IE-352
Section 1, CRN: 32997
Section 2, CRN: 5022
Second Semester 1431-32 H (Spring-2011) – 4(4,1,1)
MANUFACTURING PROCESSES - 2

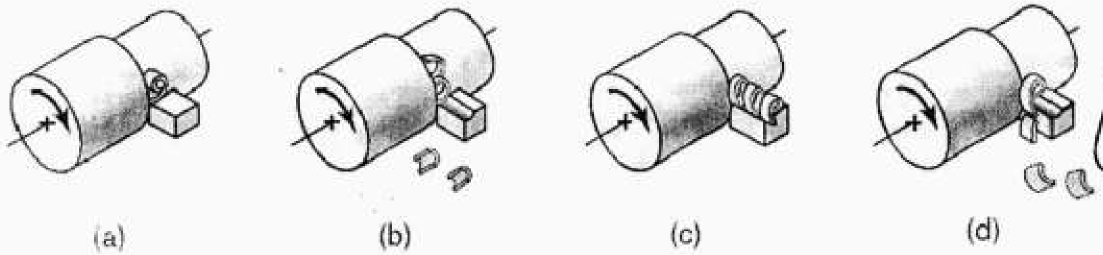
Saturday, May 28, 2011 (25/6/1432H)

Midterm 2 [10 POINTS] ANSWERS

Name:	Student Number:	Section:
Ahmed M. El-Sherbeeny	42	8:00 / 10:00

6.12.11

Place the correct letter in the box at the right of each question [$\frac{1}{2}$ Point Each]



1. **In which diagram(s) –above- does the chip hit the tool shank and break off?** E
   a. (a) and (b)
   b. (b)
   c. (c)
   d. (b) and (d)
   e. (d) → slide 28

2. **During metal cutting, what type of chip is partly deposited on the workpiece?** B
   a. Continuous chip
   b. Built-up edge chip → slide 23
   c. Serrated chip
   d. Discontinuous chip
   e. Possible for ALL types of chips

D

3. **Label the diagram shown below.**

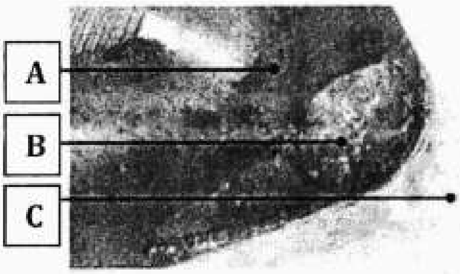
   a. A: flank face; B: crater wear; C: rake face

   b. A: rake face; B: flank wear; C: flank face

   c. A: rake face; B: nose wear; C: flank face

   d. A: rake face; B: crater wear; C: flank face → slide 52

   e. A: flank face; B: flank wear; C: rake face



C

4. **What carries most of the heat generated during metal cutting?**

   a. Tool: rake face

   b. Tool: flank face

   c. Chips → slide 48

   d. Workpiece

   e. The tool, chips, and workpiece carry almost equal ratios of the heat

E

5. **What is the location of maximum temperature encountered during cutting?**

   a. the location where the chip leaves the rake face

   b. the middle of the shear zone

   c. about half-way up the flank face

   d. tool-tip

   e. about half-way up the tool-chip interface → slide 46

D

6. **Which of the following is true regarding *helical cutting*?**

   a. as inclination angle increases, chip becomes thicker and cutting force decreases

   b. as inclination angle increases, chip becomes thicker and cutting force increases

   c. as inclination angle increases, chip becomes thicker and cutting force is the same

   d. as inclination angle increases, chip becomes thinner and cutting force decreases → slide 30

   e. as inclination angle increases, chip becomes thinner and cutting force increases

A

7. **Which of the following is true regarding *shaving* and *skiving*?**

   a. Shaving can be used to improve the dimensional accuracy (unlike skiving) → slide 31

   b. Shaving is used in cutting a combination of shapes (unlike skiving)

   c. In shaving, a cutting tool moves tangentially across the workpiece (not skiving)

   d. Shaving is used to remove thin layers of material (unlike skiving)

   e. Shaving usually produces a lower surface finish than in skiving

8. **Which of the following is true regarding *surface finish* and *integrity*?** C
   - a. Surface finish (unlike integrity) pertains to the material properties of the workpiece
   - b. Surface integrity (unlike finish) pertains to the geometry of the workpiece
   - c. Surface finish (unlike integrity) determines how well the part performs in service → Slide 69
   - d. Surface finish (unlike integrity) is affected by the nature of the surface
   - e. Surface integrity (unlike finish) affects the dimensional accuracy of the workpiece

