Fayoum University
Faculty of Engineering
Industrial Engineering Department

جـــامعة الفـــيوم
Fayoum University

Term Exam 1st year
Machining Processes (
Jan. 2010, Time: 3 Hrs

عمليات تشغيل المعادن (١) السنة الأولى – قسم الهندسة الصناعية

Answer the Following Questions

Question No. (1) **(14 Points)**

3 a) Explain with drawing the main elements of the cutting tool turning, its angles and the function of each angle?

3 b) The failure of cutting tool can be classified into two categori Explain?

3 c) Define the cutting motion and feed motion, and show by drawing t cutting motion and the feed motion in turning, shaping and drilli processes.

3 d) What is the difference between shaping and planning? Give sket for basic geometry of shaping and planning?

4 e) A slab milling operation is being carried out on a 30-in.-long, 10-i wide high strength steel block at a feed of 0.02-in./tooth and a dep of cut of 0.2-in the cutter has a diameter of 3.5-in., has eight straig cutting teeth, rotates at 150 rpm, and the cutting force 125 Calculate MRR, CT, the power required (at the spindle), the speci horse power, and the horse power for the motor.

(**Note**: The efficiency of the motor 80% and CF = 1.5).

Question No. (2) **(14 Points)**

3 a) Explain with net drawing how does face milling differs basically fr peripheral milling. In addition, explain why there are different types milling cutters?

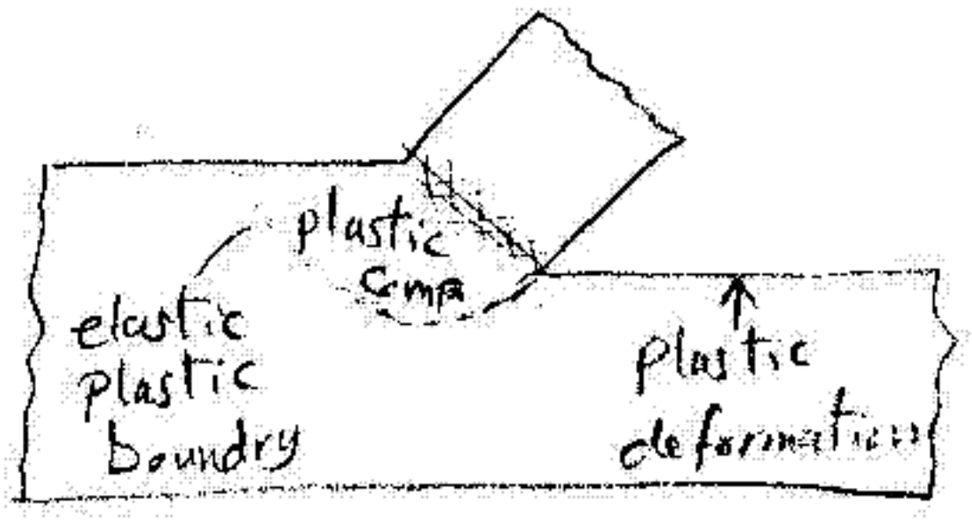
3 b) Explain with net drawing the selection of cutting tool material, geomet and the cutting condition for a given application?

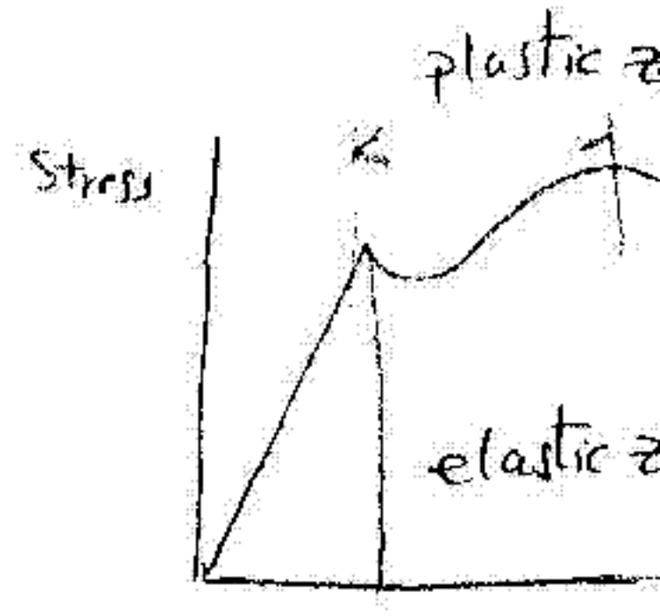
3 c) What are the main characteristics required for the cutting tool. Menti two different types of the cutting tool material and the advantages each type.

3 d) Explain by drawing five different types of turning processes?

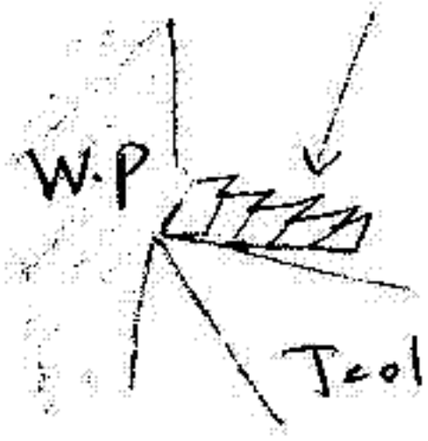
Q3

@ the chip is formed by alocalized shear process that takes
over avery narrow region. This large strain, high stra
plastic deformation evolves out of aradial compre
zone that travels ahead of the tool as it passes
the workpiece.



