

Differential Eqns  
MAP2302 4689

C-Class

Prof. JLF King  
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**C1:** Show no work.

**a** A soln to  $[f'' - 3f'](x) = 14 - 6x$  is **polynomial**  
 $f(x) = \dots$ . Using parameters  $\alpha$  and  $\beta$ ,  
then, the *general* solution to  $[h'' - 3h'](x) = 14 - 6x$   
is

$h_{\alpha,\beta}(x) = \dots$ .

And the  $h$  with  $h(0) = 0$  and  $h'(0) = 0$   
is  $h(x) = \dots$ .

**b** DiffOperators **P, Q, R, S** are defined as

$P(f) := f(3) \cdot f'$ ,  $Q(f) := \cos(3) \cdot f^{(3)}$ ,  
 $R(f) := [\cos(3) \cdot f] + f''$ ,  $S(f) := \cos(3) + [3f']$ .

Then... **P** is linear:  $T \ F$ . **Q** is linear:  $T \ F$ .  
**R** is linear:  $T \ F$ . **S** is linear:  $T \ F$ .

**c** Complex number  $[x + iy]^2 = -8i$ , for *real num-*  
*bers*  $x = \dots$  and  $y = \dots$ .

**d** With **1()** the constant-1 fnc and  $F(x) := \sin(5x)$ ,  
then, convolution  
 $[1 \otimes F](x) = \dots$ .

**C2:** OYOP: In *grammatical English sentences*, write  
your essay on every *third* line (usually), so that I can  
easily write between the lines. Do not restate the question.

Brine with  $5 \frac{\text{lb}}{\text{gal}}$  salt flows at rate  $1 \frac{\text{gal}}{\text{min}}$  into a tank  
that initially held 100gal of  $2 \frac{\text{lb}}{\text{gal}}$ -salt brine. The tank  
is well-mixed, and brine is flowing *out* at rate  $3 \frac{\text{gal}}{\text{min}}$ .  
So the tank will empty in \_\_\_\_\_ minutes.

At time  $t$ , let  $\sigma(t)$  denote the tank-salinity [in lb/gal]  
and use  $y(t)$  for the total number of pounds of salt in  
the tank.

*Explain* how to derive a DE for  $y()$ . Don't just  
pull a DE out of the air; **explain**, using *Text* and  
*Pictures*, how it comes from the physical situation.  
Now re-write the DE in linear-DE form. Use FOLDE

to solve the DE. Dividing by the amount of water in  
the tank at time  $t$ , gives this formula for the salinity:

$$\sigma(t) = \left[ \dots \right] \frac{\text{lb}}{\text{gal}}.$$

As the tank approaches empty, its salinity ap-  
proaches  $\left[ \dots \right] \frac{\text{lb}}{\text{gal}}$ . Do Not  
approximate.

End of C-Class

**C1:** \_\_\_\_\_ 100pts

**C2:** \_\_\_\_\_ 100pts

**Total:** \_\_\_\_\_ 200pts