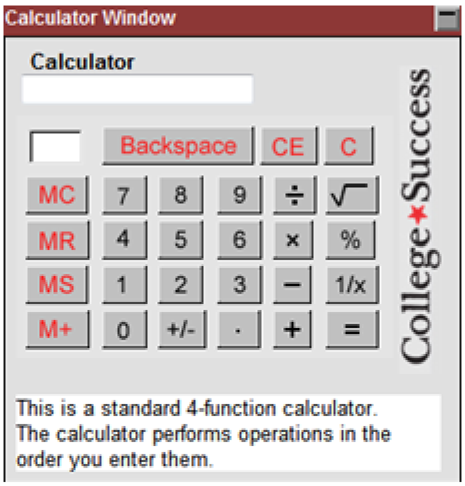
Graduate Assessment Test Study Guide

September 2014

Test Taking Tips

- **Prepare**
  Take practice assessments and study areas of weakness. If you need a calculator during practice, use a standard four-function calculator (sample below), which will be available during the assessment.



- **Read the directions carefully**
  When you take the assessments, make sure to take your time and carefully follow the instructions for each question.
- **Use reasoning when answering**
  1. Identify the key phrase in the question.
  2. Try to find the correct answer before you read all the choices.
  3. Eliminate the choices that you know are not correct.
  4. Read all the choices and pick the best answer.
- **Review**
  Be sure to review each answer carefully before submitting. You will not be able to go back to any questions.

Keller Graduate Subject Area Tests

There are three Keller Graduate multiple choice tests. There is also a written essay portion. The content that is covered in the multiple choice tests are listed below by subject:

Standard Math (MATH500) – All Non-Engineering Students (*time limit: 1 hour*):

- Fractions, decimals, and percents
- Expressions—simplify and evaluate
- Word problems—interpret and solve
- Equations—solve and graph

Advanced Math (MATH451) – All Engineering Students (*time limit: 2 hours*):

- Given a homogeneous or nonhomogenous system of linear equations, solve the system using Gaussian elimination method.
- Given a square matrix, find its inverse and rank.
- Given a square matrix, find its eigenvalues and eigenvectors and state if the matrix has linearly independent eigenvectors.
- Given two vectors, find the sum, the difference, the dot product, and the cross product.
- Given a vector, find the derivative vector and the gradient.
- Given a surface integral, use the divergence theorem and Stokes' theorem to evaluate the integral.
- Given a periodic function, find its Fourier series equation.
- Given a nonperiodic function, find its Fourier Transform.

Advanced Math (MATH450) – All Engineering Students (*time limit: 2 hours*):

- Given a physical process, a system, or an electric circuit, write an ODE (ordinary differential equation) of the first order and solve it.
- Given a physical process, a system, or an electric circuit, write an ODE of the second order and solve it.
- Given a linear ODE of degree three or higher, solve it by extending the methods used for solving second order ODE.
- Given a physical process, a system, or an electric circuit, write a system of *n* first order ODEs and solve it.
- Given a linear ODE with variable coefficients, use the power series method to solve it.
- Given a linear ODE, use Laplace transform method to solve it.
- Given a first order ODE, use a numerical method for solving it.
- Given a complex function (exponential, trigonometric, hyperbolic, or logarithmic), determine whether it is continuous, differentiable, or analytical.

Standard Math Sample Questions (MATH 500):

