CONCORDIA UNIVERSITY
FACULTY OF ENGINEERING AND COMPUTER SCIENCE
DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

MIDTERM EXAMINATION MECH 311 – *MANUFACTURING PROCESSES*
FALL 2005

Date: October 27, 2005 **Duration:** 1 hour
Materials allowed: NO **Calculators : YES**
Class instructors: sections T and X: Drs. I. Stiharu and M. Packirisamy

Instructions: Answer the multiple choice type questions on the first page of the first answer sheet by darkening the correct answer on the corresponding line indicated by the number of the question. Select the most appropriate answer. For an example, if a question would ask: "What is the benefit of hardening the surface of the tool?" and it would offer option answers as: a) Higher cutting speed b) Extended life of the tool, c) Reduce thermal effect on the tool or d) Lower lifespan cost of the cutting tool. You should select b) as your answer because d) is a consequence of the extended life of the tool.
The objective answer questions will be solved in your answer book and only the final requested answers will be written in the separate answer tables. *No answer in the answer box will receive zero marks.* Make sure that your name is written on the exam book and the answer sheets. You *can do the calculation in your exam book itself.*
At the end of the exam, gather the question book and the answer sheets in the answer book and submit them all. Please, do not forget to sign out.

Student's name: [redacted]

Student's I.D. #: [redacted]

Date: October 27, 2005

Student's Signature: [redacted]

MARKS: **Total 50**

9		2		0				11	

9

MULTIPLE CHOICE QUESTIONS

Q1. Gundrills are cutting tools that perform drilling at a high deep-to-diameter ratio. The maximum ratio that could be machined is:

a) 60 b) 100 c) 200 d) 500

Q2. Assume a cylindrical cutting process of a cold drawn steel bar of 1.25 in. In your production you need parts of maximum diameter of 1 in only. You plan to cut them removing 0.125 in on the radius in a single pass instead of two passes. Which of the forces will increase more?

a) Cutting force b) Feed force c) Radial force d) None of these forces

Q3. TiN is added to tool inserts because it mainly

a) increases wear resistance b) increases hot oxidation resistance
c) increase tool elasticity d) reduces friction

Q4. A slab mill cutter of 50mm diameter and 100mm wide machines a length of 400mm in one pass. What would be the approximate cutting time in *minutes* when no allowance is considered? The cutter with 7 teeth rotates at 100RPM. Feed per revolution is 0.4mm/rev.

a) 1.43min b)0.4min c)10.2min d) 100min

Q5. Machinability is defined by the ease a material could be machined. Machinability is not related to:

a) The tool
b) The relative cutting speed
c) The relative feed
d) The quality control

Q6. Assume that you have performed a process capability (PC) study and ended up with a *process capability index* $C_p = 1.60$ and a *mismatch* value D which is close to zero. Find the standard deviation of the process if the upper and lower specification limits are 40.5 mm and 40.05 mm, respectively.

a) 0.0938mm
b) 0.0234mm
c) 0.0469mm
d) 0.1876mm

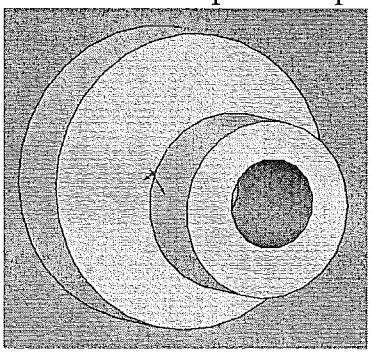
Q7. A 4" diameter rod is cut by turning at a speed around 60 m/min. The approximate RPM of the spindle of the lathe must be:

a) 189 rpm b) 300 rpm c) 412 rpm d) *590* rpm

Q8 Which of the following component is essential for thread cutting in lathe?

a) Feed Rod
b) Threaded collet
c) Quill Shaft with offset
d) Lead-screw

Q9. A cosine cam as the one illustrated below must be machined. Turning has been identified as the preferred process as the part must be machined as a single piece.

