

$$1) \int_{-1}^2 x(1+x^2)^3 dx \quad \text{let } u=1+x^2 \\ dv=2x dx$$

$$\frac{1}{2} \int_{-1}^2 (1+x^2)^3 2x dx$$

$$\frac{1}{2} \frac{(1+x^2)^4}{4} \Big|_{-1}^2 = \frac{1}{8} \left((1+x^2)^4 \right) \Big|_{-1}^2 = \frac{1}{8} (5^4 - 2^4) \\ = \frac{609}{8}$$

$$2) \int_0^{\pi/6} 2 \cos 3x \, dx$$

$$\frac{2}{3} \int_0^{\pi/6} (\cos 3x) 3 \, dx$$

$$\frac{2}{3} \int_0^{\pi/2} \cos u \, du$$

$$= \frac{2}{3} \sin u \Big|_0^{\pi/2} = \frac{2}{3} (\sin \frac{\pi}{2} - \sin 0)$$

$$= \frac{2}{3} (1 - 0)$$

$$= \frac{2}{3}$$

$$u = 3x$$

$$du = 3 \, dx$$

$$x = 0 \quad u = 0$$

$$x = \frac{\pi}{6} \quad u = \frac{\pi}{2}$$

$$3) \int_1^2 \frac{dx}{(x-3)^2}$$

$$\int_{-2}^{-1} u^{-2} du$$

$$\frac{u^{-1}}{-1} \Big|_{-2}^{-1} = -\frac{1}{u} \Big|_{-2}^{-1} = -\frac{1}{-1} + \frac{1}{-2} = 1 - \frac{1}{2} = \frac{1}{2}$$

$$\text{let } u = x - 3 \\ du = dx$$

$$x=1 \quad u=-2 \\ x=2 \quad u=-1$$

$$4) \int_0^1 \sin \pi x \, dx$$

$$\frac{1}{\pi} \int_0^1 (\sin \pi x) (\pi dx)$$
$$-\frac{1}{\pi} \cos \pi x \Big|_0^1 = -\frac{1}{\pi} (\cos \pi - \cos 0)$$
$$-\frac{1}{\pi} (-1 - 1) = \frac{2}{\pi}$$

$$5) \frac{1}{3-0} \int_0^3 e^{-3x} dx$$

$$-\frac{1}{3} \frac{1}{3} \int_0^3 e^{-3x} (-3 dx) = -\frac{1}{9} e^{-3x} \Big|_0^3$$

$$= -\frac{1}{9} (e^{-9} - 1)$$

$$-\frac{e^{-9}}{9} + \frac{1}{9} \approx \frac{1}{9}$$