



**UTM**  
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of  
Mechanical Engineering

**FINAL EXAMINATION  
SEMESTER II, SESSION 2016/2017**

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**COURSE CODE : SKMM 2713 / SME 2713**

**COURSE NAME: MANUFACTURING PROCESSES**

**PROGRAMME : SKMM/SKMP/SKMI/SKMB/SKMT/SKMV/SKMO**

**DURATION : 3 HOURS**

**DATE : JUNE, 2017**

**INSTRUCTION TO CANDIDATES:**

**PART A: ANSWER ALL QUESTIONS.  
(QUESTION 1, QUESTION 2, QUESTION 3, AND QUESTION 4)**

**PART B: ANSWER ONLY ONE (1) OF TWO (2) QUESTIONS.  
(QUESTION 5 OR QUESTION 6)**

**ANSWER EACH QUESTIONS IN A NEW PAGE OF ANSWERS SCRIPT**

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**PART A (ANSWER ALL QUESTIONS)**

**QUESTION 1 (20 MARKS)**

A. The unit melting energy for aluminum is  $3.7 \text{ J/mm}^3$ . The thickness of each of the TWO (2) sheets to be spot welded is 4.0 mm. To achieve required strength, it is desired to form a weld nugget that is 6.0 mm in diameter and 3.0 mm thick. The weld duration will be set at 0.3 sec. If the electrical resistance between the surfaces is  $140 \times 10^{-6}$  ohms, and only one-third of the electrical energy generated will be used to form the weld nugget (the rest being dissipated), determine the minimum current level required in this operation.

(4 marks)

B. A 0.5 mm thick metal sheet is to be drawn with a limiting drawing ratio (LDR) of 1.8 to produce a cup (refer Figure Q1(B)) with an inside diameter of 50 mm and a height of 65 mm. Tensile strength is 175 MPa. Assume the thickness of the bottom and the walls of the cup remain unchanged.

- i. Calculate the diameter of the initial circular blank necessary.
- ii. For drawing the same initial circular blank, check if single drawing is enough and then if not, calculate the smallest possible punch diameter for the first step and estimate the number of redrawing necessary.
- iii. Calculate the drawing force for the first step.

(6 marks)

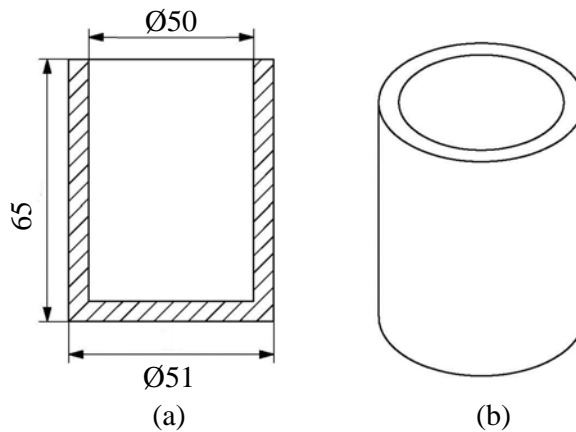


Figure Q1(B): (a) Detail dimension (b) final product

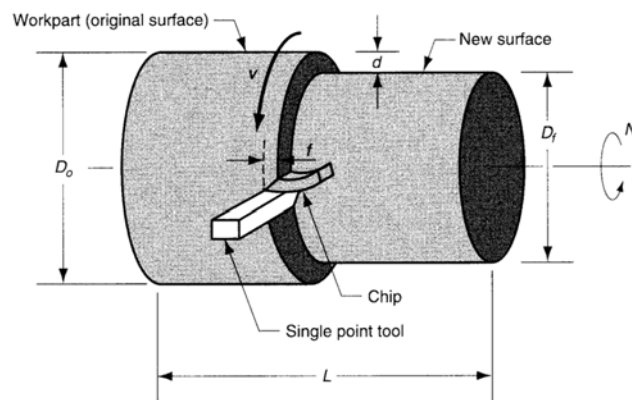
C. A cylindrical Stainless Steel with a  $\text{Ø}80$  mm and a length 200 mm, will be reduced to  $\text{Ø}70$  mm and 100 mm along the cylindrical by turning process in ONE (1) pass. The spindle rotates at 500 rpm, and the tool is travelling at an axial velocity of 200 mm/min.