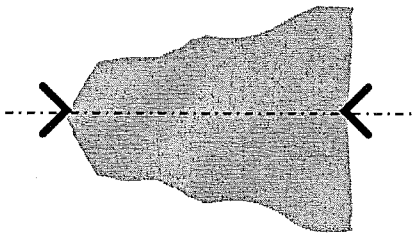


How the work should be held to machine the cam?

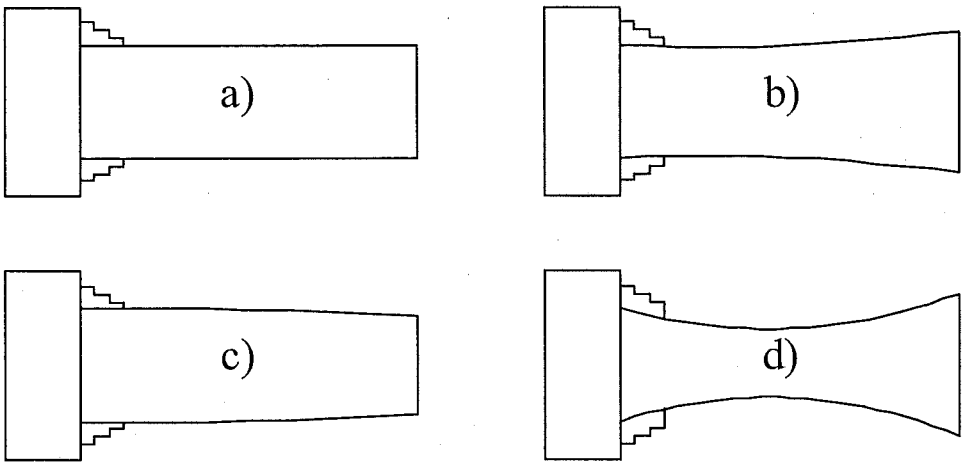
a) In a three jaw self centering chuck
b) In a four jaw chuck
c) Between centers
d) In a collete

Q10. The following cylindrical component with shaped tapering is turned in lathe. Which of the following technique will be most suitable?

a) Taper attachment
b) Offset method
c) Combined feed method
d) None of the above



Q11. Assume that one has to perform a long cylindrical cutting. The part is cut from the tailstock to the headstock. When the part is machined, it heats by about 100 degrees. Which of the following shapes (exaggerated in the representation) will be the part after it cools down?



Q12. Optical flats are measurement tools that enable high accuracy measurement. Which of the below statement is correct

a) The measurement is based on light interference.
b) The measurement principle is based on color change of light.
c) The measurement principle is based on the accuracy of the scanning video system.
d) The measurement principle is based on the wring between the optical flat and the surface to measure.

Q13. Which of the below factors is not used in selecting an inspection equipment?

a) Resolution b) Stability c)Linearity d)Location

Q14. Roughness measurements are performed in various ways. Which of the following methods provides the most effective evaluation of the R_a?

a) Stylus profile measurement b)Optical scanning
c) Atomic force microscopy d)Electronic microscopy

Q15. In case you have to make by turning a tapered shaft, which of the following methods is not appropriate?

a) Use of the offset guide bar attached to the carriage
b) Turning of the inclined work
c) Usage of form turning
d) Offset of the tailstock

Q16. Which of the above methods is not appropriate to test defects (flaws and cracks) in a bronze bell?

a) Liquid penetrant method
b) Magnetic particle inspection
c) Ultrasonic inspection
d) Radiography inspection

Q17. Swing of a lathe is:

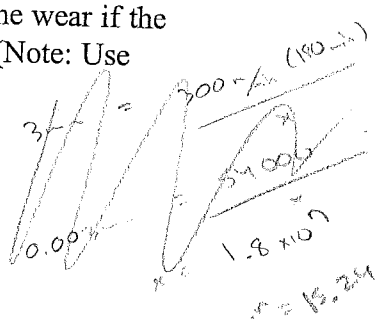
a) The angle that the bar spins in the chuck
b) The distance between the ways of the lathe machine
c) Twice the distance form the axe of the spindle to the closest point on the ways
d) The minimum distance form the axe of the spindle to the ways

