1. The Frobenius method can be applied about the point $x = 0$ for the differential equation
   
   (a) $y'' + y'/x^2 + y/x^2 = 0$
   
   (b) $y'' + y'/x + y/x^3 = 0$
   
   (c) $y'' + y'/x + y/x^2 = 0$
   
   (d) None of the above
   
   Answer (c)

2. The indicial equation for the differential equation
   
   $x^2 y'' + xy' + x^2 y = 0$
   
   solved using the Frobenius method with a trial solution $y = \sum_{n=0}^{\infty} c_n x^{n+r}$ is
   
   (a) $r^2 = 0$ (b) $r^2 - 1 = 0$ (c) $r^2 - r - 1 = 0$
   
   (d) None of the above
   
   Answer (a)

3. The correct statement regarding solution of the ODE
   
   $(1 - x^2)y'' - 4xy' + 4y = 0$
   
   using the Frobenius method about $x = 1$ is
   
   (a) The equation can be solved using the Frobenius method with $r = 0$ about $x = 1$.
   
   (b) The equation can be solved using the Frobenius method about $x = 1$ but $r$ is not equal to 0.
   
   (c) The equation cannot be solved using the Frobenius method about $x = 1$.
   
   (d) There is not enough information to decide whether the equation can be solved using the Frobenius method about $x = 1$.
   
   Answer (b)

4. The indicial equation for the differential equation
   
   $x^2 y'' + xy' + x^2 y - 9y/4 = 0$
   
   solved using the Frobenius method with the usual notation is
   
   (a) $r^2 - 1 = 0$ (b) $r^2 - r = 0$ (c) $r^2 - 9/4 = 0$
   
   (d) None of the above
   
   Answer (c)

5. The correct statement regarding solution of the ODE
   
   $x^2 y'' - 2xy' + 2y = 0$
   
   about the point $x = 1$ is
(a) The equation can be solved using the Frobenius method with $r = 0$ about $x = 1$.
(b) The equation cannot be solved using the Frobenius method about the point $x = 1$.
(c) The equation can be solved using the Frobenius method about $x = 1$ but $r$ is not equal to 0.
(d) There is not enough information to decide whether the equation can be solved using the Frobenius method about $x = 1$.

Answer (a)

6. One of the solutions of the differential equation

$$x^2 y'' + xy' + x^2 y - 16y = 0$$

involves
(a) $J_0(x)$ (b) $J_2(x)$ (c) $J_4(x)$
(d) None of the above

Answer (c)

7. In the solution for the radial part of the Hydrogen atom for $n = 3, l = 0$, the solution contains a polynomial multiplying an exponential function. The degree of the polynomial is
(a) 0 (b) 1 (c) 2 (d) 3

Answer (c)

8. The recursion relation for the differential equation

$$x^2 y'' + xy' + x^2 y - 4y = 0$$

can take the form
(a)

$$a_{2n} = \frac{(-1)^n a_0}{2^{n+1} n!}$$

(b)

$$a_{2n} = \frac{(-1)^n 2a_0}{2^{n+1} (n!)^2}$$

(c)

$$a_{2n} = \frac{-a_0}{2^n n!}$$

(d) None of the above

Answer (b)

9. Writing the 2-dimensional partial differential equation

$$\nabla^2 u(x, y) + 4u(x, y) = 0$$

in plane polar coordinates and looking at the solution that is independent of the angular coordinate, we get a differential equation for the radial coordinate $r$. One solution of this differential equation involves
(a) $J_0(2r)$ (b) $J_2(2r)$ (c) $J_4(r)$
(d) None of the above

Answer (d)

10. The solution of the radial part of the hydrogen atom for a certain orbital is proportional to $r^2 P_2(r)e^{-r/4a_0}$. The values of the quantum numbers $n$ and $l$ are
(a) $n = 2, l = 1$ (b) $n = 3, l = 1$ (c) $n = 4, l = 2$
(d) None of the above

Answer (d)