



ANSWER ONLY FOUR QUESTIONS

Q1/

- a) The downsprue leading into the runner of a certain mold has a length = 175 mm. The cross-sectional area at the base of the sprue is 400 mm². The mold cavity has a volume = 0.001 m³. Determine (a) the velocity of the molten metal flowing through the base of the downsprue (b) the volume rate of flow (c) the time required to fill the mold cavity. [10D]
- b) An 92% aluminum-8% copper alloy casting is made in a sand mold using a sand core that weighs 20 kg. Determine the buoyancy force in Newtons tending to lift the core during pouring. ($\rho=1.6\text{gm/cm}^3$ for Molding sand, And for Al-Cu $\rho=2.81\text{gm/cm}^3$) [9D]
- c) What are some of the factors that affect the fluidity of a molten metal during pouring into a mold cavity? [6D]

Q2/

- a) A large steel sand casting shows the characteristic signs of penetration defect: a surface consisting of a mixture of sand and metal. (a) What steps can be taken to correct the defect?(b) What other possible defects might result from taking each of these steps? [15D]
- b) Answer all of the multiple choice questions; [10D]
1. A feeder in casting is described by which of the following (three correct answers): (a) an insert in the casting that inhibits buoyancy of the core, (b) gating system in which the sprue feeds directly into the cavity, (c) metal that is not part of the casting, (d) source of molten metal to feed the casting and compensate for shrinkage during solidification, and (e) waste metal that is usually recycled?
 2. In a sand-casting mold, the V/A ratio of the feeder should be (a) equal to, (b) greater than, or (c) smaller than the V/A ratio of the casting itself?
 3. During solidification of an alloy when a mixture of solid and liquid metals is present, the solid-liquid mixture is referred to as which one of the following: (a) eutectic composition, (b) ingot segregation, (c) liquids, (d) mushy zone, or (e) solidus?
 4. Total solidification time is defined as which one of the following: (a) time between pouring and complete solidification, (b) time between pouring and cooling to room temperature, (c) time between solidification and cooling to room temperature, or (d) time to give up the heat of fusion?

5. A runner is which one of the following: (a) channel in the mold leading from the downsprue to the main mold cavity, (b) foundryman who moves the molten metal to the mold, or (c) vertical channel into which molten metal is poured into the mold?
6. Which of the following casting processes are expendable mold operations (three correct answers): (a) centrifugal casting, (b) die casting, (c) investment casting, (d) vacuum molding (e) sand casting, (f) shell molding, (g) slush casting, and (h)
7. Which of the following casting processes are permanent mold operations (three correct answers): (a) centrifugal casting, (b) die casting, (c) expanded polystyrene process, (d) sand casting, (e) shell molding, (f) slush casting, and (g) vacuum molding.
8. Which of the following metals would typically be used in die casting (three best answers) (a) aluminum, (b) cast iron, (c) steel, (d) tin, (e) tungsten, and (f) zinc?
9. Which of the following are advantages of die casting over sand casting (four best answers): (a) better surface finish, (b) closer tolerances, (c) higher melting temperature metals, (d) higher production rates, (e) larger parts can be cast, and (f) mold can be reused?
10. A misrun is which one of the following defects in casting: (a) globules of metal becoming entrapped in the casting, (b) metal is not properly poured into the downsprue, (c) metal solidifies before filling the cavity, (d) microporosity, and (e) "pipe" formation?

Q3/

- a) Determine the shrink rule to be used by mold makers for die casting of zinc. Using the shrinkage value = 2.6, express your answer in terms of decimal mm of elongation per 300 mm of length compared to a standard 300-mm scale. [6D]
- b) The total solidification times of three casting shapes are to be compared: (1) a sphere, (2) a cylinder, in which the length-to-diameter ratio = 1.0, and (3) a cube. For all three geometries, the volume = 1000 cm³. The same casting alloy is used in the three cases. (a) Determine the relative solidification times for each geometry (C_m=1). (b) Based on the results of part (a), which geometric element would make. [12D] (c)
- c) A sand core used to form the internal surfaces of a steel casting experiences a buoyancy force of 23 kg. The volume of the mold cavity forming the outside surface of the casting = 5000 cm³. What is the weight of the final casting? Ignore considerations of shrinkage (Sand $\rho = 1.6 \text{ g/cm}^3$, steel casting $\rho = 7.82 \text{ g/cm}^3$) (c) If the mold constant = 3.5 min/cm² in Chvorinov's rule, compute the total solidification time for each casting. [7D]

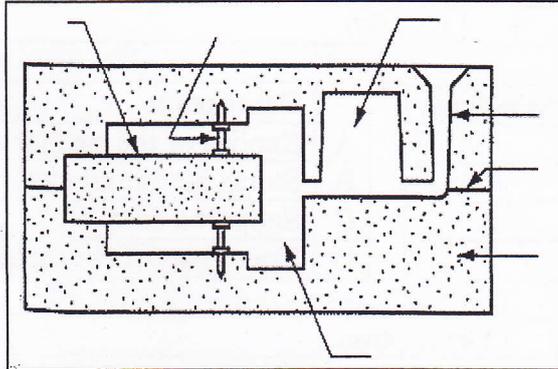
Q4/

- a) A disk-shaped part is to be cast out of aluminum. The diameter of the disk = 500 mm and its thickness = 20 mm. If the mold constant = 2.0 sec/mm² in Chvorinov's rule, how long will it take the casting to solidify? [8D]
- b) What is the difference between a pattern and a core in sand molding? [5D]
- c) A horizontal true centrifugal casting process is used to make brass bushings with the following dimensions: length = 10 cm, outside diameter = 15 cm, and inside diameter = 12 cm. (a) Determine the required rotational speed in order to obtain a

