Adda247

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"There is nothing impossible to they who will try."

ISRO | BHEL | DRDO & OTHER PSUs

GATE

PRODUCTION

TOOL LIFE

MOST EXPECTED QUESTIONS

Live@ 11:30Am

PART-1

Gaurav sir


GATE-2023
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AIR 403 EC MOHAN KUMAR SINGH
AIR 567 EE SHANKAR JHA
AIR 571 ME VIJENDER MEENA

YouTube Classes Schedule

MECHANICAL ENGINEERING

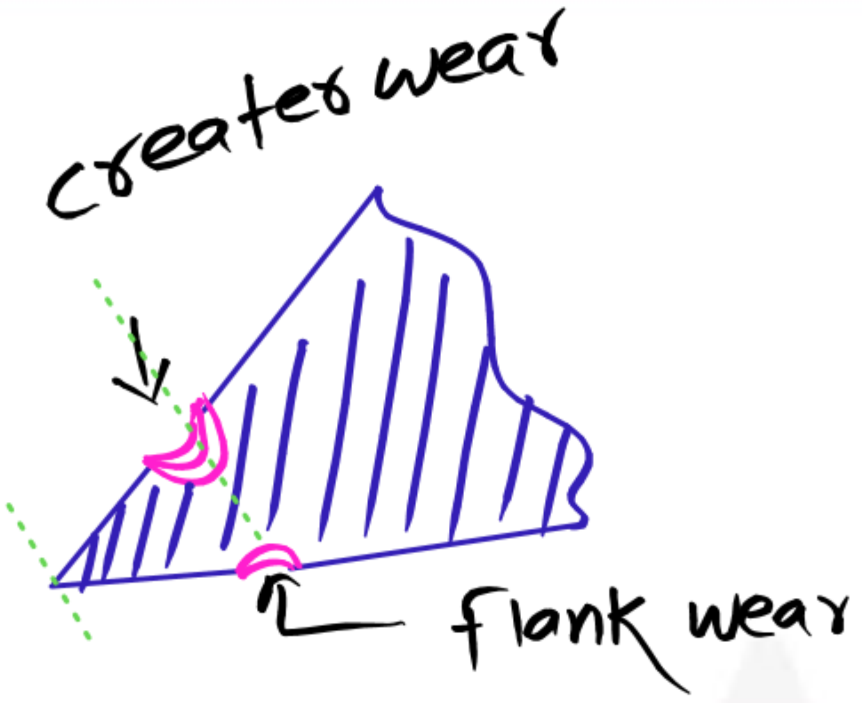
EXAM TARGET	SUBJECT	TIME	FACULTY
ALL PSUs	ENGINEERING MATHS	10:00 AM	ANANT SIR
ALL PSUs	PRODUCTION	11:30 PM	GAURAV SIR
ALL PSUs	THERMODYNAMICS	3:00 PM	KANISTH SIR
GATE 2024-25	HMT	4:30 PM	YOGESH SIR
GATE 2024-25	SOM	9:00 PM	MUKESH SIR

FREE APP CLASS SCHEDULE

MECHANICAL ENGINEERING

GATE

HMT	MONDAY Live @11AM	YOGESH SIR
PRODUCTION	TUESDAY Live @11AM	GAURAV SIR
SOM	WEDNESDAY Live @8PM	MUKESH SIR
THERMODYNAMICS	THURSDAY Live @11AM	KANISTH SIR
ENGINEERING MATHEMATICS	FRIDAY Live @11AM	ANANT SIR



Flank wear occurs mainly on which of the following?

(a) Nose part and top face

(b) Cutting edge only

(c) Nose part, front relief face, and side relief face of the cutting tool

(d) Face of the cutting tool at a short distance from the cutting edge

The fatigue failure of a tool is due to

(a) abrasive friction, cutting fluid and chip breakage

(b) Variable thermal stresses, chip breakage and variable dimensions of cut

(c) Abrasive friction, chip breakage and variable dimensions of cut

(d) Chip breakage, variable thermal stresses and cutting fluid

Why does crater wear start at some distance from the tool tip?

