CHICXULUB CRATER: WIDESPREAD DEATH AND DESTRUCTION?

One of the best-known mass-extinctions to have beset life on this planet occurred about 65 million years ago at the end of the Cretaceous period. Among other things, the end of the Cretaceous marked the end of the dinosaurs. One theory is that all this death and destruction was caused by the impact of a large meteor on earth. Theoretically, the energy released from the impact of a large meteor can punch a hole in the atmosphere, allowing the pulverized bits of rock and other ejecta to spread quickly around the earth. The presence of so much material in the atmosphere would block out light from the sun, quickly cooling the entire globe. Land animals could also be wiped out by ejecta falling back on earth, or atmospheric poisoning resulting from the vaporization of material from the impacting body and the impact site. The "meteor-impact" theory has gained momentum with the discovery of an enormous, circular depression buried in the Yucatan Penninsula, known as the Chicxulub Crater. The Chicxulub Crater is buried, but its diameter is estimated at 180 km.

The destructive power of meteor impacts comes from the amount of energy released on impact. Energy is measured in Joules (J). Recall that:

$$1J = 1\frac{kg \bullet m^2}{s^2}$$

For comparison, the amount of energy released upon the detonation of 1 kg of TNT is 4 million joules.

Given that the amount of energy released by a meteor impact that caused a crater 1 km in diameter in Africa (the Tswaing/Soutpan crater) is equal to the detonation of 10 billion kilograms of TNT, calculate the following.

Please show your work and list all assumptions you made. You will need to make some estimations based on the relationship between the size of the crater and the amount of energy required to create it. You do not need to derive a detailed mathematical relationship, simply explain your reasoning!

1)

a. The amount of energy released in the impact that created Chicxulub Crater in Joules:
b. Assumptions:
c. Kilograms of TNT needed to produce equivalent energy:

2) The velocity of a large meteor about to impact the earth has been estimated at 16,000 m/s. Using the kinetic energy equation and assuming the estimated velocity is correct, calculate the mass of the Chicxulub Meteor. Recall what kinetic energy (KE) is:
where m = mass in kg and v = velocity in m/s.

$$KE = \frac{1}{2}mv^2$$

3) Assume the density of the meteor is 3000 kg/m^3. What was the radius of the Chixcalub Meteor? What assumptions did you have to make to calculate it?