Problem 11 in Section 1.1. Check that $y_1 = \frac{1}{x^2}$ and $y_2 = \frac{\ln x}{x^2}$ are solutions of the Differential Equation $x^2y'' + 5xy' + 4y = 0$, where $y' = \frac{dy}{dx}$.

Problem 16 in Section 1.1. Find all constants r so that $y = e^{rx}$ is a solution of $y'' + 3y' - 4y = 0$.

Problem 26 in Section 1.1. Verify that $y(x) = (x + C)\cos x$ is a solution of the Differential Equation $y' + y\tan x = \cos x$ for any constant C. Find the constant C for which $y(\pi) = 0$.

Problem 30 in Section 1.1. Consider the functions $y = g(x)$ which have the property that the graph of g is perpendicular to every curve of the form $y = x^2 + k$ (k is a constant) wherever they meet. Write a Differential Equation of the form $\frac{dy}{dx} =$ some function of x and y, which has g as one of its solutions.

Problem 36 in Section 1.1. In a city with a fixed population of P persons, the time rate of change of the number N of those persons infected with a certain contagious disease is proportional to the product of the number who have the disease and the number who do not.

Problem 45 in Section 1.1. Suppose a population of rodents satisfies the Differential Equation $\frac{dP}{dt} = kP^2$. Initially, there are $P(0) = 2$ rodents, and their number is increasing at the rate of $\frac{dP}{dt} = 1$ rodent per months when there are $P = 10$ rodents. How long will it take for this population to grow to one hundred rodents? To a thousand? What is happening here?

Problem 46 in Section 1.1. Suppose the volicity v of a motorboat in water satisfies the Differential Equation $\frac{dv}{dt} = kv^2$. The initial speed of the boat is $v(0) = 10$ meters per second (m/s) and v is decreasing at the rate of 1 m/s^2 when $v = 5$m/s, How long does it take for the velocity of the boat to decrease to 1m/s? To 1/10 m/s? When does the boat stop?

Problem 6 in Section 1.2. Solve the Initial Value Problem

$$\frac{dy}{dx} = x\sqrt{x^2 + 9} \quad \text{and} \quad y(-4) = 0.$$

Problem 7 in Section 1.2. Solve the Initial Value Problem

$$\frac{dy}{dx} = \frac{10}{x^2 + 1} \quad \text{and} \quad y(0) = 0.$$

Problem 10 in Section 1.2. Solve the Initial Value Problem

$$\frac{dy}{dx} = xe^{-x} \quad \text{and} \quad y(0) = 1.$$

Problem 16 in Section 1.2. The position of an object at time t is $x(t)$. The acceleration of the object is $x''(t) = \frac{1}{\sqrt{t+4}}$, the initial velocity is $x'(0) = -1$ and the initial position is $x(0) = 1$. Find the formula for $x(t)$.

Problem 32 in Section 1.2. Suppose that a car skids 15 m if it is moving at 50 km/h whe the brages are applied. Asuming that the car has the same constant deceleration, how far will it skid if it is moving at 100 km/hr when the brakes are applied?
Suggestion. I suggest that you ignore the meters, kilometers, and hours from the given problem and calculate the stopping distance as a function of the initial speed v_0 and the constant deceleration $-k$. (Notice that k is positive.) Then see how the stopping distance changes when v_0 is replaced by $2v_0$.

Problem 33 in Section 1.2. On the planet Gzyx, a ball dropped from a height of 20 feet hits the ground in 2 seconds. If a ball is dropped from the top of a 200 foot tall building, how long will it take to hit the ground? With what speed will it hit the ground? (The fact from Physics is that there is a constant g_1 so that the acceleration of each ball is g_1.)
Problem 11 in Section 1.3. What does the existence and uniqueness theorem tell you about the Initial Value Problem:

$$\tfrac{dy}{dx} = 2x^2y^2 \quad \text{and} \quad y(1) = -1,$$

if anything?