(a) Tool strength is minimum at that region

(b) Cutting fluid cannot penetrate that region

(c) Tool temperature is maximum in that region

(d) Stress on rake face is maximum at that region

Crater wear is predominant in

(a) Carbon steel tools

(b) Tungsten carbide tools

(c) High speed steel tools

(d) Ceramic tools

Consider the following actions:

1. Mechanical abrasion
2. Diffusion
3. Plastic deformation
4. Oxidation

Which of the above are the causes of tool wear?

(a) 2 and 3 (b) 1 and 2

(c) 1, 2 and 4 (d) 1 and 3

Which of the following statements are be correct for temperature rise in metal cutting operation?

1. It adversely affects the properties of tool material
2. It provides better accuracy during machining
3. It causes dimensional changes in the work-piece and affects the accuracy of machining
4. It can distort the accuracy of machine tool itself.

(a) 1 and 2 (b) 2 and 3

(c) 3 and 4 only (d) 1, 3 and 4

Tool life is generally specified by

(a) Number of pieces machined

(b) Volume of metal removed

(c) Actual cutting time

(d) Any of the above

In Taylor's tool life equation $VT^n = C$, the constants n and C depend upon

1. Work piece material
2. Tool material
3. Coolant

(a) 1, 2, and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

$VT^n = c$

* V → m/min
* T → min
* n → Exponent —depends→ Tool Material
* c → constant —depend→ Tool Material, w/p, cutting condition

Given Data :→

* $D = 50mm$
* $N_1 = 284$ Rpm
* $T_1 = 10$ mint
* $N_2 = 232$ rpm
* $T_2 = 60$ min
* $n = ?$

A 50 mm diameter steel rod was turned at 284 rpm and tool failure occurred in 10 minutes. The speed was changed to 232 rpm and the tool failed in 60 minutes. Assuming straight line relationship between cutting speed and tool life, the value of Taylorian Exponent is

(a) 0.21 (b) 0.13 (c) 0.11 ✓ (d) 0.23

Solution :→ * $VT^n = C$

(09)

* $VT^n = C$

* $V_1 T_1^n = V_2 T_2^n$

* $\frac{\pi \times 50 \times 284}{1000} \times (10)^n = \frac{\pi \times 50 \times 232}{1000} \times (60)^n$

* $n = 0.1128$

* $V \rightarrow m/min$

* $T = min$

* $V_1 = \frac{\pi D N}{1000}$ m/min

* $V_1 = \frac{\pi \times 50 \times 284}{1000}$ m/min

* $V_2 = \frac{\pi \times 50 \times 232}{1000}$ m/min

In a single-point turning operation of steel with a cemented carbide tool, Taylor's tool life exponent is 0.25. If the cutting speed is halved, the tool life will increase by

(a) Two times (b) Four times

(c) Eight times (d) Sixteen times

Given Data:→

* $n = 0.25$
* $V_2 = \frac{V}{2}$
* $T_2 = ?$

Solution:→

* $VT^n = c$
* $VT_1^n = V_2 T_2^n$
* $VT_1^{0.25} = \left(\frac{V}{2}\right) T_2^{0.25}$
* $T_2^{0.25} = 2T_1^{0.25}$
* $T_2 = (2)^{1/0.25} T_1 \Rightarrow (2)^4 \cdot T_1$
* $T_2 = 16T_1$

Given Data :→

* $V_2 = \frac{V}{2}$
* $n = 0.50$
* $c = 400$
* % Tool life = ?

Solution :→

$$\% \text{ change} = \left(\frac{T_2 - T_1}{T_1}\right) = \left(\frac{4T_1 - T_1}{T_1}\right) \times 100$$

$$= 300\% \uparrow$$

Using the Taylor equation $VT^n = c$, calculate the percentage increase in tool life when the cutting speed is reduced by 50% ($n = 0.5$ and $c = 400$)

(a) 300% (b) 400%

(c) 100% (d) 50%

$VT^n = C$

* $V_1 T_1^n = V_2 T_2^n$
* $V T_1^{0.50} = \left(\frac{V}{2}\right) T_2^{0.50}$
* $T_1^{0.50} = \left(\frac{1}{2}\right) T_2^{0.50}$
* $T_2^{0.50} = 2 \cdot T_1^{0.50}$
* $T_2 = (2)^{\frac{1}{0.50}} \cdot T_1$
* $T_2 = (2)^2 \cdot T_1$
* $T_2 = 4 \cdot T_1$

