Question 1

Microscopy is the technical field of using microscopes to view objects and areas of objects that cannot be seen with seen with the naked eye. Microscopy dates back to the 17th-century. In the first century A.D Seneca described actual magnification by a globe of water. The first modern application of optics occurred in Florence around 1280 A.D with the use of glasses as an aid to vision. The early history of the microscope and its inventors is shrouded in much confusion. Credit for the first compound microscope is given to Hans Jansen or his son Zacharias around 1595. The description of Jansen's microscope was preserved until the early 1600's. The instrument consisted of three sliding tubes measuring 18 inches in length when fully extended and two inches in diameter. The microscope was said to have a magnification of 3 x when closed and 9 x when fully extended. In the 18th century many mechanical improvements were made in the microscope but images had colourful haloes and were blurry. As the lenses multiplied, so did the distortions. The best simple microscopes attain about two micron resolutions but the best compound resolutions only had five micron resolution. The colour haloes are due to chromatic aberration. This is when light is transmitted through a substance and it will be bent different amounts depending upon its wavelength. This means that a lens will have a different focus for different colours of light. The solution to this problem came not from microscopes but telescopes in the 1730's. A man named Chester More Hall solved it by noticing a new glass called "Flint glass" dispersed colours more than the original glass "crown glass" that was being used. A telescope maker John Dolland after hearing about the two kinds of glass performed experiments in 1759 and succeeded in making achromatic lens. Although achromatic lenses were successful for telescopes, it was much difficult to fabricate it for microscopes. Finally, it became available in the 19th century. Another cause of optical distortion that had to be overcome is called spherical aberration. This is due to light from the object that hits the edge of the lens and does not have exactly the same focal distance as light which comes through the centre of the lens. The problem was solved in 1830 by Joseph Jackson Lister. He showed that if multiple low magnification lenses are placed a certain precise distance apart you get spherical aberration from the first lens but don't get the additional component from other lenses. He built the microscope in the 1830's. A new problem arose as the microscope objective had to be adjusted for the thickness of the cover glass on the slide being

examined. A Dutch amateur working with a very simple single lens instrument of his construction solved the problem and made enormous scientific contributions even when more complex instruments were available and being used.

Question 2

In a light microscope, visible light passes through the specimen and is bent through the lens system, which allows the user to see a magnified image . As visible light is passed through the sample and used to form an image directly without any modifications. A type of light microscopy also known as fluorescence microscopy , images samples that absorb one wavelength of light and emit another. Light of one wavelength is used to excite the fluorescent molecules, and the light of a different wavelength that they emit is collected and used to form a picture. In most cases, the part of a cell or tissue that we want to look at isn't naturally fluorescent, and instead must be labeled with a fluorescent dye or tag before it goes on the microscope.

Electron microscopy , is used when you want to see something very tiny at a high resolution. It differs from light microscopes in that they produce an image of specimen by using a beam of electrons rather than a beam of light. Electrons have a shorter wavelength than visible light, this allows electron microscopes to produce higher resolution images than standard light microscopes. They can be used to examine not just whole cells, but also the subcellular structures and compartments within them.

Question 3

In scanning electron microscopy (SEM), a beam of electrons moves back and forth across the surface of a cell or tissue, creating a detailed image of the 3D surface. This type of microscopy was used to take the image of the *Salmonella* bacteria shown at right, above.

In transmission electron microscopy (TEM), in contrast, the sample is cut into extremely thin slices (for instance, using a diamond cutting edge) before imaging, and the electron beam passes through the slice rather than skimming over its surface. TEM is often used to obtain detailed images of the internal structures of cells.