Part 1

In each of Problems 1-14 you are given an equation with a single variable in it. Think of the equation as $f(x) = c$, where f is a function made up of a bunch of compositions of elementary functions. For each equation, you are to draw an arrow diagram which decomposes f into its elementary components. You do not need to draw the arrows in the opposite direction nor solve the equation.

Here is one worked out example, so you can see what I mean:

Example 1: $5e^{3-x} = 12$
Solution: $x \xrightarrow{-x} \xrightarrow{x+3} \xrightarrow{e^x} \xrightarrow{5x} 12$

1. $3\sin^2 x + 2 = 3$
2. $5\cos x^2 - 2 = -1$
3. $\sin\cos x = 1$
4. $\ln 4\sqrt[3]{x} = 3$
5. $\sqrt{\ln x - 2} = 7$
6. $e^{2-5x} = 4$
7. $\sin e^x = \frac{3}{7}$
8. $4\cos(x - \pi) = 1$
9. $4\cos^2(x + \pi) = 0$
10. $4\cos(x^2 + \pi) = 0$
11. $4\cos x^2 + \pi = 0$
12. $(4\cos x)^2 + \pi = 4$
13. $2x^{3/4} - 6 = 11$
14. $\arctan 2\ln(\sqrt{5x - 3} + 4) - 7 = -8$

Part 2

In each of Problems 15-26, solve the given equation.

15. $\frac{1}{2x-3} = 7$
16. $\frac{1}{2}x - 3 = 7$
17. $\frac{1}{2x} - 3 = 7$
18. $\ln\ln x = 2$
19. $\sqrt{5x^{7/3} + 4} = 7$
20. $e^{1/x} = \frac{1}{5}$
21. $\sin\left(2x - \frac{\pi}{4}\right) = \frac{1}{2}$
22. $5x^{-3} = 2$

    Hint: Write x^{-3} in another way.
23. $2(x-1)^{-2} = \frac{1}{8}$
24. $2\cos(x + \frac{\pi}{3}) = 1$
25. $\tan\frac{x}{3} = -1$
26. $|\sin|x|| = \frac{\sqrt{3}}{2}$

Answers (I think)

1. $x \xrightarrow{\sin x} \xrightarrow{x^2} \xrightarrow{3x} \xrightarrow{x+2} 3$
2. $x \xrightarrow{x^2} \xrightarrow{\cos x} \xrightarrow{5x} \xrightarrow{x-2} -1$
3. $x \xrightarrow{\cos x} \xrightarrow{\sin x} 1$
4. $x \xrightarrow{\sqrt[3]{x}} \xrightarrow{4x} \xrightarrow{\ln x} 3$
5. $x \xrightarrow{\ln x} \xrightarrow{x-2} \xrightarrow{\sqrt{x}} 7$
6. $x \xrightarrow{-5x} \xrightarrow{x+2} \xrightarrow{e^x} 4$
7. $x \xrightarrow{e^x} \xrightarrow{\sin x} \frac{3}{7}$
8. $x \xrightarrow{x-\pi} \xrightarrow{\cos x} \xrightarrow{4x} 1$
9. $x \xrightarrow{x+\pi} \xrightarrow{\cos x} \xrightarrow{x^2} \xrightarrow{4x} 0$
10. $x \xrightarrow{x^2} \xrightarrow{x+\pi} \xrightarrow{\cos x} \xrightarrow{4x} 0$
11. $x \xrightarrow{x^2} \xrightarrow{\cos x} \xrightarrow{4x} \xrightarrow{x+\pi} 0$
12. $x \xrightarrow{\cos x} \xrightarrow{4x} \xrightarrow{x^2} \xrightarrow{x+\pi} 4$
13. Two ways to do this:

    $x \xrightarrow{x^3} \xrightarrow{\sqrt[4]{x}} \xrightarrow{2x} \xrightarrow{x-6} 11$

    or

    $x \xrightarrow{\sqrt[4]{x}} \xrightarrow{x^3} \xrightarrow{2x} \xrightarrow{x-6} 11$
14. $x \xrightarrow{5x} \xrightarrow{x-3} \xrightarrow{\sqrt{x}} \xrightarrow{x+4} \xrightarrow{\ln x} \xrightarrow{2x} \xrightarrow{\arctan x} \xrightarrow{x-7} -8$
15. $x = \frac{1}{2}\left(\frac{1}{7} + 3\right)$, which simplifies to $x = \frac{11}{7}$.
16. $x = 20$.
17. $x = \frac{1}{20}$.
18. $x = e^{e^2}$.
19. $x = 9^{3/7}$, a.k.a. $x = \sqrt[7]{9^3}$, a.k.a. $x = \left(\sqrt[7]{9}\right)^3$.
20. $x = \frac{1}{\ln \frac{1}{5}}$ (this is the same as $x = \frac{1}{-\ln 5}$ using a log rule).
21. $x = \frac{\frac{\pi}{4}+\frac{\pi}{6}+2\pi n}{2}, \frac{\frac{\pi}{4}+\frac{5\pi}{6}+2\pi n}{2}$, which simplifies to $x = \frac{5\pi}{24} + \pi n, \frac{13\pi}{24} + \pi n$.
22. $x = \frac{1}{\sqrt[3]{\frac{2}{5}}}$, which can also be written as $x = \frac{\sqrt[3]{5}}{\sqrt[3]{2}}$ or $x = \sqrt[3]{\frac{5}{2}}$.
23. $x = 5, -3$.
24. $x = \frac{-\pi}{3} \pm \frac{\pi}{3} + 2\pi n$, which can be rewritten as $x = 2\pi n, \frac{2\pi}{3} + 2\pi n$.
25. $x = 3\left(\frac{\pi}{4} + \pi n\right)$, which simplifies to $x = \frac{3\pi}{4} + 3\pi n$.
26. $x = \pm\frac{\pi}{3} \pm 2\pi n, \pm\frac{2\pi}{3} \pm 2\pi n, \pm\frac{-\pi}{3} \pm 2\pi n, \pm\frac{4\pi}{3} \pm 2\pi n$

    (if you are clever, you can see that this answer simplifies to $x = \frac{\pi}{3}n$).