Problem 13 in Section 1.3. What does the existence and uniqueness theorem tell you about the Initial Value Problem:

$$\tfrac{dy}{dx} = y^{1/3} \quad \text{and} \quad y(0) = 1,$$

if anything?

Problem 15 in Section 1.3. What does the existence and uniqueness theorem tell you about the Initial Value Problem:

$$\tfrac{dy}{dx} = \sqrt{x-y} \quad \text{and} \quad y(2) = 2,$$

if anything?
Problem 1 in Section 2.4. Use Euler's method to approximate $y(\frac{1}{2})$ where y is a solution of the Initial Value Problem

$$y' = 2y \quad \text{and} \quad y(0) = 2.$$

Use two steps only; in other words, take $h = \frac{1}{4}$. Compare your approximation of $y(\frac{1}{2})$ to the actual value of $y(\frac{1}{2})$.

Problem 9 in Section 1.4. Find the general solution of $(1-x^2)\frac{dy}{dx} = 2y$.

Problem 13 in Section 1.4. Find the general solution of $y^3 \frac{dy}{dx} = (y^4+1)\cos x$.

Problem 21 in Section 1.4. Solve the Initial Value Problem

$$2y\frac{dy}{dx} = \frac{x}{\sqrt{x^2-16}} \quad \text{and} \quad y(5) = 2.$$

Problem 24 in Section 1.4. Solve the Initial Value Problem

$$(\tan x)\frac{dy}{dx} = y \quad \text{and} \quad y(\tfrac{\pi}{2}) = \tfrac{\pi}{2}.$$

Problem 35 in Section 1.4. Carbon extracted from an ancient skull contained only one-sixth as much ${}^{14}C$ as carbon extracted from present-day bone. How old is the skull. (refer to example 4).

Problem 37 in Section 1.4. Upon the birth of their first child, a couple deposited 5000 in an account that pays interest compounded continuously. The interest payments are allowed to accumulate. How much will the account contain on the child's eighteenth birthday. (Continuously compounded interest is discussed on the bottom of page 35.)

Problem 43 in Section 1.4. A pitcher of buttermilk initially at $25°$C is to be cooled by setting it on the front porch, where the temperature is $0°$C. Suppose that the temperature of the buttermilk has dropped to $15°$C after 20 min. When will it be at $5°$C?(refer to example 5).

Problem 1 in Section 2.3. The acceleration of a Maserati is propostional to the differebce between 250 km/h and the velocty of this sports car. If this machine can accelerate from rest to 100 km/hr in 10s, how long will it take for the car to accelerfate from rest to 200 km/hr.

Problem 2 in Section 2.3. Suppose that a body through a resisting medium with resitance proportional to its velocity v, so that $\frac{dv}{dt} = -kv$.

1. Show that its velocity and position at time t are given by

$$v(t) = v_0 e^{-kt} \quad \text{and} \quad x(t) = x_0 + (\tfrac{v_0}{k})(1 - e^{-kt}).$$

2. Conclude that the body travels only a finite distance, and find that distance.

Problem 3 in Section 2.3. Suppose that a motorboat is moving at 40 ft/s when its motor suddenly quits, and that 10 s later the boat has slowed to 20 ft/s. Assume, as in Prolem 2, that the resistance it encounters while coasting is proportional to its velocity. How far will the boat coast in all?

Problem 7 in Section 2.3. Suppose that a car starts from rest, its engine providing an acceleration of 10 ft/s^2, while air resistance provides $.1$ ft/s^2 of deceleration for each foot per second of the car's velocity.

1. Find the car's maximum possible (limiting) velocity.
2. Find how long it takes the car to attain 90% of its limiting velocity, and how far it travels while doing so.

Problem 13 in Section 1.5. Solve the Initial Value Problem

$$y' + y = e^x \quad \text{and} \quad y(0) = 1.$$

In this problem $'$ means $\frac{d}{dx}$.