(hint: *The specific cutting energy of Stainless Steel range from 3.0 – 5.3 W.s/mm<sup>3</sup>*)

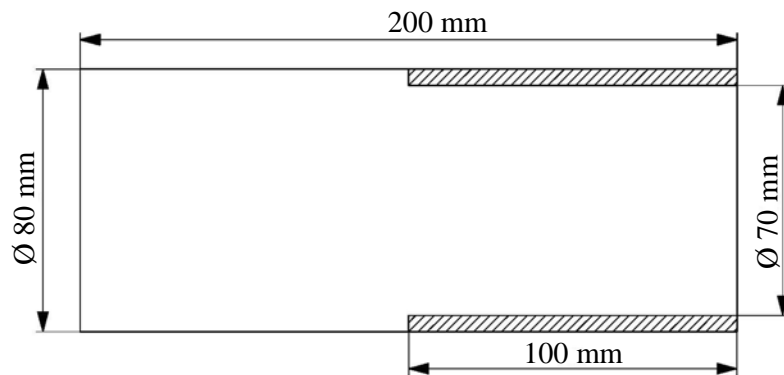
Calculate:

- i. The cutting speed
- ii. The material removal rate
- iii. The cutting time
- iv. The power required
- v. The cutting force

(10 marks)



(a)



(b)

Figure Q1(C): (a) Turning operation (b) Detail Dimension


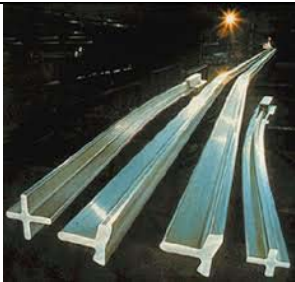

**QUESTION 2 (20 MARKS)**

- A. Define what is sustainable manufacturing? Explain what is the FOUR (4) basic area that Coca-Cola is focusing on?  
(5 marks)
- B. Describe TWO (2) reasons why Coca-Cola has to pay more attention in the sustainable manufacturing issues in the design and production of their products.  
(2 marks)
- C. In the hierarchy of recycling, differentiate what is meant by; (i) Reuse, (ii) Recycle, and (iii) Reduce. Gives ONE (1) example on how the application of (i), (ii), and (iii) is implemented in Coca-Cola.  
(6 marks)
- D. Discuss the possible target of sustainable manufacturing goals and the strategies to green manufacturing implemented in beverage companies like Coca-Cola. You may discuss based on the approach that is achievable by these companies.  
(7 marks)

**QUESTION 3 (20 MARKS)**

- A. Explain briefly, TWO (2) differences of between cold working and hot working in metal forming processes.  
(4 marks)
- B. Explain with the help of sketches in detail the blanking and punching process.  
(4 marks)
- C. Select any ONE (1) of the applications listed in Table Q3(C):

Table Q3(C): Metal forming products

	(a) Wire Rod	(b) T - Beam	(c) Conneting Rod
Product			
Dimension	Diameter: 5.0 mm	Length: 5.0 m Thickness: 5.0 mm	Length: 250.0 mm
Material	Steel	Aluminium	Stainless Steel

Then, answer the following:

- i. Suggest the most suitable metal forming process and justify your suggestion.
- ii. With aid of sketches, explain how the suggested process works.
- iii. Describe ONE (1) possible defects that may occur.

(6 marks)

D. Explain the main reason of occurring the defects shown in Figure Q3(D) that occurred during the rolling process and suggest a solution.