Q18. A design requires a shaft of F20 mm with the maximum size F20.045 and the minimum size of F20.000. The safer process designed to produce the part must yield with a UCL and LCL as it follows:

a) UCL = F20.030, LCL = F20.000
b) UCL = F20.037, LCL = F20.008
c) UCL = F20.045, LCL = F20.000
d) UCL = F20.055, LCL = F19.990

Q19. When the work material AISI 1100 is machined with the cutting speed of 300m/min the tool life for 3mm wear is 180 minutes. Find out the tool life for the same wear if the cutting speed is increased to the maximum allowable value of 600m/min. (Note: Use Taylor's Model with exponent n=0.25, TV^n=constant)

a) 11.25min
b) 22.50min
c) 151.36min
d) 90min



Q20. Which of the below is not a function of the cooling fluid?

a) Reduces the temperature of the work and tool
b) Removes the chips from the cutting area
c) Filters the chips form the cooling circuit
d) Lubricates the contact between the tool and the work

Design Questions:

1.) Consider the following component to be machined in a slab milling machine. The machining has to be done only on the surfaces marked. Other surfaces are left as cast. Assume that an allowance of 1mm on the machined surfaces to be removed in *single pass* on each side. The slab milling cutter of 70mm diameter and 160mm long with 8 teeth is used. The maximum allowed cutting speed is 20m/min. The maximum feed per tooth is 0.1mm. The specific power, mechanical efficiency and correction factor can be assumed as 1.3 Ws/mm^3, 75 % and 1.15. Neglect the cutting allowance. You can neglect the machining stock for calculation. (20 Marks)

Find out the following:

a) The maximum *rpm* of the cutter — 2 mark
b) The maximum possible width of the cut at any time, in ***mm*** — 2 marks
c) The maximum feed per minute in *mm/min* — 2 marks
d) The total cutting time to machine the three faces in *min* — 3 marks
e) The maximum possible MRR in mm^3/min — 3 marks
f) The actual MRR with no allowance in mm^3/min — 3 marks
g) The maximum motor power required in Watts — 3 marks
h) The total machining cost(Assume \$275/hr) in \$ — 2 marks

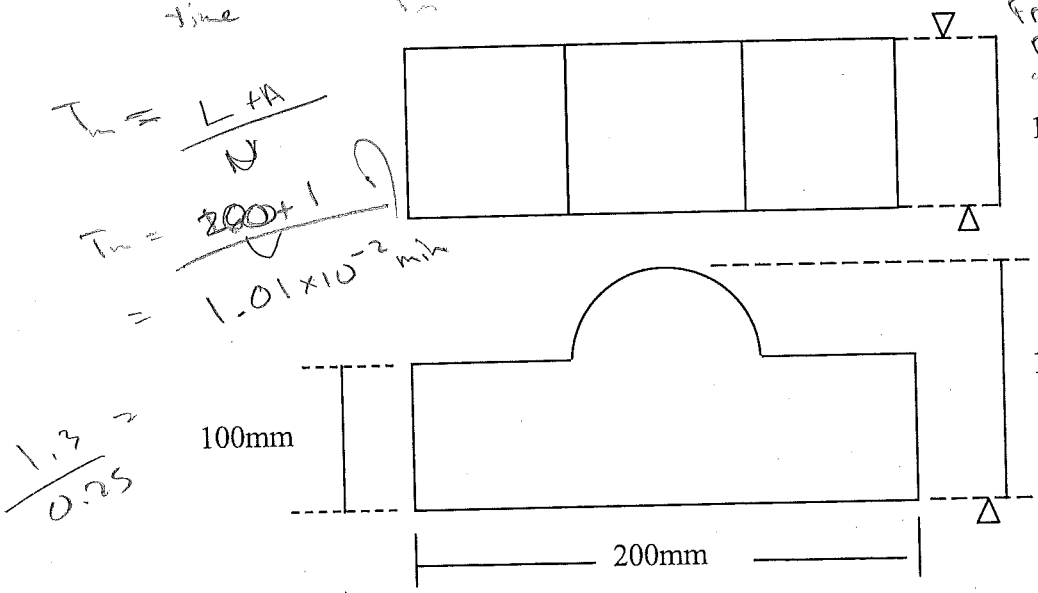
$$Power = \frac{specificpower * MRR * CF}{\eta}$$

