



# POSTAL BOOK PACKAGE 2024

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### MECHANICAL ENGINEERING

#### Objective Practice Sets

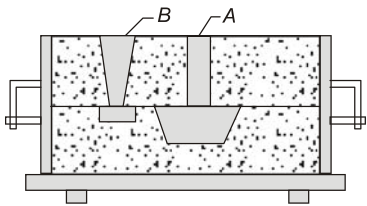
### Production and Maintenance Engineering

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## Metal Casting

## MCQ and NAT Questions

- Q.1** A sand casting mould assembly is shown in the given figure. The elements marked *A* and *B* are respectively



- (a) Sprue and riser      (b) Ingate and riser  
(c) Drag and runner    (d) Riser and sprue
- Q.2** Pattern for very large casting would require a tremendous amount of timber for full pattern. In such case which one of the following pattern can be used?
- (a) Sweep pattern  
(b) Skeleton pattern  
(c) Segmental pattern  
(d) Shell pattern
- Q.3** In solidification of metal during casting, compensation for solid contraction is
- (a) Provided by the oversize pattern  
(b) Achieved by properly placed riser  
(c) Obtained by promoting direction solidification  
(d) Made by providing chills
- Q.4** The allowances which are provided for by making a pattern slightly smaller than actual size is known as
- (a) Shrinkage allowance  
(b) Draft allowance  
(c) Camber allowance  
(d) Rapping allowance
- Q.5** Which of the following material will require the largest size of riser for the same size of casting?
- (a) aluminium              (b) cast iron  
(c) steel                      (d) copper
- Q.6** Which one of the following is not a sand conditioning advantage
- (a) Binder is uniformly distributed around the sand grains  
(b) Properly controlled moisture content  
(c) decrease flowability of sand  
(d) foreign particles are separated and removed
- Q.7** Which one of the following is not an advantage of green sand mould?
- (a) Good dimensional accuracy across the parting line  
(b) Less danger of hot tearing  
(c) Erosion does not occur in large casting  
(d) least expensive method of producing castings
- Q.8** Heated metal pattern in shell moulding is made of
- (a) Aluminium  
(b) Medium carbon steel  
(c) Grey cast Iron  
(d) Bronze
- Q.9** Hot box moulding process is used to produce
- (a) small casting in large quantities  
(b) small casting in small quantities  
(c) large casting in small quantities  
(d) large casting in large quantities
- Q.10** Which of the following are the requirements of an ideal gating system?
1. The molten metal should enter the mould cavity with as high a velocity as possible.
  2. It should facilitate complete filling of the mould cavity.
  3. It should be able to prevent the absorption of air or gases from the surroundings on the molten metal while flowing through it.
- Select the correct answer using the codes given below:
- (a) 1, 2 and 3              (b) 1 and 2  
(c) 2 and 3                (d) 1 and 3

**Q.11** A pattern material should be

1. Less in weight
2. Dimensionally stable
3. Strong, hard & durable
4. Repairable

Which of the above properties are correct for a pattern material?

- (a) 1, 2 and 4
- (b) 2, 3 and 4
- (c) 1, 3 and 4
- (d) 1, 2, 3 and 4

**Q.12** Consider the following advantage of dry sand mould over green sand moulds

1. They are stronger than green sand moulds
2. Overall better dimensional accuracy
3. Better surface finish
4. Less susceptible to hot tears

Which of the above statements are correct?

- (a) 1, 2 and 3
- (b) 1, 2 and 4
- (c) 1, 3 and 4
- (d) 2, 3 and 4

**Q.13** Directional solidification can be achieved by providing

- (a) chills and chaplets
- (b) chaplets and padding
- (c) chills and padding
- (d) chills, chaplets and padding

**Q.14** Misrun is a casting defect which occurs due to

- (a) very high pouring temperature of the metal.
- (b) insufficient fluidity of the molten metal.
- (c) absorption of gases by the liquid metal.
- (d) improper alignment of the mould flasks.