Problem 21 in Section 1.5.
Solve the Initial Value Problem

$$xy' = 3y + x^4 \cos x \quad \text{and} \quad y(2\pi) = 0.$$

In this problem $'$ means $\frac{d}{dx}$.

Problem 25 in Section 1.5. Solve the Initial Value Problem

$$(x^2+1)\frac{dy}{dx} + 3x^3 y = 6xe^{-(3/2)x^2} \quad \text{and} \quad y(0) = 1.$$

Problem 33 in Section 1.5. A tank contains 1000 liters (L) of a solution consisting of 100 kg of salt dissolved in water. Pure water is pumped into the tank at the rate of 5 L/s, and the mixture – kept uniform by stirring – is pumped out at the same rate. How long will it be until 10 kg of salt remain in the tank?

Problem 37 in Section 1.5. A 400-gal tank initially contains 100 gal of brine containing 50 lb of salt. Brine containing 1 lb of salt per gallon enters the tank at the rate of 5 gal/s, and the well-mixed brine in the tank flows out at the rate of 3 gal/s. How much salt will the tank contain when it is full of brine?

Problem 1 in Section 1.6. Solve $(x+y)y' = x - y$.

Problem 3 in Section 1.6. Solve $xy' = y + 2\sqrt{xy}$. Solve $xy' = y + 2\sqrt{xy}$.

Problem 14 in Section 1.6. Solve $yy' + x = \sqrt{x^2+y^2}$.

Problem 15 in Section 1.6. Solve $x(x+y)y' + y(3x+y) = 0$.

Problem 17 in Section 1.6. Solve $y' = (4x+y)^2$.

Problem 18 in Section 1.6. Solve $(x+y)y' = 1$.

Problem 19 in Section 1.6. Solve $x^2y' + 2xy = 5y^3$.

Problem 20 in Section 1.6. Solve $y^2y' + 2xy^3 = 6x$.

Problem 21 in Section 1.6. Solve $y' = y + y^3$.

Problem 9 in Section 2.1 The time rate of change of a rabbit population P is proportional to the square root of P. At time $t = 0$ (months) the population numbers 100 rabbits and is increasing at the rate of 20 rabbits per month. How many rabbits will there be one year later?

Problem 15 in Section 2.1 Consider a population $P(t)$ which satisfies the logistic equation $\frac{dP}{dt} = aP - bP^2$, where a and b are constants, $B = aP$ is the birth rate, and $D = bP^2$ is the death rate. Write M in terms of $B(0)$, $D(0)$, and $P(0)$.

Comment The point of the problem is that we know the solution of

$$\frac{dP}{dt} = kP(M - P).$$

In particular, we know that in the long term the population will approach M.

Someone interested in the population can probably calculate $B(0)$, $D(0)$, and $P(0)$. If we can express M in terms of $B(0)$, $D(0)$, and $P(0)$, then we can make a plausible prediction of what the population will do without doing anymore calculating.

Problem 16 in Section 2.1 A rabbit population satisfies the Logistic Differential Equation $\frac{dP}{dt} = aP - bP^2$. If the initial population is 120 rabbits and there are 8 births per month and 6 deaths per month occurring at time $t = 0$, how many months does it take for $P(t)$ to reach 95% of the limiting population M?

Problem 18 in Section 2.1 Consider a population $P(t)$ which satisfies the extinction/explosion Differential Equation $\frac{dP}{dt} = aP^2 - bP$, where $B = aP^2$ is the time rate at which births occur and $D = bP$ is the rate at which deaths occur. If the initial population is $P(0) = P_0$ and B_0 births per month and D_0 births per month are occurring at time $t = 0$, show that the threshold population is $M = D_0P_0/B_0$.

Problem 19 in Section 2.1 Consider an alligator population which satisfies the extinction/explosion Differential Equation as in Problem 18. If the initial population is 100 alligators and there are 10 births per month and 9 deaths per month occurring at time $t = 0$, how many months does it take for $P(t)$ to reach 10 times the threshold population M?