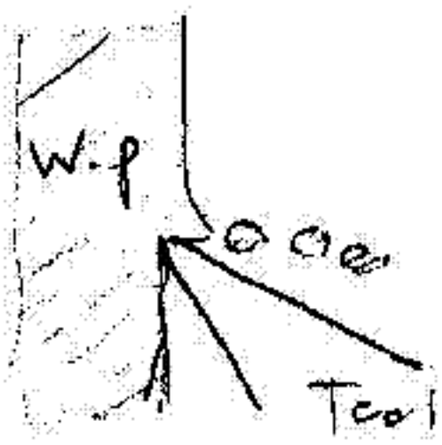


راس مقطع



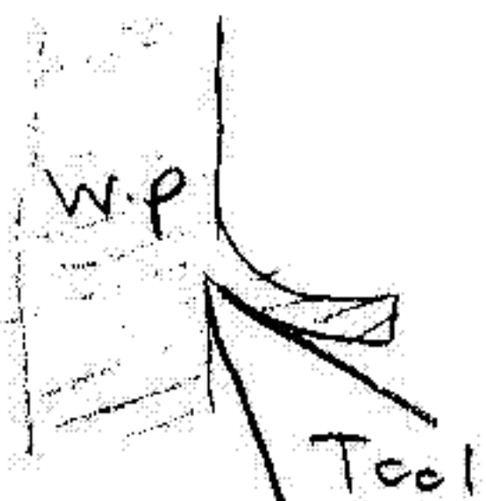
workpiece material
have medium h

راس متقت



workpiece material
have high hardness

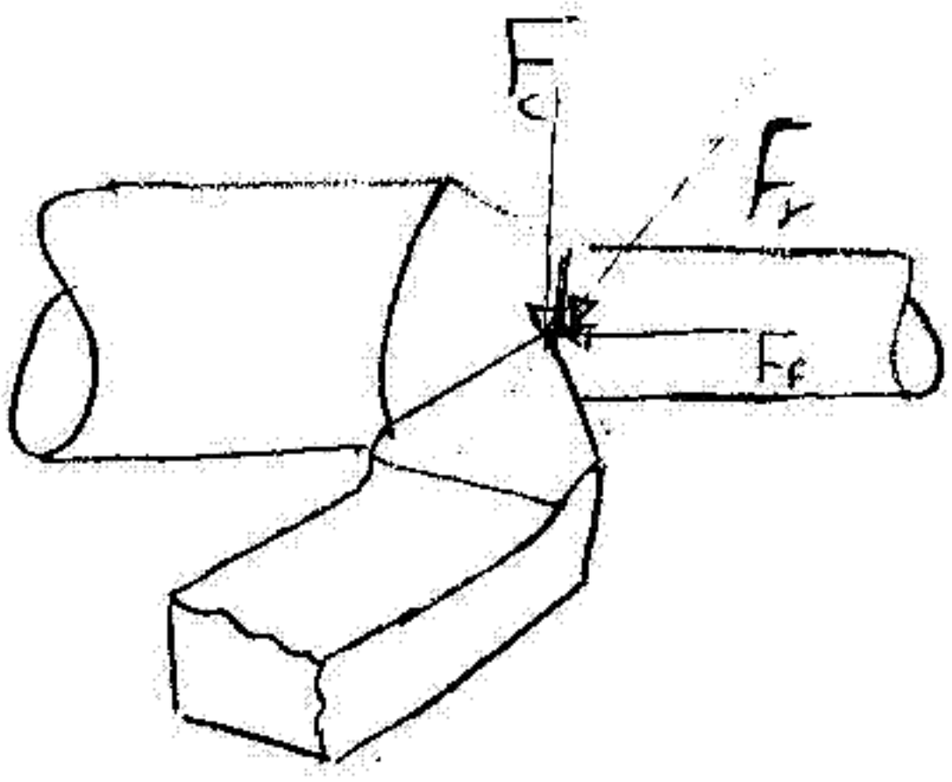
راس مفصل



workpiece material
have high ductility

Q3

(c)



1- Fc : Primary cutting force acting in the direction cutting velocity vector Fc ≈ 99 % of the

2- Ff : feed force acting in the direction of the tool f

$$F_f = 50\% F_c$$

3- Fr : radiator thrust force acting perpendicu the machine surface.

$$F_r = 50\% F_f$$

$$F_{total} = \sqrt{F_c^2 + F_f^2 + F_r^2}$$

حساب قوة القطع لكل إضافة لعملية القطع

Q3

(e) $D = 2$ in $\quad N_1 = 284 \quad T_1 = 10$

$N_2 = 232 \quad T_2 = 60$

Req $\quad V_3$? $\quad T_3 = 30$ min given.

N_3 ?

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

$$V_1 = \frac{\pi D N_1}{12} = \frac{\pi * 2 * 284}{12} = 149 \text{ ft/min}$$

$$V_2 = \frac{\pi D N_2}{12} = \frac{\pi * 2 * 232}{12} = 122 \text{ ft/min}$$

$$\frac{V_1}{V_2} = \left(\frac{T_2}{T_1}\right)^n \Rightarrow \quad \frac{149}{122} = \left(\frac{60}{10}\right)^n$$

$$1.22 = (6)^n \qquad \ln 1.22 = n \ln 6$$

$$\boxed{n = 0.11}$$

$$V_3 T_3^n = C \Rightarrow V_3 * (30)^{0.11} = \overset{?}{C}$$

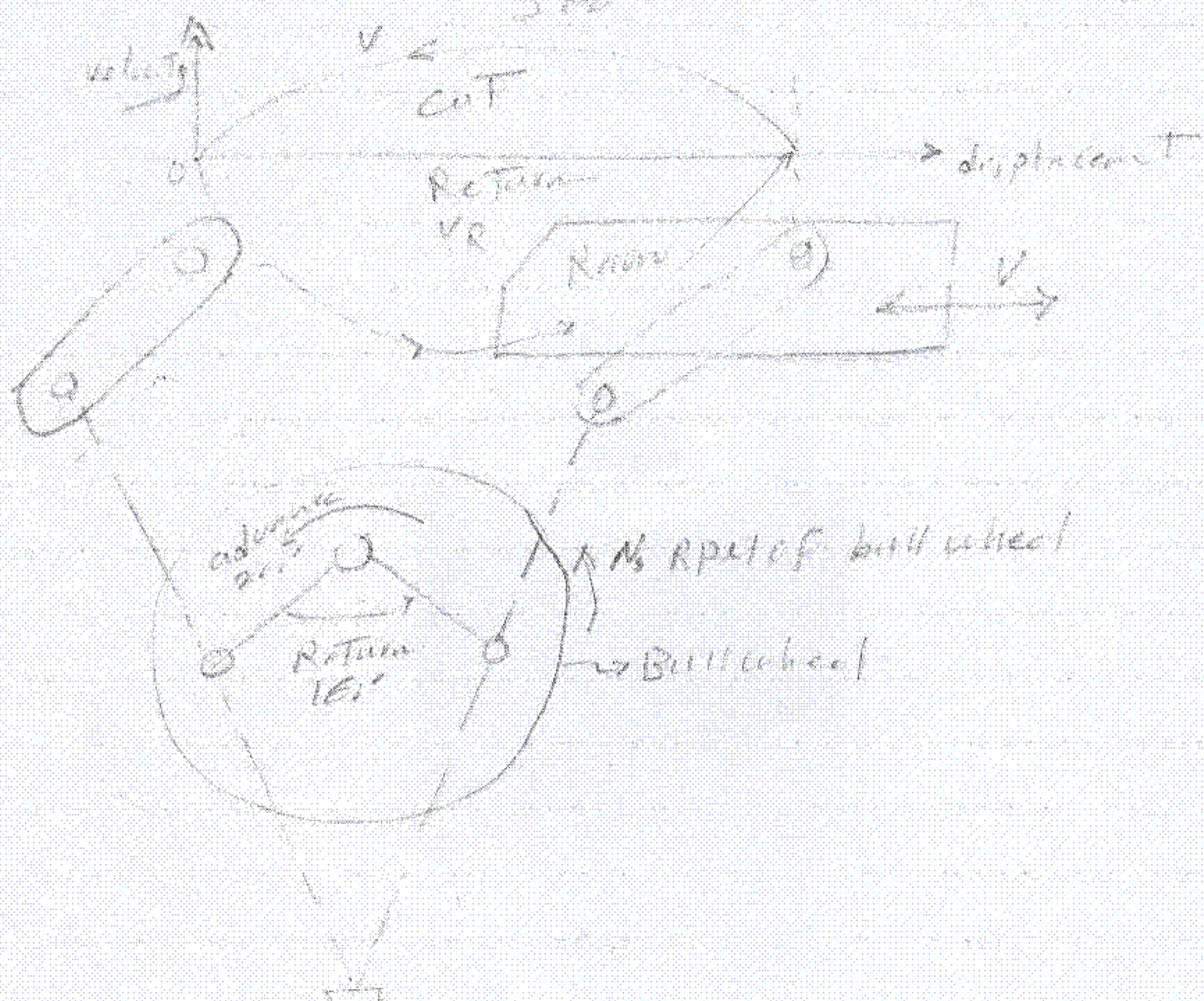
$$V_1 T_1^n = C \Rightarrow C = 149\,(10)^{0.11} = 192$$

→ Question 4)

a) Explain with drawing the shaper mechanism for obtaining Tool post with

in shaper, the cutting Tool is held in the Tool post located in the Ram which reciprocates over the work with a Quick cutting velocity V and a quick return velocity V_R. The ratio of the time taken during the stroke and return is known as Time ratio. The velocity of the stroke is

$$K_s = \frac{\text{Cutting Stroke angle}}{\text{Return angle}} = \frac{2\alpha}{360^\circ - 2\alpha}$$



Machine with dummy the division device. Most common

and if we need to make a gear with 24 Teeth. How

we will set the division device?