Given data :→

* $n = 0.5$
* $T_1 = 180$ min
* $V_1 = 18$ m/min
* $T_2 = 45$ min
* $V_2 = ?$

In the Taylor's tool life equation, $VT^n = C$, the value of $n = 0.5$. The tool has a life of 180 minutes at a cutting speed of 18 m/min. If the tool life is reduced to 45 minutes, then the cutting speed will be

(a) 9 m/min ✗ (b) ✗ 18 m/min

(c) 36 m/min ✓ (d) 72 m/min

Solution :→

* $VT^n = c$

* $V_1 T_1^n = V_2 T_2^n$

* $18 \times (180)^{0.5} = V_2 \times (45)^{0.5}$

* $V_2 = \frac{18 \times (180)^{0.5}}{(45)^{0.50}} = 18 \times (4)^{0.50} = 18 \times (4)^{\frac{1}{2}} = 18 \times 2 = 36$

* $V_2 = 36\ m/min$

Given Data :→

* $v_1 = 60$
* $T_1 = 81$
* $v_2 = 90$
* $T_2 = 36$

① $n = ?$

$K = C = ?$

In a machining experiment, tool life was found to vary with the cutting speed in the following manner:

Cutting speed (m/min)	Tool life (minutes)
60 = v_1	81 = T_1
90 = v_2	36 = T_2

Q. The exponent (n) and constant (k) of the Taylor's tool life equation are

(a) n = 0.5 and k = 540 ✓ (b) n= 1 and k=4860

(c) n = -1 and k = 0.74 (d) n-0.5 and k=1.15

Q. What is the percentage increase in tool life when the cutting speed is halved?

(a) 50% (b) 200%

(c) 300% ✓ (d) 400%

Solution :→

* $VT^n = C$

* $V_1 T_1^n = V_2 T_2^n = C$

* $60 \times (81)^n = 90 \times (36)^n$

* $\left(\frac{81}{36}\right)^n = \frac{90}{60}$

* $\left(\frac{9}{6}\right)^{2n} = \left(\frac{9}{6}\right)^1$

* $2n = 1$

* $n = \frac{1}{2}$

* $C = V_1 T_1^n$

* $C = 60 \times (81)^{1/2} = 60 \times 9$

* $C = 540$

(2)

$$\% \text{ change} = \left(\frac{T_2 - T_1}{T_1}\right) \times 100$$

$$= \left(\frac{4T_1 - T_1}{T_1}\right) \times 100$$

$$= 300\% \uparrow$$

* $v_1 = 60$ m/min
* $v_2 = 30$ m/min
* $n = 0.5$

* $v_1 T_1^n = v_2 T_2^n$
* $60 \times (T_1)^{0.5} = 30 \times (T_2)^{0.5}$
* $\left(\frac{T_1}{T_2}\right)^{\frac{1}{2}} = \frac{30}{60} = \frac{1}{2}$
* $\frac{T_1}{T_2} = \frac{1}{4} \Rightarrow T_2 = 4T_1$

What is approximate percentage change is the life, t, of a tool with zero rake angle used in orthogonal cutting when its clearance angle, α, is changed from 10° to 7°?

(Hint: Flank wear rate is proportional to cot α)

(a) 30 % increase (b) 30%, decrease

(c) 70% increase (d) 70% decrease

Tool life Affected

* v > f > doc

* $VT^n = C$

What is the correct sequence of the following parameters in order of their maximum to minimum influence on tool life?