Fractions, decimals, and percents

1. Write 4.035 as an equivalent percent (%).

   A. 403.5%
   B. 40.35%
   C. 4.035%
   D. 0.4035%

2. Convert 0.00375% to an equivalent decimal.

   A. 0.000375
   B. 3.75
   C. 0.0000375
   D. 0.375

3. Write 2.35% as an equivalent fraction. (Make sure fraction is reduced to lowest terms.)

   A. $2\frac{7}{100}$
   B. $\frac{47}{2{,}000}$
   C. $\frac{47}{200}$
   D. $4\frac{7}{2{,}000}$

4. Convert the fraction $\frac{15}{74}$ to an equivalent percent (%).

   A. 0.2027%
   B. 0.001574%
   C. 0.20%
   D. 20.27%

5. Convert 3.414 to an equivalent percent (%).

   A. 34.14%
   B. 0.03414%
   C. 341.4%
   D. 3.414%

Expressions

6. Simplify the expression by using order of operations.

$$8 \div 4(12 - 8)$$

   A. $\frac{1}{2}$
   B. 8
   C. 64
   D. 128

7. Add or subtract as indicated.

$$-\frac{3}{5} + \frac{1}{4} - \frac{3}{10}$$

   A. $-\frac{13}{20}$
   B. $\frac{7}{19}$
   C. $\frac{13}{20}$
   D. 5

8. Evaluate.

$$-6^2$$

   A. –36
   B. –12
   C. 12
   D. 36

9. Evaluate $3x^2 + 6x + 4$ for $x = -4$.

   A. –32
   B. –20
   C. 4
   D. 28

10. Simplify the expression.

$$(8y^2 - 6y + 6) - (5y^2 - 6y + 8)$$

A. $13y^2 - 12y - 2$
B. $3y^2 + 12y + 14$
C. $13y^2 + 14$
D. $3y^2 - 2$

Word problems

11. Jim purchased 2 pieces of property that had been foreclosed on by a local bank for a total of $330,000. When he sold these properties, on the first piece Jim earned a profit of 12% but on the second piece he lost 8%. His total profit was $18,000. How much did Jim pay for each property?

A. 1st piece: $108,000; 2nd piece: $222,000
B. 1st piece: $132,000; 2nd piece: $198,000
C. 1st piece: $222,000; 2nd piece: $108,000
D. 1st piece: $198,000; 2nd piece: $132,000

12. In April, Dots sold a total of 250 T-shirts and shorts. The total sales were $600. If T-shirts sell for $2 and shorts sell for $4, how many T-shirts and shorts did Dots sell in April?

A. T-Shirts = 100; shorts = 150
B. T-Shirts = 50; shorts = 200
C. T-Shirts = 200; shorts = 50
D. T-Shirts = 150; shorts = 100

13. A particular company produces widgets. Each widget sells for $9, and the variable cost of producing each unit is 40% of the selling price. If the monthly fixed costs incurred by the company are $50,000, what is the break-even point? (Write answer to 2 decimal places.)

A. 8,723.49
B. 9,259.26
C. 3,968.25
D. 5,291.01

14. You want to invest \$8,000 over a 60-month period at $3\frac{1}{2}$% simple interest. What is the total value of this investment at maturity?

    A. \$22,000
    B. \$16,800
    C. \$9,400
    D. \$9,680

15. A particular item was discounted by 20%. If the sale price is \$55, what was the original price?

    A. \$66.00
    B. \$75.00
    C. \$68.75
    D. \$75.50

Equations

16. Find the x- and y-intercepts for the line given by the equation $2x + 3y = 12$.

    A. (6, 0) and (0, 4)
    B. (–6, 0) and (0, –4)
    C. (4, 0) and (0, 6)
    D. (–4, 0) and (0, –6)

17. Use the following information to determine the equation for profit from selling x items.

    Price = \$9.00 per unit; Fixed cost = \$24,000; Variable cost = \$5.92 per unit

    A. Profit = $24{,}000 - 9.00x$
    B. Profit = $9.00x - 24{,}000$
    C. Profit = $3.08x - 24{,}000$
    D. Profit = $24{,}000 - 3.08x$

