AUB American University of Beirut

الجامعة الأميركية في بيروت

Faculty of Engineering and Architecture

Mechanical Engineering Department

CLOSED BOOK / OPEN MIND Ninety (90) minutes

Please sign and date this front sheet PRIOR to working on this test.

I, the undersigned, and in the process of taking this test, pledge that I

will conduct myself in a professional manner

will not communicate with other examinees regarding the subject-matter of this test while this test is in session and will ONLY communicate with the teacher administering this test

will use only what is handed to me with the exception of a calculator & pens

acknowledge that I am familiar with FEA's "Rules and Regulations on Disciplinary Action" and understand that in case of policy violation, that I, myself, will be responsible for the consequences of my actions.

STUDENT NAME _____

STUDENT ID _____

STUDENT SIGNATURE _____

DATE _____

I. QUALITATIVE QUESTIONS

use the provided scantron form marked B-1 to answer the following fifty (50) questions

All the qualitative questions are graded equally one (1) point each.

No penalty for wrong answer, so make sure you answer all questions.

1. Version B: Fill-in the APPROPRIATE version of your question sheet on the Scantron (this is not graded).

b-B

A Machining Overview

2. In drilling, the chisel edge is a 'mixed blessing' since it, on one hand, reduces the tendency of the drill to wonder (thus improving the accuracy of the drilled hole) while, on the other hand, significantly increases the thrust force needed to feed the tool.

A- True

B- False

3. A tell-tale sign of a lathe-turned part are the helical marks made by the contact of the single-point tool with the work. The pitch of these marks correspond with the feed rate.

A- True

B- False

4.In drilling, a rotating tool generally cuts a circular hole using the cutting edges -also called 'lips'- located at the end of the tool. Also located at the tip where the flutes connect lies the chisel edge which does not exactly cut but rather makes and indentation in the work.

A- True

B- False

5. On a cutting machine, the three parameters that need to be set by the operator are: feed, cutting speed, and depth of cut.

A- True

B- False

6. Collectively, speed, feed, and depth of cut are called the cutting conditions. They form the three dimensions of the machining process, and for certain operations their product can be used to obtain the material removal rate for the process.

A- True

B- False

7. Finishing operations are typically carried out at low feeds and depths of cut.

A- True

B- False

8. When ductile work materials are cut at high speeds and relatively small feeds and depths, long continuous chips are formed.

A- True

B- False

9. On a lathe, a _____ is best suited for processing of continuous bar stock.

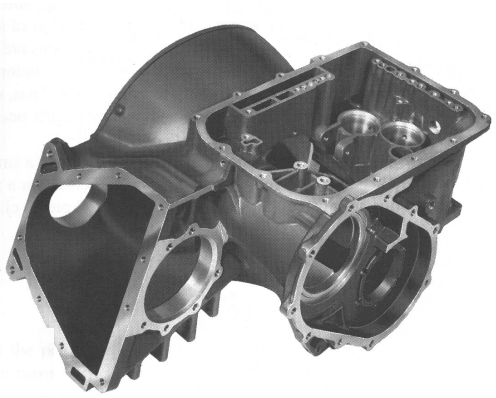
A- 3-jaw chuck

B- collet

C- dog plate

D- adjustable face plate

E- none of the above



10. On this transmission case, this machined surface (appears lighter than the gray casting) was most likely face milled.

A- True

B- False

11. This machining operation is called _____ .

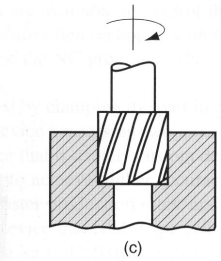
A- Boring

B- Chamfering

C- Reaming

D- Contouring

E- None of the above



12. The angle made by the tool's flank and the newly machined surface is known as the:

A- Rake angle

B- Relief angle

C- Shear angle

D- Friction angle

E- None of the above

13. If the cutting conditions in a turning operation are v = 300 ft/min, f= 0.010 in/rev, and d = 0.100 inch, which of the following is the material removal rate?

