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GATE 2024

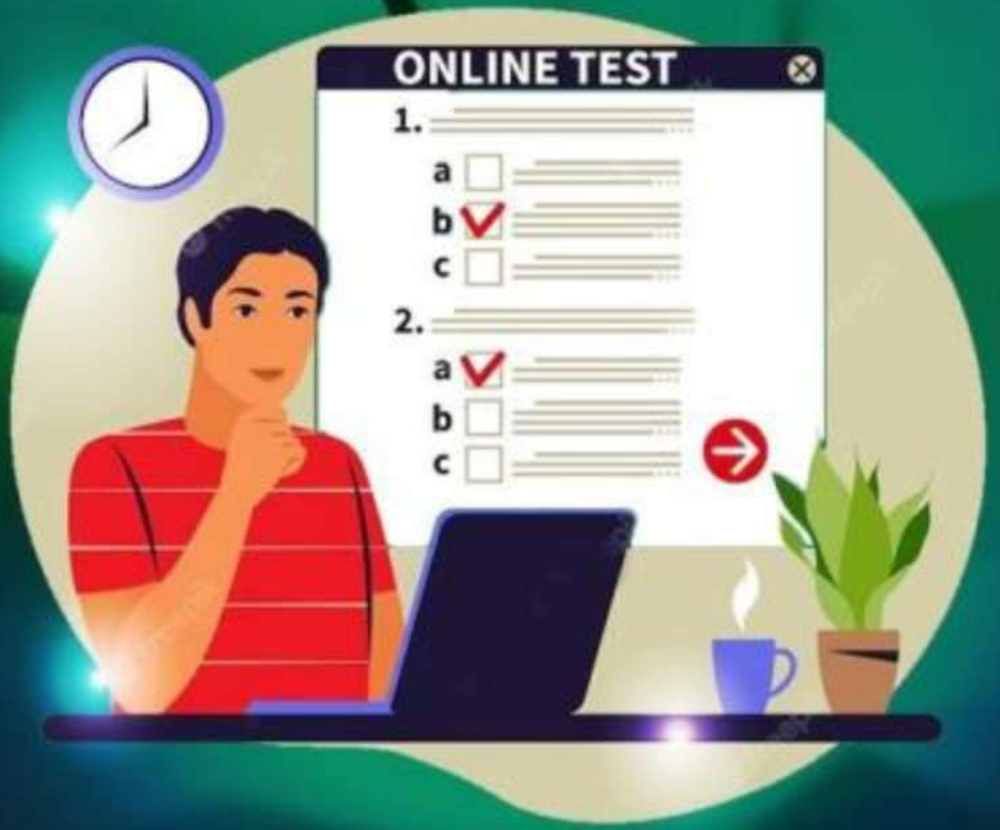
प्रचण्ड Batch

PRODUCTION

CASTING

LEC-08

Mechanical Engineering



GATE

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GATE 2024

GATE

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MECHANICAL ENGINEERING

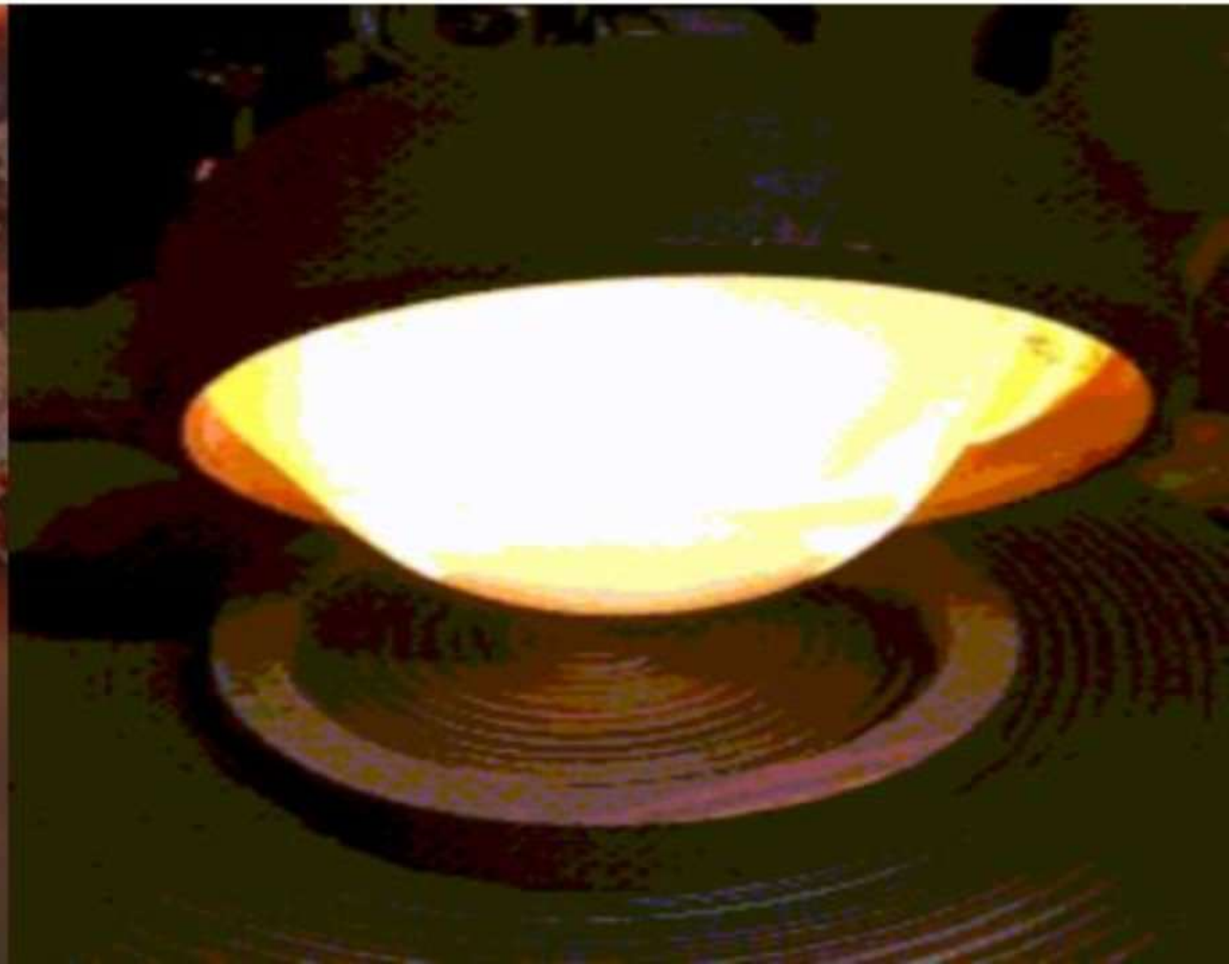
MON/ TUE/ WED- 9PM

THEORY OF MACHINE (TOM)

