Think hitting things with hammers does not require any intelligence or skill, THINK AGAIN !!

A hammer is a tool meant to deliver an impact to an object. The most common uses for hammers are to drive nails, fit parts, forge metal, strike other tools such as chisels, deform materials e.g. peining and to aid in dismantling objects. Hammers are often designed for a specific purpose, and vary in their shape and structure depending on the task they have been designed to carry out; therefore, it is important that the correct hammer is selected for any given task.
The hammer is a basic tool of many professions. The usual features are a handle and a head, with most of the weight in the head. The basic design is hand-operated, but there are also many mechanically operated models, such as steam hammers, for heavier uses.

The essential part of a hammer is the head, a compact solid mass that is able to deliver the blow to the intended target without itself deforming. The opposite side may have a ball or other shaped striking face, as in the ball-pein hammer and cross pein hammers. As the impact between steel hammer heads (normally cast steel, hardened and tempered) and the objects being hit can, and does, create sparks, which in some industries where the potential for the presence of flammable gases and vapours, can be dangerous and there is a real risk of igniting the gases. In these environments, a variety of non-sparking metal tools can be used, being principally, beryllium copper-headed hammers, however the first consideration is always to remove the source of ignitable gas.
Handles of hammers and mallets have traditionally been made of wood (typically hickory) however in more recent years the handles have been made of steel, durable plastic, GRP type materials or rubber.

Popular hand-powered variations include:

- Ball-pein hammer.
- Boiler scaling hammer.
- Carpenter's hammers (used for nailing), such as the framing hammer and the claw hammer
- Pinhammers (ball-pein and cross-pein types).
- Construction hammers, including the sledgehammer.
- Cross-peen hammer.
- Lump hammer, or club hammer
- Mallets, including the rubber hammer, dead blow hammer and soft-faced hammer.
- Straight pein hammer
- Welders' chipping hammers

Hammer as a force amplifier
A hammer is basically a force amplifier that works by converting mechanical work into kinetic energy and back.
In the swing that precedes each blow, a certain amount of kinetic energy gets stored in the hammer's head, equal to the length of the swing times the force produced by the muscles of the arm and by gravity. When the hammer strikes, the head gets stopped by an opposite force coming from the target; which is equal and opposite to the force applied by the head to the target. If the target is a hard and heavy object, or if it is resting on some sort of anvil, the head can travel only a very short distance before stopping. Since the stopping force x that distance must be equal to the head's kinetic energy, it follows that the stopping force will be much

greater than the original driving force of the muscles roughly, by a factor of the length of the swing/distance in which the hammer stops.
In this way, great strength is not needed to produce a force strong enough to bend steel, or crack the hardest stone. This is a very significant fact as it means when the correct hammer is used the hammer can be controlled relatively easily to meet its intended target.

Effect of the head's mass
The amount of energy delivered to the target by the hammer-blow is equivalent to one half the mass of the head times the square of the head's speed at the time of impact. While the energy delivered to the target increases linearly with mass, it increases quadratically with the speed (see the effect of the handle, below). High tech titanium heads are lighter and allow for longer handles, thus increasing velocity and delivering more energy with less arm fatigue than that of a steel head hammer of the same weight. As hammers must be used in many circumstances, where the position of the person using them cannot be taken for granted, trade-offs are made for the sake of practicality. In areas where one has plenty of room, a long handle with a heavy head (like a sledge hammer) can deliver the maximum amount of energy to the target. It is not practical to use such a large hammer for all tasks, however, and therefore the overall design has been modified repeatedly to achieve the optimum utility in a wide variety of situations.
A titanium head has about 3% recoil and can result in greater efficiency and less fatigue when compared to a traditional steel head which has up to 30% recoil. Handles made of shock-absorbing materials or varying angles attempt to make it easier for the user to continue to wield this tool which has been made in many forms over the centuries.

Effect of the handle
The handle of the hammer helps in several ways:
Firstly and most important it keeps the user's hands away from the point of impact and the area where the mass is. It provides a broad area that is better-suited for gripping by hand. Importantly, it also allows the user to maximize the speed of the head on each blow.
The primary constraint on additional handle length is the lack of space in which to swing the hammer. This is why sledge hammers, largely used in open spaces were space is available, they can have handles that are much longer than a standard ball pein hammer. The second constraint is a little less obvious. Even without considering the effects of fatigue wielding the mass at a big radius, the longer the handle, the harder it is to guide the head of the hammer precisely to its target at full speed.
Most designs are a compromise between practicality and efficiency. **Too long a handle:** the hammer is inefficient because it delivers force to the wrong place, resulting in off-target strikes. **Too short a handle:** the hammer is inefficient because it doesn't deliver enough force, requiring more blows to complete a given task and because of its short length the hammer travels through a tighter radius arc in the swing and hence once again the head is more prone to off target strikes. A major consideration is the potential for injury of the user, if the shaft is very short or the hammer is held close to the head it also places the users hands very close to the striking face, any glancing blow at a target can result in the users fingers/hands hitting the intended target, also as the hand is close to the hammer head (the mass) their hands are driven by the mass into the target.

Effect of gravity
Gravity exerts a force on the hammer head. If hammering downwards, gravity is your friend and increases the acceleration during the hammer stroke and increases the energy delivered with each blow. If hammering upwards, gravity reduces the acceleration during the hammer

stroke and therefore reduces the energy delivered with each blow. Hammering in the horizontal direction reduces the accuracy as gravity impacts the swing trajectory potentially increasing the likelihood of off centre strikes, the heavier the hammer and the more fatigued the user, the more the effect gravity has. Some hammering methods rely entirely on gravity for acceleration on the down stroke.