A- 0.035 in^3/min

B- 0.3 in^3/min

C- 3.6 in^3/min

D- 6.3 in^3/min

E- none of the above

14. For which of the following values of chip thickness before the cut would you expect the specific energy to be the greatest?

A- 0.005 mm

B- 0.01 mm

C- 0.20 mm

D- 0.60 mm

E- all have identical specific energy

B Cutting Mechanics

15. In machining, the dynamic coefficient of friction between the tool and workpiece is less than those measured in common friction applications.

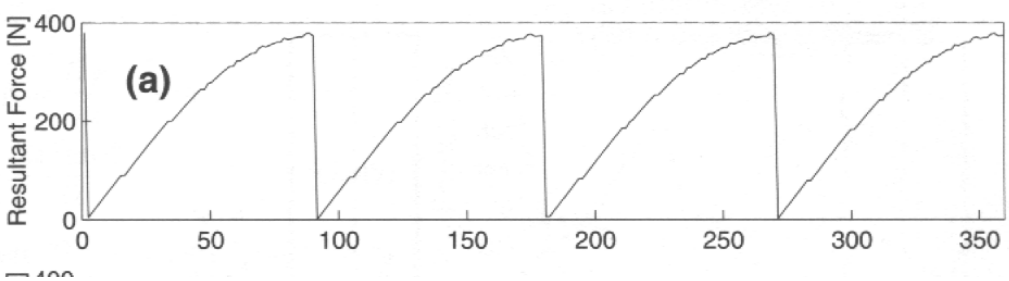
A- True

B- False

16. the following plot of cutting forces vs. time (or frequency) likely belong to a turning process.

A- True

B- False



17. The shear strains encountered in typical machining operations are significantly LARGER than those typically encountered in engineering applications.

A- True

B- False

18.the main reason why cutting tools with negative rake angles were invented is to reduce the forces along the shear plane.

A- True

B- False

19. At higher cutting speeds, most of the energy is carried off with the chip making the tool actually run cooler!

A- True

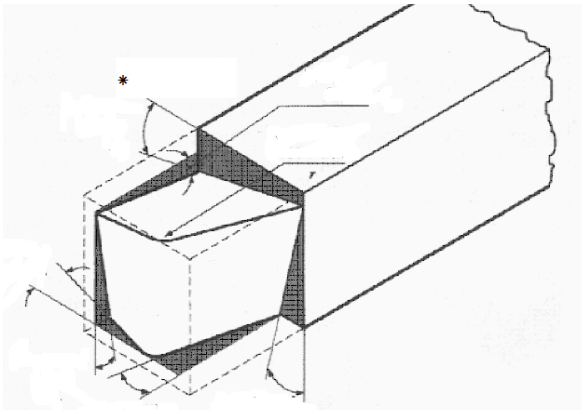
B- False

20. Converting turning operation 'lingo' to that of orthogonal cutting: feed and depth of cut in turning correspond to uncut chip thickness and width of cut in orthogonal cutting, respectively.

A- True

B- False

21. On this metal cutting tool, the angle marked on by an asterisk (*) represents the back rake angle.



A- True

B- False

C Machining Technology

22. Chronologically-speaking, carbide-based cutting tools were introduced into the market place prior to tools based on alumina-based ceramics.

A- True

B- False

23. One major consequence to reducing the tool face friction w/ the workpiece is the reduction in the friction angle.

A- True

B- False

24. Carbide inserts retain 'hot hardness' even at high machining temperatures where high speed steels (HSS) lose theirs.

A- True

B- False

25. Neither straight-carbide nor diamond cutting tools are suitable for machining steels.

A- True

B- False

26. Gold-colored carbide cutting inserts (such as the ones shown in class) indicate a TiN (titanium nitride) coating on the surface of the tool. This coating is known for its low friction.