18. Solve the equation.

$$0.4x - 0.7 = 0.3x + 7$$

    A. $x = 6.3$
    B. $x = 77$
    C. $x = 11$
    D. $x = 9$

19. Solve the formula for m.

$$Z = \frac{(x - m)}{s}$$

A. $m = x - Zs$
B. $m = Zs - x$
C. $m = x + Zs$
D. $m = Zs + x$

20. Determine the break-even point in units based on the following information.

Price = $100 per unit; Fixed cost = $160,000; Variable cost = $60 per unit

A. $x = 100$ units
B. $x = 400$ units
C. $x = 1{,}000$ units
D. $x = 4{,}000$ units

Advanced Math Sample Questions
(MATH 451: Engineering Mathematics II, Introductory Linear Algebra):

Use the following vectors and matrices for problems 1–11 in this section:

$\mathbf{A} = \begin{bmatrix} 1 & 3 \\ 4 & 2 \end{bmatrix}$ $\mathbf{B} = \begin{bmatrix} 3 & 3 \\ 4 & 4 \end{bmatrix}$ $\mathbf{C} = \begin{bmatrix} 0 & 2 & 4 \\ 6 & 5 & 5 \\ 1 & 0 & -3 \end{bmatrix}$

$\mathbf{D} = \begin{bmatrix} 2 \\ 1 \\ 5 \end{bmatrix}$ $\mathbf{E} = \begin{bmatrix} -2 \\ 2 \end{bmatrix}$ $\mathbf{F} = \begin{bmatrix} -4 & 3 & -1 \end{bmatrix}$

$\mathbf{G} = \begin{bmatrix} 2 & 1 & 5 \end{bmatrix}$ $\mathbf{H} = \begin{bmatrix} -x^3 & 4y^4 & z^{-2} \end{bmatrix}$ $\mathbf{X} = \begin{bmatrix} x \\ y \end{bmatrix}$

1. Solve the following system of equations**.**

$$\mathbf{AX} = \mathbf{E}$$

   A. $\mathbf{X} = \begin{bmatrix} -1 \\ -1 \end{bmatrix}$
   B. $\mathbf{X} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$
   C. $\mathbf{X} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$
   D. Cannot solve for **X**

2. Calculate $\mathbf{3A} - \mathbf{B}$.

   A. $\begin{bmatrix} 6 & 12 \\ 16 & 10 \end{bmatrix}$
   B. $\begin{bmatrix} 0 & 6 \\ 10 & 4 \end{bmatrix}$
   C. $\begin{bmatrix} -3 & 2 \\ 4 & 1 \end{bmatrix}$
   D. Cannot be calculated

3. Find $\mathbf{A^{-1}}$ using an augmented matrix.

   A. $\mathbf{A^{-1}} = \begin{bmatrix} -\frac{1}{5} & \frac{1}{3} \\ \frac{2}{5} & -\frac{1}{10} \end{bmatrix}$
   B. $\mathbf{A^{-1}} = \begin{bmatrix} \frac{1}{5} & -\frac{1}{3} \\ -\frac{2}{5} & \frac{1}{10} \end{bmatrix}$
   C. $\mathbf{A^{-1}} = \begin{bmatrix} \frac{1}{5} & \frac{1}{3} \\ -\frac{2}{5} & -\frac{1}{10} \end{bmatrix}$
   D. Inverse does not exist

4. Calculate the two products **DF** and **FD**. Are they equal?

   A. $\mathbf{DF} = [10]; \mathbf{FD} = [10]$; They are equal
   B. $\mathbf{DF} = \begin{bmatrix} -8 & 6 & -2 \\ -4 & 3 & -1 \\ -12 & 9 & -3 \end{bmatrix}; \mathbf{FD} = [-8]$; They are unequal
   C. $\mathbf{DF} = [10]; \mathbf{FD} = \begin{bmatrix} -8 & 6 & -2 \\ -4 & 3 & -1 \\ -12 & 9 & -3 \end{bmatrix}$; They are unequal
   D. At least one product does not exist

5. Calculate the product **FC**.

   A. $\mathbf{FC} = \begin{bmatrix} 12 & 1 & 2 \\ 3 & 14 & -9 \\ -2 & 1 & 17 \end{bmatrix}$
   B. $\mathbf{FC} = \begin{bmatrix} 17 \\ 7 \\ 2 \end{bmatrix}$
   C. $\mathbf{FC} = [17 \quad 7 \quad 2]$
   D. Undefined

