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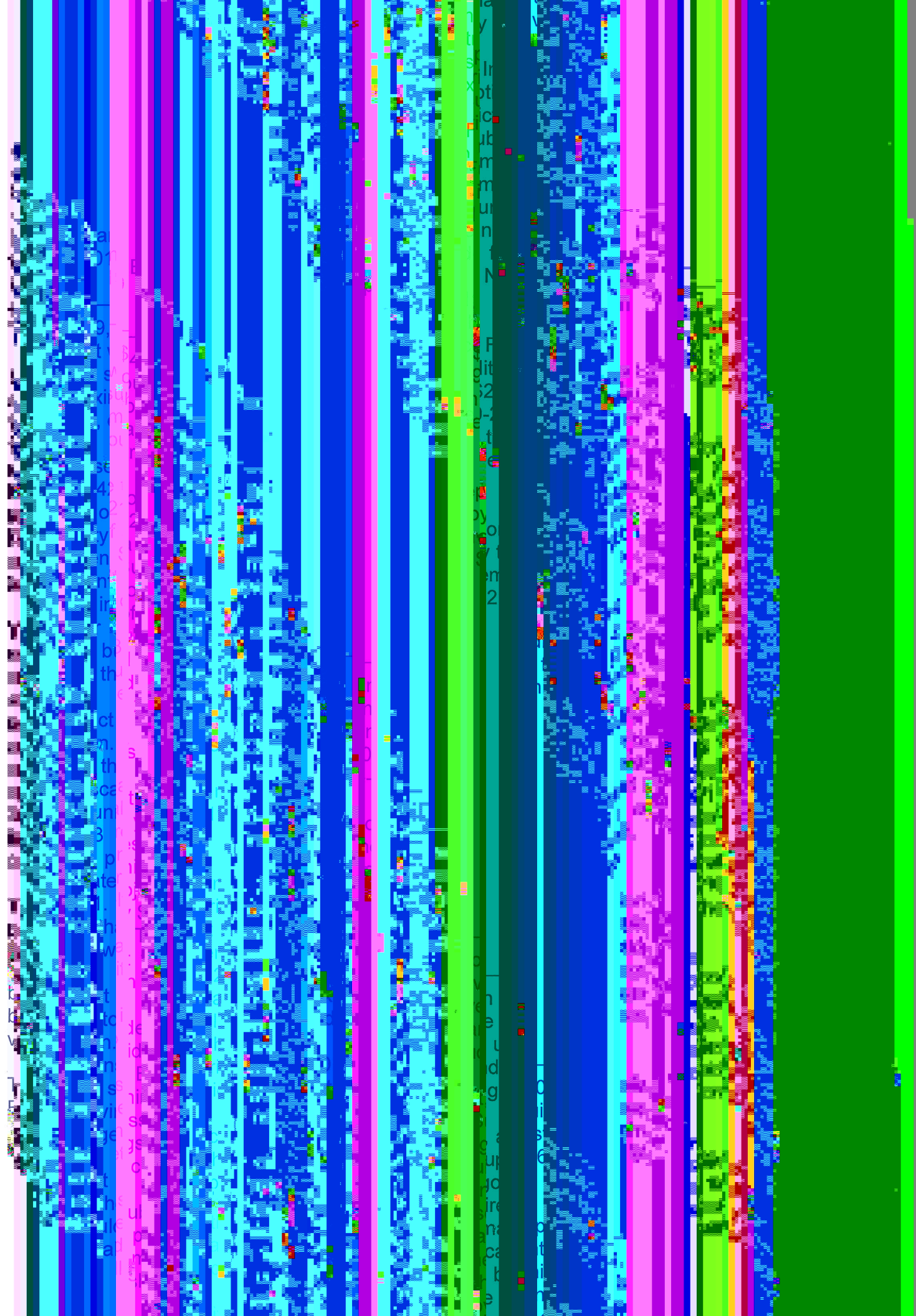
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PHYSICS 351
LECTURE 10
SOLUTIONS

PROFESSOR JOHN H. COOPER

DATE: 11/17/2017
BY: [Name]

1. A particle of mass m is confined to a one-dimensional infinite potential well of width a . The wave function is given by $\psi(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right)$ for $0 \leq x \leq a$ and zero elsewhere. Find the probability of finding the particle in the region $0 \leq x \leq \frac{a}{4}$.

Solution: The probability P of finding the particle in the region $0 \leq x \leq \frac{a}{4}$ is given by the integral of the probability density $|\psi(x)|^2$ over that region.
$$P = \int_0^{a/4} |\psi(x)|^2 dx = \int_0^{a/4} \frac{2}{a} \sin^2\left(\frac{n\pi x}{a}\right) dx$$

Using the identity $\sin^2 \theta = \frac{1 - \cos(2\theta)}{2}$, we can write
$$P = \frac{2}{a} \int_0^{a/4} \frac{1 - \cos\left(\frac{2n\pi x}{a}\right)}{2} dx = \frac{1}{a} \int_0^{a/4} (1 - \cos\left(\frac{2n\pi x}{a}\right)) dx$$

Evaluating the integral, we get
$$P = \frac{1}{a} \left[x - \frac{a}{2n\pi} \sin\left(\frac{2n\pi x}{a}\right) \right]_0^{a/4} = \frac{1}{a} \left[\frac{a}{4} - \frac{a}{2n\pi} \sin\left(\frac{n\pi}{2}\right) \right]$$

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