A- True

B- False

27. Tool manufactures utilize ultra-fine grains in order to improve the toughness of carbide cutting tools.

A- True

B- False

28. Which of the following is a NOT an ingredient in ‘cermet’ cutting tools?

A- Al_2O_3

B- TiCN

C- TiC

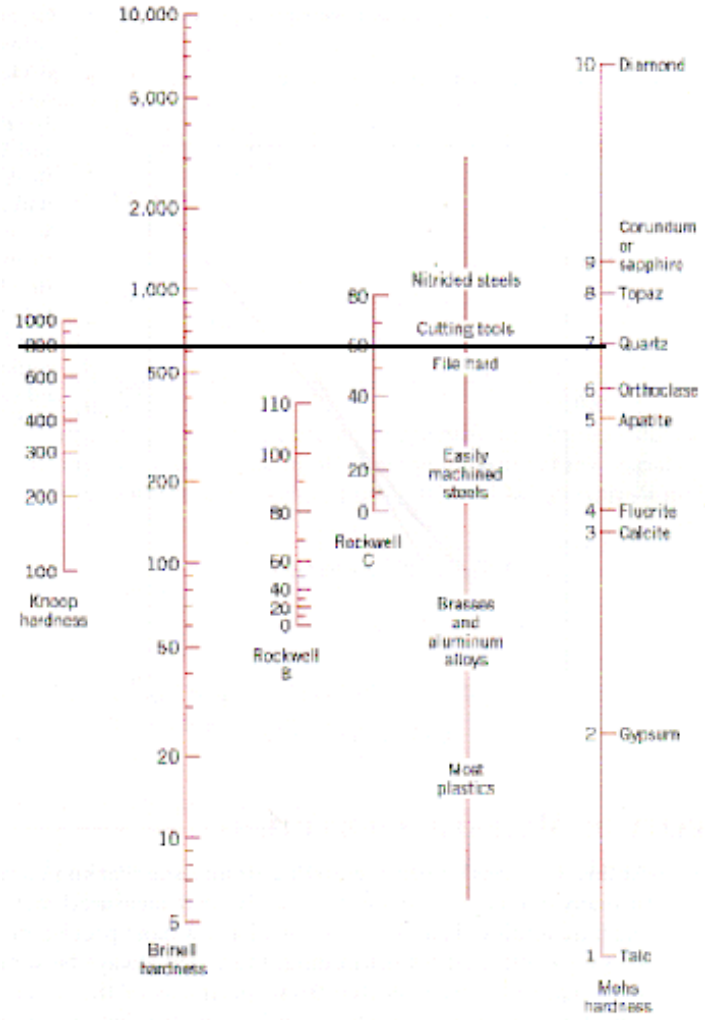
D- WC

E- TaC

29. As shown in class, the horizontal line describes the room temperature hardness of alumina ceramic.

A- True

B- False



30. Carbide tools containing ‘complex’ WC-TiC-TaC carbides are recommended for cutting steels.

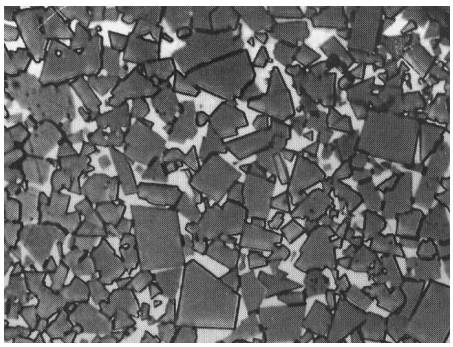
A- True

B- False

31. If you were to examine a cross section of a carbide cutting tool (such as the one shown), you will find out that the ‘binder’ is actually a metal.