6. Find the dot product $\mathbf{F} \cdot \mathbf{G}$.

   A. $\mathbf{F} \cdot \mathbf{G} = [10]$
   B. $\mathbf{F} \cdot \mathbf{G} = \begin{bmatrix} 8 & 4 & -2 \\ -1 & 3 & -1 \\ 7 & 5 & 2 \end{bmatrix}$
   C. $\mathbf{F} \cdot \mathbf{G} = [-2 \quad 4 \quad 4]$
   D. Undefined

7. Calculate the Cross product $\mathbf{F} \times \mathbf{G}$.

   A. $\mathbf{F} \times \mathbf{G} = -10i - 18j + 16k$
   B. $\mathbf{F} \times \mathbf{G} = -16i - 10j + 18k$
   C. $\mathbf{F} \times \mathbf{G} = +16i - 18j - 10k$
   D. Undefined

8. Calculate the gradient of vector $\mathbf{H}$.

   A. $\mathrm{Grad}(\mathbf{H}) = \left[-\frac{x^4}{4} \quad \frac{4y^5}{20} \quad -z^{-1}\right]$
   B. $\mathrm{Grad}(\mathbf{H}) = [-3x^2 \quad 16y^3 \quad -2z^{-3}]$
   C. $\mathrm{Grad}(\mathbf{H}) = \left[-\frac{x^4}{4} \quad \frac{4y^5}{20} \quad -z^{-1}\right]$
   D. Gradient does not exist

9. Find the eigenvalues of **A**.

   A. {5, –2}
   B. {–5, –2}
   C. {–5, 2}
   D. Cannot be determined

10. Calculate the eigenvectors of **A**. Are they independent?

   A. Eigenvectors: $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$ and $\begin{bmatrix} -1 \\ 2 \end{bmatrix}$; No
   B. Eigenvectors: $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$ and $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$; Yes
   C. Eigenvectors: $\begin{bmatrix} -2 \\ -2 \end{bmatrix}$ and $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$; Yes
   D. Cannot be calculated

11. Calculate the derivative of vector **H**.

A. $\mathbf{H} = [-x^2 \quad 4y^3 \quad z^{-3}]$
B. $\mathbf{H} = [-3x^2 \quad 16y^3 \quad -2z^{-3}]$
C. $\mathbf{H} = [4y^3 + z^{-2} \quad -x^3 + z^{-2} \quad -x^3 + 4y^4]$
D. Cannot be calculated

12. Evaluate the following surface integral.

$$S = \int_0^3 \int_0^2 (6xy^2 - 12)\, dx\, dy$$

A. $S = 36$
B. $S = 0$
C. $S = -36$
D. Cannot be calculated

13. The Fourier expansion of a function g contains only terms in $\cos(nx)$. From this, what do you know about the function?

A. g is an odd function
B. g is an even function
C. g is neither an odd function nor an even function
D. No characteristics can be derived from the information given

Advanced Math Sample Questions (MATH 450):

1. Find the general solution for the differential equation $\frac{dy}{dx} = (1 + y^2)e^x$.

   A. $y = \tan(e^x + c)$
   B. $y = \sin(e^x + c)$
   C. $y = \cos(e^x + c)$
   D. $y = \tan(x + c)$

2. Obtain the particular solution of the second-order differential equation $\frac{d^2y}{dx^2} + 6\frac{dy}{dx} + 5y = 0$ for $y(0) = 4$ and $\frac{dy}{dx}(0) = 12$.

