Q1. What is foundry and founding?

A. Foundry or casting is a process of forming metallic products by melting metal, pouring it into a cavity known as a mould, and allowing it to solidify. When removed from the mould, the metal acquires the shape and size of the mould.

Q2. What are the different sections of a foundry?

A. The whole process of producing castings may be classified into five distinct stages of which the last four are done in a foundry shop:

i. Pattern making
ii. Moulding and core making
iii. Melting and casting
iv. Fettling
v. Testing and inspection

Q3. What is a pattern? Can it be bigger than the casting? If so, why?

A. Patterns are not made the exact same size as the desired casting for because such a pattern would produce castings which are too small. After taking various allowances into account, it turns out that the net result of allowances predicts that the pattern should be larger than the casting.

Q4. What are the different allowances provided on a pattern? Which of them is negative?

A. There are five standard allowances of which only rapping allowance is negative:

i. Shrinkage allowance: As the metal solidifies and cools, it shrinks and contracts in size. To compensate for this, the pattern is made larger than the required casting size.
ii. Draft allowance: When the pattern is drawn from the mould, there is a possiblity of injuring the edges of the mould. This danger can be greatly reduced if the vertical walls of the pattern are tapered slightly inward instead of actually being vertical.
iii. Machining allowance: Dimensions of rough surfaces of castings that need to be machined are exaggerated.
iv. Distortion or camber allowance: Some patterns inherently tend to distort as the metal cools. This distortion is due to uneven cooling of various surfaces. To compensate for this distortion, the pattern is bent in the opposite direction.
v. Rapping allowance: When the pattern is rapped in the mould before being withdrawn, the cavity of the mould is slightly enlarged. To compensate for this, the pattern is made slightly smaller than necessary.

Q5. What are the different types of patterns?

A. There are many different types of patterns. Some of the common ones are listed below:

i. Single piece or solid pattern. A simple pattern with a flat surface lacking joints, partings and loose pieces.
ii. Split pattern. Patterns with irregular shapes and no flat surfaces are cut into two single-piece patterns and are fitted together after casting.
iii. Sweep pattern. Symmetrical moulds and cores, particularly in large sizes may be shaped by means of sweep patterns to minimize costs. A sweep board is rotated around a central axis of symmetry, scooping out sand to create the final mould.
iv. Skeleton pattern. Patterns for large castings may be shaped by means of a skeletal pattern to minimize costs. This is a ribbed construction with a large number of openings. The framework is filled with moulding sand. The excess sand between the ribs is scraped out with the help of a strickle board.
v. Lagged-up pattern. To minimize cost cost and maximise strength, cylindrical works are built up with log strips of wood called lags or staves glued to end pieces called heads.
vi. Loose-piece pattern. Some patterns are produced as assemblies of loose components. The loose components are cast separately and joint together.

Q6. Name the materials used to manufacture patterns.

A. Various materials can be used to produce patterns. A suitable one must be chosen depending on the requirements of the pattern/ cast.

i. Wood is the most common material used in pattern making as it is readily available, cheap, light, easily workable and provides a good surface finish. Disadvantages include its lack of durability- it wears out quickly due to sand abrasion. Wood is also readily affected by moisture.

ii. Metal is used when higher durability and surface finish is required. Metal is not affected by moisture and retains its shape and size over longer periods of time. Metal is restricted to making small paterns and master patterns as it is heavy.

iii. Plastics are light, cheap and do not absorb moisture. They have an added bonus of being easily withdrawn from the mould without damage.

iv. Rubbers. Silicon rubber is especially favoured for forming a vry intircate type of die for investment casting.

v. Plasters have high compressive strength at the cost of being heaving themselves. They are restricted to making follow boards.

vi. Waxes. Wax patterns are excellent for investment casting process. Waxes have high tensile strength and hardness, and substantial weld strength.

Q7. What is a core box? How is it different from a pattern?

A. A core box is essentially a type of pattern made of wood or metal into which sand is rammed to form a core. Complex castings that have holes and recesses of various shapes are often obtained by using sand cores which are made separately. A core box is a type of a pattern used to create these cores while a normal pattern is used in the case of simple castings to directly create the casting.

Q8. What is a core print? What is its use?

A. For supporting cores in the mould cavity, an impression in the form of a recess is made in the mould with the help of a projection suitably placed on the pattern. This projection on the pattern is known as core print.

Q9. What is a core?

A. Cores are separate shapes of sand that are generally required to form the hollow interior of a casting or a hole through a castings. Cores are also used to shape those parts of the casting that are not otherwise practically obtainable by the mould produced directly by the pattern.