**Q.15** Poor machinability of centrifugally cast iron pipe is due to

- (a) Chilling
- (b) Segregation
- (c) Dense structure
- (d) High mould rotation speed

**Q.16** Casting defect 'Drop' can be avoided by

- (a) use of gagers & adequate strength of sand
- (b) at pouring stage by use of strainer & a skim bob
- (c) having proper venting & adequate permeability
- (d) proper amount of volatile additives in the sand-mix

**Q.17** Olivine, a special sand is used

- (a) in Brass & bronze casting
- (b) in non-ferrous casting of intricate parts
- (c) in heavy steel casting
- (d) to increase chilling tendency

**Q.18** The process of removing unwanted material from the casting is called

- (a) Fettling
- (b) Cleaning
- (c) Finishing
- (d) Blowing

**Q.19** The casting defect which is not caused by the high pouring temperature of melt is

- (a) Cuts
- (b) Metal penetration
- (c) Fusion
- (d) Rat tails

**Q.20** The main purpose of chaplets is

- (a) to ensure directional solidification
- (b) to provide efficient venting
- (c) for aligning the mould boxes
- (d) to support the cores

**Q.21** Scab is a

- (a) sand casting defect
- (b) machining defect
- (c) welding defect
- (d) forging defect

**Q.22** Vertical core print is constructed with considerable tapered on the cope side as compare to drag side is

- (a) larger
- (b) equal
- (c) lesser
- (d) double

**Q.23** An improper riser may give rise to a defect called

- (a) Shift
- (b) Misrun
- (c) Penetration
- (d) Shrinkage cavity

**Q.24** Thin-walled hollow castings can be made by permanent mould casting in a process called

- (a) Slush casting
- (b) Shell moulding
- (c) Vacuum moulding
- (d) Lost-foam casting

**Q.25** Which one of the following defect is due to the expansion of mould?

- (a) Blisters
- (b) Scab
- (c) Buckle
- (d) Cold shut

**Q.26** The casting defect caused by the erosion of sand

- (a) Drop
- (b) Wash
- (c) Rat tail
- (d) Misrun

**Q.27** To improve the surface finish of sand casting, the following type of sand is applied to the mould cavity:

- (a) Coal dust
- (b) Facing sand
- (c) Iron oxide
- (d) both (a) and (b)

**Q.28** When the molten metal is poured in a mould, it may pass through the following items in sequence

- Sprue, runner, gate, top riser
- Runner, sprue, gate, top riser
- Top riser, runner, sprue, gate
- Gate, sprue, top riser, runner

**Q.29** Proportion of raw material in blast furnace in sequence, ore, fuel & flux respectively

- $\frac{1}{2}$ ,  $\frac{1}{3}$  and  $\frac{1}{6}$
- $\frac{1}{2}$ ,  $\frac{1}{4}$  and  $\frac{1}{4}$
- $\frac{3}{4}$ ,  $\frac{1}{8}$  and  $\frac{1}{8}$
- $\frac{1}{2}$ ,  $\frac{1}{6}$  and  $\frac{1}{3}$

**Q.30** Which one of the following correctly described the word collapsibility used in casting?

- ability of the mold to allow the shrinkage of the casting during solidification.
- ability to resist cracking and buckling when in contact with the molten metal.
- ability to maintain shape in the face of the flowing metal.
- ability of the mold to allow hot air and gases to escape from the cavity.

**Q.31** Which one of following is correct about the effect of water content on flowability?

- It increases as water content increases
- It decreases as water content increases
- It first increases & then decreases as water content increases
- It first decreases & then increases as water content increases

**Q.32** Match **List-I** (Casting Process) with **List-II** (Applications) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Centrifugal casting	1. Carburettors
B. Squeeze casting	2. Pipes
C. Die casting	3. Wheels for automobiles
	4. Gear housings

**Codes:**

- |     | A | B | C |
|-----|---|---|---|
| (a) | 2 | 3 | 1 |
| (b) | 4 | 1 | 3 |
| (c) | 4 | 3 | 1 |
| (d) | 3 | 2 | 4 |

