Calculus

Solving Separable Differential Equations [the method]

(Q1.) Solve $\frac{dy}{dx} = x + xy^2$ and $y(0) = -1$

(Q2.) Solve $\frac{dP}{dt} = t^2P - P + t^2 - 1$

(Q3.) Solve $(y + \sin y)\frac{dy}{dx} = x + x^3$

(Q4.) Solve $y' = x^3(1 - y)$ and $y(0) = 3$

(Q5.) Solve $\frac{1}{2}\frac{dy}{dx} = \sqrt{y+1}\cos x$ and $y(\pi) = 0$

(Q6.) Solve $\frac{dy}{dx} = e^y \sin x$ and $y(0) = 0$

(Q7.) Solve $t^{-1}\frac{dy}{dt} = 2\cos^2(y)$ and $y(0) = \frac{\pi}{4}$

(Q8.) Solve $\frac{dy}{dx} = 8x^3e^{-2y}$ and $y(1) = 0$

(Q9.) Solve $e^y dx - e^{-x} dy = 0$ and $y(0) = 0$

(Q10.) Solve $\frac{dP}{dt} = \sqrt{Pt}$ and $P(1) = 2$

(Q11.) [Model for learning] Solve $\frac{dP}{dt} = K(M - P)$, where M and K are constants, and $P(0) = 0$

Optional Challenges: Can you find non-constant functions f and g so that

$$\frac{d}{dx}(f \cdot g) = f' \cdot g' ?$$

Reference: Sect 9.3, Single Variable Calculus by James Stewart, 8th edition