Guess a possible non-homog soln for the following DEs:

1a.) $y'' - 4y' - 9y = 4cos(3t)$

Guess: $y = A\cos(3t) + B\sin(3t)$

1b.) $y'' - 9y = 4cos(3t)$ ← no y' term so don't need $B\sin(3t)$ term

Guess: $y = A\cos(3t)$ or $y = A\cos(3t) + B\sin(3t)$ ← $B=0$

since no y' term, do not need $B\sin(3t)$ term as no $\sin(3t)$ will appear on LHS when plug in guess. $\Rightarrow B = 0$

1c.) $y'' - 9y' = 4cos(3t)$

Guess: $y = A\cos(3t) + B\sin(3t)$

1d.) $y'' + 9y = 4cos(9t)$

Guess: $y = A\cos(9t)$ since no y' term

1e.) $y'' + 9y = 4cos(3t)$

If guess is homogeneous multiply non simplified guess by t due to product rule

Guess: $y = t\cdot(A\cos(3t) + B\sin(3t))$

Wrong guess $y = A\cos(3t)$ since it is a homog soln: If plug in, get 0

Solve homogeneous first

$r^2 + 9 = 0 \Rightarrow r = \pm 3i$

homog soln $y = c_1\cos(3t) + c_2\sin(3t)$

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1b.) $y'' - 9y = 4cos(3t)$ $\Rightarrow B=0$

Guess: $y = A\cos(3t) + B\sin(3t)$ or $y = A\cos(3t)$

since no y' term, do not need $B\sin(3t)$ term as no $\sin(3t)$ will appear on LHS when plug in guess.

1c.) $y'' - 9y' = 4cos(3t)$

Guess: $y = A\cos(3t) + B\sin(3t)$

1d.) $y'' + 9y = 4cos(9t)$

Guess: $y = A\cos(9t)$ since no y' term don't need $B\sin(9t)$

1e.) $y'' + 9y = 4cos(3t)$ product rule $\Rightarrow$ $\sin(3t)$ term will appear on LHS when plug in $t A\cos(3t)$

Guess: $y = t\cdot(A\cos(3t) + B\sin(3t))$

Wrong guess: $y = A\cos(3t)$ since it is a homog soln

plug in $\Rightarrow$ get 0

solve homog: $r^2 + 9 = 0 \Rightarrow r = \pm 3i$

homog soln $y = c_1\cos(3t) + c_2\sin(3t)$

2a.) $y'' + 9y = 4\cos(9t) + (t)$

Guess: $y = A_1\cos 9t + A_2 t$

don't need $+B_1 \sin 9t$ since no y' term

don't need $+B_2$ term since no y' term

2b.) $y'' + 9y = 4\cos(3t) + (t)$

Guess: $y = t\cdot(A\cos(3t) + B\sin(3t)) + A_2 t$

homog

need due to product rule

2c.) $y'' + 9y = 4t\cos(9t)$

Guess: $y = At\cos(9t) + Bt\sin(9t) + C\cos(9t) + D\sin(9t$

Alternatively, plug in wrong guess and see what is missing.

$y = t\cdot A\cos(9t)$ ← wrong guess

product rule ⇒ use nonsimplified guesses

$y = (A_1 t + B_1)\cdot(A_2\cos(9t) + B_2\sin(9t))$

$y = A A_2 t\cos(9t) + A_1 B_2 t\sin 9t + B_1 A_2\cos(9t) + B_1 B_2 \sin 9$

$y = At\cos 9t + Bt\sin(9t) + C\cos(9t) + D\sin(9t$

plug in entire guess to solve for all 4 unknowns

2d.) $y'' + 9y = 4t\cos(3t)$

Guess: ~~y~~ $y = t\cdot(At\cos(3t) + Bt\sin(3t) + C\cos(3t) + D\sin(3$

since $y = \cos(3t)$ is homog sol we multiply nonsimplified guess by t