Q10. What is a follow board?

A. Patterns that have thin sections tend to become distorted under the stress of ramming. This problem of sagging can be easily overcome by constructing a block which will fit inside the pattern to serve as support during the ramming operation. This support block is known as a follow board.

Q11. Why are dowel pins required? How are they different from guide pins?

A. In the context of split pattern making, dowel pins are used to hold the two parts of the pattern in proper relative positions. Dowel pins are fastened in one piece and are fitted in holes bored in the other. Guide pins, on the other hand, are used to align the cope box with the drag box so that the parting surface does not move during the ramming operation.

Q12. What is a master pattern?

A. A master pattern is a pattern (usually metallic) used to cast other patterns. These patterns created from the master pattern are used in the industry to create castings.

Q13. What are the different moulding methods?

A. The two moulding methods are hand moulding and machine moulding. There are several moulding processes which fall under these two categories.

Q14. What are the advantages and disadvantages of machine moulding?

A. Hand moulding is found to be economical when only a few castings are required. Hand

moulding is slow and requires considerable skill to produce good castings. On the other hand, the use of moulding machine is advisable when large number of repetitive castings are to be produced since hand moulding is more time consuming, laborious and expensive.

Q15. *What are the significant differences between holding and squeezing machine moulding*?

A. In the squeeze method, moulding sand in the flask is squeezed between the machine table and the overhead squeeze board pneumatically or hydraulically until the mould achieves desired density. In jolting method, the flask is first filled with moulding sand and then the table supporting the flask is mechanically raised and dropped in succession. The limitation of the squeezer is that the sand is packed more densely on the top of the mould from which the pressure is applied and desnity decreses uniformly with depth. At the parting plane, the density is the least. On the other hand, the jolting machine has a limitation that the sand is rammed hardest at the parting plane leaving the top less dense.

Q16. What is match plate pattern?

A. When split patterns are mounted with one half on one side of the plate and the other half directly opposite on the other side of the plate, the pattern is called match plate pattern.

Q17. What is the composition of moulding sand?

A. The principal ingredients of moulding sand are silica, grains, clay, and other materials like binders and parting materials.

Q18. What is green sand moulding?

A. Green sand moulding is a moulding processes based on green sands. The principal methods of green-sand moulding are:

i. Open-sand method.
ii. Bedded-in method.
iii. Turn-over method.

Q19. What are the different types of base sands used in the foundry?

A. Moulding sands may be classified according to their use into a number of varieties:

i. Green sand. Mixture of silica sand with 18~30% clay, having total water of 6~8%. Fine, soft, light and porous.
ii. Dry sand. Dried green sand suitable for large castings.
iii. Loam sand. ~50% clay. Dries hard.
iv. Facing sand. Forms face of the mould and comes in contact with molten metal of the casting. Consists of silica sand and clay with a little addition of used sand. Carbon is added to prevent the metal from burning into the sand.
v. Backing sand. Backs up the facing sand and fills the volume of the mould box. Black old sand.
vi. System sand. Used to fill up complete moulding box in mechanical foundries. System sand is used sand cleaned up and reactive.
vii. Parting sand. Clay free silica sand dust used to keep facing sand in the cope and drag from mixing.
viii. Core sand. Used to make cores. Core sand is silica sand mixed with core oils such as linseed oil, resin and light mineral oil.

Q20. Name the different sand moulding practises followed in a foundry.

A. Moulding processes may be broadly classified under hand moulding and machine moulding:

i. Hand moulding. These moulding methods can further be classified under two general classes
    - Based on moulding material
        - Green sand moulds
        - Dry sand moulds
        - Skin-dried moulds
    - Based on moulding methodology

- Bench moulding
- Floor moulding
- Pit moulding
- Sweep moulding
- Plate moulding

ii. Machine moulding. Can be further subdivided on the basis of the methodolgy of compacting sand

- Squeezer machine
- Jolt machine
- Jolt-squeeze machine
- Sand slingers
- Straight-draw moulding machine
- Stripping-plate moulding machine
- Turn-over moulding machine

Q21. What is the necessity of using additives and binders in moulding sands? Name the additives and binders.