(6 marks)

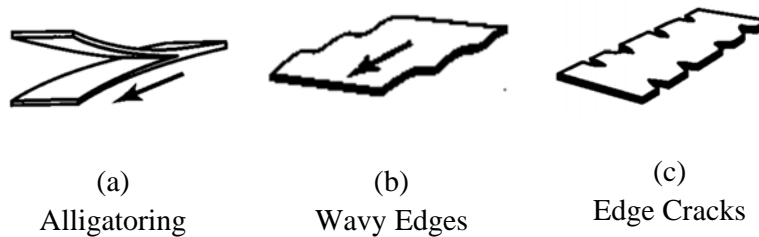


Figure Q3(D): Defects in Rolling process

#### QUESTION 4 (20 MARKS)

A. Identify TWO (2) situations in which brazing or soldering process is preferable to be used as compared with fusion welding. List TWO (2) advantages and TWO (2) disadvantages of brazing or soldering as compared with the welding process.

(5 marks)

B. Based on the description and welding processes in Table Q4(B) below;

Table Q4(B)

Descriptions	Welding processes
<ul style="list-style-type: none"> <li>• Uses a non-consumable electrode to produce the weld.</li> <li>• Most commonly used to weld stainless steel and nonferrous materials, such as aluminum and magnesium.</li> <li>• Pressure is not required during the process of welding.</li> </ul>	<ul style="list-style-type: none"> <li>• Oxy-acetylene welding (<b>OAW</b>)</li> <li>• Gas Metal Arc Welding (<b>GMAW</b>)</li> <li>• Resistance spot welding (<b>RSW</b>)</li> <li>• Gas tungsten arc welding (<b>GTAW</b>)</li> </ul>

i. Namely ONE (1) of the most suitable process based on the information given. With the help of sketches, clearly explain the principle of the welding operation.

(4 marks)

ii. Describe ONE (1) problem that may be faced in this welding process and ONE (1) method to overcome it.

(2 marks)

C. With the aid of appropriate sketches, explain the oxy-acetylene process with regards to the following aspects:

- i. The oxy-acetylene system, its characteristics and advantages compared to other welding processes.
- ii. Type of flames used in oxy-acetylene process.

(6 marks)

D. Choose ONE (1) of the types of non-destructive welding inspection (NDT) listed below. Explain with simple sketches to illustrate your explanation.

- i. Ultrasonic test.
- ii. Liquid penetrant test.
- iii. Magnetic particle test.

(3 marks)

**PART B: ANSWER ONLY ONE (1) OF TWO (2) QUESTIONS.  
(QUESTION 5 OR QUESTION 6)**

**QUESTION 5 (20 MARKS)**

A. What is Built-Up-Edge (BUE). Explain THREE (3) problems caused by the presence of Built-Up-Edge (BUE). (4 marks)

(4 marks)

B. Explain THREE (3) functions of a cutting fluid in machining operation. List FOUR (4) problems arise if no cutting fluid is used during machining. (5 marks)

(5 marks)

C. Refer to Figure Q5(C):

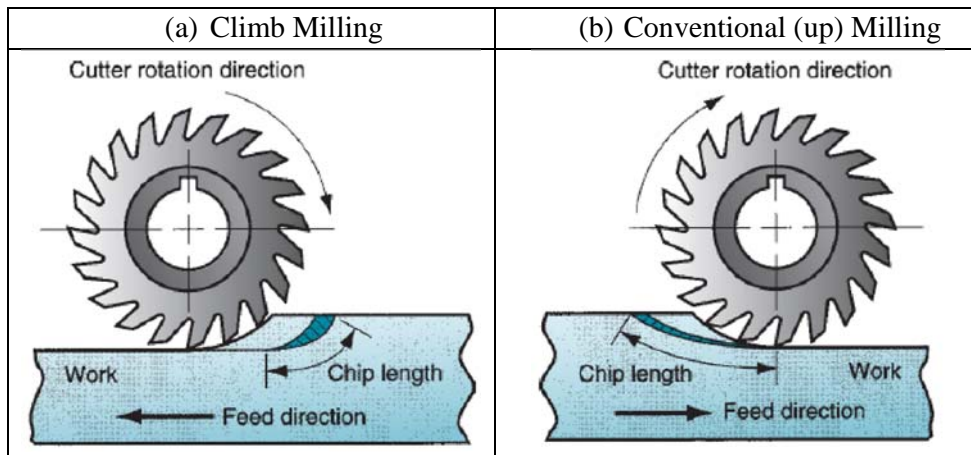


Figure Q5(C): Schematic of milling processes

- i. Explain TWO (2) advantages of climb milling as compared to up milling.
- ii. Why climb milling is less recommended when using an old milling machine?