Problem 32 in Section 2.1 Solve the Initial Value Problem

$$\frac{dP}{dt} = kP(M - P) \quad P(0) = P_0.$$

Draw the solution for

- $P_0 = M$,
- $M < P_0$, and
- $P_0 < M$.

Problem 33 in Section 2.1 Solve the Initial Value Problem

$$\tfrac{dP}{dt} = kP(P - M) \quad P(0) = P_0.$$

Draw the solution for

- $P_0 = M$,
- $M < P_0$, and
- $P_0 < M$.

Problem 1 in Section 2.2. (You can ignore the instruction about slope fields.) Consider the Differential Equation $\frac{dx}{dt} = x - 4$.

- What are the equilibrium solutions of this autonomous Differential Equation?
- Draw the phase diagram for this Differential Equation.
- Are the equilibrium solutions of this Differential Equation stable or unstable?
- Sketch the solution of the Initial Value problem

  $$\frac{dx}{dt} = x - 4 \quad x(0) = x_0,$$

  for a few choices of x_0.
- Solve the Differential Equation. (Be sure that your answer is in the form x is equal to some function of t.)

Problem 3 in Section 2.2. (You can ignore the instruction about slope fields.) Consider the Differential Equation $\frac{dx}{dt} = x^2 - 4x$.

- What are the equilibrium solutions of this autonomous Differential Equation?
- Draw the phase diagram for this Differential Equation.
- Are the equilibrium solutions of this Differential Equation stable or unstable?

- Sketch the solution of the Initial Value problem

$$\frac{dx}{dt} = x^2 - 4x \quad x(0) = x_0, \tag{1}$$

  for a few choices of x_0.

- Solve the Initial Value Problem (1). (Be sure that your answer is in the form x is equal to some function of t.)

Problem 5 in Section 2.2. (You can ignore the instruction about slope fields.) Consider the Differential Equation $\frac{dx}{dt} = x^2 - 4$.

- What are the equilibrium solutions of this autonomous Differential Equation?

- Draw the phase diagram for this Differential Equation.

- Are the equilibrium solutions of this Differential Equation stable or unstable?

- Sketch the solution of the Initial Value problem

$$\frac{dx}{dt} = x^2 - 4 \quad x(0) = x_0, \tag{2}$$

  for a few choices of x_0.

- Solve the Initial Value Problem (2). (Be sure that your answer is in the form x is equal to some function of t.)

Problem 7 in Section 2.2. (You can ignore the instruction about slope fields.)

Consider the Differential Equation $\frac{dx}{dt} = (x-2)^2$.

- What are the equilibrium solutions of this autonomous Differential Equation?

- Draw the phase diagram for this Differential Equation.

- Are the equilibrium solutions of this Differential Equation stable or unstable?

- Sketch the solution of the Initial Value problem

$$\frac{dx}{dt} = (x-2)^2 \quad x(0) = x_0, \tag{3}$$

  for a few choices of x_0.

- Solve the Initial Value Problem (3). (Be sure that your answer is in the form x is equal to some function of t.)

Problem 9 in Section 2.2. (You can ignore the instruction about slope fields.)

Consider the Differential Equation $\frac{dx}{dt} = x^2 - 5x + 4$.

- What are the equilibrium solutions of this autonomous Differential Equation?
- Draw the phase diagram for this Differential Equation.
- Are the equilibrium solutions of this Differential Equation stable or unstable?
- Sketch the solution of the Initial Value problem

$$\frac{dx}{dt} = x^2 - 5x + 4 \quad x(0) = x_0, \tag{4}$$

for a few choices of x_0.

- Solve the Initial Value Problem (4). (Be sure that your answer is in the form x is equal to some function of t.)

Problem 11 in Section 2.2. (You can ignore the instruction about slope fields.)

Consider the Differential Equation $\frac{dx}{dt} = (x-1)^3$.