A. Additives are minerals generally added to the sand mixture to develop special properties in the mould and consequently in the castings. Some additives and binders are:

i. Fire clay. Essentially hydrated aluminium silicate. The purpose of fire clay is that it offers good bond when mixed with burnt sand, in the proportion of 1 to 2 for coating the inside of cupolas and pouring ladles.

ii. Clay wash is a mixture of fire clay and water. Used when a strong bond is required and for repainting ladle linings with a fresh daubing mixture.

iii. Parting materials are parting sands or parting dust which contain no bond. It is applied on the parting surface and on the joint of the mould to prevent the moulding sand from adhering to the moulding box or to the pattern.

iv. Binders can be classified as organic and inorganic. Organic binders include carbohydrate, molasses and oils while inorganic binders include clays, cements and gypsum.

Q22. Can any type of sand be used of moulding? If not, what should be the different criteria?

A. No. This is the table for choice of moulding sands

Type	Application	Reasons
Natural sand	Light castings	Permeability is unimportant; good surface finish is
	Jobbing foundry	Few poor quality castings reqd.
	Mechanised production of castings with few cores	There is little influx of sand cores
	Dry sand moulding	High permeability unnecessary as little gas is evolved; patching easy
Synthetic sand	Heavily cored castings	At shake-out, large amount of clay-free core sand enter moulding sand; regular clay additions possible
	Mechanised production	Better hardness; uniform properties
	High pressure moulding	good hardness, permeability; easy stripping; high strength

Q23. What is the importance of testing moulding sands?

A. Foundry sand deserves as much attention as the casting metal as it accounts for a third of the cost of the casting metal. Periodic testing is required to control composition and properties.

Q24. What is permeability? How is it determined?

A. Permeability is measured by the quantity of air that will pass through a standard specimen of sand under a given pressure in a prescribed time. Permeability number is calculate as v x h / (p x a x t) where

i. v = volume of air
ii. h = height of sand specimen
iii. p = air pressure
iv. a = cross-sectional area of specimen
v. t = time for 2000 cc of air in seconds

Q25. What is green compressive strength (GCS)?

A. The green compressive strength of foundry sand is maximum compressive strength a mixture is capable of developing when moist.

Q26. What is standard sand specimen? How is it made?

A. Standard sand specimen is a cylindrical shaped sand pile having 5.08 mm diameter and 50.8 mm height made in a cylinder taking a predefined quantity of sand and ramming it well.

Q27. What is green hardness? How is it measured?

A. The hardness of a compacted sand surface can be determined by portable spring loaded indentation tester. For the measurement of green hardness a spherical or conical intender is used depending upon the expected hardness level. The depth of penetration from the flat reference surface of the instrument is measured in an empirical scale of hardness ranging between 1-100.

Q28. Why is venting required?

A. Venting is needed so as to let the hot gasses in the molten metal escape. If not allowed to escape, the final casting may have air pockets.

Q29. What are the different types of casting defects? Why do they occur?

A. Sand castings are subject to various defects. The following defects can occur:

i. Shifts. External defect in casting caused due to core misplacement or mismatching of top and bottom parts of casting usually at a parting line. The defect can be eliminated by ensuring proper alignment.
ii. Warpage. Unintentional and undesirable deformation in casting that occurs after solidification due to different rates of cooling. Large flat sections like ribs are especially prone to this defect.
iii. Fin.
iv. Swell.
v. Blowholes.
vi. Drop.
vii. Dirt.
viii. Honeycombing or sponginess.
ix. Metal penetration and rough surface.
x. Sand holes.
xi. Pin holes.
xii. Scabs.
xiii. Shrinkage cavity.
xiv. Hot tears (pulls).
xv. Cold shut and mission.
xvi. Poured short.
xvii. Internal air pocket.

Q30. What is a furnace? What are the different types of furnaces used in a foundry?

A.Furnace is a hot insulated vessel which takes up charge and converts them into desired product in high temperature by means of chemical reactions.

The two type of furnaces used in foundry are---

i) pit type furnace

ii) tilting furnace

Q31. What are the furnaces used for melting ferrous and non-ferrous alloys and metals?

A.Furnaces for ferrous alloys----blast furnace, L-D converter, Bessemer converter.

Non ferrous alloys---sinterer furnace.

Q32. Why should tapping temperature of metal be higher than melting temperature?

A.The optimum temperature at which the molten metal should be poured into the mould is called tapping temperature. It has to be higher than melting temperature otherwise the molten metal may freeze before the mold is filled causing misruns and other defects.

Q33. Why should metal be degassed?

A. To avoid air pockets in the final casting.

Q34. What are the melting temperatures of Al, Fe, Cu and their alloys?

A. Al---660.32°c Fe—1538° C Cu----1084° C