   A. $y = 3e^x + e^{5x}$
   B. $y = 8e^{-x} - 4e^{-5x}$
   C. $y = -8e^x + 4e^{5x}$
   D. $y = -3e^{-x} + 3e^{-5x}$

3. Obtain the general solution of the differential equation $\frac{d^4y}{dx^4} - 4\frac{d^2y}{dx^2} + 4y = 0$.

   A. $y = (c_1 + c_2x)e^{2x} + (c_3 + c_4x)e^{-2x}$
   B. $y = (c_1 + c_2x)e^{4x} + (c_3 + c_4x)e^{-4x}$
   C. $y = c_1xe^{\sqrt{2}x} + c_2xe^{-\sqrt{2}x}$
   D. $y = (c_1 + c_2x)e^{\sqrt{2}x} + (c_3 + c_4x)e^{-\sqrt{2}x}$

4. Determine the eigenvalues and stability of the following system.

$$\frac{dy_1}{dx} = y_1 + y_2$$
$$\frac{dy_2}{dx} = 4y_1 + y_2$$

   A. Eigenvalues: $-1 + i, 1 + i$; unstable system
   B. Eigenvalues: $-1, 3$; unstable system
   C. Eigenvalues: $1, 4$; unstable system
   D. Eigenvalues: $-1, -4$; stable system

5. Obtain the Laplace transform of the following function. (V_0 =const.)

$$f(t) = \begin{cases} V_0 & for \quad a < t < b \\ 0 & otherwise \end{cases}$$

A. $F(s) = \frac{V_0}{s}[e^{-bs} - e^{-as}]$
B. $F(s) = V_0\left[\frac{1}{s+a} - \frac{1}{s+b}\right]$
C. $F(s) = \frac{V_0}{s}[e^{-as} - e^{-bs}]$
D. $F(s) = \frac{a}{s} - \frac{b}{s+1}$

6. Find current I as a function of time t for the following differential equation (RLC circuit).

$$\frac{d^2I}{dt^2} + \frac{R}{L}\frac{dI}{dt} + \frac{1}{LC}I = \frac{1}{L}\frac{dE}{dt}$$

Assume that $R = 2$ Ohms, $L = 1$ H, $C = 0.1$ F, and $E = 10$ V (constant).

A. $I = e^{-t}(A\cos(3t) + B\sin(3t)) + 3\sin(t)$
B. $I = e^{-t}(A\cos(3t) + B\sin(3t)) - \frac{100}{9}e^{-t}$
C. $I = e^{-3t}(A\cos(t) + B\sin(t))$
D. $I = e^{-t}(A\cos(3t) + B\sin(t))$

7. Which of the following pairs of functions $\{y_1, y_2\}$ is a basis of solutions for the differential equation $x\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + xy = 0$?

A. $\left\{\frac{1}{x}, \frac{1}{x^2}\right\}$
B. $\left\{\frac{\sin x}{x^2}, \frac{\cos x}{x}\right\}$
C. $\left\{\frac{\sin x}{x}, \frac{\cos x}{x}\right\}$
D. $\{\ln x, \cos x\}$

8. Find solution T as a function of variable t for the differential equation $\frac{dT}{dt} = -0.056(T - 45)$ with $T(0) = 70$.

   A. $T = 70e^{-0.056t}$
   B. $T = 25 + 45e^{-0.056t}$
   C. $T = 69.944e^{-45t} + 0.056$
   D. $T = 45 + 25e^{-0.056t}$

9. Given the complex numbers $a = 3 + 4j$ and $b = -1 - j$, where $j = \sqrt{-1}$, calculate $a + b$ and $a * b$.

   A. $-3 - 4j$ and $1 - j$
   B. $+2 + 3j$ and $1 - j$
   C. $+2 + 3j$ and $1 - 7j$
   D. $-2 + 3j$ and $- 3 - 4j$

10. Apply the power series methods where $y = \sum_{k=0}^{\infty} a_k x^k$ to solve the ODE $y' + y = 0$.

   A. $y = \sum_{k=0}^{\infty}(a_k)x^k$
   B. $y = \sum_{k=1}^{\infty}(ka_k)x^k$
   C. $y = \sum_{k=0}^{\infty}(-a_k)x^k$
   D. $y = \sum_{k=1}^{\infty}(-ka_k)x^k$