9. **Machinability is defined in terms of ALL the following, except...** D
   - a. Force and power required
   - b. How easily the chip is removed
   - c. Tool life
   - d. Workpiece and tool material → Slide 75
   - e. Surface finish and surface integrity of machined part

10. **Inclusions acting as stress raisers in the shear zone are added to what steel type?** E
    - a. Leaded steels
    - b. Alloy steels
    - c. Carbon steels
    - d. Stainless Steels
    - e. Free-machining steels → Slide 78

11. **What is associated with a "dull" tool?** B
    - a. tool tip radius > depth of cut; +ve rake angle; no chips produced
    - b. tool tip radius $\boxed{>}$ depth of cut; -ve rake angle; no chips produced → Slide 71
    - c. tool tip radius > depth of cut; -ve rake angle; discontinuous chips produced
    - d. tool tip radius < depth of cut; +ve rake angle; discontinuous chips produced
    - e. tool tip radius = depth of cut; -ve rake angle; continuous chips produced

12. **Which of the following is a *direct method* used to monitor tool conditions?** A
    - a. sensor used to detect broken tools after every machining cycle → Slide 68
    - b. radiation pyrometer
    - c. sensors which measure temperature during machining
    - d. transducers which correlate acoustic emissions to tool wear and chipping
    - e. transducers which continually monitor torque and forces during cutting

13. **How much should the feed be reduced in order to keep the mean temperature constant when the cutting speed is tripled (use, $a = 0.5, b = 0.375$)?**

B

a. 23.1%

[✓ b. 76.9%]

c. 43.9%

d. 56.1%

e. 12.8%

$T_{mean} \propto V^a f^b$

$T_{mean} = \text{Const}\,;\ V_2 = 3V_1\,;$

$\Rightarrow V_1^{0.5} f_1^{0.375} = V_2^{0.5} f_2^{0.375}$

$= (3V_1)^{0.5} f_2^{0.375}$

$\Rightarrow \left(\frac{f_2}{f_1}\right)^{0.375} = \left(\frac{V_1}{3V_1}\right)^{0.5} = 3^{-0.5}$

$\Rightarrow \frac{f_2}{f_1} = 3^{\frac{-0.5}{0.375}} = 3^{-4/3} = 0.2311 \Rightarrow \frac{f_1 - f_2}{f_1} = 1 - \frac{f_2}{f_1} = 1 - 0.2311 = 0.7688$

$\Rightarrow \boxed{\text{feed reduc}^n = 76.9\%}$ ◀

14. **In a turning operation, if the speed is increased by 75%, how much should the feed be reduced to obtain a constant tool life (use, $n = 0.15, y = 0.6$)?**

E

a. 38.1%

b. 28.5%

c. 71.5%

d. 39.3%

[✓ e. 60.7%]

$V_2 = 1.75V_1$

$VT^n d^x f^y = C \Rightarrow V_1 T_1^n d_1^x f_1^y = V_2 T_2^n d_2^x f_2^y$

$T = \text{Const} \Rightarrow T_1 = T_2\,;$ assume $d_1 = d_2$

$\Rightarrow V_1 \cancel{T_1^n} \cancel{d_1^x} f_1^y = V_2 \cancel{T_2^n} \cancel{d_2^x} f_2^y \Rightarrow V_1 f_1^y = V_2 f_2^y = 1.75 V_1 f_2^y$

$\Rightarrow \left(\frac{f_2}{f_1}\right)^y = \frac{V_1}{1.75V_1} = \frac{1}{1.75} \Rightarrow \frac{f_2}{f_1} = 1.75^{(-1/0.6)} = 0.3935$

$\Rightarrow$ feed reduction $= 1 - \frac{f_2}{f_1} = 0.6065 = \boxed{60.7\%}$ ◀

15. **Determine the feed for $R = 0.5\ mm$ and desired roughness of $10\ \mu m$?**