THUR/ FRI/ SAT- 6PM

PRODUCTION ENGINEERING

CASTING



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Introduction of Casting

Broad Steps in Sand Casting

Cooling Curve for Sand Casting

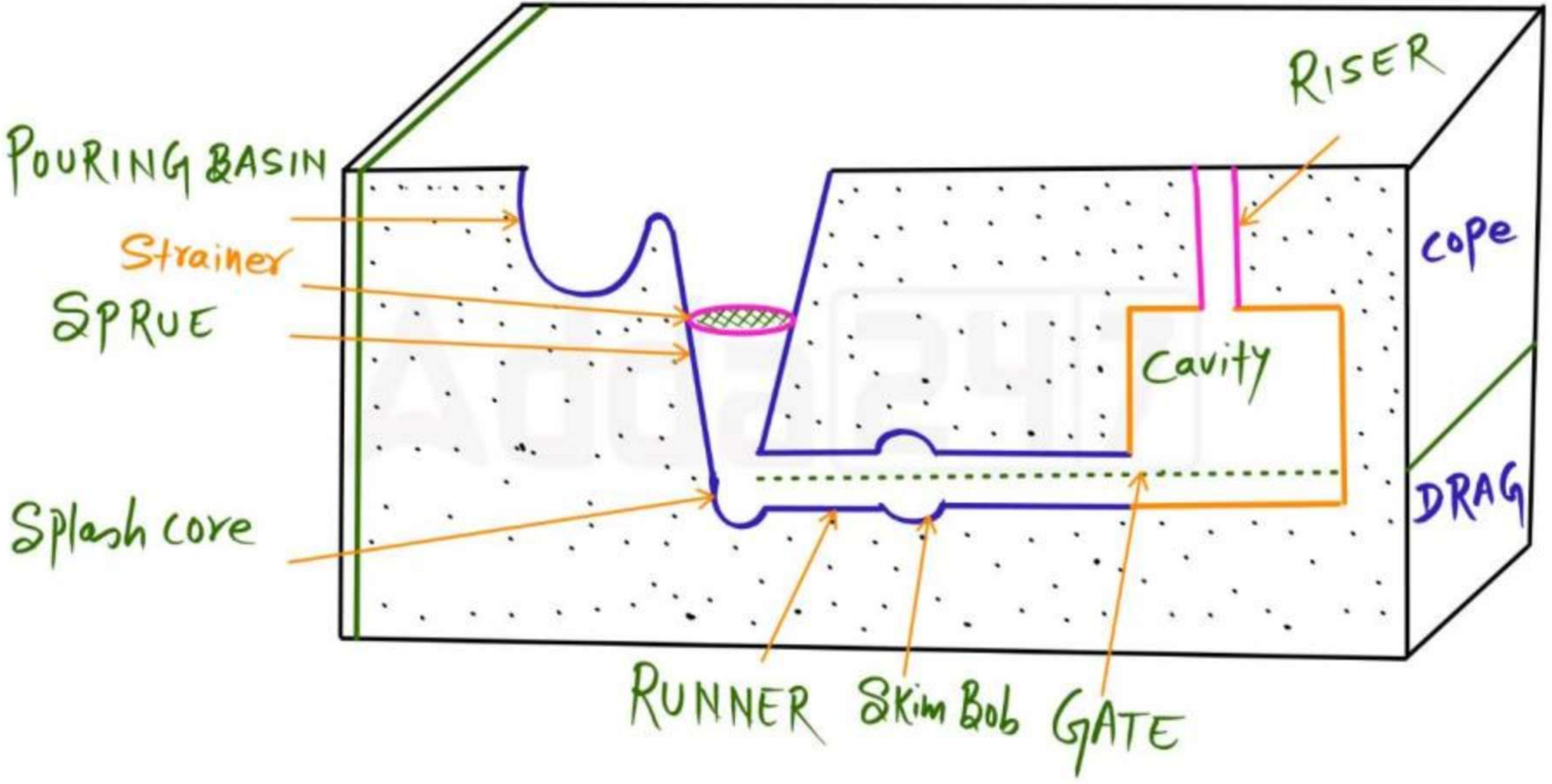
Types of allowances

Types of pattern

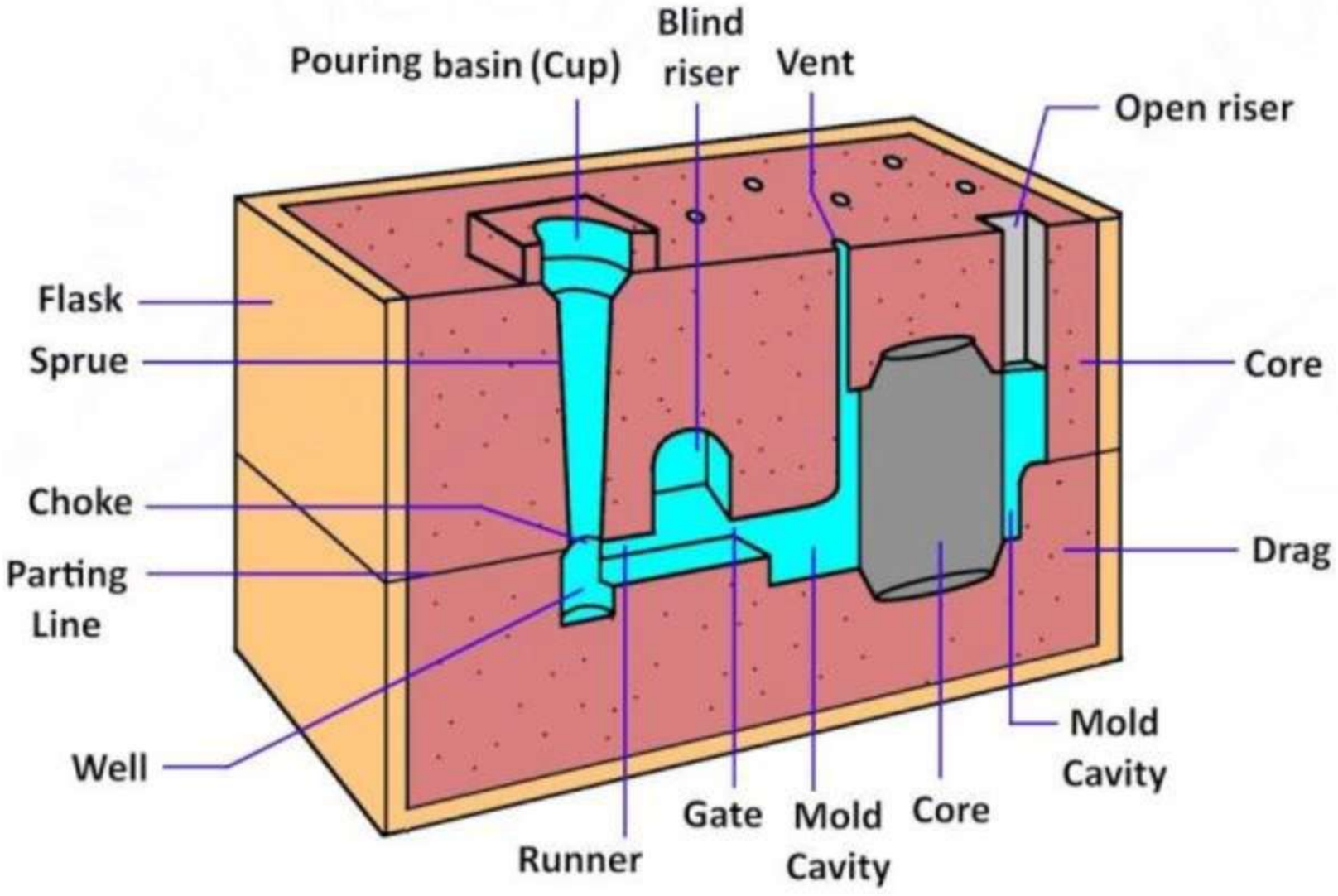
