Assignment 10

1) Consider the PDE $\frac{\partial^2 u(x,t)}{\partial x^2} = \frac{\partial u}{\partial t}$ in the domain $-\infty < x < \infty$, where $u(x, t)$ is some time dependent field. The form of this equation is typical of the **1 point**

- wave equation
- Schrodinger equation
- diffusion equation
- None of the above

Accepted Answers:
diffusion equation

2) Consider the PDE $\frac{\partial^2 u(x,t)}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$ in the domain $-L < x < L$, where $u(x, t)$ is some time dependent field. The solutions to this equation typically involve **1 point**

- real exponentials
- complex exponentials
- polynomial functions
- none of the above

Accepted Answers:
complex exponentials

3) The wave equation in 3D is given by $\nabla^2 u(x0, y, t) = \frac{1}{4} \frac{\partial^2 u(x,y,t)}{\partial t^2}$ The velocity of the wave is equal to **1 point**

- 2
- 4
- 1/2
- 1/4

Accepted Answers:
2

4) On complete separation of the 3D time-dependent Schrodinger equation, we get **1 point**

- 1 ordinary and 1 partial differential equation
- 3 ordinary differential equations
- 3 ordinary and 1 partial differential equation
- 4 ordinary differential equations

Accepted Answers:
4 ordinary differential equations

5) Solution of the radial part of the Schrodinger equation of a particle confined to a 2D circular domain typically involves **1 point**

- Hermite polynomials
- Associated Legendre polynomials
- Bessel functions
- complex exponentials

Accepted Answers:
Bessel functions

6) Fourier transform of the 1D heat diffusion equation gives a/an **1 point**

- ordinary differential equations in the time and wave vector variables.
- partial differential equation in the time variable and ordinary differential equation in the wave vector variable.
- partial differential equation in the time variable and an algebraic equation in the wave vector variable
- None of the above

Accepted Answers:
partial differential equation in the time variable and an algebraic equation in the wave vector variable

7) The solution of an axisymmetric vibrating drum of radius R involves **1 point**

- $J_0(r)$
- $J_0(r/R)$
- $J_0(\alpha_n r/R)$ where $J_0(\alpha_n) = 0$
- $J_0(\alpha_n R/r)$ where $J_0(\alpha_n) = 0$

Accepted Answers:
$J_0(\alpha_n r/R)$ where $J_0(\alpha_n) = 0$

8) The solution of the partial differential equation $\frac{\partial c}{\partial t} = \frac{\partial^2 c}{\partial x^2}$ with initial condition $c(x, 0) = 2$ is **1 point**

- $2 \cos x$
- $2(\sin x + \cos x)e^{-t}$
- $2 \cos x e^{-t}$
- 2

Accepted Answers:
2

9) Consider the PDE $\frac{\partial^2 u(x,y,t)}{\partial x^2} + 4y\frac{\partial u(x,y,t)}{\partial y} + 2\frac{\partial^3 u(x,y)}{\partial t^3} = 0$ ***1 point***

On solving this using separation of variables, we get 3 ODEs. The ODE in the variable *y* is (where *c* is a constant)

- $\frac{1}{Y(y)}\frac{dY(y)}{dy} = c$
- $\frac{y}{Y(y)}\frac{dY(y)}{dy} = c$
- $\frac{1}{Y(y)}\frac{dY(y)}{dy} = cy$
- None of the above

Accepted Answers:
$\frac{y}{Y(y)}\frac{dY(y)}{dy} = c$

10) Consider the PDE $\nabla^2 u(r,\theta,\phi) = -u(r,\theta,\phi)$. On solving this equation using separation of variables, we get a θ dependent equation which is (where *c* is a constant) ***1 point***

- $\frac{1}{\sin\theta}\frac{d}{d\theta}\sin\theta\frac{dS(\theta)}{d\theta} + \frac{m^2 S(\theta)}{\sin^2(\theta)} = cS(\theta)$
- $\frac{1}{\sin\theta}\frac{d}{d\theta}\sin\theta\frac{dS(\theta)}{d\theta} = c$
- $\frac{1}{\sin\theta}\frac{d^2 S(\theta)}{d\theta^2} = cS(\theta)$
- None of the above

Accepted Answers:
$\frac{1}{\sin\theta}\frac{d}{d\theta}\sin\theta\frac{dS(\theta)}{d\theta} + \frac{m^2 S(\theta)}{\sin^2(\theta)} = cS(\theta)$