A

[✓ a. 0.20 mm/rev]

b. 0.20 m/rev

c. 0.070 mm/rev

d. 0.070 m/rev

e. 6.3 mm/rev

$R = 0.5mm$

$R_t = 10\mu m$

$f = ?$

$R_t = \frac{f^2}{8R} \Rightarrow f^2 = (8R)(R_t) \Rightarrow f = \sqrt{(8R)(R_t)}$

$\Rightarrow \underline{f} = \sqrt{(8)(0.5\times10^{-3})(10\times10^{-6})} = 0.0002\ m/rev = \boxed{0.20\ mm/rev}$ ◀

16. **In Q15 above, how would you account for nose wear during extended cuts?**

C

a. decrease the depth of cut

b. decrease the feed

c. increase the feed → slide 72 (as nose wear ↑ ⇒ R ↑

⇒ to keep R_t Const ⇒ f ↑)

d. increase the cutting speed

e. decrease the cutting speed

Q 17-20. Consider the *Taylor Equation* for tool life, letting $n = 0.2$. A high speed steel (HSS) tool was first used in machining a workpiece at a cutting speed of $50\ m/min$, resulting in a tool life of $25\ min$. The process was then repeated under similar conditions with the cutting speed reduced by 50%.

D

17. **What is *Taylor Equation* for this workpiece and tool material**

- a. $VT^n = C$
- b. $VT^{95.18} = 0.2$
- c. $VT^{0.2} = 54.67$
- [✓ d. $VT^{0.2} = 95.18$]
- e. $VT^{50} = 54.67$

$n = 0.2$

$V_1 = 50\ m/min;\ V_2 = 25\ m/min$

$T_1 = 25\ min$

$VT^n = C \Rightarrow (50)(25)^{0.2} = C$

$\Rightarrow C = (50)(1.90) = 95.18$

$\Rightarrow \boxed{VT^{0.2} = 95.18}$ ◄

C

18. **What is the percent change in *tool life* between the two operations?**

- a. a 100% increase
- b. a 32-fold increase (i.e. 3200%)
- [✓ c. a 31-fold increase (i.e. 3100%)]
- d. a 2.4-fold increase (i.e. 240%)
- e. a 1.4-fold increase (i.e. 140%)

$V_1 T_1^{0.2} = V_2 T_2^{0.2}$

$\Rightarrow \left(\frac{T_2}{T_1}\right)^{0.2} = \frac{V_1}{V_2} = \frac{V_1}{0.5V_1} = 2$

$\Rightarrow \left(\frac{T_2}{T_1}\right) = 2^{1/0.2} = 2^5 = 32$

$\Rightarrow T_2 = 32\, T_1 = (32)(25 min) = 800 min$

$\Rightarrow \frac{T_2 - T_1}{T_1} = \frac{800}{25} - 1 = 32 - 1 = 31 = \boxed{3100\%}$ ◄

B

19. **What is the percent change in *material removed* between the two operations?**

- a. a 16-fold increase (i.e. 1600%)
- [✓ b. a 15-fold increase (i.e. 1500%)]
- c. a 31.5-fold increase (i.e. 3150%)
- d. a 32.5-fold increase (i.e. 3250%)
- e. a 100% increase

$change = V_2 T_2 - V_1 T_1$

$= (25\ m/min)(800\ min) - (50\ m/min)(25\ min)$

$= 18{,}750\ m$

$\Rightarrow \%\ change = \frac{V_2 T_2 - V_1 T_1}{V_1 T_1} = \frac{18{,}750}{1{,}250} = 15 = \boxed{1500\%}$ ◄

A

20. **What can be concluded for Q17-20?**

3100%   1500%

- a. decrease in cutting speed creates a <u>larger increase in tool life</u> than in <u>material removed</u>
- b. increase in cutting speed creates a larger increase in tool life than in material removed
- c. decrease in cutting speed creates a larger increase in material removed than in tool life
- d. decrease in cutting speed creates a larger decrease in material removed than in tool life
- e. decrease in cutting speed creates a larger decrease in tool life than in material removed