Moulding sand and its properties

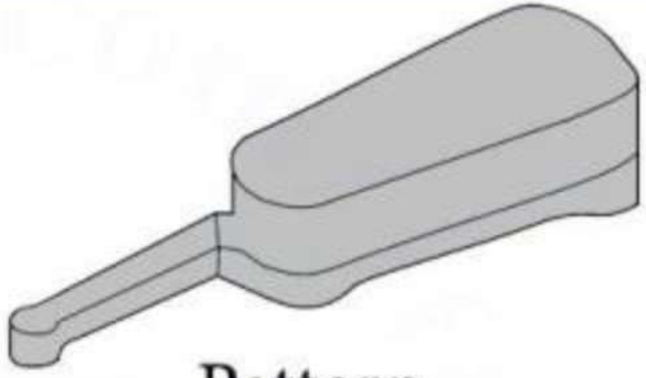
Elements of Gating Design

Riser and Riser Design

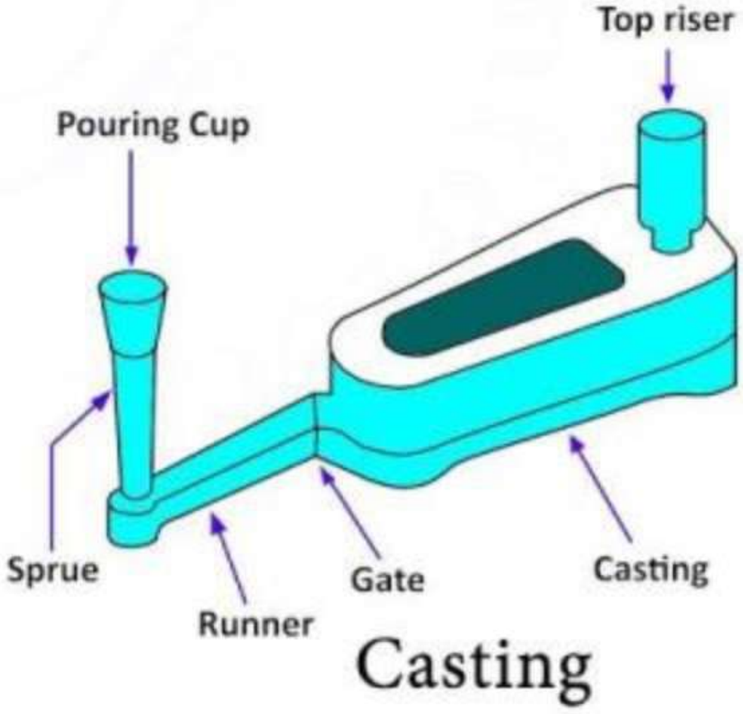


Gating System (Metal Casting Process)





Pattern



Casting

Gate

It is the actual entry point through which liquid metal can be enter into the cavity.