A- True

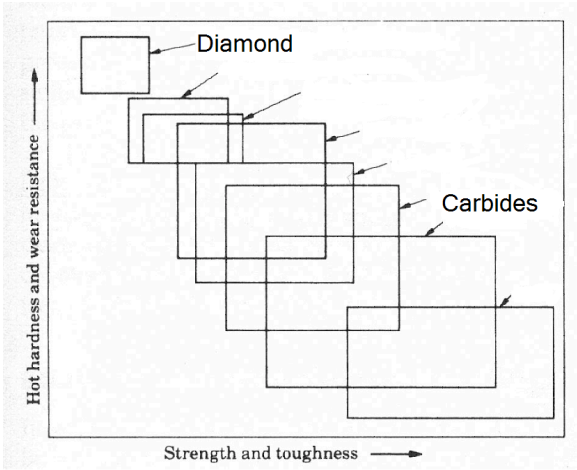
B- False



32. On this plot, the relative position of Carbides and Diamond is correct as shown.

A- True

B- False



33. M (molybdenum-based) high speed steels generally have higher abrasion resistance than the T (tungsten-based) HSS.

A- True

B- False

34.This plot shows the hardness of HSS as a function of _____

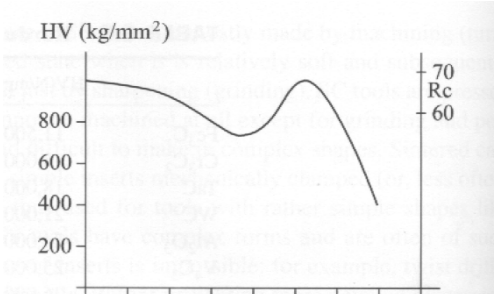
A- wt% of C

B- wt% of Cr

C- wt% of V

D- wt% of Co

E- none of the above

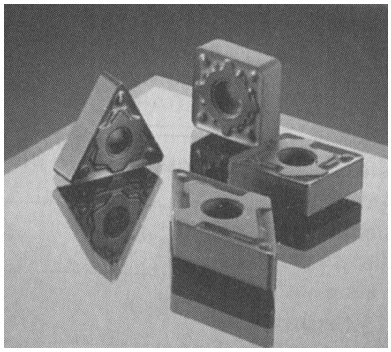


35. The ISO & ANSI standards for carbide tools designates the steel-cutting tools as P grades while the non-steel-cutting grades as K grades where lower grade numbers favor high speeds (requiring high hardness) and higher grade numbers favor high feeds (requiring higher strength).

A- True

B- False

36. Which of the following processes are used to provide the thin coatings on the surface of coated carbide inserts (such as the ones shown)?



A- Casting

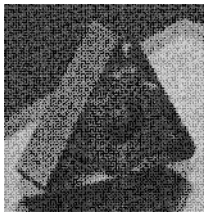
B- Electroplating

C- Physical vapor deposition

D- Pressing and sintering

E- All of the above.

37. This negative-rake, indexable cutting insert has _____ cutting edges.



A- 3

B- 6

C- 9

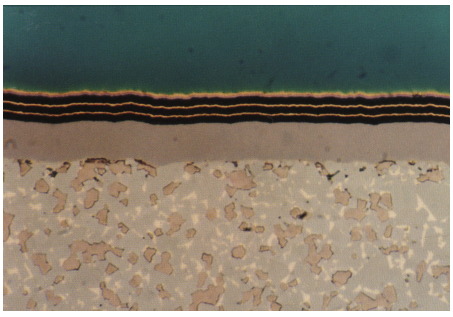
D- 12

E- none of the above

38. Titanium carbide TiC gives the lowest coefficient of friction with a steel chip; therefore TiC is a favorite material to apply as the outermost layer in multi-layer coating of cutting tools (such as the one shown).

A- True

B- False



39. Diamond and SiN-base tools are not suitable for machining steels

A- True

B- False

40. Given the choice to use CBN or diamond tools to cut a “super-alloy”, you hot-shot AUB mechanical engineering graduate should choose:

A- CBN

B- Diamond

41. Friction between chip and tool plays a detrimental role in the cutting process. This friction may be reduced by any of the following except one. Identify this exception:

A- Improved tool finish and sharpness of the cutting edge

B- Increased cutting speed

C- Increased rake angle

D- Use of a cutting fluid

E- None of the above

42. Increasing the shear angle increases the shear plane temperature.

A- True

B- False

43. Recommended feeds for drilling depend on the size of the drill.

A- True

B- False

44. Of all the root mechanisms of wear, plastic deformation contributes mainly to flank wear, (abbreviated as FW or also commonly referred to as VB from German).