- What are the equilibrium solutions of this autonomous Differential Equation?
- Draw the phase diagram for this Differential Equation.
- Are the equilibrium solutions of this Differential Equation stable or unstable?
- Sketch the solution of the Initial Value problem

$$\frac{dx}{dt} = (x-1)^3 \quad x(0) = x_0, \tag{5}$$

for a few choices of x_0.

- Solve the Initial Value Problem (5). (Be sure that your answer is in the form x is equal to some function of t.)

Problem 2 in Section 3.1.

(a) Verify that $y_1 = e^{3x}$ and $y_2 = e^{-3x}$ both are solutions of the Differential Equation $y'' - 9y = 0$.

(b) Solve the Initial Value Problem:

$$y'' - 9y = 0, \quad y(0) = -1, \quad y'(0) = 15.$$

Problem 17 in Section 3.1. Show that $y = \frac{1}{x}$ is a solution of $y' + y^2 = 0$, but that $y = \frac{c}{x}$ is not a solution of $y' + y^2 = 0$, unless c happens to be zero or one.

Problem 18 in Section 3.1. Show that $y = x^3$ is a solution of $yy'' = 6x^4$, but that $y = cx^3$ is not a solution of $yy'' = 6x^4$, unless c happens to be 1 or -1.

The point of this problem is that our tricks for linear Differential Equations do not work for non-linear Differential Equations. In particular if y_1 is a solution of a homogeneous linear Differential Equation, then cy_1 is also a solution of the Differential Equation. This statement is not true for non-linear Differential Equations.

Problem 19 in Section 3.1.

Show that $y_1 = 1$ and $y_2 = \sqrt{x}$ are both solutions of $yy'' + (y')^2 = 0$, but the sum $y_1 + y_2 = 1 + \sqrt{x}$ is not a solution of $yy'' + (y')^2 = 0$.

Problem 20 in Section 3.1. Are the functions $f(x) = \pi$ and $g(x) = \cos^2 x + \sin^2 x$ linearly independent or linearly dependent?

Problem 22 in Section 3.1. Are the functions $f(x) = 1+x$ and $g(x) = 1+|x|$ linearly independent or linearly dependent?

Problem 29 in Section 3.1. Show that $y_1 = x^2$ and $y_2 = x^3$ are both solutions of the Initial Value Problem

$$x^2y'' - 4xy' + 6y = 0, \quad y(0) = 0, \quad y'(0) = 0.$$

Why doesn't the Existence and Uniqueness Theorem apply to this problem?

Problem 3 in Section 3.2. Find a nontrivial linear combination of $f(x) = 0$, $g(x) = \sin x$, and $h(x) = e^x$ which is the constant function zero.

Problem 4 in Section 3.2. Find a nontrivial linear combination of $f(x) = 17$, $g(x) = 2\sin^2 x$, and $h(x) = 3\cos^2 x$ which is the constant function zero.

Problem 14 in Section 3.2. The problem tells us that $y_1 = e^x$, $y_2 = e^{2x}$, and $y_3 = e^{3x}$ all are solutions of the Differential equation $y''' - 6y'' + 11y' - 6y = 0$. We are supposed to solve the Initial Value Problem

$$y''' - 6y'' + 11y' - 6y = 0, \quad y(0) = 0, \quad y'(0) = 0, \quad y''(0) = 3.$$

Problem 16 in Section 3.2.

The problem tells us that $y_1 = e^x$, $y_2 = e^{2x}$, and $y_3 = xe^{2x}$ all are solutions of the Differential equation $y''' - 5y'' + 8y' - 4y = 0$. We are supposed to solve the Initial Value Problem

$$y''' - 5y'' + 8y' - 4y = 0, \quad y(0) = 1, \quad y'(0) = 4, \quad y''(0) = 0.$$

Problem 21 in Section 3.2. The problem tells us that $y_{\text{homog}} = c_1 \cos x + c_2 \sin x$ is the general solution of the homogeneous problem $y'' + y = 0$ and $y_{\text{partic}} = 3x$ is a particular solution of the Differential Equation $y'' + y = 3x$. The problem tells us to find the solution of the Initial Value Problem

$$y'' + y = 3x, \quad y(0) = 2, \quad \text{and} \quad y'(0) = -2.$$

Problem 26 in Section 3.2. Find a particular solution for each of the following Differential Equations.