SAFETY AND USE OF HAMMERS

The employer is responsible for the safe condition of tools and equipment used by employees but the employees have the responsibility for properly using and maintaining tools.

Preparation before use:

- **Is there an alternative method for the activity**, ideally one which does not necessitate the use of a hammer, e.g. impact guns and sockets, hydraulic tools, jacks etc.
- **Is the work area suitable for use of a hammer**, ensure that the work area is free from obstacles both on the ground and local to the hammer swing path- it is easy for a hammer to be deflected by a glancing blow off an obstacle close to the intended swing path.
- **Can the work be positioned to make the hammer use easier**, unfortunately sometimes a hammer may have to be used in awkward confined spaces, in which case extreme care should be taken.
- **Is the object or tool being struck suitable for use with hammers**. Brittle materials, such as cast iron, may shatter if impacted, chrome vanadium coated spanners when hit with hammers will cause the coating to flake off and can cause cuts and infections, also because the spanner is not designed to be hit the target area for the strike is smaller and the spanner will most likely recoil or vibrate when hit.
- **Can you keep your hands away from potential impact**, (remember a glancing blow can deflect the hammer away from the intended object to be struck). Use finger savers or lanyards for flogging spanners, chisel guards on chisels.
- It's also important to remember it's not just the hand holding object to be struck which is in danger, if you have a short shafted hammer, or choke down on the handle, your hammer holding hand will be close to the intended target object at impact, therefore, that hand is in danger from a miss or glancing blow, it's also nearer to the mass of the hammer head and hence will feel more of the effect of that mass if the hand or fingers come into contact a solid object.
- **Assess the risks associated with the task** every time.
- **Appropriate personal protective equipment**, e.g., safety goggles/visor, appropriate well fitting gloves with good grip, etc., should be worn due to hazards that may be encountered while using hammers.

Using hammers:

- **Inspect your hammers/mallets condition before use**:
    - Ensure the handle is not splintered, split either longitudinally or across its section.
    - Ensure the head is not damaged, loose – check wedges are secure and hammer head is not free to move on the shaft.
    - Ensure the head is not cracked or chipped.
    - Ensure the shaft is free from oil or grease.

- **Select the right tool for the job**. Substitutes significantly increase the chance of having an accident. Choose a hammer with a striking face diameter at least 12 mm (0.5 inch) larger than the face of the tool being struck (e.g., chisels, punches, wedges, etc.).
- **Take a solid neutral/natural stance**, this aids the likelihood of striking the target squarely for maximum transfer of the applied force.
- **Hold the hammer at the end of the handle whenever possible**, with hand firmly wrapped around the handle.
- **When possible let gravity assist you**.
- **Use good quality tools**.
- **Swing the hammer** using you whole arm not just your wrist.
- **Keep your wrist straight** in the stroke.
- **Focus your eyes on the intended target**, strike a hammer blow squarely with the striking face parallel to the surface being struck. Always try to avoid glancing blows and over and under strikes.
- **Don't let your concentration be distracted** when swinging the hammer.
- Do not use a hammer for any purpose for which it was not designed or intended.
- **Do not use one hammer to strike another hammer**, other hard metal objects, stones or concrete.
- **Do not redress**, grind, weld or reheat-treat a hammer head, these may impact the balance, and striking face hardness of the tool.
- **Do not strike with the side or cheek of the hammer**, it's not designed as a striking face and the shaft may be weaker in this direction.

- **If working at height** don't forget **the following tools must be secured by lanyard or other firm measures when working above 1.8m: Hammers, wedges, drifts, and flogging spanners** (All must have suitable means to attach lanyards e.g. wedges and drifts shall be drilled).

Maintaining hammers:

- Keep tools in good condition at all times.
- Replace or repair defective tools.

Mallets:

Generally most of the above comments are also true for mallets, a few other considerations: Mallets are susceptible to head damage due to the soft nature of the face material, the more damaged the face, the less of the striking force will be applied to the stuck object.

Use mallets if you need to strike chrome vanadium or other coated spanners.

Misuse of hammers and spanners

Below are some examples of hammers in various stages of disrepair, found in the central workshops, and examples of safe, and potentially unsafe handling and use.

Correct handling of a ball pein hammer;
Hand gripping further down the shaft to reduce potential of striking hand during swing

INCORRECT handling of hammer;
Grip too close to the striking face, resulting in increased risk of impact to the hand

Evidence of damage to hammer handle from striking objects;

Impact damage seen on handle and on the cheeks of the head from hitting objects. The shaft damage could be caused by a miss hit or glancing blow, it could also mean the hammer shaft is weakened.

Evidence of incorrect hammer use to strike chrome-vanadium spanner;

If striking spanners is necessary, use a mallet rather than a hammer. Chrome-vanadium can chip off and cause painful splinters and infection to those handling the spanner.

Lanyard fitted to lump hammer;
Lanyards should be used when using lump hammers at height, or where a potential to lose grip is present.

Examples of damaged mallets;
Plastic Mallet has one damaged face and the other is missing. This could cause the blow to deflect and injure the user. The missing face surface has been used to strike objects.
The copper hide mallet also has a substantially worn hide face, which again, could cause a blow to deflect and injure the user or others.