$MRR = \frac{Volume}{time} = \frac{w \cdot L \cdot DOC}{T_m}$

$T_m = \frac{L + A}{N}$

$T_m = \frac{200 + 1}{V}$

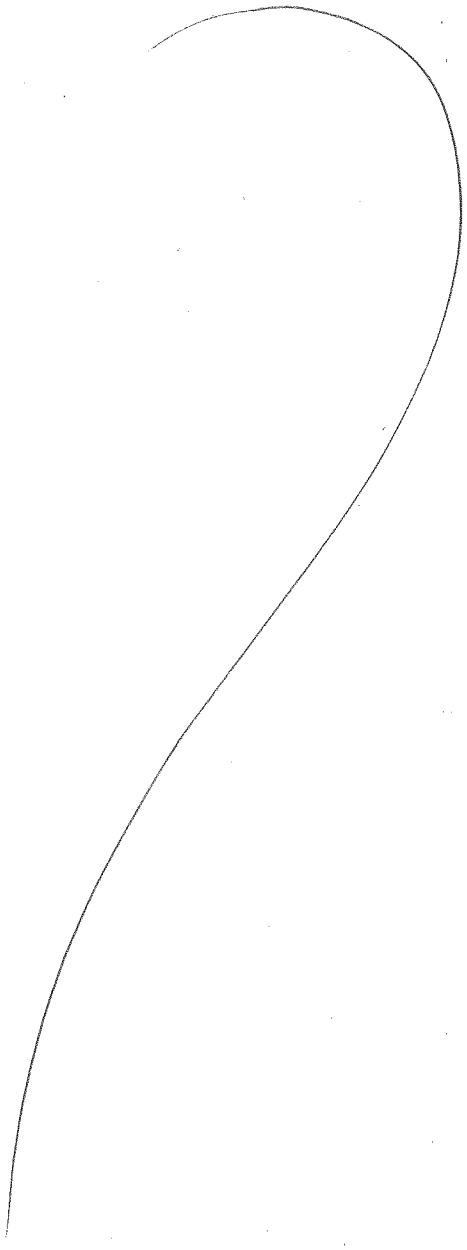
$= 1.01 \times 10^{-2}$ min



$MRR_{max} = L \cdot area \cdot DOC$ / Time

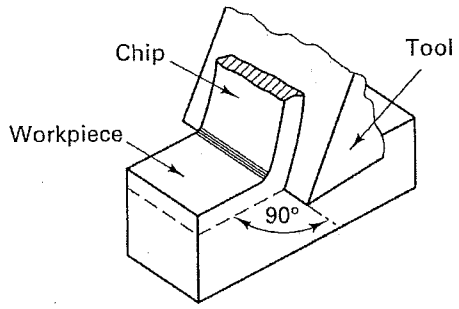
"if it is only going to pass once then it has to be the maximum width = 150 mm"

$cost = \frac{\$275}{hr} \times \frac{1hr}{60min} \times$



2) Consider orthogonal machining as depicted in the following figure. The width of the tool is 10mm while the width of the job is 5mm. The depth of cut is 1mm. The shear stress produced during machining is 500MPa. Assume the cutting force (F_c) in cutting motion direction is 1.5times the force in tangential direction (F_t). shear angle obtained is 45° while the rake angle of the tool is 30°. (10 marks)

Estimate: a) Shear area in mm^2 — 2 marks
b) F_t in N — 4 marks
c) F_c in N — 4 marks



$$F = F_c \sin\alpha + F_t \cos\alpha$$
$$N = F_c \cos\alpha - F_t \sin\alpha$$
$$F_s = F_c \cos\phi - F_t \sin\phi$$
$$F_n = F \sin\phi - F_t \cos\phi$$

$$\tau_s = \frac{F_s}{A_s}$$

DOC = 1mm
w_j = 5mm
w_t = 10mm
τ = 500MPa
$F_c = 1.5F_t$
α° = 45°

Student's name: . . . . . .