The dividing head is by far the most widely used m

machine accessory, provide a means of holding and indexing w

Through any desired arc of rotation. The work may be mounted between centers or held in chuck that is mount

the spindle hole of the dividing head

Basically, the dividing head is rugged accurate 40:1 gear reduction unit. The spindle of the dividing hea is rotated one revolution by turning the input crank an index plate mounted beneath the crank containing a number holes arranged in concentric circles and equally spaced each circle have a different # of holes, a plunger pin on the crank handle can be adjusted to engage the holes of any as represented by the increment between any two holes of a circle on the index plate

where $\# \text{ of Turns of crank} = \dfrac{40}{\text{cut per revolution of}}$

$\text{Holes to be indexed} = \dfrac{40 \times \text{hole in index}}{\text{cuts per revolution}}$

— if we Required a gear with 24 Teeth

$\therefore \frac{24}{40} = 2\frac{2}{3}$

Q4

(e) Given

$V = 135\ ft/min$

$A = 0.004\ in^2$

$d = 0.08\ in$

$E = 0.8$

$K_{s.1.1} = 129032\ lb$

$Z = 0.26$

$C_F = 1.5$

Req قدرة المطلوبة

$HP_{at\ spindle}$

HP_{motor}

$F = b \cdot h \cdot K_s = A \cdot K_s$

$A = b \cdot h$, $b = d = 0.08\ in$

$0.004 = 0.08 * h$

$h = 0.05\ in$

$K_s = K_{s.1.1} / h^z = 129032/(0.05)^{0.26}$

$K_s = \frac{129032}{0.46} = 280504\ lb/in^2$

$F_c = 0.004 * 280504 = 1122\ lb$

$Hp = \frac{F_c \cdot V}{} = \frac{1122 * 135}{} = 4.59\ hp$

Question 5

a) explain with drawing the component of Grinding wheel why there are different Types of Grinding wheel.

- The Grinding wheel consists mainly of abrasive ma
and bonding material.
- The abrasive particle accomplish cutting
- Bonding material holding practicles in place and estab
shape and structure of wheel.

There are different Types of Grinding wheel depending
The Geometry, the grain size, the abrasive material Typ
The Type of bonding material & The density of
abrasive particles

4 what are the advantages of using cutting fluids?

cutting fluids ,Also Called lubricants and coolants and it is used in machining operation to:

1- cool the cutting zone so it help to reduce work piece temperature & distortion and in the tool life.

2- reduce friction and wear so it improves tool and surface finish.

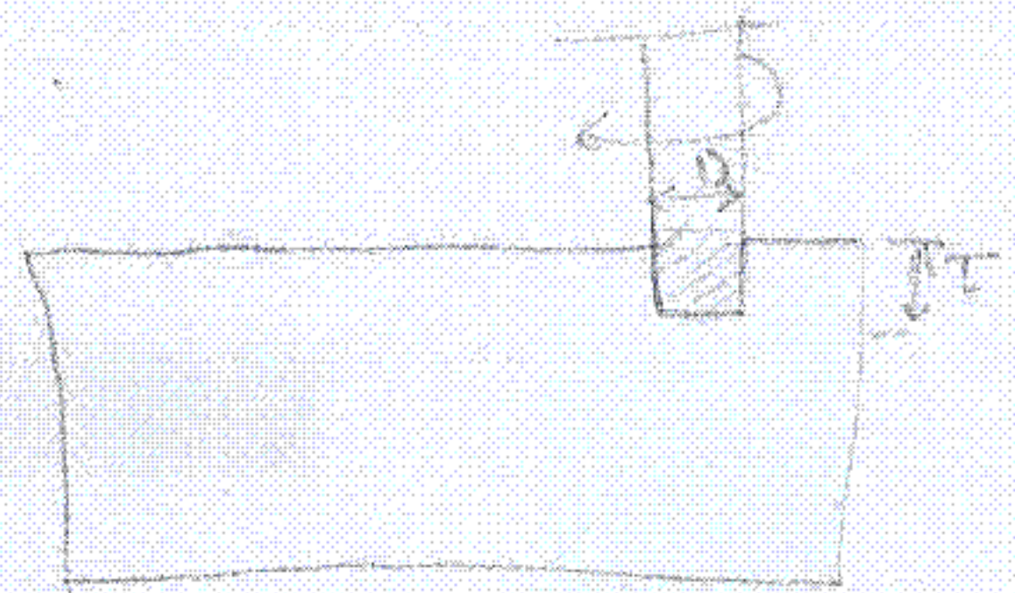
3- reduce the required forces and energy consumption

4- wash away chip

5- protect the newly machined surface from corrosion attack.

e) on milling "vertical milling"

1=



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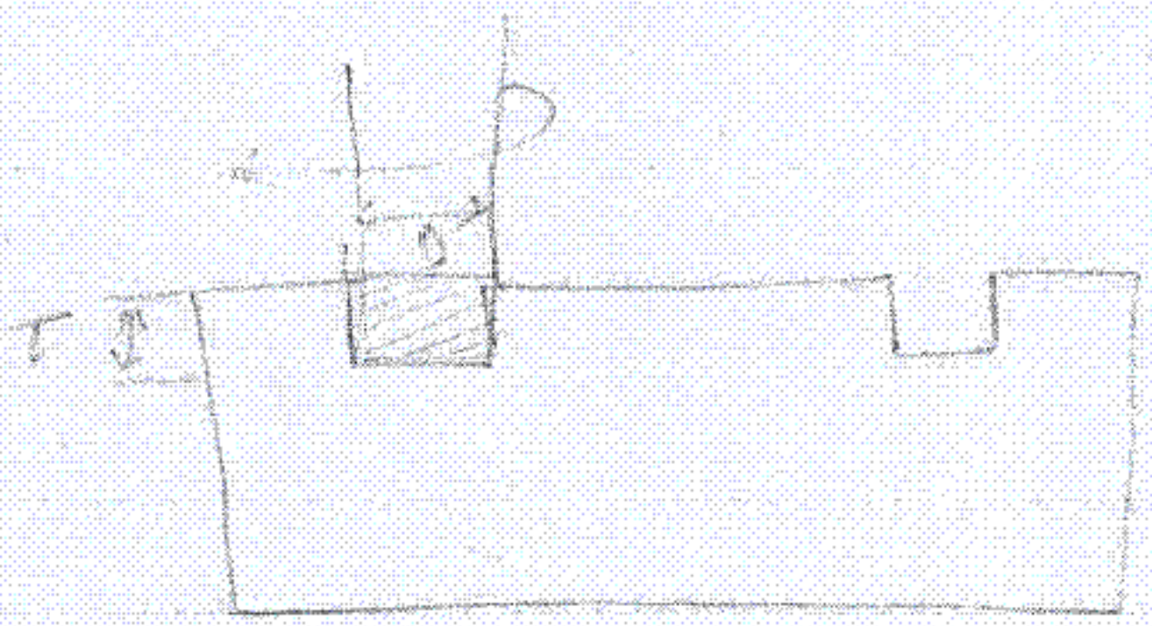