Answer Keys:

Standard Math (MATH 500):

Sequence	Description	Key
1	Fractions, decimals, and percents	A
2	Fractions, decimals, and percents	C
3	Fractions, decimals, and percents	B
4	Fractions, decimals, and percents	D
5	Fractions, decimals, and percents	C
6	Expressions	B
7	Expressions	A
8	Expressions	A
9	Expressions	D
10	Expressions	D
11	Word problems	C
12	Word problems	C
13	Word problems	B
14	Word problems	C
15	Word problems	C
16	Equations	A
17	Equations	C
18	Equations	B
19	Equations	A
20	Equations	D

Advanced Math
(MATH 451: Engineering Mathematics II, Introductory Linear Algebra):

Sequence	Description	Key
1	Given a homogeneous or nonhomogenous system of linear equations, solve the system using Gaussian elimination method.	C
2	Given a homogeneous or nonhomogenous system of linear equations, solve the system using Gaussian elimination method.	B
3	Given a square matrix, find its inverse and rank.	A
4	Given a homogeneous on nonhomogenous system of linear equations, solve the system using Gaussian elimination method.	B
5	Given a homogeneous on nonhomogenous system of linear equations, solve the system using Gaussian elimination method.	C
6	Given two vectors, find the sum, the difference, the dot product, and the cross product.	A
7	Given two vectors, find the sum, the difference, the dot product, and the cross product.	C
8	Given a vector, find the derivative vector and the gradient	B
9	Given a square matrix, find its eigenvalues and eigenvectors and state if the matrix has linearly independent eigenvectors.	A
10	Given a square matrix, find its eigenvalues and eigenvectors and state if the matrix has linearly independent eigenvectors.	B
11	Given a vector, find the derivative vector and the gradient.	B
12	Given a surface integral, use the divergence theorem and Stokes' theorem to evaluate the integral.	C
13	Given a nonperiodic function, find its Fourier Transform.	B

Advanced Math (MATH 450):

Sequence	Description	Key
1	Given a physical process, a system, or an electric circuit, write an ODE (ordinary differential equation) of the first order and solve it.	A
2	Given a physical process, a system, or an electric circuit, write an ODE of the second order and solve it.	B
3	Given a linear ODE of degree three or higher, solve it by extending the methods used for solving second order ODE.	D
4	Given a physical process, a system, or an electric circuit, write a system of *n* first order ODEs and solve it.	B
5	Given a linear ODE, use Laplace transform method to solve it.	C
6	Given a physical process, a system, or an electric circuit, write a system of *n* first order ODEs and solve it.	D
7	Given a physical process, a system, or an electric circuit, write a system of *n* first order ODEs and solve it.	C
8	Given a complex function (exponential, trigonometric, hyperbolic, or logarithmic), determine whether it is continuous, differentiable, or analytical.	D
9	Given a complex function (exponential, trigonometric, hyperbolic, or logarithmic), determine whether it is continuous, differentiable, or analytical.	C
10	Given a linear ODE with variable coefficients, use the power series method to solve it.	D

Selected solutions for MATH 450 Sample Questions:

1. Using separation of variables we obtain $\frac{dy}{1+y^2} = e^x\,dx$. Integrating both sides yields $\int \frac{dy}{1+y^2} = \int e^x\,dx$. This gives $\tan^{-1}y = e^x + c$. Computing y from the last expression we obtain $y = \tan(e^x + c)$.

2. From the given differential equation we obtain characteristic equation $\lambda^2 + 6\lambda + 5 = 0$. Solving this equation gives $\lambda_1 = -1$ and $\lambda_2 = -5$. Using the characteristic values we can write the solution as $y = Ae^{-x} + Be^{-5x}$, where A and B are two constants to be computed. Taking derivative of the solution we have $\frac{dx}{dy} = -Ae^{-x} - 5Be^{-5x}$. Now, from the given initial conditions we obtain two linear equations: $A + B = 4$ and $-A - 5B = 12$. By solving this system we obtain $A = 8$ and $B = -4$. Thus, $y = 8e^{-x} - 4e^{-5x}$.

