9.3.3.i	Identify that artificial implants can be either cemented or uncemented into place

9.3.3.j	Describe the properties of the cement that is used in implants and discuss how an uncemented implant forms a bond with bone

Attaching implants to the body

Artificial hip joints are broadly of two types; those that require bone cement to anchor it in the human body and those that do not.

Properties of the cement Rather than glue or cement, implant adhesive works more like the grout in your bathroom tile. It's a **space-occupying material** that has some **minor adhesive capability**, but its real function is to fill the space between the prosthesis and the bone. The liquid cement flows into minute cavities and cracks in the bone surface, creating a finely bonded, rigid enclosure for the stem of the prosthesis. To attach the components the cavity is first filled with bone cement. Then the component (stem or cup) is pushed into place and held still until the cement sets. As such the cement would be relatively **quick setting**. Unfortunately, over time, this cement dries and cracks, causing the shaft to loosen. Patients then need to undergo (revision) surgery to re-glue the shaft.

Bonding uncemented prostheses to the bone The ability of the human body to repair itself is used to keep the prosthesis in place. The implant has a specially designed surface on its outer side that feels porous like a sponge. It is designed to "fool" the body into mistaking it for bone and causes your bone to actually grow into the implant over time. The implant is hammered into the bone, causing some trauma. The bone responds to the trauma by gradually growing into the surface of the implant, in a similar way a bone repairs itself when broken. The healing process takes 6-12 weeks and bond gets stronger over time. It is important that the implant is held firmly in place during this time. Hammering the implant into an accurately machined cavity achieves the initial fit. Further fixation can be obtained if necessary by using additional screws.

Which implant – cemented or uncemented

The choice of implant is made by the specialist taking into account your age, lifestyle, how active you are, whether the hip replacement is being done for the first time or is a replacement for a previously carried out artificial hip and also the specialists own experience and training. The uncemented implant is usually chosen for a younger patient (under 65), who presumably will need at least one revision, because it provides better fixation (and potentially longer 'life') than the cemented model. It also takes longer for the bond to become secure, though a younger patient's bone would generally grow more quickly into the prosthesis (up to a year). Most people over 65 would have a cemented prosthesis, at least a cemented femoral stem.

Elderly people have softer, more osteoporotic bone. As well, for the elderly, the basic bone structure on which the prosthesis is attached isn't as strong or as good to begin with, so there's a

greater risk that it may crack. The ingrowth of bone into an uncemented prosthesis may not be as great, and it may be more fibrous soft tissue that doesn't calcify effectively.

Of course, it depends on a person's physical condition: If you're 65 and osteoporotic, and you've lived a very inactive life without much exercise, there's a good chance your bone quality will be relatively poor. In this case a cemented prosthesis would be recommended. On the other hand, if you're 70, and you've jogged every day of your life, you may have excellent bone quality. In this case, your surgeon might recommend that you have an uncemented prosthesis.

9.3.3 g	Explain why artificial joints have the articulating ends covered in polyethylene

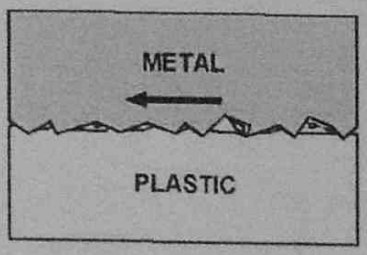
Reducing friction and wear at joints

The articulating ends of artificial joints need to be covered in polyethylene because it reduces friction. A reduction in friction means that there is a reduction in wear of the biomaterial.

Joint prostheses are bearings. One function of bearings is to reduce friction and wear of the moving parts. In machines, some bearings use fluids to reduce friction. Friction is a force that is present between two moving surfaces and is required in order to produce movement.

Friction and wear are a major concern in joint prostheses. If the friction force is high enough, it can produce shearing stresses that can cause loosening of the prosthetic at the bone-prosthesis interface and cause fatigue failure in the prosthesis itself. The highest friction forces are seen in metal on metal joints, next in metal on UHMWPE, and they are even lower in ceramic on UHMWPE. There are many causes and results of wear and the wear debris, and any one will cause prosthetic failure.

There are different types of wear. One example is called abrasive wear. It results from the direct contact between metal and plastic components. Even highly polished surfaces have a microscopic roughness. When the plastic and metal come into direct contact, the peaks of the metal will cut into the plastic.



To reduce this problem of surface roughness in a machine bearing a lubricant is used. The lubricant is placed between the moving surfaces and this results in one part actually floating over the other. The two articulating surfaces do not come into contact if the parts are moving. Also, the bearing is usually moving at a constant velocity and in a unidirectional motion. Under these conditions, abrasive wear is negligible. In the body, the motion is oscillating and the liquid film cannot be maintained.

A special type of abrasive wear is called third-body wear. This occurs when foreign substances such as bone cement, metal beads, bone debris, and wear particles are present. The harder substances become embedded into the softer plastic bearing. The embedded bodies can then quickly deteriorate the metal surface.