(5 marks)

D. Explain in details the function of rake angle, and discuss at least TWO (2) differences between positive and negative rake angles in order to improve tool life. (6 marks)

(6 marks)

**QUESTION 6 (20 MARKS)**

- A. What is Built-Up-Edge (BUE). Explain THREE (3) problems caused by the presence of Built-Up-Edge (BUE). (4 marks)
- B. Explain THREE (3) functions of cutting fluids. (3 marks)
- C. In metal cutting operation, there are TWO (2) types of wear occurring on the cutting tool, i.e. flank wear and crater wear.  
i. With the aid of appropriate sketches, clearly explain both types of wear.  
ii. State TWO (2) effects of each type of wear towards the metal cutting operation. (6 marks)
- D. State with the help of sketches the basic steps in performing the soldering process. (3 marks)
- E. Refer the Figure Q6(E), name the type of extrusion process shown. State TWO (2) advantages and TWO (2) disadvantages of this process. (4 marks)

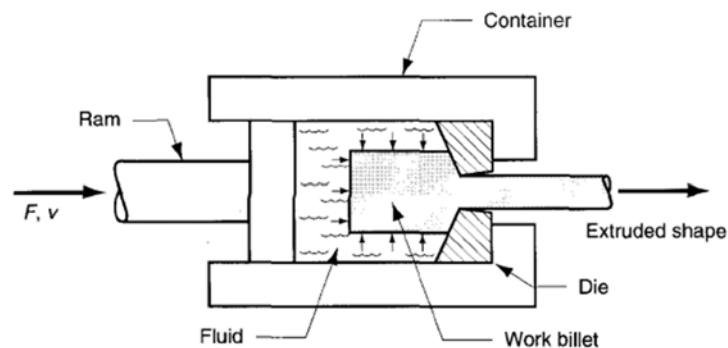


Figure Q6(E): Extrusion Process



**BAHAGIAN A (JAWAB SEMUA SOALAN)**

**SOALAN 1 (20 MARKAH)**

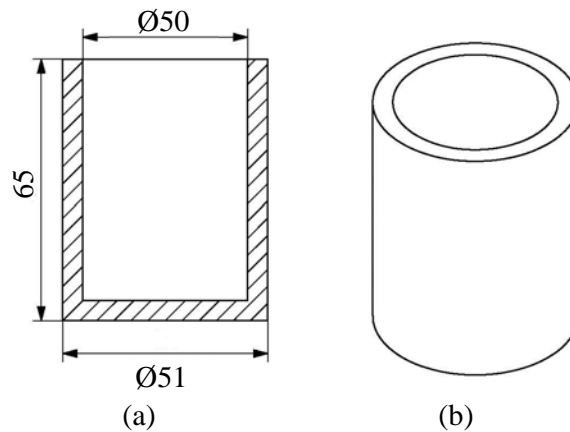
A. Unit bagi tahap peleburan tenaga untuk Aluminium adalah  $3.7 \text{ J/mm}^3$ . Ketebalan setiap DUA (2) keping plat Aluminium untuk dikimpal ialah 4.0 mm. Untuk mencapai kekuatan kimpalan bintik yang dikehendaki, pembentukan naget kimpalan adalah diameter 6.0 mm dan ketebalan ialah 3.0 mm. Masa kimpalan adalah 0.3 saat. Jika rintangan elektrik diantara permukaan ialah  $140 \times 10^{-6}$  ohm, dan hanya satu pertiga daripada tenaga elektrik yang dihasilkan akan digunakan untuk membentuk naget kimpalan (selebihnya dilesapkan), tentukan tahap semasa minimum arus elektrik yang diperlukan dalam proses ini.