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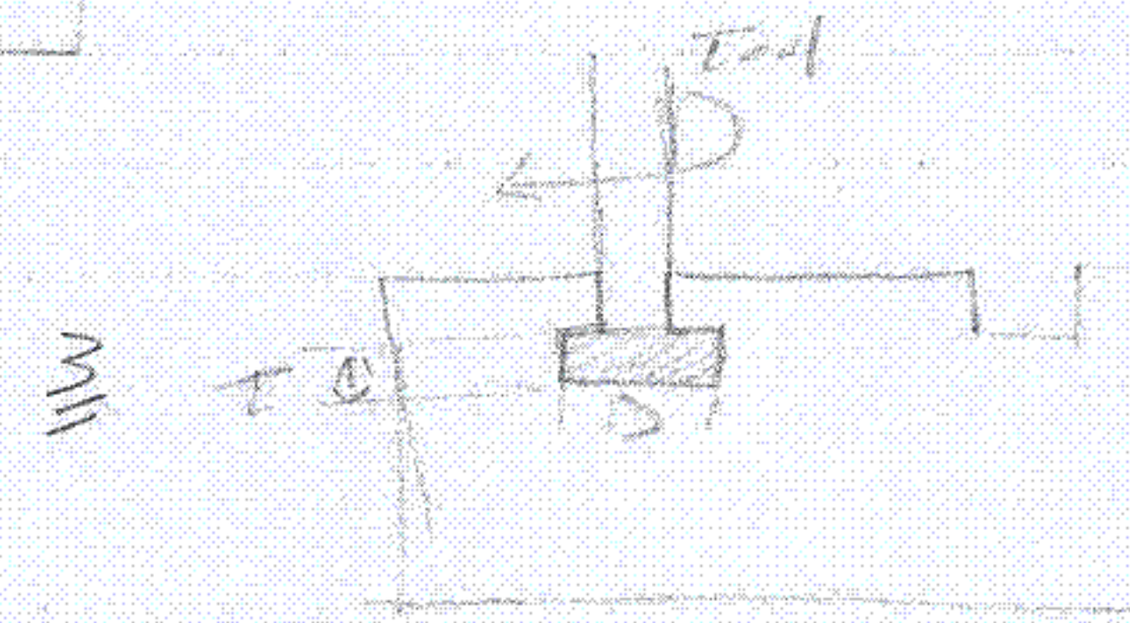
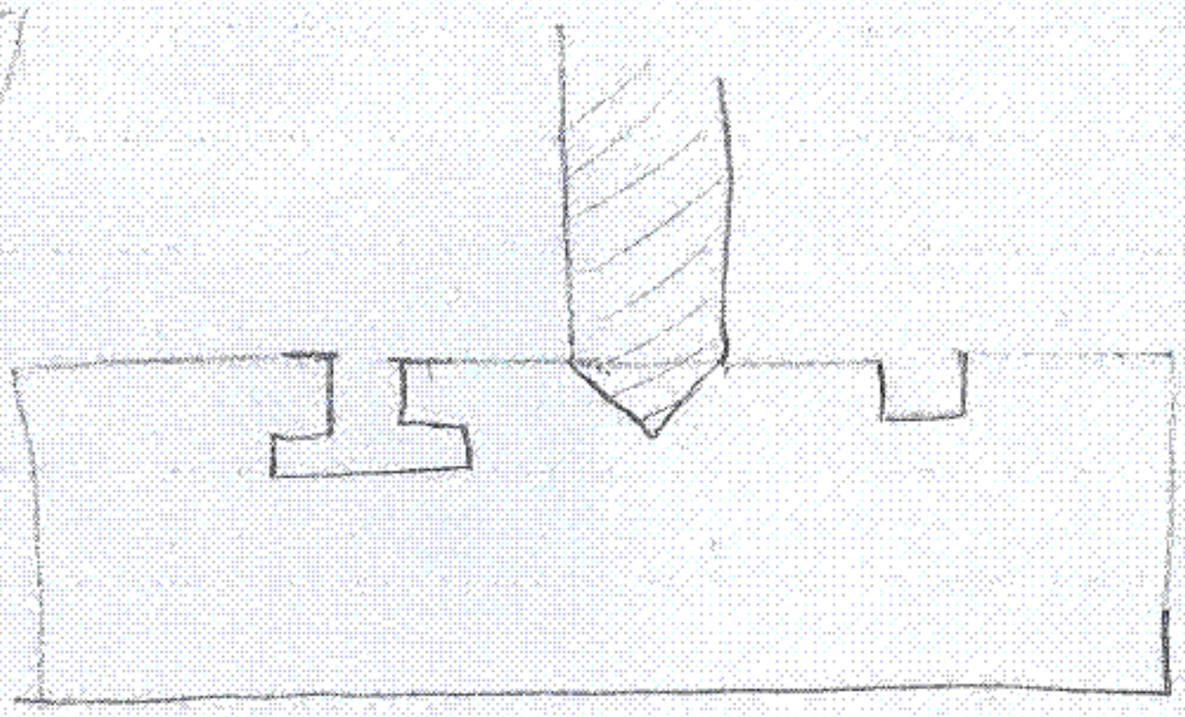
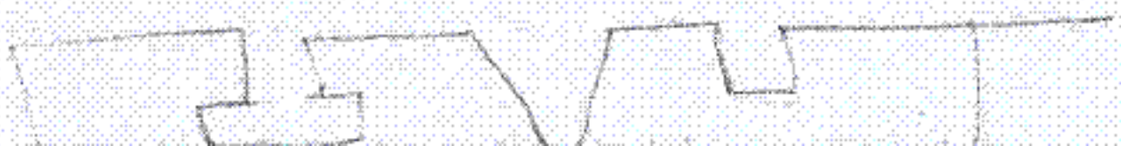


end on shapping machig

4=





Question No. (3) (14 Points

3 a) Explain by drawing the fundamental mechanism of chip formation, the diffe types of chip and the conditions for each type?

3 b) Explain with drawing the main element of the twist drill and the function of e element?

3 c) Explain with drawing the components of cutting force and its percentage. Exp briefly the importance to determine the cutting force?

3 d) Mention the main sources of heat in machining. Explain the distribution of generated in machining and how we can overcome this generated heat?

4 e) When a 2 in diameter steel is turned on a lathe at N= 284 rpm the cutting too changed after 10 min. if the spindle rotates at N=232 rpm the cutting too changed after 60 min. calculate the cutting speed when the cutting too changed after 30 min and also calculate the rotating speed of the spindle?