1. Feed rate
2. Depth of cut
3. Cutting speed

Select the correct answer using the codes given below

(a) 1, 2, 3 (b) 3, 2, 1 (c) 2, 3, 1 (d) 3, 1, 2 ✓

* v > f > doc

Consider the following elements:

1. Nose radius
2. Cutting speed
3. Depth of cut
4. Feed

The correct sequence of these elements in DECREASING order of their influence on tool life is

(a) 2, 4, 3, 1
(b) 4, 2, 3, 1
(c) 2,4, 1, 3
(d) 4, 2, I, 3

09

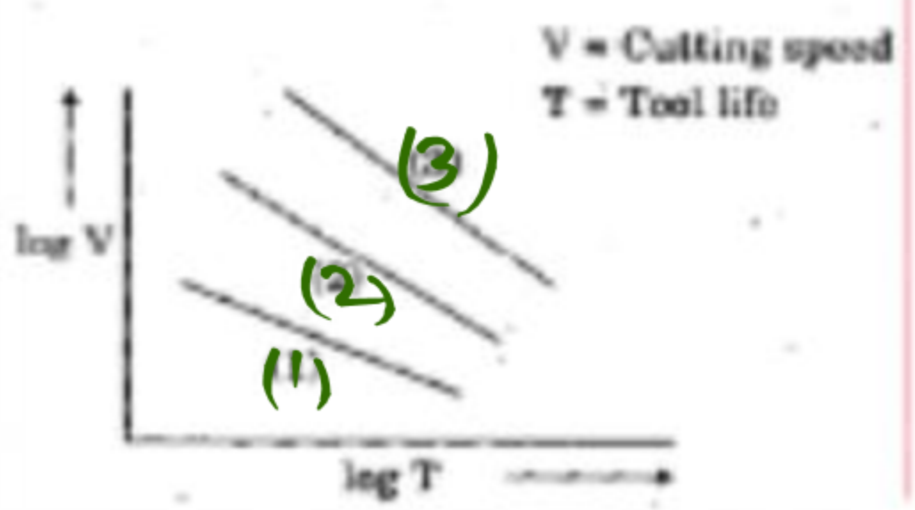
$VT^n = C$

* n → Tool Materials

Tool Material — n

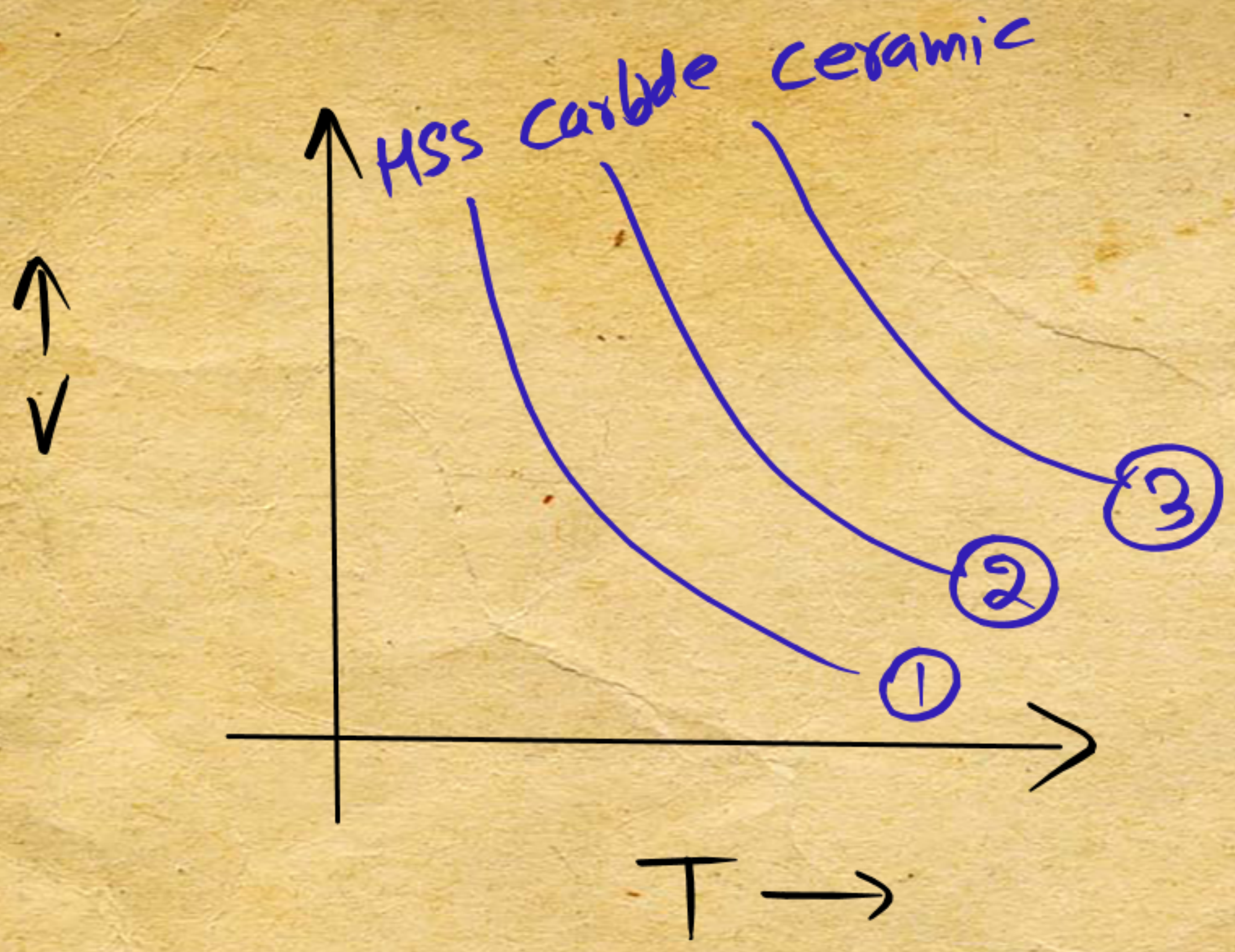
* HCS → 0.08 − 0.1
* HSS → 0.1 − 0.2
* Carbide → 0.2 − 0.4
* Ceramic → 0.4 − 0.6
* Diamond/CBN 0.7 − 0.9