(4 markah)

B. Satu kepingan logam berketebalan 0.5 mm akan ditarik dengan nisbah menghad penarikan (LDR) adalah 1.8 untuk menghasilkan satu cawan (rujuk Rajah Q1(B)) dengan diameter dalam adalah 50 mm dan tinggi adalah 65 mm. Kekuatan tegangan adalah 175 MPa. Andaikan ketebalan bahagian bawah dan dinding cawan adalah tidak berubah.

- i. Kirakan diameter awal kepingan yang diperlukan.
- ii. Untuk proses penarikan bagi diameter awal kepingan, semak sekiranya penarikan tunggal mencukupi dan sekiranya tidak kirakan diameter penumbuk untuk langkah pertama tersebut dan jangkakan bilangan penarikan yang diperlukan.
- iii. Kirakan daya penarikan untuk langkah pertama.

(6 markah)



Rajah Q1(B): (a) Dimensi terperinci dan (b) Produk akhir

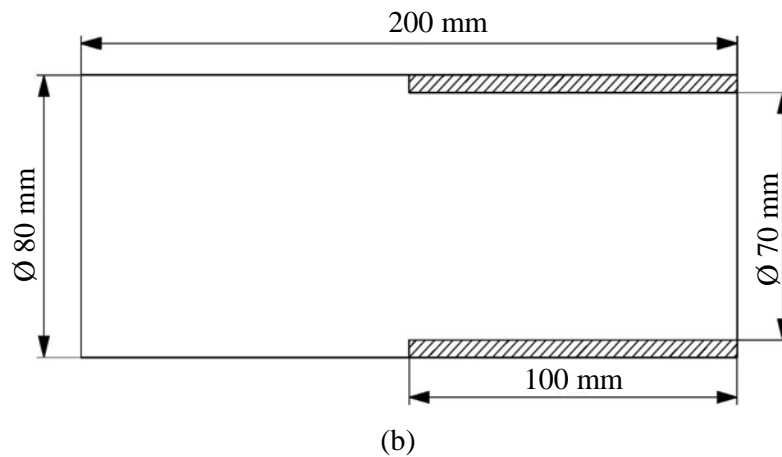
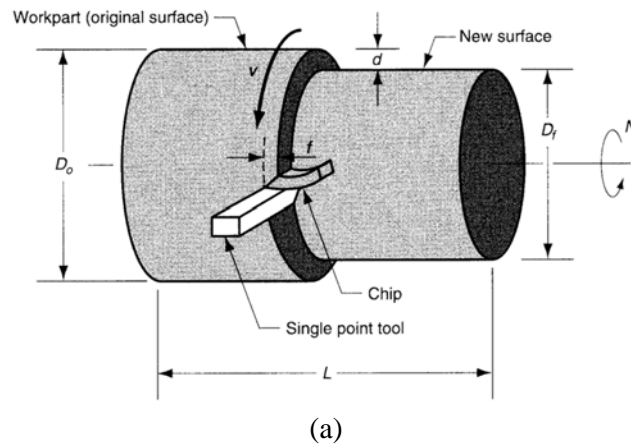
C. Satu selinder Keluli Tahan Karat dengan  $\text{Ø}80$  mm dan panjangnya 200 mm, akan dikurangkan kepada  $\text{Ø}70$  mm dan 100 mm sepanjang selinder tersebut dengan menggunakan proses melarik dengan SATU (1) laluan pemotongan sahaja. Gelendong berpusing dengan kelajuan 500 ppm, dan matalat bergerak pada paksi alat dengan kelajuan 200 mm/min.

(Petunjuk: Tenaga Tentu pemotongan untuk Keluli Tahan Karat adalah diantara  $3.0 - 5.3 \text{ W.s/mm}^3$ )

Kirakan:

- Kelajuan Pemotongan
- Kadar Pembuangan bahan
- Masa Pemotongan
- Kuasa diperlukan
- Daya pemotongan

(10 markah)