3. For the given differential equation we have the following characteristic equation: $\lambda^4 - 4\lambda^2 + 4 = 0$. We can reduce this equation to $z^2 - 4z + 4 = 0$ (with the assumption that $z = \lambda^2$). From the quadratic equation we obtain $z_1 = 2$ and $z_2 = 2$. Thus, the four lambdas are $\sqrt{2}, \sqrt{2}, -\sqrt{2}, -\sqrt{2}$. Since we have two pairs of identical solutions, therefore we get $(c_1 + c_2x)e^{\sqrt{2}x}$ for the first two lambdas and $(c_3 + c_4x)e^{-\sqrt{2}x}$ for the last two lambdas. This gives the final solution.$y = (c_1 + c_2x)e^{\sqrt{2}x} + (c_3 + c_4x)e^{-\sqrt{2}x}$.

4. From the given system of differential equations we obtain the matrix of coefficients $\begin{bmatrix} 1 & 1 \\ 4 & 1 \end{bmatrix}$ and its characteristic equation $\begin{vmatrix} 1-\lambda & 1 \\ 4 & 1-\lambda \end{vmatrix} = 0$. The last expression is equivalent to $\lambda^2 - 2\lambda - 3 = 0$. Solving the last equation we obtain eigenvalues $\lambda_1 = -1$ and $\lambda_2 = 3$. Since one of the eigenvalues is positive, therefore the system is unstable.

5. The given function can be written as $f(t) = V_0[H(t-a) - H(t-b)]$, where $H(t)$ is the Heaviside function (unit step function). Using the rules of Laplace transform for functions with delays we obtain $F(s) = \frac{V_0}{s}e^{-as} - \frac{V_0}{s}e^{-bs} = \frac{V_0}{s}[e^{-as} - e^{-bs}]$.

6. Substituting the given values of parameters we obtain $\frac{d^2I}{dt^2} + 2\frac{dI}{dt} + 10I = 0$ and characteristic equation $\lambda^2 + 2\lambda + 10 = 0$. Solutions of the characteristic equations are $\lambda_{1,2} = -1 \pm 3i$ (complex conjugates). Since the solutions are complex conjugate, with real part –1 and imaginary parts ± 3, therefore we obtain
$I = e^{-t}(A\cos(3t) + B\sin(3t))$.

7. Checking the pairs in options A, B, and D we conclude that the functions given in those pairs are not solutions of the given differential equation. On the other hand, for the pair in option C, that is $\{y_1, y_2\} = \left\{\frac{\sin x}{x}, \frac{\cos x}{x}\right\}$, it is easy to check that both y_1 and y_2 satisfy the differential equation. Moreover, functions y_1 and y_2 are linearly independent, since $\begin{vmatrix} y_1 & y_2 \\ y_1' & y_2' \end{vmatrix} = \begin{vmatrix} \frac{\sin x}{x} & \frac{\cos x}{x} \\ \frac{x\cos x - \sin x}{x^2} & \frac{-x\sin x - \cos x}{x^2} \end{vmatrix} = -\frac{1}{x^2} \neq 0$. Thus, the pair in option C is the basis of solution.

8. Using separation of variables and integration we have $\int \frac{dT}{T-45} = -\int 0.056dt$. Computing both integrals we obtain $\ln|T - 45| - \ln c = -0.056t$. Simplifying the last expression we get $\ln\left|\frac{(T-45)}{c}\right| = -0.056t$ and further $T - 45 = ce^{-0.056t}$. Substituting $T = 70$ and $t = 0$, we have $70 - 45 = c$. Thus, $c = 25$ and finally we get $T = 45 + 25e^{-0.056t}$.