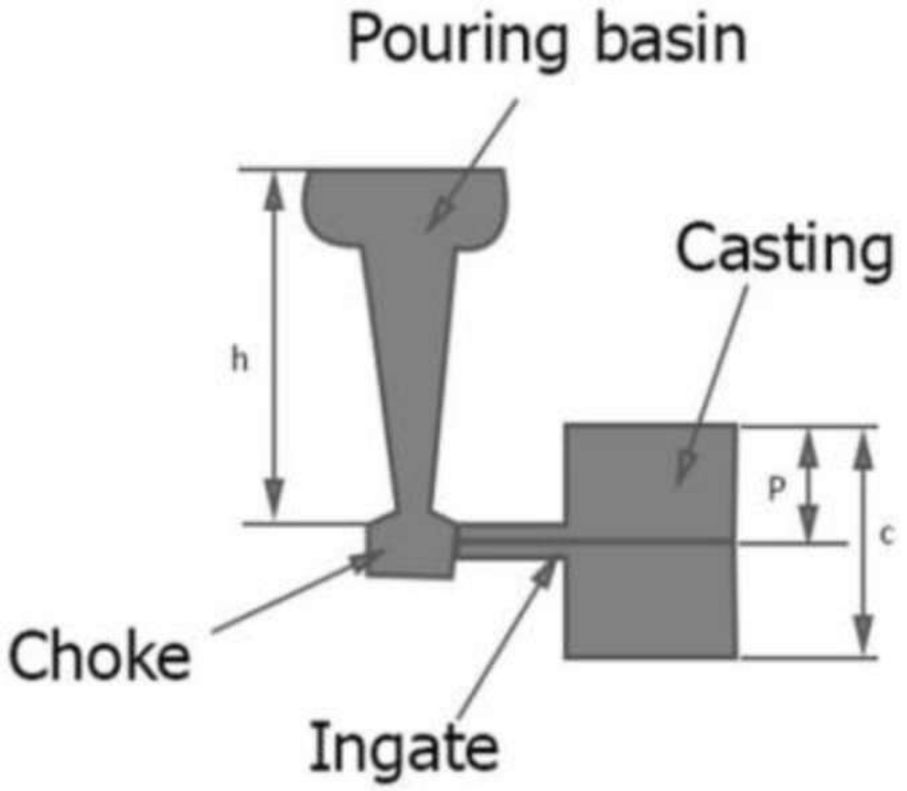
Types

1 Top gate

2 Bottom gate

3 Parting line gate

4 Step gate



Parting line gate

* Gate is Provided along the PL

⇓

Such the below the PL cavity will be filled by Top Gate

⇓

Above the PL cavity will be filled by Bottom Gate

☺ To get advantage of both Top and Bottom Gate Parting Line Gate will be used.

Parting line gating

(A) → Top Gate

(B) → Bottom Gate

* gt is most commonly used Gate.

Q

Calculate the cross-sectional area of the gate such that liquid metal can be filled into the cavity in 10 seconds

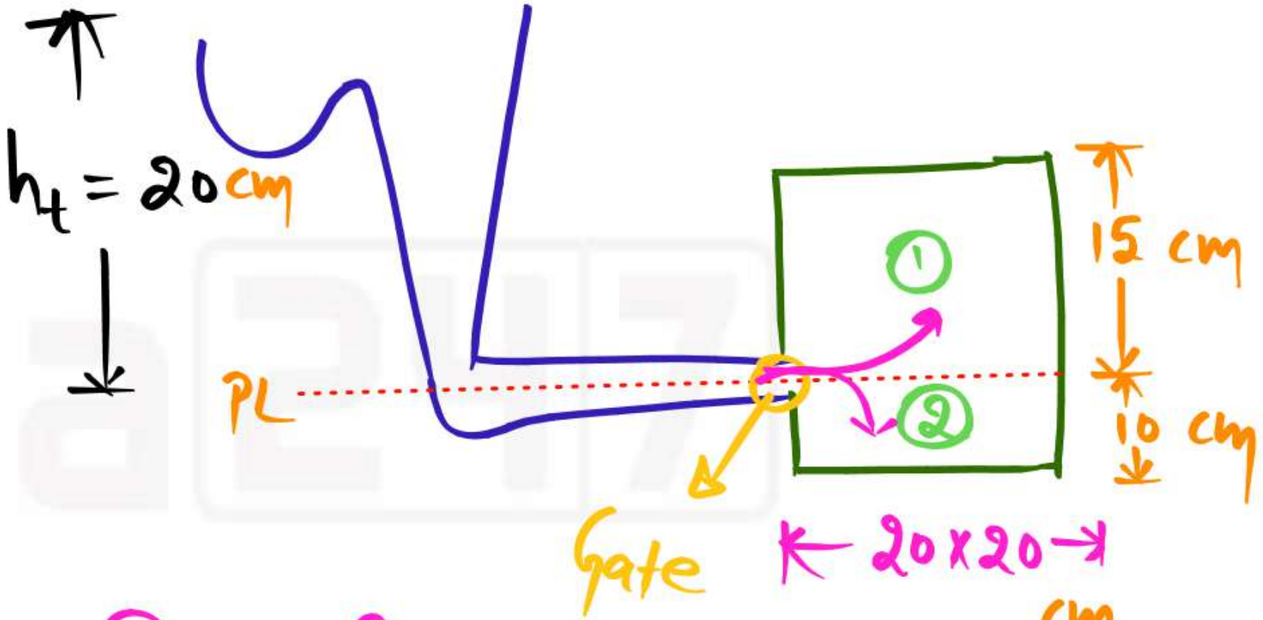
Given Data :→

* t_f = 10 Sec
* A_g = ?

Gate

↓

Parting Line Gate



① → Bottom Gate

② → Top Gate

Solution :→

$$* \quad t_f = t_{f①} + t_{f②}$$

$$* \quad t_f = \frac{2A_m}{A_g \times \sqrt{2g}}\left[\sqrt{h_t} - \sqrt{h_t - h_m}\right] + \frac{V_m}{A_g \times \sqrt{2gh_t}}$$

$$* \quad 10 = \frac{2 \times 20 \times 20}{A_g \times \sqrt{2 \times 981}}\left[\sqrt{20} - \sqrt{20-15}\right] + \frac{20 \times 20 \times 10}{A_g \times \sqrt{2 \times 981 \times 20}}$$

