**Chapter 7**

**Second-Order Differential Equations**

**7.4. Series Solutions of Differential Equations**

**Section Exercises**

**Find a power series solution for the following differential equations.**

105. 

Answer: 

107. 

Answer: 

109. 

Answer: 

111. 

Answer: 

113. 

Answer: 

115. 

Answer: 

**Chapter Review Exercises**

***True or False*? Justify your answer with a proof or a counterexample.**

117. If andare both solutions to  then  is also a solution.

Answer: True

119.  is a solution to the second-order differential equation 

Answer: False

**Classify the differential equation. Determine the order, whether it is linear and, if linear, whether the differential equation is homogeneous or nonhomogeneous. If the equation is second-order homogeneous and linear, find the characteristic equation.**

121. 

Answer: second order, linear, homogeneous, 

123. 

Answer: first order, nonlinear, nonhomogeneous

**For the following problems, find the general solution**

125. 

Answer: 

127. 

Answer: 

129. 

Answer: 

131. 

Answer: 

**For the following problems, find the solution to the initial-value problem, if possible.**

133.   

Answer: 

**For the following problems, find the solution to the boundary-value problem.**

135.   

Answer: 

**For the following problem, set up and solve the differential equation.**

137. The motion of a swinging pendulum for small angles  can be approximated by  where  is the angle the pendulum makes with respect to a vertical line, *g* is the acceleration resulting from gravity, and *L* is the length of the pendulum. Find the equation describing the angle of the pendulum at time  assuming an initial displacement of  and an initial velocity of zero.

Answer:

**The following problems consider the “beats” that occur when the forcing term of a differential equation causes “slow” and “fast” amplitudes. Consider the general differential equation that governs undamped motion. Assume that **

139. Assuming the system starts from rest, show that the particular solution can be written as 

Answer: This is a proof; therefore, no answer is provided.

**For the following problem, set up and solve the differential equations.**

141. An opera singer is attempting to shatter a glass by singing a particular note. The vibrations of the glass can be modeled by  where  represents the natural frequency of the glass and the singer is forcing the vibrations at  For what value  would the singer be able to break that glass? (Note: in order for the glass to break, the oscillations would need to get higher and higher.)

Answer:

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