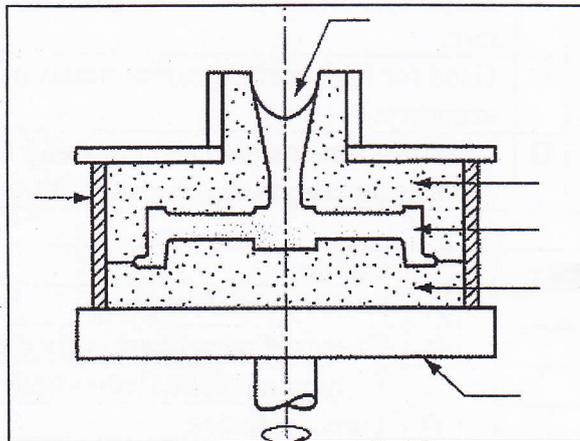
G-factor of 70. (b) When operating at this speed, what is the centrifugal force per square meter (Pa) imposed by the molten metal on the inside wall of the mold?
 [12D]

Q5 / Point to the drawing details illustrated below: [25D]

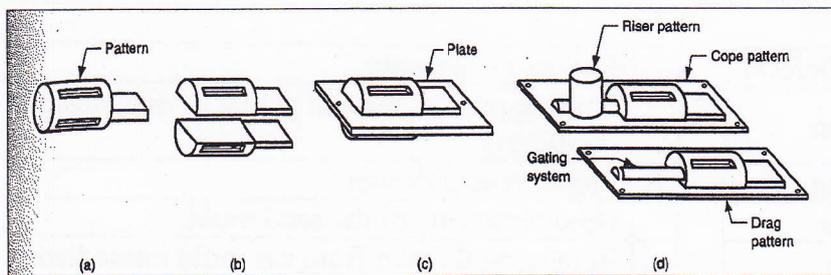
1) Sand casting mold.



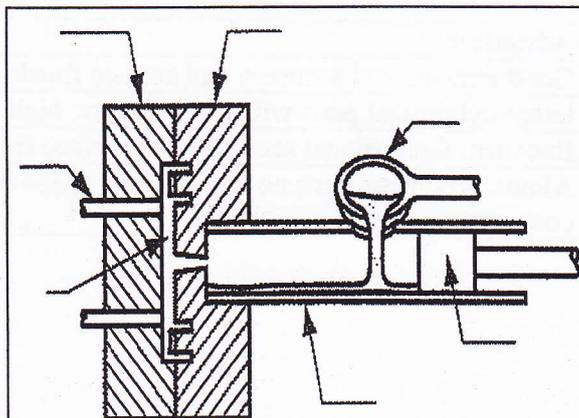
2) Semicentrifugal Casting.



3) Types of patterns used in sand casting.



4) Cold chamber die casting.



Q6 /Match list (I) with list (II) and select the correct answer? [25D]

[1]

List I		List II	
	Metal or alloy		Volumetric solidification contraction (%)
1	Gray cast- iron	A	3.8
2	Aluminum	B	Expansion to 2.5
3	Al-12%Si	C	6.6

[2]

Casting terminology		Description	
1	Chaplet	A	Replica of the casting to be made
2	Cope	B	Stores hot liquid metal
3	pattern	C	Support a core
4	Feeder	D	Upper part of the mold

[3]

Casting processes		Description	
1	Hot-chamber die casting	A	Almost any metal cast; no limit to size, shape or weight; low tooling cost
2	Sand casting	B	Large cylindrical parts with good quality; high production rate.
3	Centrifugal casting	C	Used for high melting point metals of high dimensional accuracy.
4	Investment casting	D	Excellent dimensional accuracy and surface finish; high production rate, used for low melting point metals

[4]

Casting processes		Casting	
1	Sand	A	Primary simple casting.
2	Slush	B	Pipes, cylinder liners, gray castiron.
3	Centrifugal	C	Turning machine (lathe) body, gray castiron.
4	Die	D	Turbine Blades.
5	Single Crystal	E	Camera, high purity magnesium case.
6	Ingot Casting	F	A bronze statue.

[5]

Casting Defects		Reduce or alleviate	
1	Penetration	A	Pouring procedures and gating system designs that avoid splattering.
2	Hot tearing	B	Proper feeder design.
3	Cold shots	C	Harder packing of the sand mold.
4	Shrinkage cavity	D	Removing the part from the mold immediately after solidification.

[6]

Process		Advantages	
1	Sand	A	Good dimensional accuracy and surface finish; high production rate .
2	Shell mold	B	Large cylindrical parts with good quality; high production rate .
3	Centrifugal	C	Excellent dimensional accuracy and surface finish; high production rate
4	Die	D	Almost any metal cast; no limit to size, shape or weight; low tooling cost