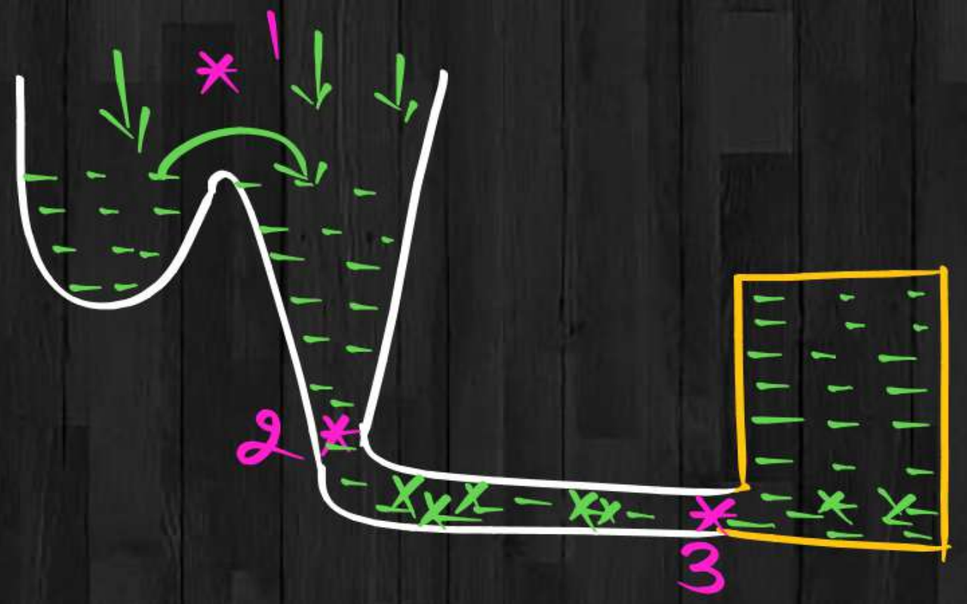
$$* \quad \boxed{A_g = 6.05\ cm^2}$$

A , B , C

$(\text{fluidity})_A = 12\,\text{cm}$ ✗

$f_B = 18\,\text{cm}$ ✓

$f_C = 10\,\text{cm}$ ✗



$1 \rightarrow 3 \Rightarrow 15\,\text{cm}$

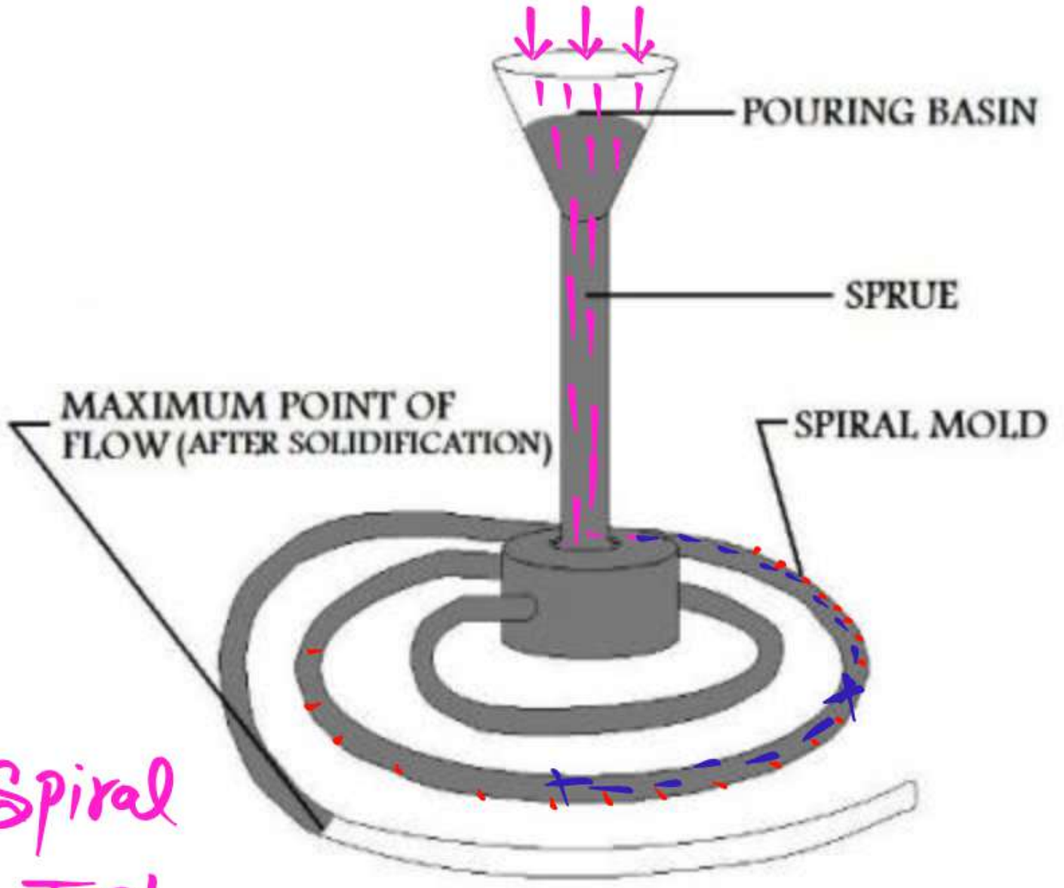
Fluidity

Ability of the liquid metal to fill into the cavity is known as fluidity.

It is the property of the liquid metal.

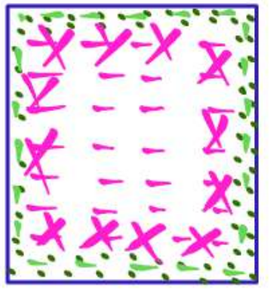
It can be determine by conducting spiral test.

Distance covered by liquid metal before solidification in a standard spiral will gives the value of fluidity.



To check fluidity of Material used ⇒ Spiral Test

Property	Fluidity
1.Pouring temperature ↑	↑
2.Viscosity ↑	↓
3.Density ↑	↓
4.Percentage of water in sand ↑	↓
5.Surface finish of cavity ↑	↑



Fluidity of Molten Liquid

⇓

More Affected by

⇓

Pouring Temperature

Choke Area

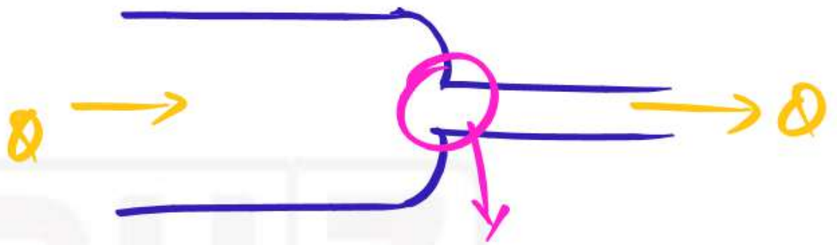
$Q = A \cdot V$

$A \downarrow \Rightarrow V \uparrow \Rightarrow P \downarrow$

It is a minimum c/s area in all the gating elements .

It will control the flow of the liquid metal which is enter into the cavity.