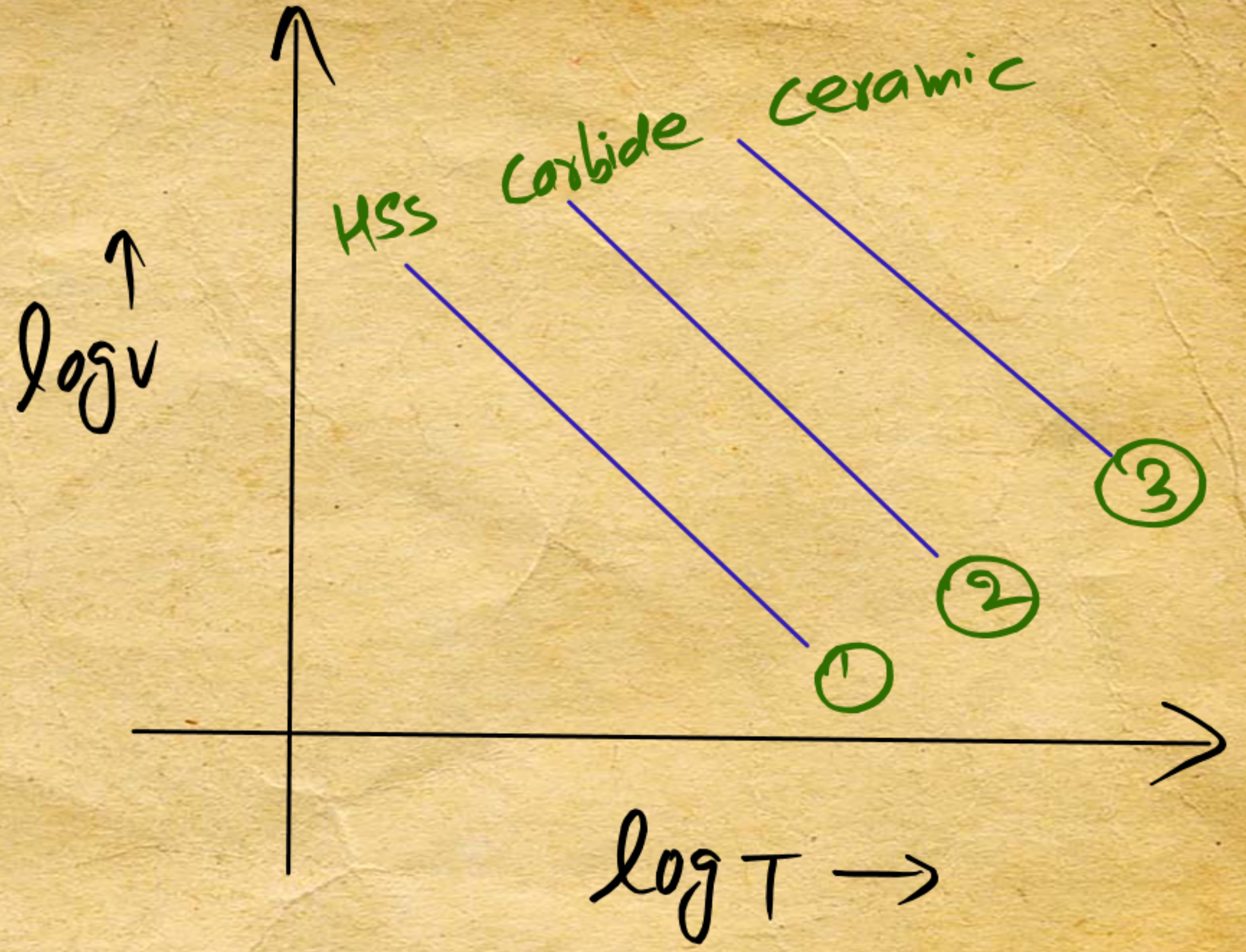
The above figure shows a typical relationship between tool life and cutting speed for different materials. Match the graphs for HSS, Carbide and Ceramic tool materials and select the correct answer using the code given below the lists:



Code:	HSS	Carbide	Ceramic
(a) ✓	1	2	3
(b)	3	2	1
(c)	1	3	2
(d)	3	1	2

* HSS → 0.1 − 0.2
* Carbide → 0.2 − 0.4
* Ceramic → 0.4 − 0.6


HSS
Carbide
ceramic
V
T
1
2
3


HSS
Carbide
ceramic
log V
log T
1
2
3

* $VT^n = c$

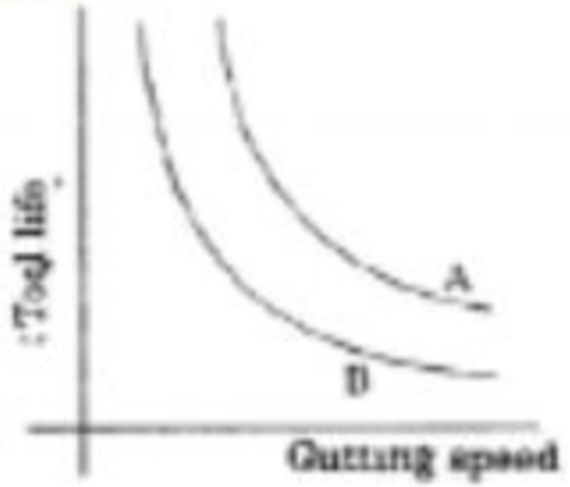
The tool life curves for two tools A and B are shown in the figure and they follow the tool life equation $VT^n = C$. Consider the following statements:

1. Value of n for both the tools is same.
2. Value of C for both the tools is same.
3. Value of C for tool A will be greater than that for the tool B.
4. Value of C for tool B will be greater than that for the tool A.

Which of these statements is/are correct?

(a) 1 and 3 (b) 1 and 4

(c) 2 only (d) 4 only



If the Taylor's tool life exponent n is 0.2, and the tool changing time is 1.5 min, then the tool life (in min) for maximum production rate is ....

(99) $V_0 T_0^n = c$

* V_0 → optimum cutting speed
* T_0 → optimum Tool life

Optimum
⇓
① Min cost criteria (T_0)
② Max Production Rate (T_0)

The optimum cutting speed is one which should have:

1. High metal removal rate
2. High cutting tool life
3. Balance the metal removal rate and cutting tool life

(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 3 only

Consider the following approaches normally applied for the economic analysis of machining:

1. Maximum production rate
2. Maximum profit criterion
3. Minimum cost criterion

The correct sequence in ascending order of optimum cutting speed obtained by these approaches is

(a) 1, 2, 3 (b) 1, 3, 2

(c) 3, 2, 1 (d) 3, 1, 2

The magnitude of the cutting speed for maximum profit rate must be

(a) In between the speeds for minimum cost and maximum production rate

(b) Higher than the speed for maximum production rate

(c) Below the speed for minimum cost

(d) Equal to the speed for minimum cost

In economics of machining, which one of the following costs remains constant?