(a) $y'' + 2y = 4$,

(b) $y'' + 2y = 6x$,

(c) $y'' + 2y = 6x + 4$.

We learn how to find particular solutions of non-homogeneous linear Differential Equations with constant coefficients in section 3.5. The basic technique is, "Guess the form of the answer and then adjust the coefficients". This problem serves as a warm-up for the procedure.

Problem 1 in Section 3.3. Find the general solution of $y'' - 4y = 0$.

Problem 3 in Section 3.3. Find the general solution of $y'' + 3y' - 10y = 0$.
Problem 5 in Section 3.3. Find the general solution of $y'' + 6y' + 9y = 0$.
Problem 11 in Section 3.3. Find the general solution of $y^{(4)} - 8y^{(3)} + 16y'' = 0$.

Problem 13 in Section 3.3. Find the general solution of $9y''' + 12y'' + 4y' = 0$.

Problem 17 in Section 3.3. Find the general solution of $6y'''' + 11y'' + 4y = 0$.

Problem 35 in Section 3.3. Find the general solution of

$$6y'''' + 5y''' + 25y'' + 20y' + 4y = 0.$$

Hint: one solution is $y = \cos(2x)$.

Problem 49 in Section 3.3. Solve the Initial Problem

$$y'''' = y''' + y'' + y' + 2y, \quad y(0) = 0, y'(0) = 0, \quad y''(0) = 0, \quad y'''(0) = 30$$

Hint: one solution is $y = \cos(2x)$.

Problem 15 in Section 3.4. Solve the Initial Problem

$$\tfrac{1}{2}x'' + 3x' + 4x = 0, \quad x(0) = 2, \quad x'(0) = 0.$$

Put your answer in the form $x(t) = Ce^{at}\cos(bt - \alpha)$ if this makes sense. Sketch the graph of $x = x(t)$.

Problem 17 in Section 3.4. Solve the Initial Problem

$$x'' + 8x' + 16x = 0, \quad x(0) = 5, \quad x'(0) = -10.$$

Put your answer in the form $x(t) = Ce^{at}\cos(bt - \alpha)$ if this makes sense. Sketch the graph of $x = x(t)$.

Problem 19 in Section 3.4. Solve the Initial Problem

$$4x'' + 20x' + 169x = 0, \quad x(0) = 4, \quad x'(0) = 16.$$

Put your answer in the form $x(t) = Ce^{at}\cos(bt - \alpha)$ if this makes sense. Sketch the graph of $x = x(t)$.

Problem 21 in Section 3.4. Solve the Initial Problem

$$x'' + 10x' + 125x = 0, \quad x(0) = 6, \quad x'(0) = 50.$$

Put your answer in the form $x(t) = Ce^{at}\cos(bt - \alpha)$ if this makes sense. Sketch the graph of $x = x(t)$.

Problem 2 in Section 3.5. Find a particular solution of

$$y'' - y' - 2y = 3x + 4.$$

Problem 3 in Section 3.5. Find a particular solution of

$$y'' - y' - 6y = 2\sin 3x.$$

Problem 5 in Section 3.5. Find a particular solution of

$$y'' + y' + y = \sin^2 x.$$

Problem 6 in Section 3.5. Find a particular solution of

$$2y'' + 4y' + 7y = x^2.$$

Problem 33 in Section 3.5. Solve the initial value problem

$$y'' + 9y = \sin 2x, \quad y(0) = 1, \quad y'(0) = 0.$$

Problem 37 in Section 3.5. Solve the Initial Value Problem

$$y''' - 2y'' + y' = 1 + xe^x, \quad y(0) = y'(0) = 0, \quad y''(0) = 1.$$

Problem 39 in Section 3.5. Solve the Initial Value Problem

$$y''' + y'' = x + e^{-x}, \quad y(0) = 1, \quad y'(0) = 0, \quad y''(0) = 1.$$

Problem 43 in Section 3.5.

