

EXAMPLE EXAM QUESTIONS COVERING DAY 18 - 25.

① Calculate the Fourier transform of $\delta(x)$.

② Using the special property of Hermitian ^{differential} operators

$$\int_a^b (\mathcal{L} f(x))^* g(x) dx = \int_a^b (f(x))^* \mathcal{L} g(x) dx$$

Show that the eigenvalues of a Hermitian operator are real.

③ Starting from the ^{three} linearly independent functions
 $1, e^x, e^{-x}$

Construct 3 orthonormal functions over the interval $[-1, 1]$. Do these three functions form a complete basis?

- ④ a) Put the Hermite eq. into Sturm-Liouville form. The Hermite eq. is

$$y'' - 2xy' + 2\lambda y = 0 \quad [-\infty, \infty]$$

- b) How would you define the inner product so that the eigenfn's of the Hermite eq. are orthogonal?

MISCELLANEOUS QUESTIONS:

- ⑤ Sketch the function

$$y(x) = (x - \pi) \sin x$$

over the range 0 to 2π .

Pay attention to the curvature, the zeros, the scale of the y-axis.

- ⑥ Use dimensional analysis to find the scaling relation between the orbital period of a planet and its orbital radius. Assume the mass of the planet is much smaller than the mass of the sun.

Note, the gravitational constant G has dimensions
$$\frac{\text{Force} \cdot \text{Length}^2}{\text{Mass}^2}$$