely to engender a change in my clinical practice.  
3. The questions on the test reflected the content of the book.  
4. The activity content was comprehensive.  
5. The activity directions were clear.  
6. The CNE activity was free of commercial bias.  
7. I would recommend this CNE activity to colleagues.  
8. I perceive the education level of this course to be: 1 = Basic; 2 = Intermediate; 3 = Advanced  
9. How long did it take you to complete the course?  
   ___ hours ___ minutes  
10. In what level unit do you practice?  
   I___ II___ III___  

I am a  □ staff nurse  □ NNP  □ nurse manager  ________________________________ other (please state)  
I have been a nurse for _______ year(s).  

What subjects would you like to see offered for CE courses?  
________________________________________________________________________  
________________________________________________________________________  
________________________________________________________________________  

Additional comments:  
________________________________________________________________________  
________________________________________________________________________  
________________________________________________________________________