Student's I.D. #: . . . . . .

ANSWER SHEET

Q1. a b c d

Q2. a b c d

Q3. a b c d

Q4. a b c d

Q5. a b c d

Q6. a b c d

Q7. a b c d

Q8. a b c d

Q9. a b c d

Q10. a b c d

Q11. a b c d

Q12. a b c d

Q13. a b c d

Q14. a b c d

Q15. a b c d

Q16. a b c d

Q17. a b c d

Q18. a b c d

Q19. a b c d

Q20. a b c d

The design problems: after performing the necessary calculations in your answer book, fill in the answers in the tables below. Write the answer and the units.

Problem #1.

	Answer	Units
A	N = 5.20 rpm	rpm
B	150	mm
C		m/min
D	1.01×10^{-2}	min
E		mm^3/min
F		mm^3/min
G	34600000	Watts
h	0.05	#

2

909
150
72.72
8.25
10908
82247
273.24
31.8

Problem #2.

	Answer	Units
a	2500	mm^2
b	3244	N
c	4866	N

0

0

7.07×10^6
10 000
15000

CONCORDIA UNIVERSITY
Faculty of Engineering and Computer Science
Department of Mechanical and Industrial Engineering

MIDTERM TEST – MECH 311 – Manufacturing processes

PLEASE, MAKE ATTENTION TO THE INSTRUCTIONS

October 28, 2004
Duration – 1.25 hours
Closed Book Exam – Only calculators allowed

Answer all following multiple choice questions on the answer sheet. Each question has unique good answer. For the problem, use the answer book for calculations and once you find the answer, write it in the answer sheet. Write all derivations in your answer book. Return the question sheet, the answer book and the answer sheet all signed.. Please, do not forget to write your name on all three items that you have to return.

Select the MOST appropriate answer.

Q1. Milling cutters have multiple cutting edges. Most of these cutting edges are shaped helical. What is the benefit of having helical cutting edges?

A: 1. The chips are broken and the surface is not altered by the chips rubbing against the work
(2.) The distribution of cutting forces is more uniform
3. The life of the cutting tool is significantly extended
4. The cooling fluid has a better circulation through the tool-work system

Q2. Turning could yield cylindrical surfaces as well as tapered surfaces. What is the attachment that enables tapered cutting of a cylindrical stock bar?

A: 1. The division head
(2.) The Taper attachment
3. The tapered mandrel
4. The four-jaw self centering chuck

Q3. The life of the cutting tool depends of the cutting parameters, the material of the tool and work and on other variable of the process. However, the first formulation of Taylor in 1907, still actual on the life of the cutting tool takes into consideration only two most significant parameters out of the ones mentioned above. The two parameters are:

A: 1. The material of the tool and the material of the work
(2.) The material of the tool and the cutting speed
3. The material of the tool and the cutting feed
4. The material of the work and the chip thickness

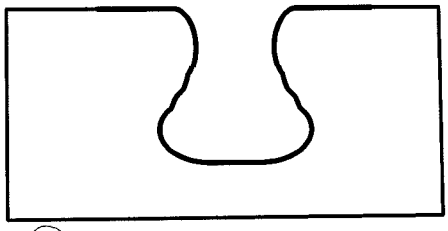
Q4. During metal cutting, a significant amount of heat is generated. The heat is distributed among the chip, tool, work and the cutting fluid. What is the type of regime at which the cutting is recommended?

A: 1. Slow speeds to enable heat removal
2. Optimal speed, such that the heat is optimally distributed
3. High speed, for better distribution of heat among the four bodies
4. The optimization of heat is carried out through the optimal feed rate.

