

THE UNIVERSITY OF WOLLONGONG
SCHOOL OF MATHEMATICS AND APPLIED STATISTICS

MATH111: Applied Mathematical Modelling 1

Skills Test: Differential equations

Time allowed : 45 minutes

Number of questions: 15 multiple choice

Attempt all questions.

CALCULATORS

ARE PERMITTED.

Please Note: Examination Paper is printed on both sides.

1. The amount of a chemical in a lake is decreasing at a rate of 30% per year. If $p(t)$ is the total amount of the chemical in the lake as a function of time t (in years), which differential equation models this situation?
 - (a) $p'(t) = -30$
 - (b) $p'(t) = -0.30$
 - (c) $p'(t) = p - 30$
 - (d) $p'(t) = -0.3p$
 - (e) $p'(t) = 0.7p$

2. Which of the following differential equations is not separable?
 - (a) $y' = 3 \sin x \cos y$
 - (b) $y' = x^2 + 7y$
 - (c) $y' = e^{2x+y}$
 - (d) $y' = 4x + 7$
 - (e) More than one of the above.

3. $y' = -\frac{1}{3}y$ with $y(0) = 2$. As x becomes large, the solution will
 - (a) diverge to $+\infty$
 - (b) diverge to $-\infty$
 - (c) approach 0 from above
 - (d) approach 0 from below
 - (e) do none of the above

4. The differential equation $\frac{dy}{dt} = (t - 3)(y - 2)$ has steady-state solutions of
 - (a) $y = 2$ only
 - (b) $t = 3$ only
 - (c) $y = 2$ and $t = 3$
 - (d) No steady-state solutions.

5. The amount of drug in the bloodstream follows the differential equation $c' = -kc + d$, where d is the rate it is being added intravenously and k is the fractional rate at which it breaks down. If we double the rate at which the drug flows in, how will this change the equilibrium value?
- (a) It will be double the old value.
 - (b) It will be greater than the old, but not quite doubled.
 - (c) It will be more than doubled.
 - (d) It will be the same.
 - (e) Not enough information is given.
6. The population of rainbow trout in a river system is modelled by the differential equation $P' = 0.2P - 4 \times 10^{-5}P^2$. What is the maximum number of trout that the river system could support?
- (a) 4×10^5 trout
 - (b) 4,000 trout
 - (c) 5,000 trout
 - (d) 25,000 trout
 - (e) Not enough information is given
7. We are testing the function $f(x) = C_0e^{3x}$ as a possible solution to a differential equation. After we substitute the function and its derivative into the differential equation we get: $3C_0e^{3x} = -2C_0e^{3x} + 4e^{3x}$. What was the differential equation?
- (a) $f' = -2f + \frac{4}{C_0}f$
 - (b) $f' = -2f + 4e^{3x}$
 - (c) $3f = -2f + 4e^{3x}$
 - (d) $3C_0e^{3x} = -2f + 4e^{3x}$
 - (e) None of the above

8. The differential equation for a mixing problem is $x' + 0.08x = 4$, where x is the amount of dissolved substance, in pounds, and time is measured in minutes. What are the units of '4'?
- (a) pounds
 - (b) minutes
 - (c) pounds/minute
 - (d) minute/pound
 - (e) None of the above.
9. $x'(t) = \frac{1}{2}x^2 + bx + 8$. If $b = 2$ what are the steady-state solutions of the system?
- (a) $x = -8$
 - (b) $x = -2 \pm \sqrt{2}$
 - (c) $x = 2$
 - (d) No steady-state solutions exist and all solutions are increasing.
 - (e) No steady-state solutions exist and all solutions are decreasing.
10. Which of the following is an integrating factor for $3y' + 6ty = 8t$?
- (a) e^{3t^2}
 - (b) e^{t^2}
 - (c) e^6
 - (d) All of the above
 - (e) None of the above
 - (f) This problem cannot be solved with integrating factors.

11. Which of the following couldn't be the solution of a differential equation?
- (a) $z(t) = 6$
 - (b) $y = 3x^2 + 7$
 - (c) $x = 0$
 - (d) $y = 3x + y'$
 - (e) All could be solutions of a differential equation.
12. If we separate the variables in the differential equation $3z't = z^2$, what do we get?
- (a) $3z^{-2}dz = t^{-1}dt$
 - (b) $3tdt = z^2dt$
 - (c) $3z'tdz = z^2dt$
 - (d) $z = \sqrt{3z't}$
 - (e) This equation cannot be separated.
13. A small company grows at a rate proportional to its size, so that $c'(t) = kc(t)$. We set $t = 0$ in 1990 when there were 50 employees. In 2005 there were 250 employees. What equation must we solve in order to find the growth constant k ?
- (a) $50e^{2005k} = 250$
 - (b) $50e^{15k} = 250$
 - (c) $250e^{15k} = 50$
 - (d) $50e^{tk} = 250$
 - (e) Not enough information is given.
14. Suppose that 3 is a steady-state solution of a differential equation. This means that
- (a) the values will approach 3.
 - (b) if the initial value is below 3, the values will decrease.
 - (c) if the initial value is 3, then all of the values will be 3.
 - (d) all of the above.

15. How many steady-state solutions does the differential equation $y' = y^2 + a$ have?

- (a) Zero
- (b) One
- (c) Two
- (d) Three
- (e) Not enough information is given


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Spring Session 2007

2007 Skills Test B

Student Name: _____ Student Number: _____

Answer Sheet

Completely fill in the appropriate box for each question: 

1. A B C D E F

2. A B C D E F

3. A B C D E F

4. A B C D E F

5. A B C D E F

6. A B C D E F

7. A B C D E F

8. A B C D E F

9. A B C D E F

10. A B C D E F

11. A B C D E F

12. A B C D E F

13. A B C D E F

14. A B C D E F

15. A B C D E F