(a) Find a Trig identity which expresses $\cos^3 x$ in terms of $\cos ax$ for various values of a. (Hint: Use Euler's Identity.)

(b) Find the general solution of

$$y'' + 4y = \cos^3 x.$$

Problem 1 in Section 7.1. Use the definition of $\mathcal{L}$ to compute $\mathcal{L}(f(t))$ for $f(t) = t$.

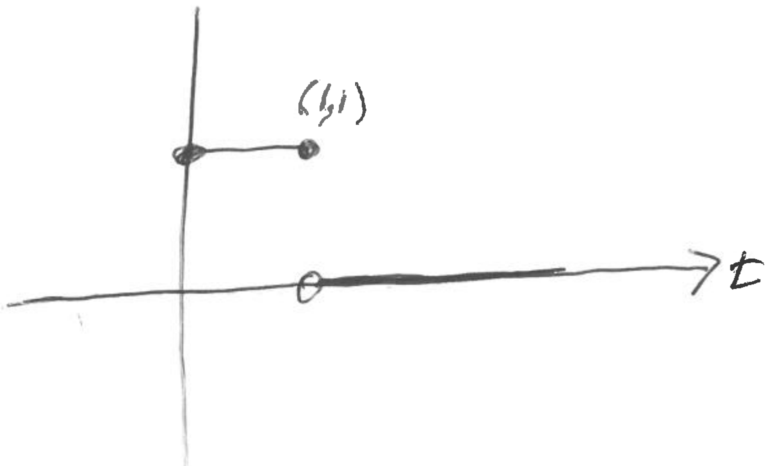
Problem 2 in Section 7.1. Use the definition of $\mathcal{L}$ to compute $\mathcal{L}(f(t))$ for $f(t) = t^2$.

Problem 3 in Section 7.1. Use the definition of $\mathcal{L}$ to compute $\mathcal{L}(f(t))$ for $f(t) = e^{3t+1}$.

Problem 5 in Section 7.1. Use the definition of $\mathcal{L}$ to compute $\mathcal{L}(f(t))$ for $f(t) = \frac{e^t - e^{-t}}{2}$.

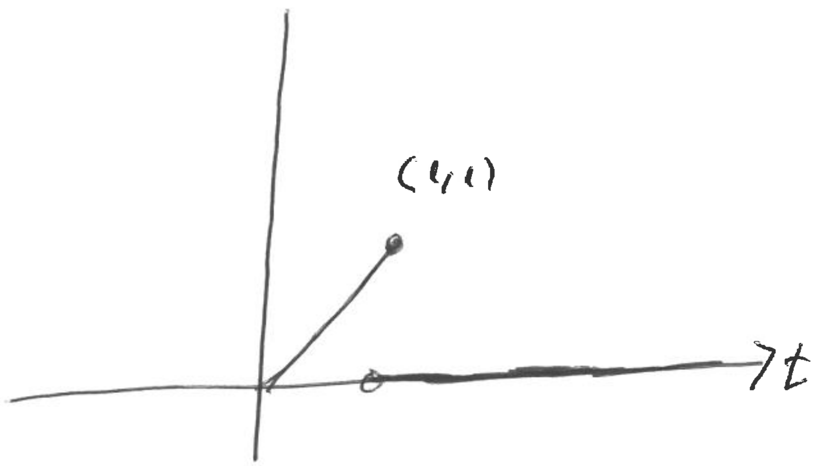
Problem 7 in Section 7.1. Compute the Laplace transform of the function $f(t)$ whose picture is on the next page.