Q4) As a workshop manager, you have to be constantly aware of the effectiveness of the metal cutting process. The effectiveness of the cutting expressed through the shear angle can be adjusted through a judicious sharpening of the cutting tool. Which geometric feature of the cutting tools would you recommend to improve the efficiency of the cutting, according to the theory of the orthogonal cutting?

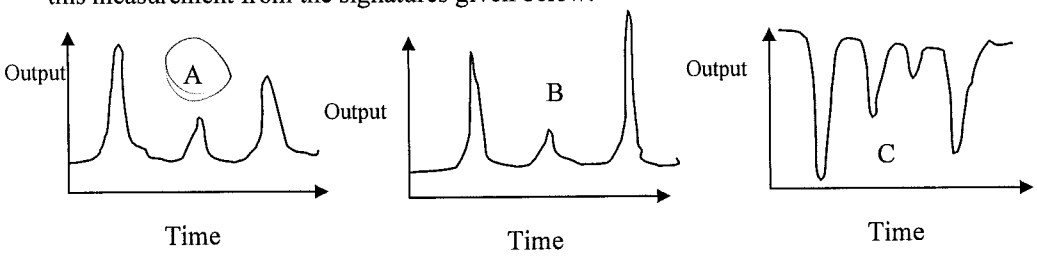
A) Relief angle B) Tool wedge angle C) Tool width D) Back rake angle

Q5) What type of milling cutter you would suggest to machine a slot with the geometry as shown below. (Hint: The length of the slot is very long compared to the slot width, width of the slot is in the order of 1.5")



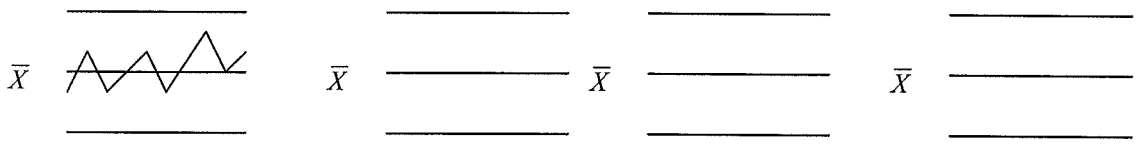
A) Form Slab milling B) Form end milling C) Angle milling D)Slot milling

Q6) An inspector has carried out the ultrasonic inspection of a few plates of different thicknesses using pulse-echo technique in order to detect cracks. Identify the real output of this measurement from the signatures given below:



D) None of the above

Q7) Which of the following processes raises concern?



A) B) C) D)

Q8) What is the most appropriate sequence of hot hardness from the worst to the best in terms of their cutting speed.

a) Ceramics
b) Diamond
c) HSS
d) Carbon and Low/medium alloy steels

A)a-b-c-d B) c-a-b-d C) d-b-a-c D) d-c-a-b

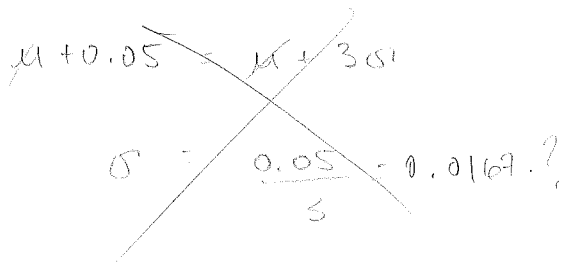
Q9) In a finishing orthogonal metal cutting operation with the cutting speed of 20m/min and 0° back rake angle, what would be the chip velocity if the material shears at 45^0?

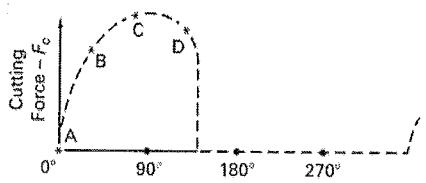
A) 20m/min B)10m/min C) 28.28m/min D)14.142 m/min

Q10) Assume you are production in-charge to establish a manufacturing process for making a part with a tolerance of +/- 0.05mm. What will be the maximum standard deviation you would aim in order to qualify the process for production?