**Q.33** A mold sprue is 20 cm long and the cross-sectional area at its base is  $2.5 \text{ cm}^2$ . The sprue feeds a horizontal runner leading into a mold cavity whose volume is  $1800 \text{ cm}^3$  then required time to fill the mold is: (Assume,  $g = 10 \text{ m/s}^2$ )

- 36 s
- 3.6 s
- 3.64 s
- 36.4 s

**Q.34** Turbulence during pouring of the molten metal is undesirable for the following reasons.

- It increases the mold filling time.
- It increases erosion of the mold surfaces.
- It dissolves the binder which is used to hold sand mold.
- It increases the formation of metallic oxides that can be entrapped during solidification.

Which of the above statements are correct?

- 1, 2 and 4 only
- 2, 3 and 4 only
- 1 and 3 only
- 2 and 4 only

**Q.35** The success of a casting process depends mainly on the following properties of the moulding sand:

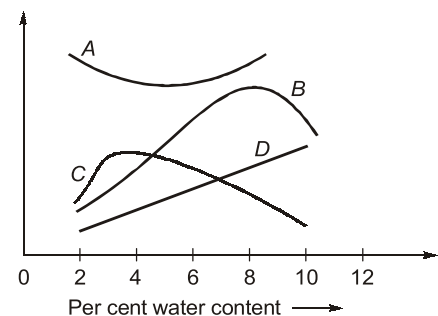
- Permeability
- Strength
- Deformation
- Flowability
- Refractoriness

Which of the these are valid?

- 1, 2, 3 and 4
- all of these
- 1, 2, 4 and 5
- 1 and 2

**Q.36** Match the **List-I** with **List-II** and select the correct answer using the codes given below the lists:

**List-I**



**List-II**

- Deformation
- Flowability
- Permeability
- Refractoriness
- Strength

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 4 | 5 | 3 |
| (b) | 2 | 3 | 5 | 1 |
| (c) | 1 | 2 | 3 | 5 |
| (d) | 2 | 5 | 3 | 4 |

**Q.37** Three pieces being cast have the same volume but different shapes. One is sphere, one a cube, and the other a cylinder with a height equal to its diameter. Which piece will solidify the fastest?

- (a) Sphere (b) Cube  
(c) Cylinder (d) Insufficient data

**Q.38** Which of the following pattern-materials is used in precision casting?

1. Plaster of paris
  2. Plastics
  3. Anodized aluminium alloy
  4. Frozen mercury
- (a) 1 and 2 (b) 2 and 4  
(c) 3 and 4 (d) 1 and 3

**Q.39** Arrange the following materials in order of their increasing die life casting ability:

- (a) brass, cast iron, zinc and aluminium  
(b) brass, cast iron, aluminium and zinc  
(c) cast iron, brass, aluminium and zinc  
(d) cast iron, brass, zinc and aluminium

**Q.40** Match **List-I** (Material to be cast) with **List-II** (Shrinkage allowance in mm/m) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Grey cast iron	1. 7 - 10
B. Brass	2. 15
C. Steel	3. 20
D. Zinc	4. 24

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 2 | 3 | 4 |
| (b) | 3 | 4 | 1 | 2 |
| (c) | 1 | 4 | 3 | 2 |
| (d) | 3 | 2 | 1 | 4 |

**Q.41** Match **List-I** (Process) with **List-II** (Products/materials) and select the correct answer using the codes given below the lists:

- List-I**
- A. Die casting  
B. Shell molding  
C. CO<sub>2</sub> molding  
D. Centrifugal casting
- List-II**
1. Phenol formaldehyde  
2. C. I. Pipes  
3. Non-ferrous alloys  
4. Sodium silicate

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 3 | 4 | 2 |
| (b) | 3 | 1 | 4 | 2 |
| (c) | 3 | 1 | 2 | 4 |
| (d) | 1 | 3 | 2 | 4 |

**Q.42** Match **List-I** ( Products) with **List-II** (Casting Process) and select the correct answer using the codes given the lists:

**List-I**

- A. Hollow statues  
B. Dentures  
C. Aluminium alloy pistons  
D. Rocker arms

**List-II**

1. Centrifugal Casting
2. Investment Casting
3. Slush Casting
4. Shell Moulding
5. Gravity Die Casting

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 3 | 2 | 4 | 5 |
| (b) | 1 | 3 | 4 | 5 |
| (c) | 1 | 2 | 3 | 4 |
| (d) | 3 | 2 | 5 | 4 |

**Q.43** Consider the following advantage of CO<sub>2</sub> moulding process

1. Eliminates the need for internal support for cores
2. Greatest dimensional accuracy
3. Semi-skilled labour can be used
4. Moulds & cores can be used immediately after processing

Which of the above advantage are correct?

- (a) 1, 2 and 3 (b) 1, 3 and 4  
(c) 2, 3 and 4 (d) 1, 2, 3 and 4

**Q.44** Consider the following limitation of shell moulding process.

1. High pattern cost
2. High equipment cost
3. Uneconomical for small runs
4. High resin cost

Which of the above limitations are correct?

- (a) 1, 2 and 3 (b) 1, 3 and 4  
(c) 2, 3 and 4 (d) 1, 2, 3 and 4

**Q.45** Consider the following advantages of investment casting process

1. Surface finish is around 1.5 micron
2. Extremely thin section can be cast
3. Complex shape parts can be produced
4. Suitable for mass production of small size casting
5. Economic in all aspects

Which of the above statements are correct?

- (a) 1, 2, 3 and 5
- (b) 1, 2, 3 and 4
- (c) 2, 3, 4 and 5
- (d) 1, 3, 4 and 5

**Q.46** Consider the following advantages of die casting process:

1. Close dimensional tolerance of  $\pm 0.025$  mm is possible
2. Very thin section of order of 0.5 mm can be cast
3. Limit cost is minimum
4. Very high rate of production

Which of the above statements are correct?

- (a) 1, 2 and 3
- (b) 1, 3 and 4
- (c) 1, 2 and 4
- (d) 1, 2, 3 and 4

**Q.47** Match **List-I** (Equipment) with **List-II** (Application) and select the correct answer using the codes given below the lists:

**List-I**

- A. Riddle
- B. Trowel
- C. Lifter
- D. Strike off bar

**List-II**

1. Strike off excess sand from mould
2. To smooth the mould surface
3. Removing foreign materials
4. Clean and finish the bottom and sides of deep, narrow opening in moulds

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 3 | 1 | 4 |
| (b) | 3 | 2 | 4 | 1 |
| (c) | 2 | 3 | 4 | 1 |
| (d) | 3 | 2 | 1 | 4 |

**Q.48** Match **List-I** (Moulding process) with **List-II** (Process) and select the correct answer using the codes given below the lists:

**List-I**

- A.  $\text{CO}_2$  moulding
- B. Shell moulding
- C. Green sand moulding
- D. Core sand moulding

**List-II**

1. Thermosetting resin
2. Sodium silicate
3. Organic
4. Clay

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 1 | 4 | 3 |
| (b) | 1 | 2 | 3 | 4 |
| (c) | 1 | 2 | 4 | 3 |
| (d) | 2 | 1 | 3 | 4 |

**Q.49** Match **List-I** (Casting type) with **List-II** (Application) and select the correct answer using the codes given below the lists:

**List-I**

- A. Investment casting
- B. Plaster moulding
- C. Ceramic moulding
- D. Slush casting

**List-II**

1. Ornamental parts
2. Toys and fixtures
3. Turbine plates
4. Dies

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 4 | 1 | 3 | 2 |
| (b) | 3 | 2 | 4 | 1 |
| (c) | 3 | 1 | 4 | 2 |
| (d) | 4 | 2 | 3 | 1 |

**Q.50** Match **List-I** (Casting process) with **List-II** (Application) and select the correct answer using the codes given below the lists:

**List-I**

- A. True centrifugal casting
- B. Semi centrifugal casting
- C. Continuous casting
- D. Slush casting

**Q.80** Which of the following statements is(are) correct about un-pressurized gating system?

- (a) There is no problem of turbulence and splashing.
- (b) It is preferred for the casting of ferrous materials.
- (c) There is no possibility of air aspiration.
- (d) Casting yield is less.