7.1 Problem 7 Picture



Problem 9 in Section 7.1. Compute the Laplace transform of the function $f(t)$ whose picture is on the next page.

Section 7.1 Problem 9 Picture



Problem 11 in Section 7.1. Compute $\mathcal{L}(f(t))$ for $f(t) = \sqrt{t} + 3t$.

Problem 13 in Section 7.1. Compute $\mathcal{L}(f(t))$ for $f(t) = t - 2e^{3t}$.

Problem 17 in Section 7.1. Compute $\mathcal{L}(f(t))$ for $f(t) = \cos^2 2t$.

Problem 23 in Section 7.1. Find the inverse Laplace transform of $F(s) = \frac{3}{s^4}$.

Problem 25 in Section 7.1. Find the inverse Laplace transform of $F(s) = \frac{1}{s} - \frac{2}{s^{5/2}}$.

Problem 27 in Section 7.1. Find the inverse Laplace transform of $F(s) = \frac{3}{s-4}$.

Problem 29 in Section 7.1. Find the inverse Laplace transform of $F(s) = \frac{5-3s}{s^2+9}$.

Problem 1 in Section 7.2. Use Laplace transforms to solve the Initial Value Problem

$$x'' + 4x = 0, \quad x(0) = 5, \quad x'(0) = 0.$$

Problem 7 in Section 7.2.

Use Laplace transforms to solve the Initial Value Problem

$$x'' + x = \cos 3t, \quad x(0) = 1, \quad x'(0) = 0.$$

Problem 17 in Section 7.2. Find the inverse Laplace transform of

$$F(s) = \frac{1}{s(s-3)}$$

Problem 21 in Section 7.2. Find the inverse Laplace transform of

$$F(s) = \frac{1}{s^2(s^2+1)}$$

Problem 23 in Section 7.2. Find the inverse Laplace transform of

$$F(s) = \frac{1}{s^2(s^2-1)}.$$

Problem 31 in Section 7.2. In class we calculated

$$\mathcal{L}(t\cos kt) = \frac{s^2-k^2}{(s^2+k^2)^2} \quad \text{and} \quad \mathcal{L}(\sin kt) = \frac{k}{(s^2+k^2)}.$$

Use these facts to calculate

$$\mathcal{L}^{-1}\left(\frac{1}{(s^2+k^2)^2}\right).$$

Problem 1 in Section 7.3. Find the Laplace transform of $f(t) = t^4 e^{\pi t}$.

Problem 3 in Section 7.3. Find the Laplace transform of $f(t) = e^{-2t}\sin 3\pi t$.

Problem 5 in Section 7.3. Find the inverse Laplace transform of $F(s) = \frac{3}{2s-4}$.

Problem 7 in Section 7.3. Find the inverse Laplace transform of $F(s) = \frac{1}{s^2+4s+4}$.

Problem 9 in Section 7.3. Find the inverse Laplace transform of $F(s) = \frac{3s+5}{s^2-6s+25}$.

Problem 13 in Section 7.3. Find the inverse Laplace transform of $F(s) = \frac{5-2s}{s^2+7s+10}$.

Problem 19 in Section 7.3. Find the inverse Laplace transform of $F(s) = \frac{s^2-2s}{s^4+5s^2+4}$.

Problem 27 in Section 7.3. Use Laplace transforms to solve the Initial Value Problem:

$$x'' + 6x' + 25x = 0, \quad x(0) = 2, \quad x'(0) = 3.$$

Problem 33 in Section 7.3. Use Laplace transforms to solve the Initial Value Problem:

$$x'''' + x = 0, \quad x(0) = x'(0) = x''(0) = 0, \quad x'''(0) = 1.$$

(You probably want to use some of the problems 23-26 in 7.3 when you do this problem.)

Problem 37 in Section 7.3. Use Laplace transforms to solve the Initial Value Problem:

$$x'' + 4x' + 13x = te^{-t}, \quad x(0) = 0, \quad x'(0) = 2.$$