It is the 1st parameters to be calculated in all the gating elements.



Minimum c/s Area

Choke Area

$$* \quad C \cdot A = \frac{m}{\rho \cdot t_f \cdot C_d \cdot \sqrt{2 g h_t}}$$

* $m \rightarrow$ Mass of casting
* $\rho \rightarrow$ Density of Material
* $C_d \rightarrow$ coeff of Discharge
* $t_f \rightarrow$ filling Time Required
* $h_t \rightarrow$ Height of the liquid Metal above the Gate.

Gating Ratio

* $A_s : A_r : A_g$

Ex: → 1 : 2 : 3

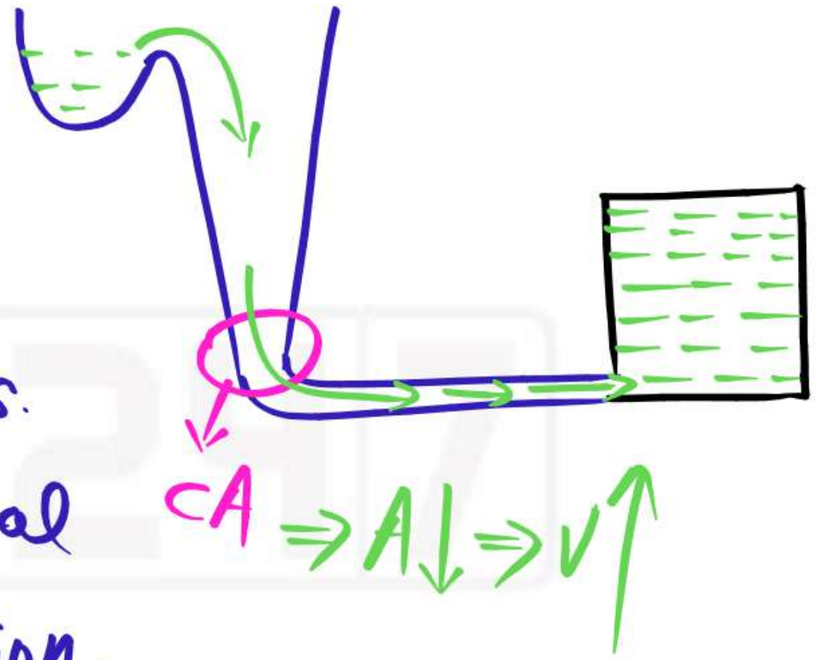
→ 3 : 2 : 0.5

* A_s → Area of Sprue
* A_r → Area of Runner
* A_g → Area of Gate

Unpressurised Gating system

OR

Non-Pressurised Gating System

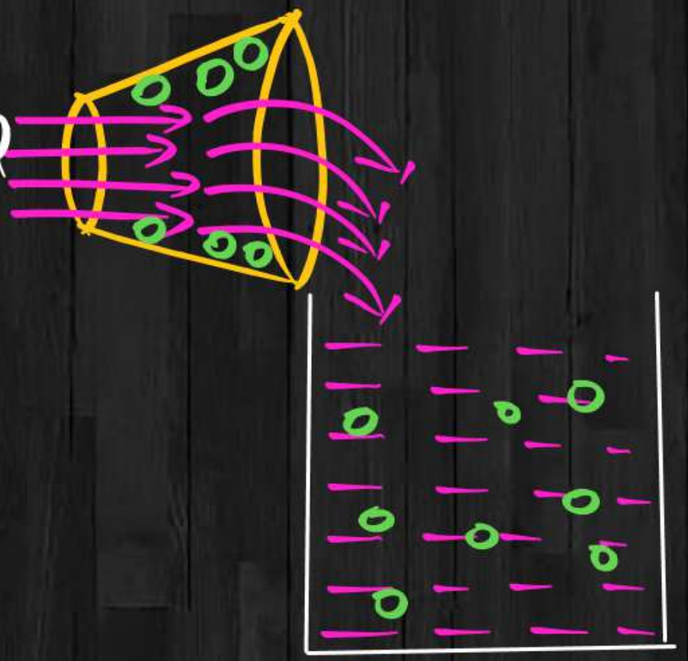


* Choke Area at Bottom of Sprue.
* Velocity of Liquid Metal at cavity is Less.
* There is No Turbulence of Liquid Metal

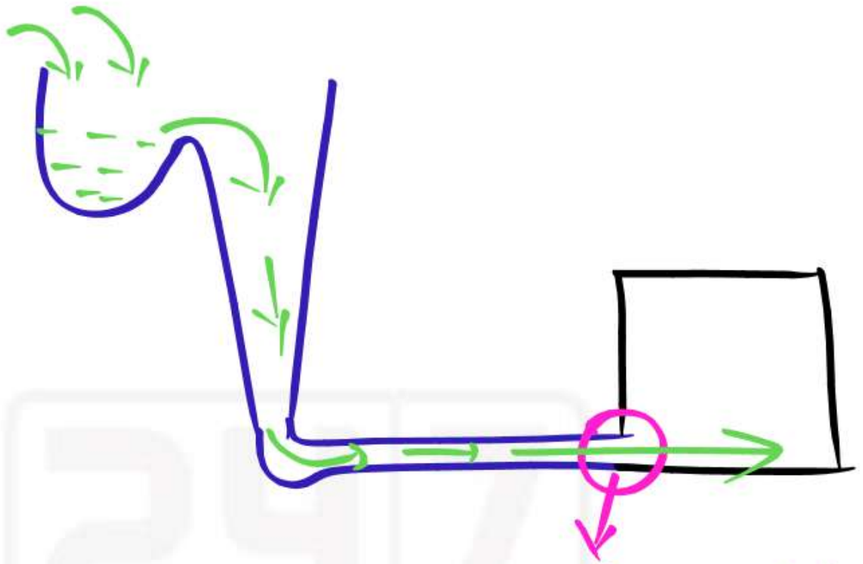
  ⇓

  No Splacing And Mould Erossion.
* There is a Possibility of Air-aspiration Effect

* It can be used for casting of Soft material like Non-ferrous material



Pressurised Gating system



* Choke Area is at Gate.

* Velocity of liquid metal in the cavity is very High Velocity

⇓

There is a possibility of Turbulence.