A) 0.1252mm B)0.01252mm C)0.0250mm D) 0.1000mm

Q11) The figure given below schematically illustrates the magnitude of the cutting force (acting on a single tooth of a milling cutter) with respect to the spindle position. Identify the machining method.





A) Downward Turning B) Upward Turning C)Upward milling D) Downward milling

Q12) In a finishing orthogonal metal cutting operation with the cutting speed of 100m/min and 0^0 back rake angle, what would be the chip thickness if the material shears at 45^0 and the uncut chip thickness is 2mm?

(Note: $r_c = \frac{t}{t_c} = \frac{\sin\phi}{\cos(\phi-\alpha)}$, $\tan\phi = \frac{r_c\cos\alpha}{1-r_c\sin\alpha}$, $\varepsilon = \frac{2\cos\alpha}{1+\sin\alpha}$)

A) 2mm B)1mm C) 1.414mm D)2.828mm

Ans: the r_c = (sin45/cos(45-0))=tan45=1 → t=tc → t=2mm.

Q13) Identify the part that will not be useful in drilling a hole of 1" through a rectangular slab (6"x4"x1") in Lathe machine.

A) Tail-Stock Assembly B) Four-Jaw chuck C) Self-centering chuck D)quill shaft

Q14) Identify a method that will be used for surface crack detection.

A) FPI B) Eddy current C) X-Ray D)Ultrasonic

Q15) Identify a part that will needed for turning outside diameter of a shaft held "in-between" two centers in a Lathe machine

A) Dog plate B) Collete C)indexing head D)Mandrel

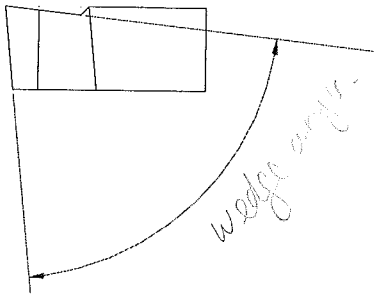
Q16) Identify the critical parameter that influences the thrust force in drilling.

A) helical angle B) Point angle C) Chisel edge D) Lip

Q17) Which is the right sequence for machining a hole in order to get very close positional tolerance and size tolerance:

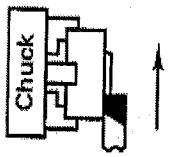
A) centering drill-drilling-reaming
B) centering drill-drilling-boring
C) Drilling-centering drill- boring
D) centering drill-drilling-boring-reaming

Q18) Identify the angle maked below for the cutting tool



A) Bake Rake angle B) Wedge angle C) Relief angle D) Side rake angle

Q19) What is name of the machining shown in the following scheme

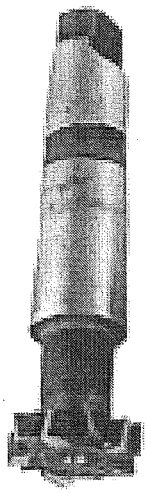


A) Turning
B) Facing
C) Knurling
D) End milling

Formatted: Bullets and Numbering

Q20) Name the cutter shown in the figure.

A) Form mill cutter B) Reamer C) T-slot cutter D) drill



8) The thickness of a slab of 75x300mm is reduced by 8mm with an **end** milling cutter of 100mm diameter and 150mm long with 10 teeth. The maximum allowed cutting speed and depth of cut are 20m/min and 4mm. The maximum feed per tooth is 0.25mm. Consider **no** cutting allowance and selecting the proper direction of cutting for maximum MRR. The specific power of the workpiece is 1.3 Ws/mm^3, and the mechanical efficiency is 75 %. The machining cost is 100$/hour.