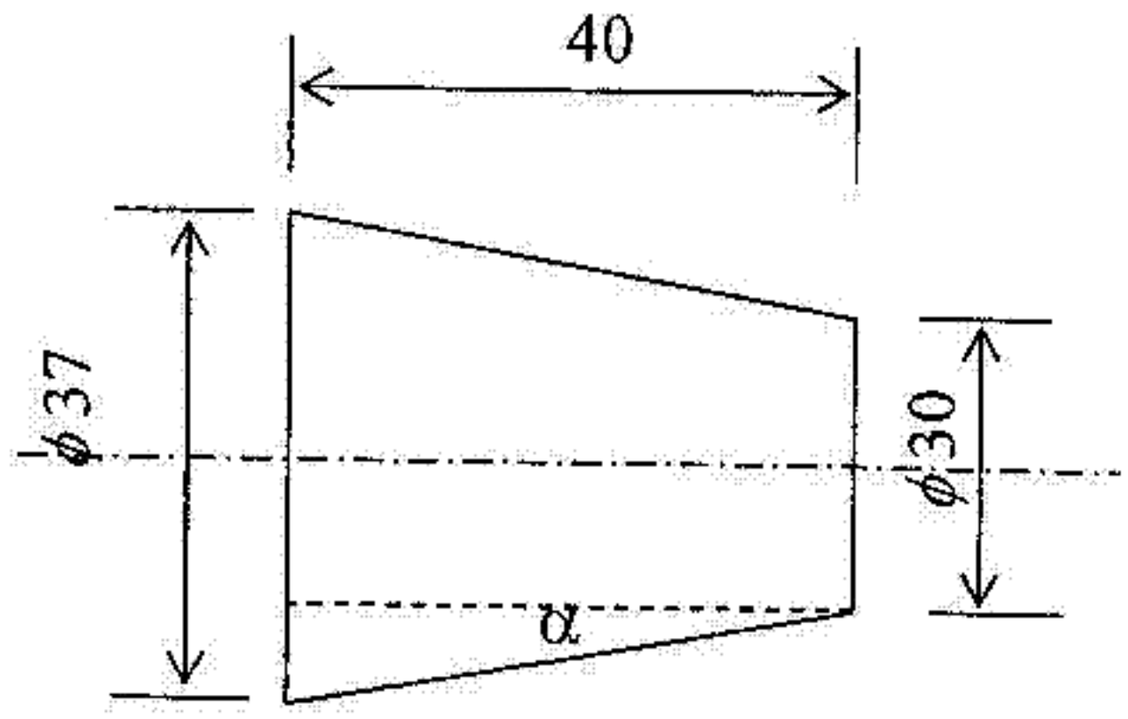
Question No. (4) (14 Points

3 a) Explain with drawing the shaper (quick return) mechanism for driving tool p work?

3 b) Explain with drawing (counter boring – counter sinking – spot facing)?

3 c) Explain with drawing the division head, how it work and if we need to make a g with 24 teeth. How we will set the deviation device?

2 d) Mention the different methods for making taper turning? And calculate the ta angle for the following product?



4 e) It is required to machining a bar of steel in turning machine with cutting spe 135 ft/min, chip cross section 0.004 in^2 and depth of cut 0.08 in. Where K equal 129032 lb/in^2. Determine:

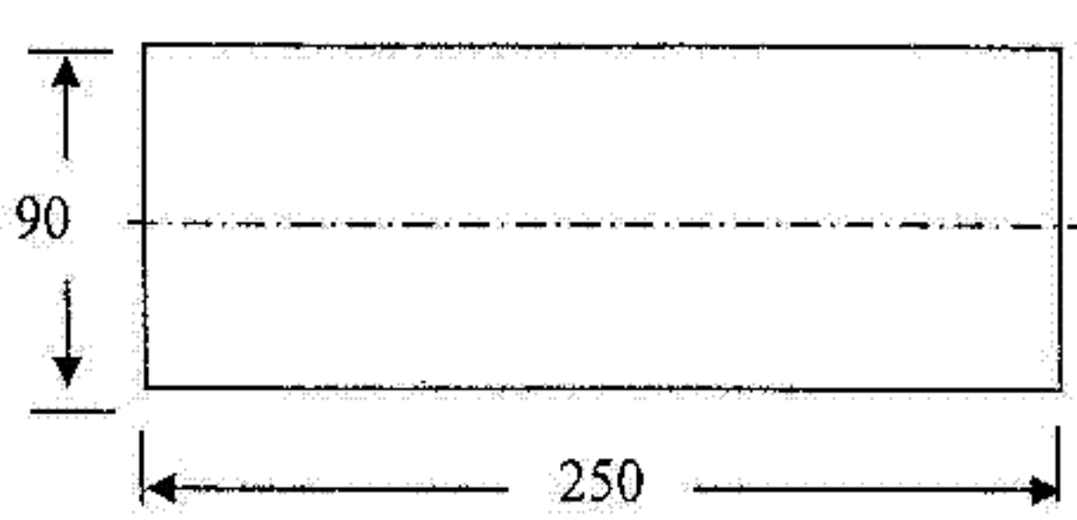
Question No. (5) (14 Points)

3 a) Explain with drawing the component of grinding wheel, and why there ar different types of grinding wheels?

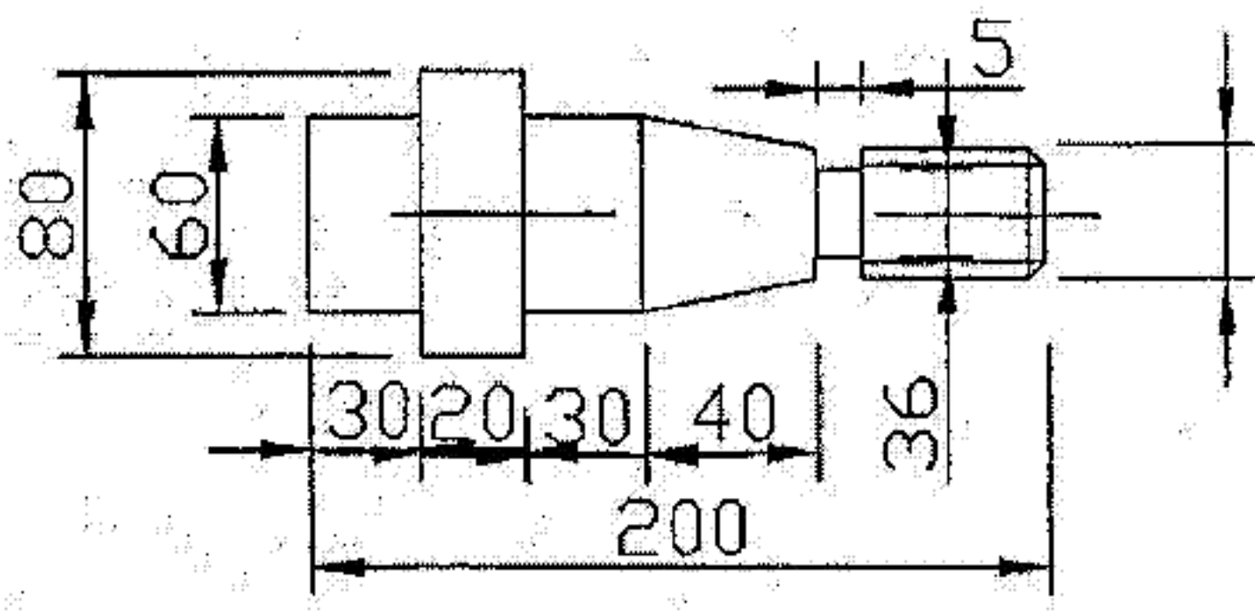
3 b) Explain the relation between cutting speed and cost per price?

5 c) What are the advantages of using cutting fluid?