**Q.81** Which of the following statements is(are) correct for shrinkage allowance?

- (a) Liquid and solidification shrinkages are compensated by providing riser.
- (b) Liquid and solidification shrinkage are given as % of shrinkage volume of the material.
- (c) Solid shrinkage is provided on pattern.
- (d) Solid shrinkage is expressed in terms of linear dimension.

**Q.82** A slab casting of dimensions  $40 \times 20 \times 10 \text{ cm}^3$  has to be produced by using a cylindrical side riser with ( $h = d$ ) using modulus method.

Which of the following is(are) correct?

- (a) The modulus of casting is 2.857.
- (b) The modulus of riser is 3.43.
- (c) Height of the cylindrical side riser is 20.6 cm.
- (d) Volume of the cylindrical side riser is  $3418 \text{ cm}^3$ .

**Q.83** Which of the following statements is(are) correct?

- (a) True centrifugal casting is used for producing hollow cylindrical objects without using the core in mass production.
- (b) Semi centrifugal casting can be used for the production of pulleys, wheels and spoked wheels.
- (c) Cold chamber die casting is used for producing complex shape of the objects which are made up of Al, Cu and Brass.
- (d) Hot chamber die casting is used for producing complex shape of the objects which are made up of lead, tin and zinc.

■■■■

Answers		Metal Casting				
1. (d)	2. (b)	3. (a)	4. (d)	5. (a)	6. (c)	7. (c)
8. (c)	9. (a)	10. (c)	11. (d)	12. (a)	13. (c)	14. (b)
15. (c)	16. (a)	17. (b)	18. (a)	19. (b)	20. (d)	21. (a)
22. (a)	23. (d)	24. (a)	25. (c)	26. (b)	27. (d)	28. (a)
29. (a)	30. (a)	31. (d)	32. (a)	33. (b)	34. (d)	35. (b)
36. (b)	37. (b)	38. (a)	39. (c)	40. (a)	41. (b)	42. (d)
43. (d)	44. (d)	45. (b)	46. (d)	47. (b)	48. (a)	49. (b)
50. (d)	51. (a)	52. (c)	53. (b)	54. (c)	55. (a)	56. (c)
57. (c)	58. (c)	59. (b)	60. (b)	61. (d)	62. (a)	63. (a)
64. (a)	65. (a)	66. (80.21)	67. (40)	68. (66.81)	69. (5.05)	70. (203.8)
71. (33.85)	72. (144.952)		73. (112.5)	74. (96.415)	75. (18)	76. (8.18)
77. (b, c, d)	78. (a, c, d)	79. (a, d)	80. (a, d)	81. (a, b, c, d)	82. (a, b, c)	83. (a, b, c, d)

**Explanations      Metal Casting****1. (d)**

In gating design, *A* is shown as riser and *B* is sprue.

**2. (b)**

Skeleton pattern is used for very large size pattern. The pattern is produced with the help of wooden workpiece, wire mesh and loam sand.

**3. (a)**

Liquid and solidification shrinkage are compensated by riser and solid shrinkage are compensated by oversize pattern.

**4. (d)**

Rapping allowance

- (i) Provide to make clearance between pattern and moulds.
- (ii) Depends on the skill of operator and it is negative in nature.

**5. (a)**

Al will require largest size of riser because of its high liquid and solidification shrinkage.

**6. (c)**

Sand conditioning advantage: Increase in flowability of sand so that it can flow to the corner of box during ramming.

**7. (c)**

In green sand moulding there is chance of erosion in case of large casting.

**8. (c)**

Heated metal pattern for shell mouldings is made of gray cast iron. A two-piece metal pattern is created in the shape of the desired part, typically from iron or steel. Aluminum for low production volume and graphite for casting reactive materials.

