Assignment 8

1) Consider a function given by **1 point**

$f(x) = 0 \;\; for \;\; x < -1$
$= x + 1 \;\; for \;\; -1 \leq x \leq 0$
$= 1 - x \;\; for \;\; 0 < x \leq 1$
$= 0 \;\; for \;\; x > 1$

The Fourier series of $f(x)$ from -1 to 1 contains

- only nonzero sine terms
- only nonzero cosine terms
- both nonzero sine and nonzero cosine terms
- Only the A_0 term

Accepted Answers:
only nonzero cosine terms

2) Consider a function given by **1 point**

$f(x) = 0 \;\; for \;\; x < -1$
$= -x - 1 \;\; for \;\; -1 < x < 0$
$= 1 - x \;\; for \;\; 0 < x < 1$
$= 0 \;\; for \;\; x > 1$

The Fourier coefficient A_0 is equal to

- 1
- 2
- -2
- 0

Accepted Answers:
0

3) Consider the function $f(x) = 4\sin(3x) + 2e^{ix}\cos(2x)$ defined from -1/2 to 1/2. The Fourier coefficient A is equal to **1 point**

- 1
- 2
- -12
- 0

Accepted Answers:
1

4) The wave function of a quantum mechanical particle is given by $A\cos(2x)$. The momentum of this particle **1 point**

- is exactly equal to $2\hbar$
- is exactly equal to $-2\hbar$
- can be either equal to $-2\hbar$ or equal to $2\hbar$
- None of the above

Accepted Answers:
can be either equal to $-2\hbar$ or equal to $2\hbar$

5) For a quantum mechanical particle in a box between $x = 1$ and $x = 3$, the wavefunction of the ground state is proportional to **1 point**

- $\cos(2\pi x)$
- $\cos(\pi x)$
- $\sin(\pi x)$
- None of the above

Accepted Answers:
None of the above

6) Consider the differential equation $y'' - 2xy' + 2ny = 0$. This equation can be put into Sturm-Liouville form using $q(x) = 0$ and $p(x) = r(x)$ equal to **1 point**

- 1
- x^2
- e^{-x^2}
- None of the above

Accepted Answers:
e^{-x^2}

7) Consider the integral involving the Hermite polynomials $H_v(x)$ given by **1 point**

$$\int_{-\infty}^{\infty} H_v(x)H_{v'}(x)e^{-x^2}\,dx$$

The above integral is equal to zero unless $|v - v'|$ equals

- 0
- 1

- -1
- None of the above

Accepted Answers:
0

8) The associated Legendre Polynomials $P_l^m(x)$ satisfy the ODE **1 point**

$$(1-x^2)\frac{d^2P_l^m(x)}{dx^2} - 2x\frac{dP_l^m(x)}{dx} + \left(l(l+1) - \frac{m^2}{1-x^2}\right)P_l^m(x) = 0$$

When this equation is put into the Sturm-Liouville form, the value of $r(x)$ is equal to

- $\frac{-m^2}{1-x^2}$
- $l(l+1)$
- 1
- None of the above

Accepted Answers:
1

9) The Legendre Polynomials $P_l(x)$ satisfy the orthogonality relation **1 point**

- $\int_0^1 P_1(x)P_2(x)dx = 0$
- $\int_{-1}^1 P_1(x)P_2(x)dx = 0$
- $\int_{-1}^1 P_1(x)P_2(x)\cos x dx = 0$
- None of the above

Accepted Answers:
$\int_{-1}^1 P_1(x)P_2(x)dx = 0$

10) Consider the equation **1 point**

$xy'' + (1-x)y' + ny = 0$

This equation can be converted into Sturm-Liouville equation by multiplying the entire equation by $r(x)$ such that $r(x)$ is equal to

- 1
- x
- e^{-x}
- None of the above

Accepted Answers:
e^{-x}