(a) Machining cost per piece

(b) Tool changing cost per piece

(c) Tool handling cost per piece

(d) Tool cost per piece

The usual method of defining machinability of a material is by an index based on

(a) Hardness of work material

(b) Production rate of machined parts

(c) Surface finish of machined surfaces

(d) Tool life

Tool life is generally better when

(a) Grain size of the metal is large ✓

(b) Grain size of the metal is small → Hard w/p

(c) Hard constituents are present in the microstructure of the tool material ✗

(d) None of the above ✗

w/p

* Hard w/p → Tool life ↓
* Soft w/p → Tool life ↑
* Soft Material → Large Grain

Machinibility

⇓

Ease of doing Machining

Consider the following:

1. Tool life
2. Cutting forces
3. Surface finish

Which of the above is/are the machinability criterion/criteria?

(a) 1, 2 and 3 ✓ (b) 1 and 3 only

(c) 2 and 3 only (d) 2 only

Machinability depends on

(a) Microstructure, physical and mechanical properties and composition of workpiece material.

(b) Cutting forces

(c) Type of chip

(d) Tool life

The elements which, added to steel, help in chip formation during machining are

(a) Sulphur, lead and phosphorous

(b) Sulphur, lead and cobalt

(c) Aluminium, lead and copper

(d) Aluminium, titanium and copper

99

* Surface finish ↑ ⇒ Machinability ↑

Consider the following criteria in evaluating machinability:

1. Surface finish
2. Type of chips
3. Tool life
4. Power consumption

In modern high speed CNC machining with coated carbide tools, the correct sequence of these criteria in DECREASING order of their importance is

(a) 1, 2, 4, 3 (b) 2, 1, 4, 3

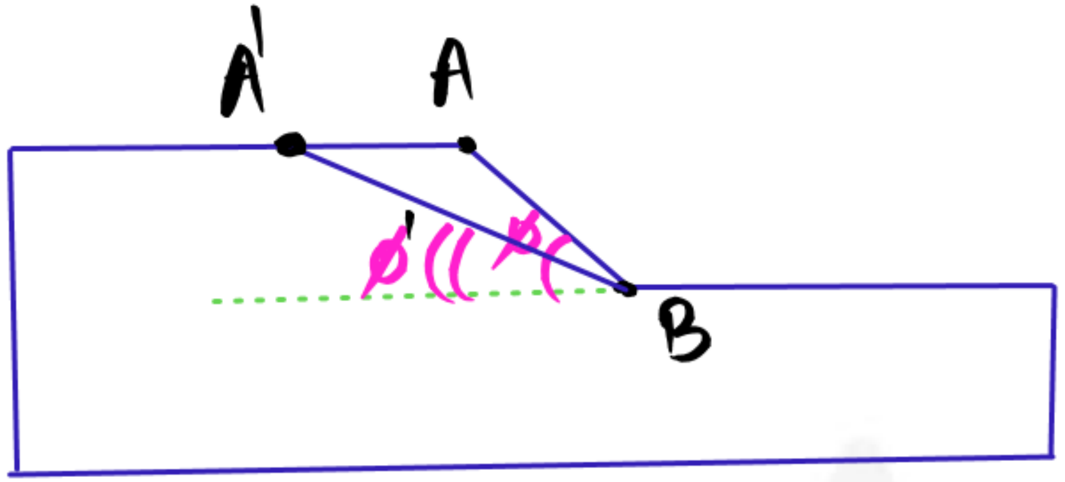
(c) 1, 2, 3, 4 (d) 2, 1, 3, 4

Which of the following indicate better machinability?