**9. (a)**

Hot box moulding process is used to produce small casting in large quantities.

**10. (c)**

Objective of gating system

- (i) Molten metal has to enter into the mould cavity with optimum velocity without eroding gating elements and mould cavity.

- (ii) It should facilitate complete filling of mould cavity.
- (iii) It should be able to prevent the absorption of air or gases from the surroundings on the molten metal while flowing through it.
- (iv) Gating element should be designed in such a way that casting yield is maximum.

**11. (d)**

Properties of good pattern material:

- light weight
- easily worked, shaped and joined
- strong, hard and durable
- resistant to wear and abrasion
- low cost
- no moisture absorption and dimensionally stable.

**12. (a)**

Dry sand moulds are more susceptible to hot tears.

**13. (c)**

The main function of chaplets is to support core in the mould. Chills and padding are used for directional solidification.

If in option only chills and padding is not available as separate option, then go for option (d).

**14. (b)**

Misrun is caused when the metal is unable to fill the mould cavity completely and thus leaving unfilled cavities.

**15. (c)**

Dense structure formed due to high chilling tendency because of metallic mould.

**16. (a)**

Gagger is a piece of iron imbedded in the sand of a mould to keep the sand in place.

They are pieces of wires or rods bent at one or both ends which are used for reinforcing the downward projecting sand mass in the cope. They support hanging bodies of sand. They are always used in cope. Its surface should be rough in order to have a good grip with the moulding sand.

17. (b)

Olivine sand is used in non-ferrous casting of intricate parts.

18. (a)

The casting as obtained from the moulds are not fit for immediate use or for work in the machine shop as they carry unwanted metal attached in the form of gates and risers.

19. (b)

Metal penetration is not caused due to high pouring temperature. It is caused due to improper ramming of sand.

20. (d)

Main purpose of chaplets is to support cores although it also helps in directional solidification.

21. (a)

Scabs are rough, irregular projections on surface of castings containing embedded sand.

22. (a)

Vertical core is positioned both in cope and drag boxes usually top and bottom of the core is provided with a taper, but the amount of taper on the top is greater than that of the bottom.

23. (d)

Improper rise will have given rise to defect called shrinkage cavity.

24. (a)

Slush casting is used for thin-walled hollow castings.

25. (c)

Casting defect scabs occurs when a portion on the face of mould or core lifts and metal flows underneath in a thin layer.

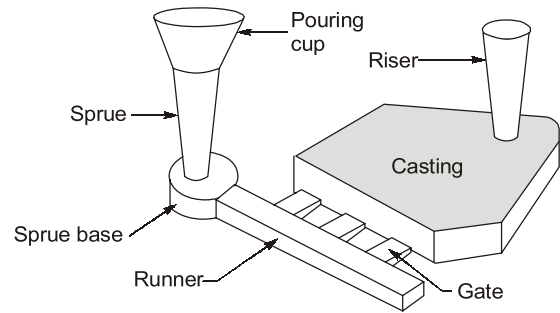
26. (b)

Cuts and washes appear as rough spots and areas of excess metal and are caused by the erosion of moulding sand by the flowing molten metal.

27. (d)

Coal dust and facing sand are added to improve surface finish.

28. (a)



**Components of gating system.**

Hence metal passes through pouring basin-sprue-runner-gate-casting-top riser.

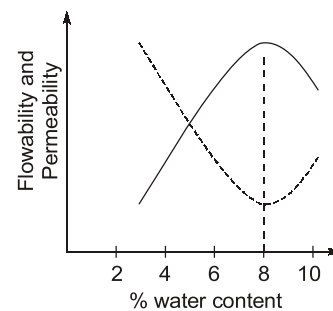
29. (a)

Proportion of raw material in blast furnace of ore, fuel and flux are  $\frac{1}{2}$ ,  $\frac{1}{3}$  and  $\frac{1}{6}$  respectively.