3 d) Explain with drawing the steps to get the following final product from the given ra material using turning machine?



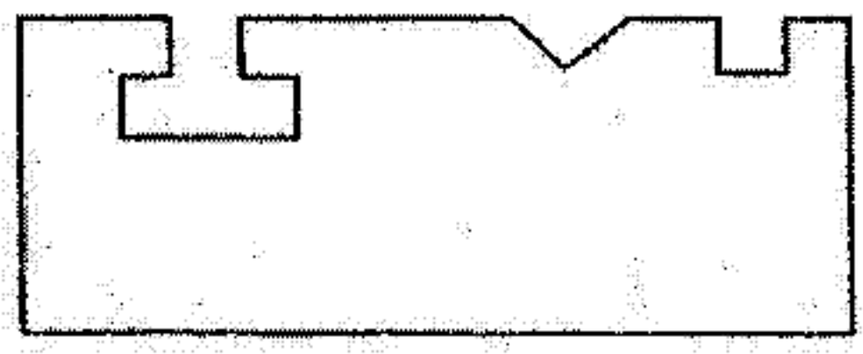
Raw material



Final product

4 e) Explain with drawing the steps to get the following final product from the given ra material?

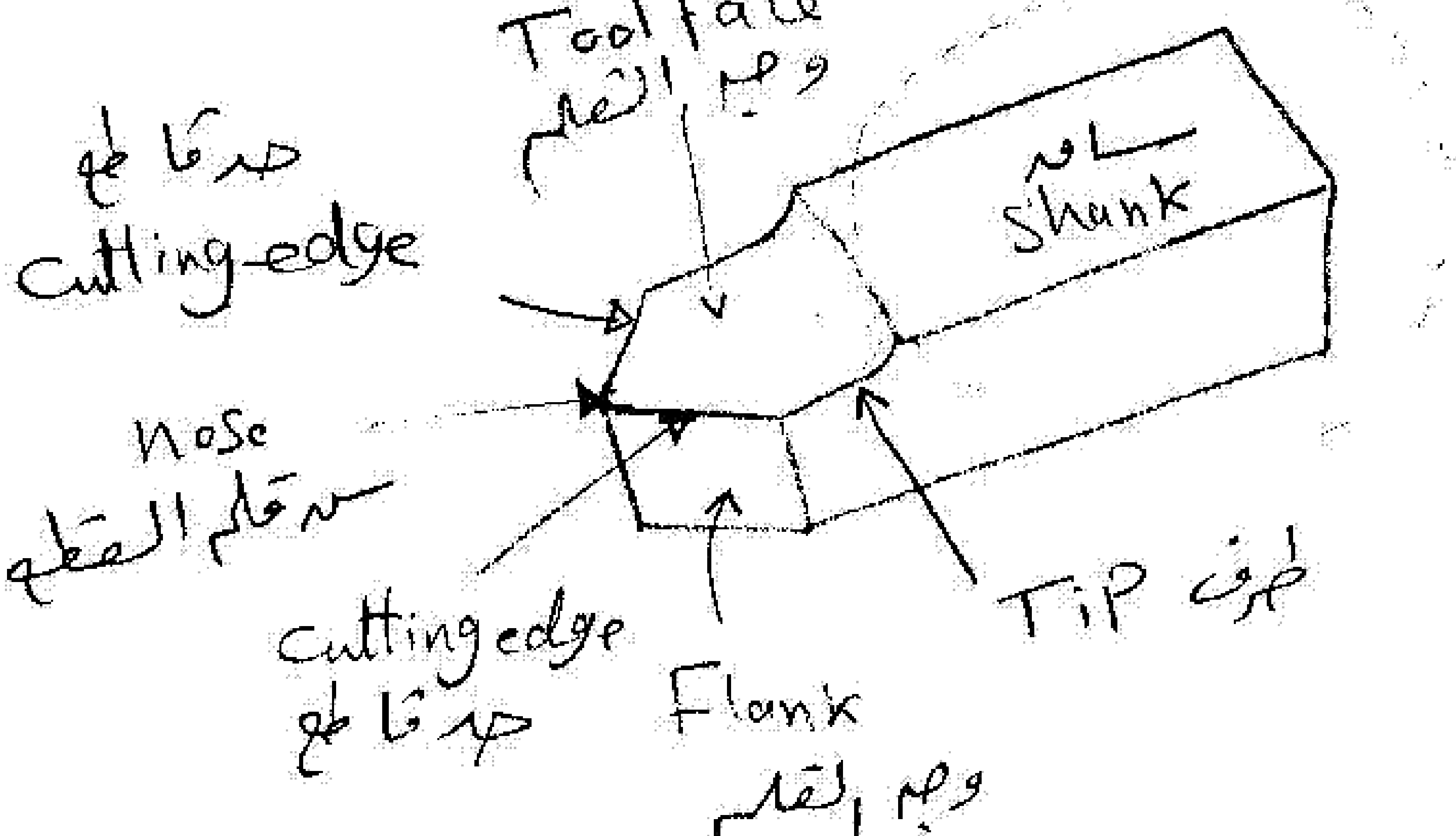
Raw material

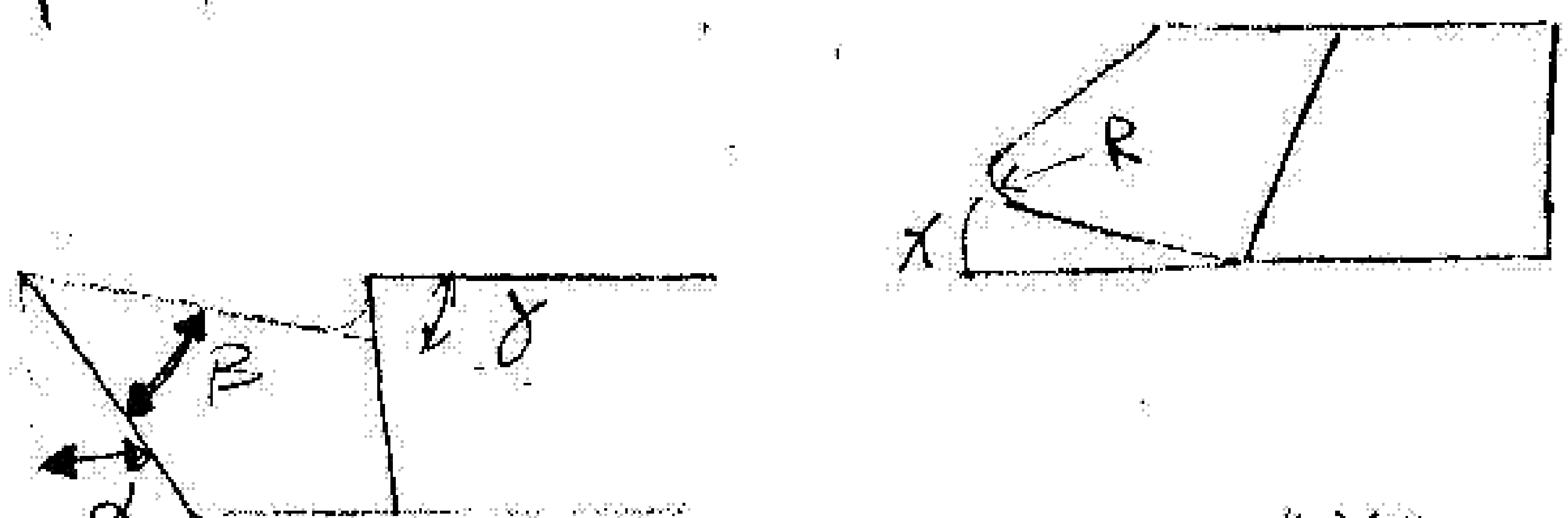


Final product

Q 1

(a)





