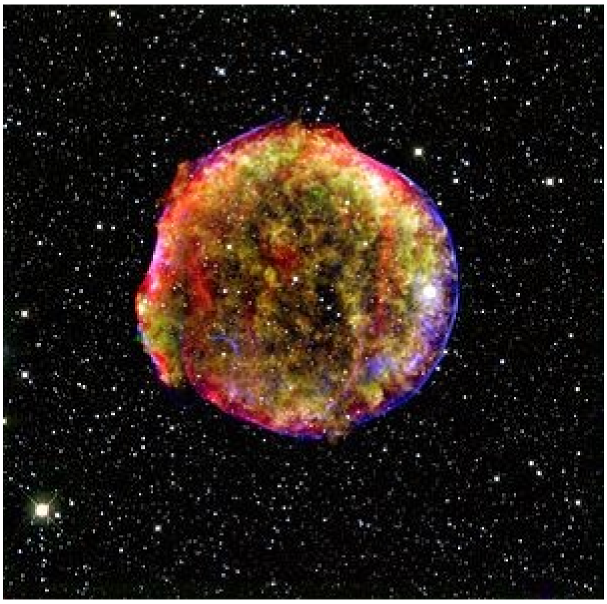
PLASMA

I. Complete the text on plasma with suitable pieces of information

In physics and chemistry, **plasma** is a state of 1. ______________ similar to gas in which a certain portion of the particles are 2. _____________. Heating a gas may 3. ____________ its molecules or atoms (reduce or increase the number of 4. _____________in them), thus turning it into a plasma, which contains 5. ___________ particles: positive ions and negative electrons or ions. Ionization can be 6. ____________ by other means, such as strong electromagnetic field applied with a laser or 7. _____________ generator, and is accompanied by the dissociation of molecular bonds, if present.

The presence of a non-negligible number of charge carriers makes the plasma electrically conductive so that it responds strongly to 8. _______________ fields. Plasma, therefore, has properties quite unlike those of solids, liquids, or gases and is considered a distinct 9. _________________. Like gas, plasma does not have a definite shape or a definite volume unless enclosed in a container; unlike gas, under the influence of a magnetic10.___________, it may form structures such as filaments, beams and double layer. Some common plasmas are found in 11. ________________.



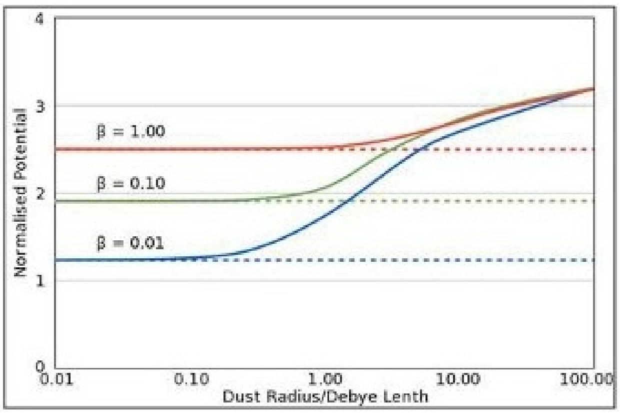
II. Read the text on dusty plasma and answer the questions below

1. Where can dusty plasma be found?
2. Why is the interaction between a dust grain and the surrounding plasma a two-way proces?
3. What is OML and how reliable is it?
4. What does the charge on a dust grain depend on?

DUSTY PLASMA (source: http://www3.imperial.ac.uk/plasmaphysics)
Many plasmas contain dust (small, usually solid particles), but although dusty plasmas occur widely, the detailed study of their properties is a fairly new area of plasma science. Dusty plasmas are found in space, in industry, in fusion, and also in special laboratory experiments to explore the unexpected, and often beautiful, collective phenomena which occur when large numbers of micron-sized monodisperse spheres are immersed in plasma. Such phenomena, of which dust crystals are the most familiar, form a large part of the dusty plasma literature.

Basic Dusty Plasmas
The interaction between a dust grain and the surrounding plasma is an extremely complicated two-way process. For instance, an obvious manifestation of this interaction is the charging of the dust grain, which happens very rapidly. The charge depends on the fluxes of ions and electrons from the plasma onto the grain surface, and those fluxes, in turn, depend on the charge. Furthermore, the charged grains will modify their plasma environments by, for instance, setting up space charges and electrostatic fields.
Collection of plasma ions and electrons is the most basic charging mechanism, and it is interesting to ask if we can predict, for given dust grains and plasma conditions, the resulting steady state charge. Rather surprisingly the answer to this question in most cases is "no". For a single, perfectly spherical dust grain in an infinite, uniform, stationary, unmagnetised plasma, the properties of which are constant in time, the most widely used charging theory is Orbit Motion Limited (OML), but even then the theory is usually wrong: OML is only strictly valid for dust grains much smaller than the plasma Debye length, dust grains which are not spherical, dust grains which are not solid, plasmas which vary in space and time, flowing plasmas, magnetic fields, and charging processes other than collection of particles from the plasma. The basic dust-plasma interaction is an area of fundamental plasma physics which is still rather poorly understood, and we need better understanding of it because it underpins any attempt to describe any dusty plasma, for instance, our work on tokamak dust transport.

Charging of Large Dust Grains
The charge on a plasma immersed dust grain is of paramount importance to the subsequent behaviour of said dust grain. The charge on a grain depends on parameters like the plasma temperature, constituent components, dust grain size, temperature and velocity.
For small dust grains with respect to electron Debye length there is a tried and trusted approach for determining the potential of a grain known as Orbit Limited Theory (OML), for larger grains the OML approach falls down. In Fig 1 the normalised potential of a dust grain is shown for three values of the ion to electron temperature ratio (beta). The dashed lines are the prediction of OML, the solid lines are due to a more advanced (and in this case reliable) theory.



III. Think about three categories of plasma: artificially produced, terrestrial and space and astrophysical plasmas. Try to come up with at least 4 examples of each.

IV. Add the strips of paper given to you by your teacher to complete each of the categories above.