1. Which of the following is equal to $\frac{e^x - 1 - x}{x^2}$?

(a) $\sum_{n=0}^{\infty} \frac{x^n}{(n+2)!}$

(b) $\sum_{n=0}^{\infty} \frac{(-1)^n x^n}{n!}$

(c) $\sum_{n=0}^{\infty} \frac{x^n}{(n+1)!}$

(d) $\sum_{n=0}^{\infty} \frac{(-1)^n x^n}{(n+2)!}$

(e) $\sum_{n=0}^{\infty} \frac{x^n}{n!}$

2. Find a unit vector in the direction of $\mathbf{b} - \mathbf{a}$ where $\mathbf{a} = \langle 0, 2, 1 \rangle$ and $\mathbf{b} = \langle 1, 1, 3 \rangle$.

(a) $\langle 1, -1, 2 \rangle$

(b) $\left\langle \frac{1}{\sqrt{6}}, -\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}} \right\rangle$

(c) $\left\langle -\frac{1}{\sqrt{6}}, \frac{1}{\sqrt{6}}, -\frac{2}{\sqrt{6}} \right\rangle$

(d) $\left\langle \frac{1}{\sqrt{26}}, \frac{3}{\sqrt{26}}, \frac{4}{\sqrt{26}} \right\rangle$

(e) $\langle -1, 1, -2 \rangle$

3. Which of the following series converge absolutely?

(a) $\sum_{n=1}^{\infty} (-1)^n$

(b) $\sum_{n=1}^{\infty} \frac{\cos(n\pi)}{n\sqrt{n}}$

(c) $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$

(d) $\sum_{n=2}^{\infty} \frac{(-1)^n}{\ln n}$

(e) All of the above series are absolutely convergent.

4. What is the intersection of the sphere $(x+1)^2+(y-2)^2+(z-3)^2=25$ with the xz-plane?

(a) $(x+1)^2+(z-3)^2=21$

(b) $(x+1)^2+(z-3)^2=23$

(c) The point $(-1,2,3)$

(d) The point $(0,2,0)$

(e) $(x+1)^2+(y-2)^2=25$

5. Given the triangle with vertices $A(2,-2,5)$, $B(1,1,4)$ and $C(3,1,3)$, find the cosine of the angle at B.

(a) $\dfrac{3}{\sqrt{55}}$

(b) $\dfrac{1}{\sqrt{55}}$

(c) $\dfrac{3}{\sqrt{11}}$

(d) $\dfrac{1}{\sqrt{11}}$

(e) None of the above.

6. If we represent $\frac{1}{9+4x^2}$ as a power series centered at zero, what is the associated radius of convergence?

(a) $R = \frac{4}{9}$

(b) $R = \frac{2}{3}$

(c) $R = \frac{1}{2}$

(d) $R = \frac{9}{4}$

(e) $R = \frac{3}{2}$

7. Determine the radius of the sphere given by the equation $x^2 + y^2 + 2y + z^2 + z - 1 = 0$.

(a) $9/4$

(b) $3/2$

(c) 1

(d) $5/4$

(e) $\sqrt{5}/2$

8. Suppose that the power series $\sum_{n=0}^{\infty} c_n(x-3)^n$ has radius of convergence 3. Consider the following pair of series:

$$\text{(I)} \quad \sum_{n=0}^{\infty} c_n 4^n \quad \text{and} \quad \text{(II)} \quad \sum_{n=0}^{\infty} c_n 2^n$$

Which of the following statements is true?

(a) Neither series is convergent.

(b) Both series are convergent.

(c) (I) is convergent, (II) is divergent.

(d) (I) is divergent, (II) is convergent.

(e) No conclusion can be drawn about either series.

9. The vertices of a triangle are $A(2, 4, 5)$, $B(3, 5, 3)$, and $C(2, 8, -3)$.

(a) Let $\vec{\mathrm{a}}$ be the vector from A to B, $\vec{\mathrm{b}}$ be the vector from A to C, and $\vec{\mathrm{c}} = \mathbf{proj}_{\mathbf{b}}\vec{\mathrm{a}}$ (the vector projection of $\vec{\mathrm{a}}$ onto $\vec{\mathrm{b}}$). Compute the following:

i. $\vec{\mathrm{a}} =$

ii. $\vec{\mathrm{b}} =$

iii. $\vec{\mathrm{c}} =$

10. Find the radius and interval of convergence of the series $\sum_{n=1}^{\infty} \frac{(-3)^n (2x-1)^n}{n}$

11 (i).Find a Maclaurin Series representaton for $f(x) = \sin\left(\frac{x^2}{3}\right)$.

(ii) Using the result in part (i), write $\int_0^1 \sin\left(\frac{x^2}{3}\right) dx$ as an infinite series.

(iii) Using the series found in part (ii), find s_2, the sum of the first three nonzero terms, to estimate $\int_0^1 \sin\left(\frac{x^2}{3}\right)\,dx$. Give an upper bound on the error.

12. Find the Taylor Series for $f(x) = \ln x$ centered at $a = 4$.

13. Let $f(x) = e^{2-x}$.

(i) Give the fourth degree Taylor Polynomial for $f(x)$ centered around $a = 2$.

(ii) Use Taylor's Inequality to give a bound on the error when using the polynomial from (i) to estimate $f(x)$ on the interval $[-1, 5]$.

Taylor's Inequality: $|R_n(x)| \leq \frac{M}{(n+1)!}|x-a|^{n+1}$, where $|f^{(n+1)}(x)| \leq M$ for x in an interval containing a.