1. Smaller shear angle → Machinibility ↓ ✗
2. Higher cutting forces ✗
3. Longer tool life ✓
4. Better surface finish. ✓

(a) 1 and 3 (b) 2 and 4

(c) 1 and 2 (d) 3 and 4



* $\phi > \phi'$

* $(A_s)_{AB} < (A_s)_{A'B}$

* $(F_s)_{AB} < (F_s)_{A'B}$

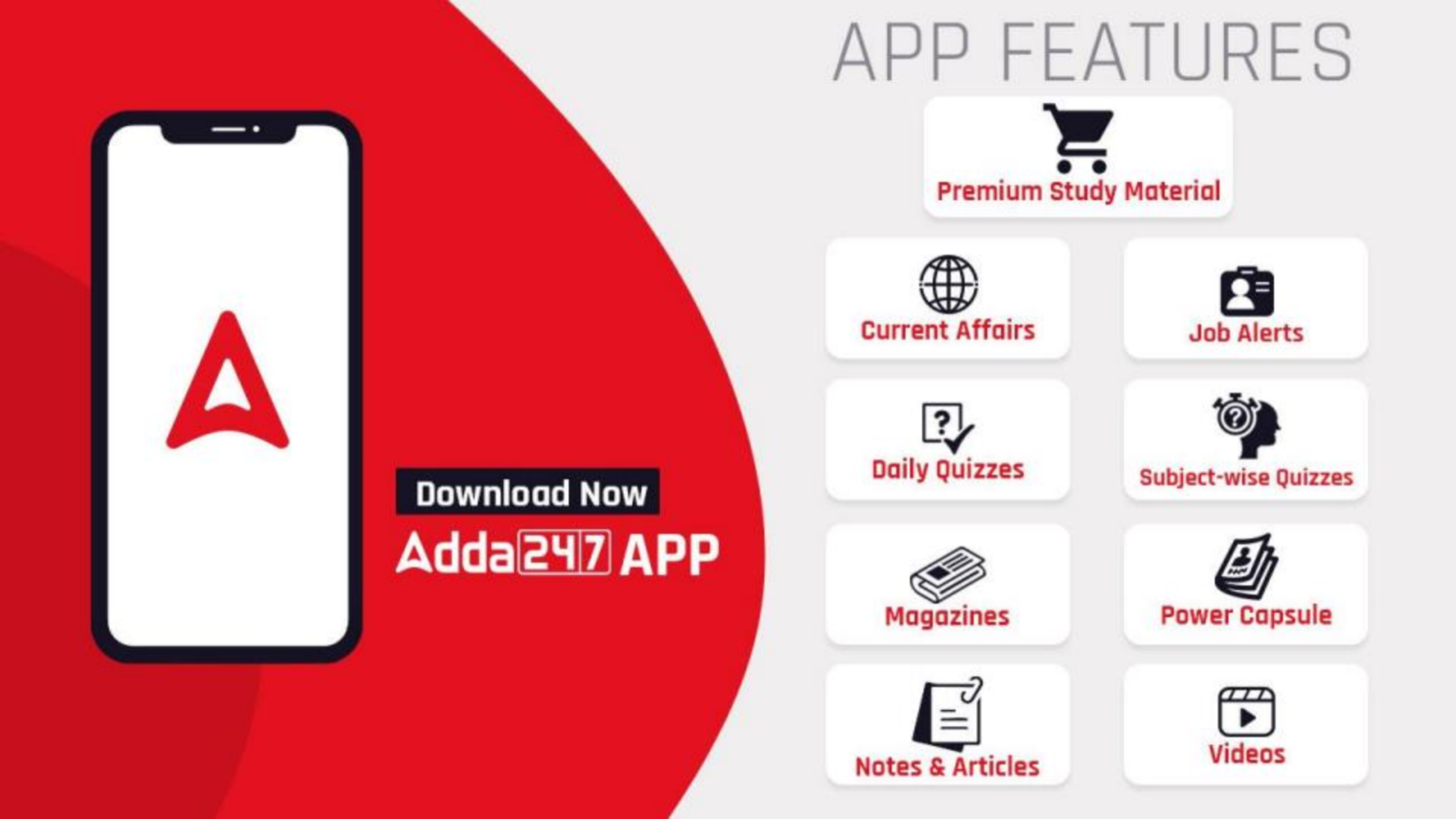
$\tau_s \times A_s = F_s$

* $\phi \uparrow \Rightarrow A_s \downarrow \Rightarrow F_s \downarrow \Rightarrow$ Machinibility ↑

In low carbon steels, presence of small quantities sulphur improves

(a) Weldability (b) Formability

(c) Machinability (d) Hardenability



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