Answer ALL questions. Unless instructed otherwise, you should show ALL your work and simplify your final answer as much as possible. Please box your final answer to each part.

**Problem 1:** [12 pts]

(a) Compute the 3rd order Taylor polynomial for $x^{1/3}$ centered at $x = 1$.

(b) The Taylor series for $x^{-1/2}$ centered at $x = 1$ is given by

$$1 + \sum_{n=1}^{\infty} (-1)^n \frac{1.3.5... (2n - 1)}{2^n n!} (x - 1)^{2n+1}.$$

Use the Taylor series to compute $\sqrt{\frac{10}{11}}$ as a fraction, accurate to within $10^{-4}$. (You must justify that your answer is within this accuracy).
Problem 2: [13 pts] Consider the three points $A(1, 0, -1)$, $B(2, -1, 2)$ and $C(1, 3, 1)$.

(a) What is the radius of the sphere centered at the point $A$ that passes through the point $B$?

(b) What is the angle $\angle BAC$? (i.e. the angle at $A$.) You may leave your answer in the form of an arccos.

(c) Find the vector projection of $A\vec{B}$ onto $A\vec{C}$.

(d) A point $D$ is constructed on the straight line through $A$ and $C$ so that the triangle $\triangle ABD$ has a right angle at $D$. Find the coordinates of the point $D$. (You may find it useful to use your answer to (c)).