30. (a)

The ability of the sand mixture to collapse under force. Collapsibility is a very important property in this type of casting manufacture. Collapsibility of the mold will allow the metal casting to shrink freely during the solidification phase of the process. If the molding sand cannot collapse adequately for the casting's shrinkage, hot tearing or cracking will develop in the casting.

31. (d)



32. (a)

Centrifugal casting → pipes  
Squeeze casting → wheels of automobile  
Die casting → carburetors

33. (b)

The velocity of the flowing metal at the base of the sprue.

Velocity of flow,

$$V = \sqrt{2gh}$$

Velocity of flow,

$$V = \sqrt{2 \times 1000 \times 20} = 200 \text{ cm/s}$$

Volume flow rate,

$$\begin{aligned} Q &= A \times V \\ &= 2.5 \text{ cm}^2 \times 200 \text{ cm/s} \\ &= 500 \text{ cm}^3/\text{s} \end{aligned}$$

Time required to fill a mold cavity

$$\begin{aligned} &= \frac{\text{Volume of mold cavity}}{\text{Volume flow rate}} \\ &= \frac{1800}{500} = 3.6 \text{ s} \end{aligned}$$

**34. (d)**

Turbulent flow should be avoided for several reasons while pouring:

- It tends to accelerate the formation of metal oxides that can be entrapped during solidification.
- Turbulence also aggravates mold erosion.

**35. (b)**

**Permeability:** It is expressed as the gas flow rate through the specimen under a specified pressure difference across it.

**Strength:** It refers to compressive strength.

**Deformation:** It indicates the change in length of a standard specimen at the point of failure.

**Flowability:** It refers to the ability of the sand to flow around and over the pattern when the mould is rammed.

**Refractioness:** It measures the ability of the sand to remain solid as a function of temperature.

**37. (b)**

$$\text{Solidification time} \propto \frac{1}{(\text{Surface area})^2}$$

Shapes having highest surface area will solidify fastest.

$$V_{\text{sphere}} = 1 = \left(\frac{4}{3}\right)\pi r^3$$

$$r = \left(\frac{3}{4\pi}\right)^{1/3}$$

$$\text{and } 4\pi r^2 = 4\pi \left(\frac{3}{4\pi}\right)^{2/3} = 4.84$$

$$V_{\text{cube}} = 1 = a^3,$$

$$A_{\text{cube}} = 6a^2 = 6$$

$$V_{\text{cylinder}} = \pi r^2 h = 2\pi r^3$$

$$\text{i.e. } r = \left(\frac{1}{2\pi}\right)^{1/3}$$

$$A_{\text{cylinder}} = 2\pi r^2 + 2\pi rh = 6\pi r^2$$

$$= 6\pi \left(\frac{1}{2\pi}\right)^{2/3} = 5.54$$

$$\therefore A_{\text{cube}} > A_{\text{cylinder}} > A_{\text{sphere}}$$

**38. (a)**

For use in precision casting, expandable patterns are made of wax, tin, frozen mercury and plastics.

**39. (c)**

Zinc and aluminium are best cast by die casting, because of their low melting points and better fluidity.

**40. (a)**

Material	Shrinkage allowance (mm/m)
Invar & bismuth	Almost NIL
Grey cast iron	7 - 10
Brass	15
Steel	20
Brass	24

**41. (b)**

- Die casting mainly used for non ferrous materials and their alloy (Pb, Sn, Zn, Al, Mg, and Cu).
- In  $\text{CO}_2$  moulding, sodium silicate are used to increase strength and hardness of moulding sand.
- In shell moulding, the sand mixed with a thermosetting resin is allowed to come into contact with a heating metallic pattern plate, so that a thin and strong shell or mould is formed around the pattern.
- Product of true centrifugal casting are hollow pipes, tubes, hollow bushes etc which are axisymmetric with a concentric hole.

**42. (d)**

Casting process	Product
Shell moulding	- Rocker arms, valve plate, Cylinder heads
Investment casting	- Jewelry, Dentures, Turbine blades,
Gravity die casting	- Aluminium alloy piston