Find out the following:

a) The maximum possible width of the cut
b) The maximum rpm of the cutter
c) The maximum feed per minute
d) The total cutting time
e) The maximum MRR
f) The actual MRR
g) The motor horse power required.
h) The total machining cost

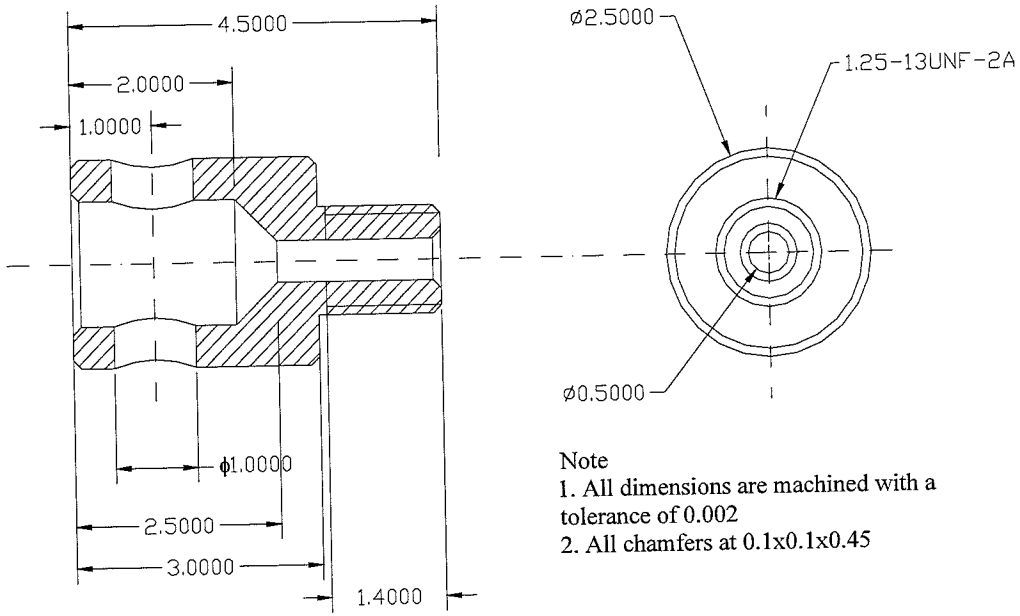
Problem #1

Read carefully the drawing below. The part is made from low carbon steel from a stock bar. Assume the bars 18 ft long, Ø3", the parting width is 0.2 in

a) Calculate the quantity of stock material in lbs to produce 200 units of the part.
b) How many stock bars one has to acquire to complete the work?
c) How much material will be removed as chips form the original stock bars.
d) Assume the cylindrical cut at a feed rate of 0.02 in/rev. Assume that one has to ensure a cutting speed of 160 ft/min under the most disadvantageous cutting conditions.

Calculate the RPM of the lathe to ensure that speed on the minimum external cylindrical feature.

e) If the maximum chip thickness is 0.1 in, what is the cutting time for the external shape of the part? The calculation will ignore the allowance and will be performed for one single component.
f) Calculate the MRR for the external cylindrical cut.
g) Which is the RPM of the lathe to ensure a cutting speed of minimum 60 ft/min?
h) Assume the drilling feed 0.05 in/rev, what is the cutting time to drill the initial hole?
i) Calculate the MRR for the drilling process.



Note
1. All dimensions are machined with a tolerance of 0.002
2. All chamfers at 0.1x0.1x0.45

The Solution Sheet

Q1 ① ② ③ ④

Q2 ① ② ③ ④

Q3 ① ② ③ ④

Q4 ① ② ③ ④

Q5 ① ② ③ ④

Q6 ① ② ③ ④

Q7 ① ② ③ ④

Q8 ① ② ③ ④

Q9 ① ② ③ ④

Q10 ① ② ③ ④

Q11 ① ② ③ ④

Q12 ① ② ③ ④

Q13 ① ② ③ ④

Q14 ① ② ③ ④

Q15 ① ② ③ ④

Q16 ① ② ③ ④

Q17 ① ② ③ ④

Q18 ① ② ③ ④

Q19 ① ② ③ ④

Q20 ① ② ③ ④

Please, write the answer to the problems in the allocated boxes below

Question	The calculated value	The units
a		
b		
c		
d		
e		
f		
g		
h		
i		