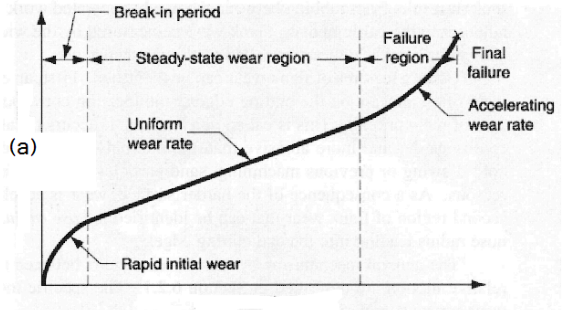
A- True

B- False

45. On the following characteristic plot, the y-axis marked (a) represents time of machining.

A- True

B- False



46. Base steel B 1112 steel is assigned the best machinability rating (MR) of 1.00. All other metals have lower MR values than this base steel's.

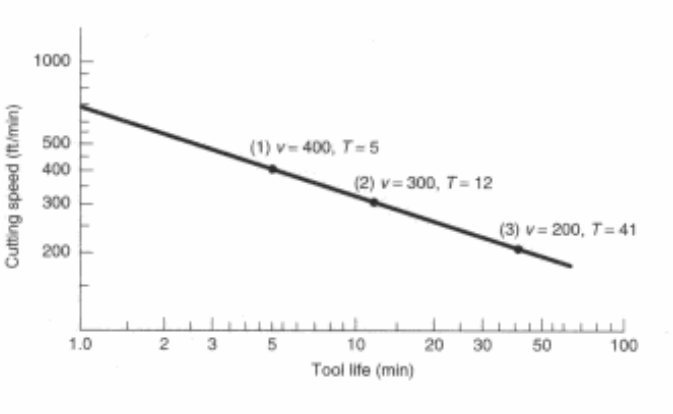
A- True

B- False

47. The slope of such a plot represents the parameter n in the Taylor tool life equation. The larger this parameter, the faster the tool wears.

A- True

B- False



48. Ceramics and carbides have larger n values than HSS.

A- True

B- False

49. Considering optimizing cutting speeds for maximum production rate, tool change time per workpart decreases as the cutting speed increases..

A- True

B- False

50. In optimizing cutting speeds for maximum production rate, three time elements are considered while in optimizing cutting speeds for minimum unit cost four cost elements are considered three of which relate to the three used in maximum production rate (through a cost rate or cost per minute basis, c). the fourth remaining element is:

A- tool change cost

B- tooling cost

C- part change cost

D- part handling time

E- none of the above.

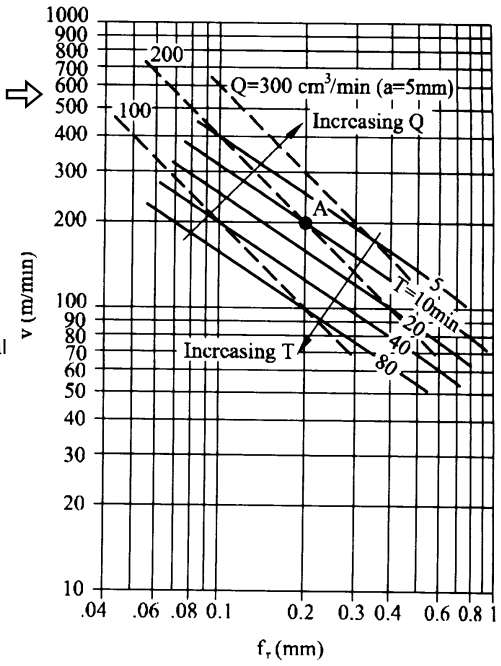
CONTINUE THE TEST: USE THE PROVIDED SCANTRON FORM MARKED B-2 TO ANSWER THE FOLLOWING 14 QUESTIONS

51. As the value of the Taylor tool life equation parameters C and n increases, the optimum cutting speed increases. Similarly, as the cost of the tool increases, so does optimum cutting speed.