⇓

Possibility of More Erosion And Splashing of Molten Liquid Metal.

$CA \Rightarrow A \downarrow \Rightarrow v \uparrow$

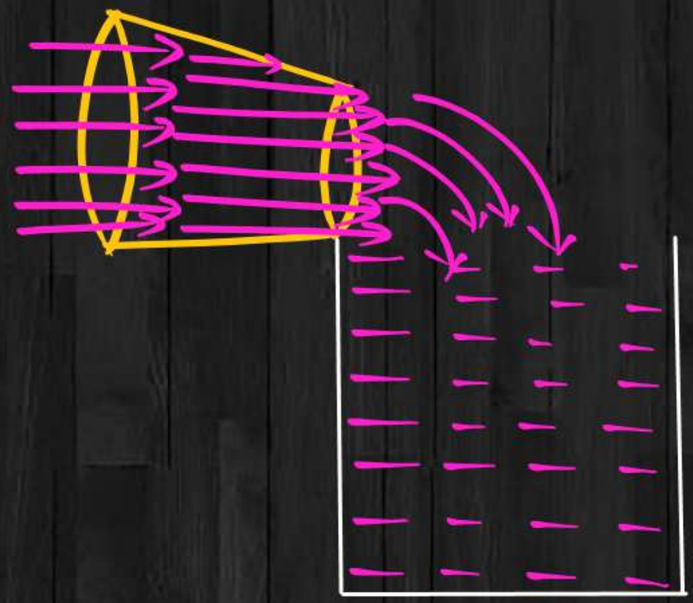
$A_g \downarrow \Rightarrow v_g \downarrow$

$C.y = \frac{V_c}{V_c + V_g} \uparrow$

* There is No Possibility of Air-aspiration Effect

* casting yield is More

* It is used for casting of Ferrous Material OR Hard Material



Q

① Ex :→ $A_s : A_r : A_g$

ⓐ * 1 : 2 : 3

ⓑ * 1 : 2 : 2

ⓒ * 0.5 : 1.5 : 1

Non-Pressurised Gating System

② Ex :→ $A_s : A_r : A_g$

ⓐ * 3 : 2 : 1

ⓑ * 2 : 2 : 1

ⓒ * 1 : 1.5 : 0.5

Pressurised Gating System

Ex :→ $A_s : A_r : A_g$

1 : 2 : 1 ⇒ Pressurised Gating System

Q)

In a gating design ratio is 3:2:1.it is used to produce a casting of mass 20kg density of the material is 2700 kg/m3,filling time
Required is 8.2 second height of the liquid metal above the gate is 200 mm, assuming Coeff of discharge as 0.98.
Calculate the dimensions of the sprue.

Given Data :→ $A_s : A_r : A_g$

* 3 : 2 : 1
* $m = 20\ kg$
* $\rho = 2700\ kg/m^3$
* $t_f = 8.2\ Sec$
* $h_t = 200\ mm = 0.200\ m$
* $C_d = 0.98$

Solution :→ $A_s : A_r : A_g$

* 3 : 2 : 1

* $cA = A_g$
* $A_s = 3A_g$
* $A_r = 2A_g$

* $cA = \dfrac{m}{\rho \cdot t_f \cdot c_d \cdot \sqrt{2gh_t}}$
* $cA = \dfrac{20}{2700 \times 8.2 \times 0.98 \times \sqrt{2 \times 9.81 \times 0.200}}$
* $cA = 4.65 \times 10^{-4}\ m^2 \Rightarrow 4.65\ cm$
* $A_g \Rightarrow c.A \Rightarrow 4.65\ cm$
* $\frac{\pi}{4} d_g^2 = 4.65$
* $d_g = 2.43\ cm$

* $A_s = 3 \times A_g = 3 \times 4.65$

* $A_s = 13.95\ cm^2$

* $\frac{\pi}{4} d_s^2 = 13.95$

* $d_s = 4.21\ cm$

* $A_r = 2 \cdot A_g = 2 \times 4.65$

* $A_r = 9.30\ cm^2$

* $\frac{\pi}{4} d_r^2 = 9.30$

* $d_r = 3.44\ cm$

Ex:→

As : Ar : Ag

1 : 2 : 3

* cA = As

* Ar = 2As

* Ag = 3As

Solidification Time

A molten drop of liquid metal which is in spherical form with 3mm radius will solidify in 10 second .what is the solidification time of same molten drop with double the radius.