ـي جرف "γ" (rake angle) مهمة لتسهيل خروج الرايش عند التشغيل كل
سطح الحد القاطع والزاوية γ يمكن ان تكون (موجب - سالب - صفر)

ـة الخلوص "α" (clearance angle) الفائدة الاساسية منع احتكاك
ـي القلم بالشغل مباشرة ولابد ان تكون موجبة دائما واكبر من 4°

ـة الاقتراب "ε" (approach angle) هي زاوية مقدمة القلم مهمة توفر
متانة لمقدمة القلم لتقليل تآكلها وتنحصر قيمتها بين (11 — 90°)

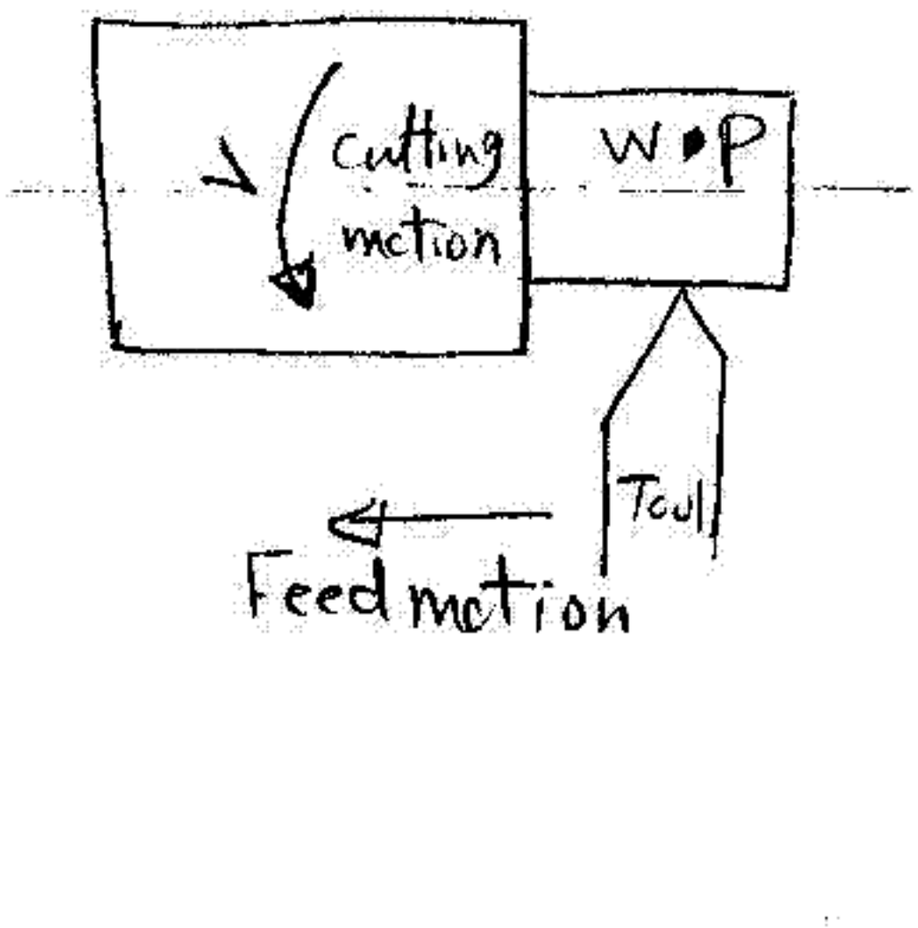
ـة الأداة "β" (tool angle) مهمة توفر متانة للاسنان حتى
تتحمل قوى القطع وتنحصر قيمتها (... - 90°) للشغلات ذات المادة

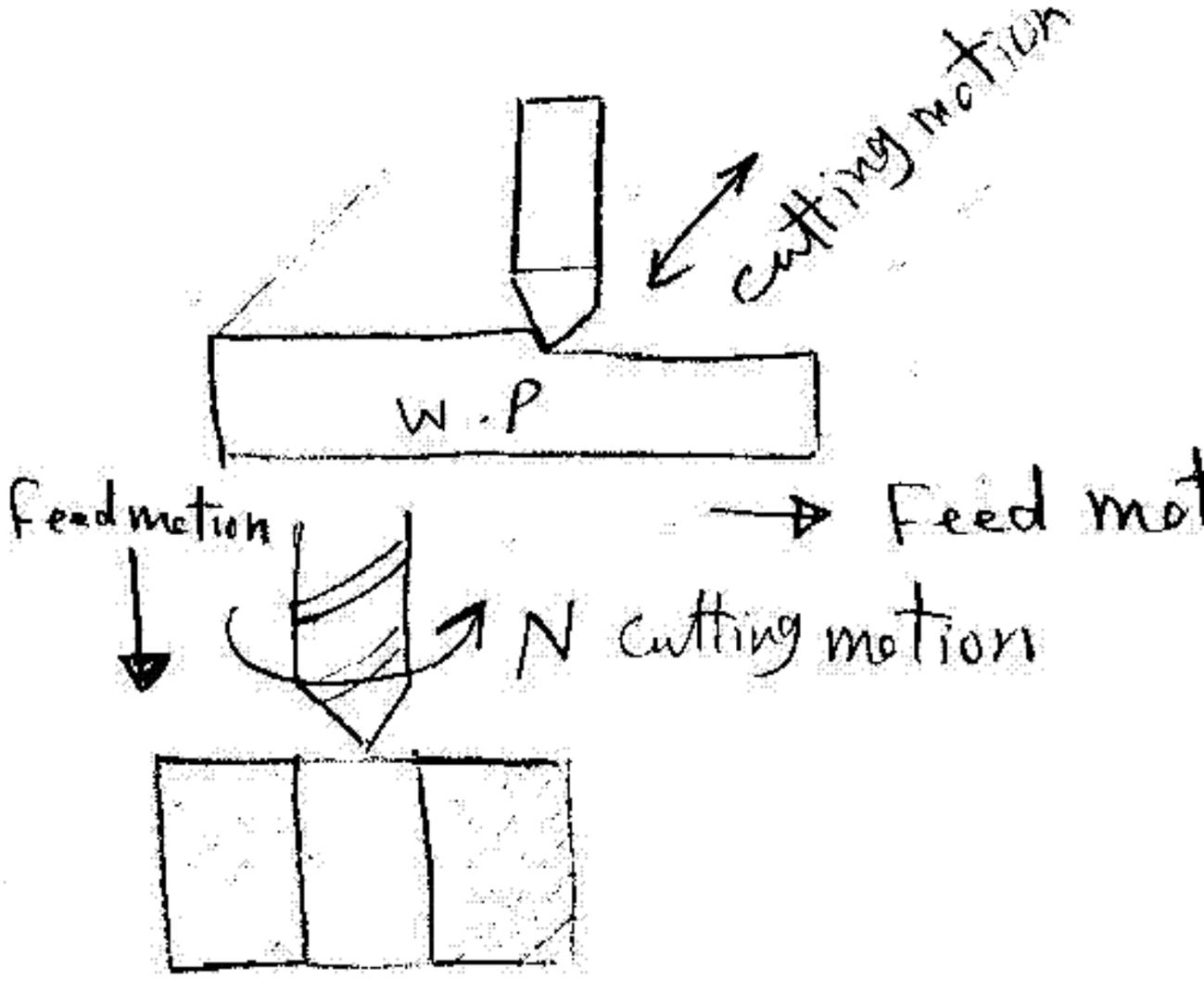
Q1

ⓒ

- cutting motion (speed (V)) is relates the velocity of the rotating workpiece with respect to the stationary tool.
حركة تشغيل سرعة العدة (أداة القطع)، الشغل قدامها أداة القطع
في عمليات (الثقب - التفريز - القشط - التجليخ) وقدامها
تشغل (الخراطة).

