**Chapter 7**

**Second-Order Differential Equations**

**7.1 Second-Order Linear Equations**

**Section Exercises**

**Classify each of the following equations as linear or nonlinear. If the equation is linear, determine whether it is homogeneous or nonhomogeneous.**

1. 

Answer: linear, homogenous

1. 

Answer: nonlinear

1. 

Answer: nonlinear

1. 

Answer: linear, nonhomogeneous

1. 

Answer: linear, homogeneous

1. 

Answer: nonlinear

**For each of the following problems, verify that the given function is a solution to the differential equation. Use a graphing utility to graph the particular solutions for several values of *c*1 and *c*2. What do the solutions have in common?**

1. **[T]**

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

1. **[T]**

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

1. **[T]**

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

1. **[T]**

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

**Find the general solution to the linear differential equation.**

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

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Answer: 

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1. 

Answer: 

**Solve the initial-value problem.**

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

**Solve the boundary-value problem, if possible.**

1. 

Answer: 

1. 

Answer: 

1. 

Answer: No solutions exist.

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. Find a differential equation with a general solution that is 

Answer: 

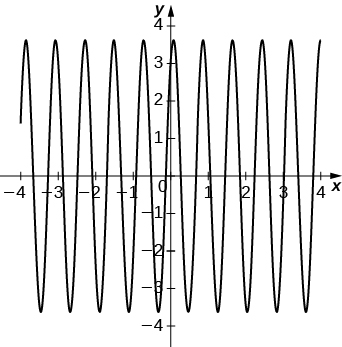
1. Find a differential equation with a general solution that is 

Answer: 

**For each of the following differential equations:**

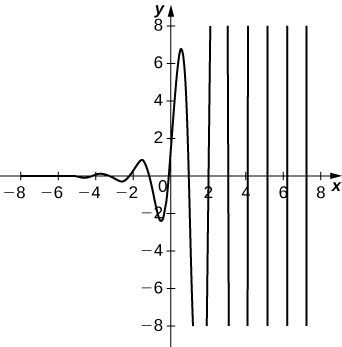
1. **Solve the initial value problem.**
2. **[T]Use a graphing utility to graph the particular solution.**
3. 

Answer: a. b.



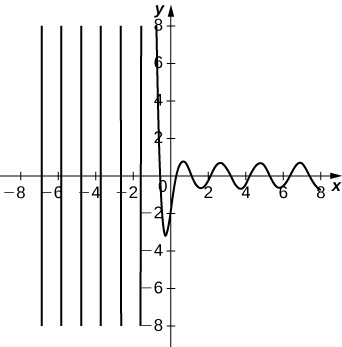
1. 

Answer: a. b.



1. 

Answer: a. b.



1. (Principle of superposition) Prove that if  and  are solutions to a linear homogeneous differential equation, , then the function , where  and  are constants, is also a solution.

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

1. Prove that if *a, b,* and *c*are positive constants, then all solutions to the second-order linear differential equation  approach zero as  (*Hint:* Consider three cases: two distinct roots, repeated real roots, and complex conjugate roots.)

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

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