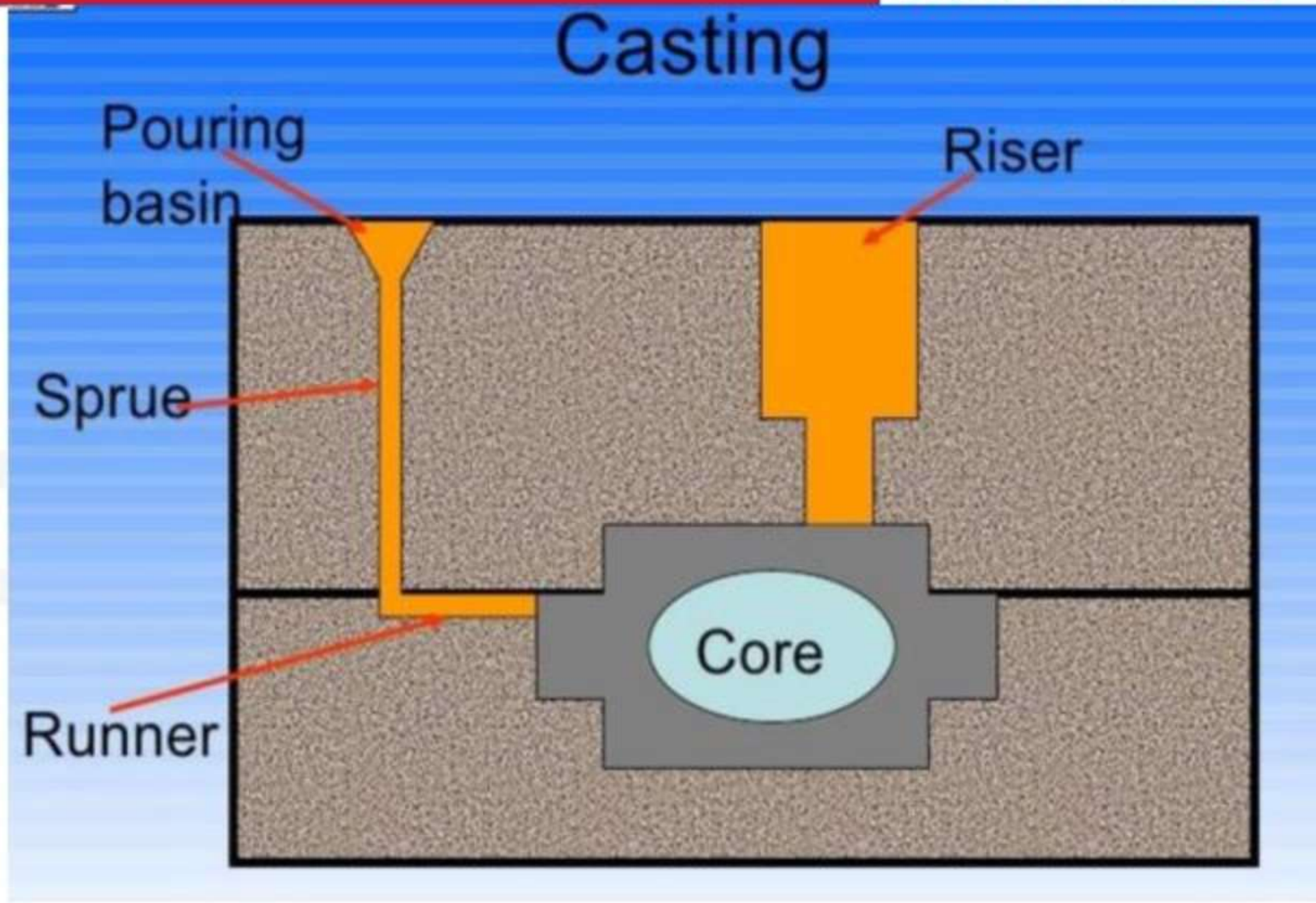
Two casting one is cube another is a sphere both are made up of same material and having the same volume .what is the ratio
Of solidification time of cube to the sphere.

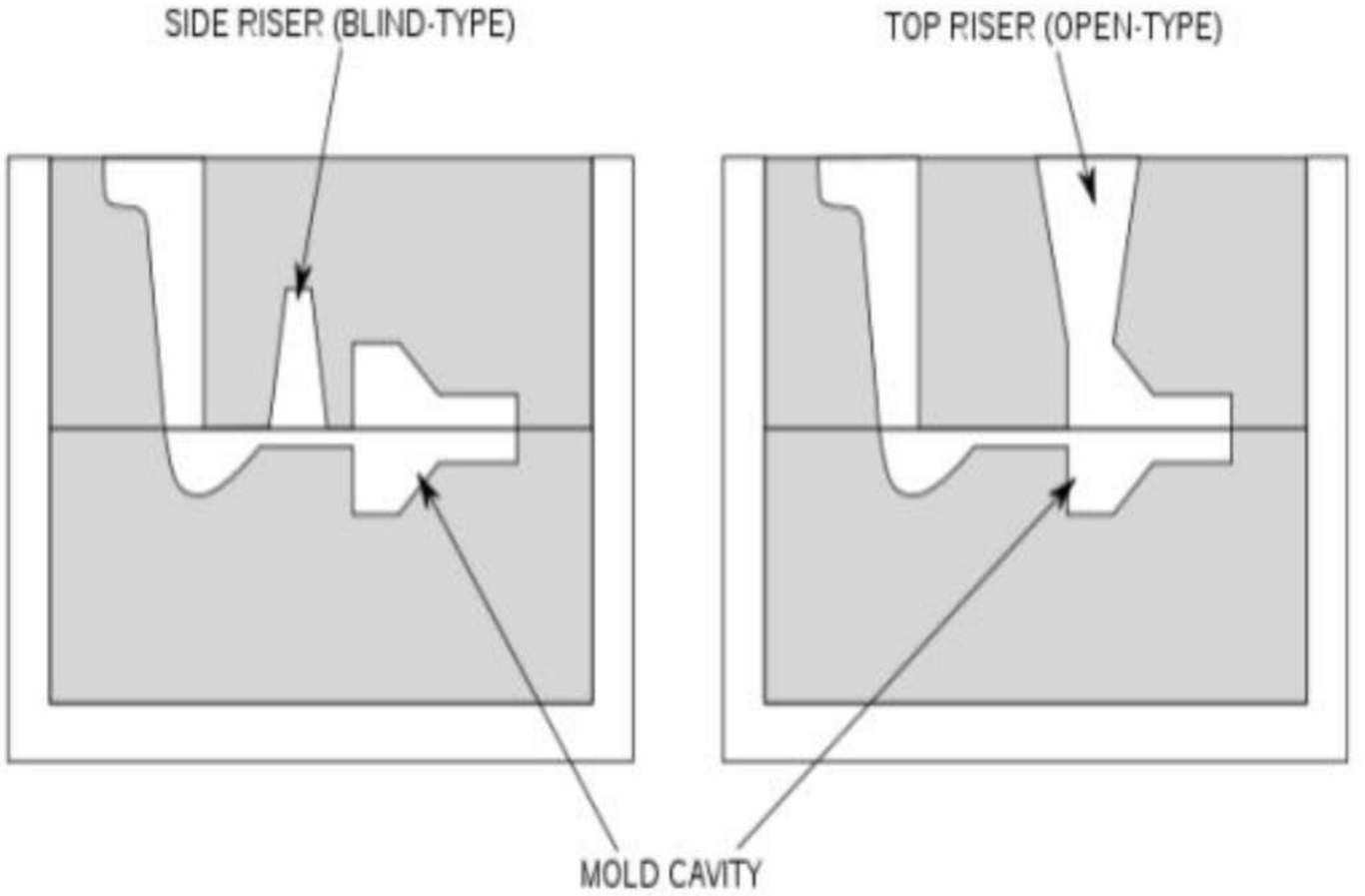
A cube casting will solidify in 5 minutes another cube casting with same material is 8 times heavier than original casting .

What is the solidification time of second cubical casting.

Riser

Function of Riser





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