- Feed motion (Feed (fr)) is the amount of the material per revolution or per pass of the tool over the work
حركة إجتياب الشغلة من العدة أو العدة من الشغل (الفرزة - التجليخ)
على العدة القاطعة مزيد من الخامة ليتم عليها إزالة الرايش





$$HP_{at\ spindle} = \frac{Fc\ V}{33000} = \frac{125 * V}{33000}$$

$$V = \frac{\pi D N}{12} = \frac{\pi * 3.5 * 150}{12} = 137.4\ ft/min$$

$$HP_{at\ spindle} = \frac{125 * 137.4}{33000} = 0.52\ hp$$

$$HP_s = \frac{HP}{MRR} = \frac{0.52}{48} = 0.011\ hp/(in^3/min)$$

$$HP_m = \frac{HP_s * MRR * CF}{E} = \frac{0.52 * 1.5}{0.8}$$

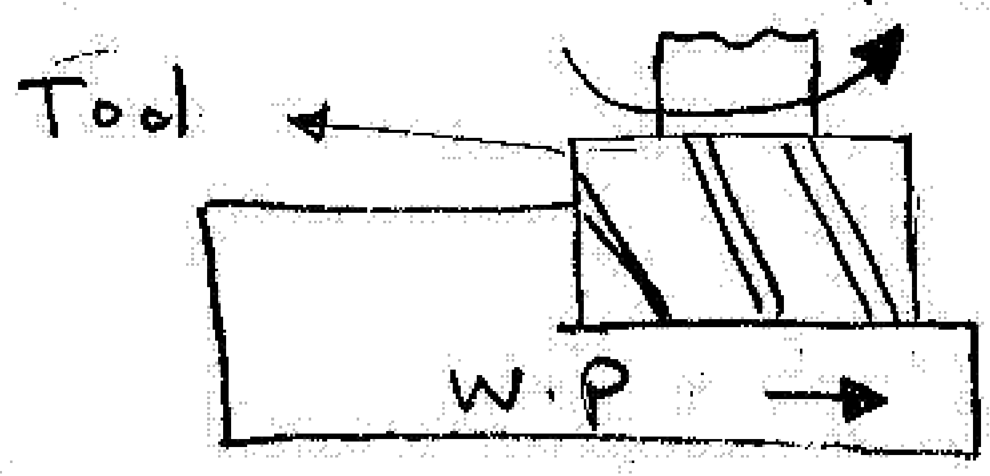
$$HP_m = 0.975\ hp$$

Q2

(a)

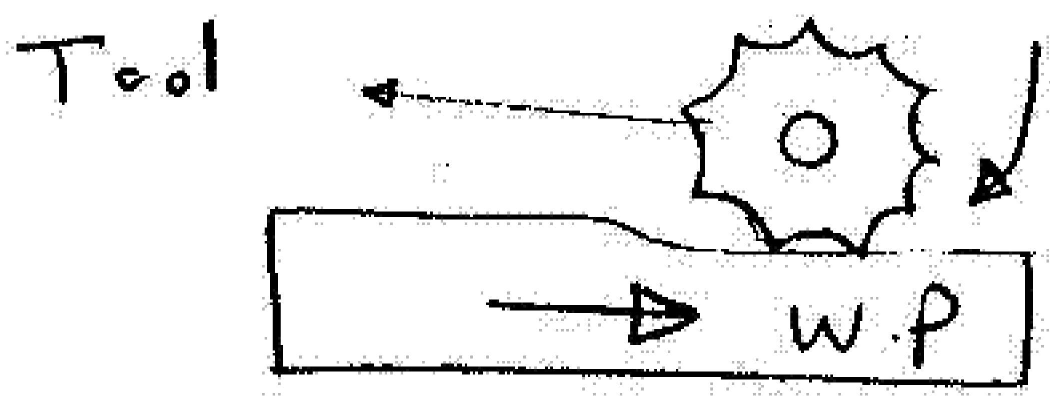
- Face milling : the surface generated is at right an
to the cutter axis

الوجهي يكون محور سكينة التفريز متعامداً على السطح المشغل



- Peripheral milling : the surface is parallel with th
of rotation of the Cutter

ـد العادي يكون السطح المشغل موازياً لمحور سكينة التفريز



ـد انواع مختلفة من سكاكين التفريز تبعاً لما يلي :

وضعها اسنانها هل هي على المحيط ام على الواجهة
القطر السكينة فبعضها صغير جداً واخرى كبيرة لتتناسب مع اسطح المشغلات
عدد الاسنان فهو كبير عند تفريز المعادن الصلدة وصغيرة للمعادن اللدنة
الاشكالها حتى يمكن انتاج مجاري تروس ، لولب ، اسطح مستوية
لشكل مجاري الرايش فهي اما مستقيمة ، او مائلة او حلزونية .

Q2
ⓒ

لخصائص التي يجب توفرها في ادوات القطع

لمتانة لتحمل الضغوط الناتجة عن عملية القطع والاصطدام بالشغل

صلادة السطح العالية لمقاومة الاحتكاك الناتج عن اشتباك الرايش

الصلادة العالية لضمان استغلال زمادة الشغل واحداث واستمرار القطع

تحمل الحرارة العالية لضمان عدم فقدان الصلادة اثناء عملية القطع

Briefly the cutting tool should have good (strength, hardn
toughness, wear resistance and hot hardness)

Tool steel	High speed steel
— Carbon steels and low/medium alloysteels (called tool steels) — tool steels lose hardness at temperture above 400°F because of tempering — low/medium-alloy steels have alloying element such as Mo and Cr which improve hardenability and W and Mo which Improve wear resistance — Low/medium alloy steels materials also lose their hardness at 300-650°F	— high alloy steel was super tool steel that is retained it ability at temperture up to exhibting good (red hardness) with Carbon steel. — Cutting speed HSS = double c speed tool steel with equal — HSS Contain significant a of W, Mo, Co, V and Cr th hardness and wear resistan — HSS is still widely used

Q 2

(e)

$w = 10$ in $L = 8$ in $V = 150$ ft/min

$f_c = 0.02$ in per stroke

$\ell \rightarrow$ stroke length $= 2L$

$\ell = 2*8 = 16$ in

$$V = \frac{2\ell N_s}{12 R_s} \qquad 150 = \frac{2*16* N_s}{12 * 5/9}$$

$N_s = 31.25$ rpm

$$CT = \frac{W}{N_s f_c} = \frac{10}{31.25 * 0.02} = 16 \text{ min}$$

$$S = \frac{w}{f_c} = 500 \text{ strokes.}$$