A- True

B- False

52. In a particular machining process, the tool life equation is plotted in the following figure. For a tool life of 10 min, in which direction does it make more production sense to move on the line T = 10 min?



A- to the right

B- to the left

C- moving in either direction would have the same results on productivity.

53. On your next machine design project, you require to lathe-turn a cylindrical shaft of diameter of 0.35 in. On the part drawing, you assign a tight dimensional tolerance of ± 0.002 in. Can this be fabricated as specified?

A- True

B- False

54. FOR THE SAME LATHE-TURNED SHAFT, you assign a surface average roughness of 16 μ in (incidentally a good surface finish!). Can this shaft be fabricated as specified?

A- True

B- False

55. With the same feed, a larger nose radius causes the feed marks to be less pronounced, thus leading to a better finish.

A- True

B- False

II. QUANTITATIVE QUESTIONS

THe FOLLOWING quaNtITative questions are NOT EQUALLY graded

NO PENALTY FOR WRONG ANSWER, SO MAKE SURE YOU ANSWER ALL QUESTIONS.

A Machining Overview

A slab milling operation on a rectangular workpiece 10 in. long x 3 in. wide involved using helical milling cutter with diameter of 2.5 in and 8 teeth which is setup to overhang the work on both sides. Operation used feed of 0.009 in/tooth, speed of 100 ft/min, and depth of cut=0.25 in.

56. Find the time needed to make one milling pass across the surface. (5 points)

A- 0.36 min

B- 0.63 min

C- 0.98 min

D- 1.33 min

E- none of the above

Drilling blind hole with a twist drill of diameter 1.0 in and depth of cut =2.0 in. if the drill has point angle of 118 degrees and if periphery cutting speed = 75 ft/min and feed of 0.012 in / rev.

57. Find the cutting time needed to drill the hole in workpiece. (5 points)

A- 0.67 min

B- 0.97 min

C- 1.36 min

D- 3.16 min

E- none of the above

B Cutting Mechanics

A turning operation involved using a HSS tool that has a rake angle of 10° to turn a workpiece using these cutting conditions

depth of cut=0.1 in

cutting speed=300 ft/min

f = 0.01 in/rev

chip ratio= 0.42

Assume constant shear strength of the work material of 40,000 lb/in2. Using the orthogonal model as an approximation of turning, calculate:

58. The shear plane angle (2.5 point)

A- 12°

B- 18°

C- 24°

D- 28°

E- none of the above

59. The shear force along the shear plane (2.5 point)

A- 28.9 lb

B- 98.2 lb

C- 128.9 lb

D- 219.8 lb

E- none of the above

60. The cutting force (2.5 point)

A- 179 lb

B- 297 lb

C- 327 lb

D- 732 lb

E- none of the above

61. The specific cutting energy for the work material (2.5 point)

A- 179,000 in-lb/in^3

B- 299,000 in-lb/in^3

C- 379,000 in-lb/in^3

D- 971,000 in-lb/in^3

E- none of the above

In an orthogonal cutting operation, given cutting speed= 4 m/s, uncut chip thickness =0.3 mm, width of cut = 2 mm, cutting force = 1100 N.

Work material properties: mass specific heat=1.1 J/g-C, density = 2.7 g/cm^3 , thermal diffusivity=0.9 cm^2/s.

62. If ambient temperature = 20°C, use the Cook equation to find the mean temperature at the tool-chip interface. (2.5 points)

A- 405°C

B- 565°C

C- 585°C

D- 655°C

E- none of the above

Tool life tests in turning yield the following data: (1) v = 100m/min, T=10 min, (2) v= 100m/min, T=30 min

63. Determine the n and C values in the Taylor tool life equation.

A-

B-

C-

D-

E-

Based on your equation,

64. compute the tool life for a speed of 90 m/min

A-

B-

C-

D-

E-