Rajah Q1(C): (a) Proses Melarik (b) Dimensi terperinci


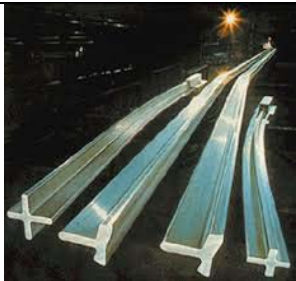
**SOALAN 2 (20 MARKAH)**

- A. Takrifkan apa itu pembuatan lestari. Bincangkan EMPAT (4) kawasan utama yang difokus oleh syarikat Coca-Cola.  
(5 markah)
- B. Terangkan secara ringkas DUA (2) sebab kenapa Coca-Cola harus tumpu pada isu pembuatan lestari dalam rekabentuk dan pengeluaran produk mereka.  
(2 markah)
- C. Dalam hierarki kitar semula, bezakan makna diantara; (i) Guna semula (Reuse), (ii) Kitar semula (Recycle), and (iii) Pengurangan (Reduce). Berikan SATU (1) contoh untuk (i), (ii), dan (iii) yang diimplimentasikan di syarikat Coca-Cola.  
(6 markah)
- D. Bincangkan sasaran yang mungkin bagi matlamat pembuatan mampan dan strategi untuk pembuatan hijau dilaksanakan di syarikat Coca-Cola. Anda boleh membincangkan berdasarkan pendekatan yang boleh dicapai oleh syarikat ini.  
(7 markah)

**SOALAN 3 (20 MARKAH)**

- A. Terangkan secara ringkas, DUA (2) perbezaan diantara pengerjaan sejuk dan pengerjaan panas dalam proses pembentukan logam.  
(4 markah)
- B. Dengan bantuan lakaran, terangkan secara terperinci bagaimana proses pengosongan dan penembusan dilakukan.  
(4 markah)
- C. Pilih salah SATU (1) daripada produk yang disenaraikan di dalam Jadual Q3(C):

Jadual Q3(C). Produk pembentukan logam

	(a) Rod Wayar	(b) Rasuk - T	(c) Rod Penyambung
Produk			
Dimensi	Diameter: 5.0 mm	Panjang: 5.0 m Tebal: 5.0 mm	Panjang: 250.0 mm
Bahan	Keluli	Aluminium	Keluli Tahan Karat

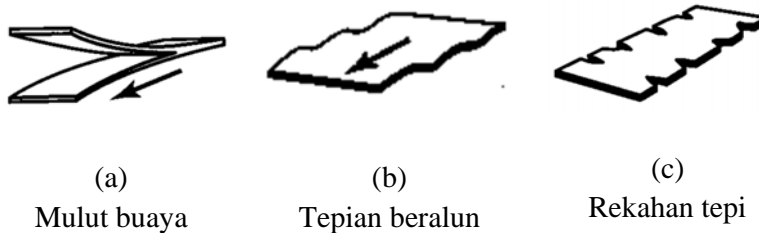
Kemudian, jawab soalan berikut:

- i. Cadangkan proses pembuatan yang paling sesuai dan berikan kewajaran cadangan anda.
- ii. Dengan bantuan lakaran, terangkan bagaimana proses yang dicadangkan ini berfungsi.
- iii. Terangkan SATU (1) kecacatan yang mungkin berlaku.

(6 markah)

D. Terangkan sebab utama berlaku kecacatan yang ditunjukkan dalam Rajah Q3(D) yang berlaku semasa proses pengelekan dan cadangkan satu penyelesaiannya.

(6 markah)



Rajah Q3(D): Kecacatan di dalam proses pengelekan

#### SOALAN 4 (20 MARKAH)

A. Jelaskan DUA (2) keadaan di mana proses pateri keras atau lembut lebih sesuai digunakan berbanding kimpalan lakuran. Senaraikan DUA (2) kelebihan dan DUA (2) kelemahan proses pateri berbanding proses kimpalan.

(5 markah)

B. Berdasarkan kepada kenyataan dan proses kimpalan di Jadual Q4(B) di bawah;

Jadual Q4(B)

Keterangan	Proses Kimpalan
<ul style="list-style-type: none"><li>• Menggunakan elektrod kekal untuk menghasilkan kimpalan.</li><li>• Kebiasaan digunakan untuk mengimpal Keluli Tahan Karat dan bahan-bahan bukan ferus, seperti Aluminium dan Magnesium.</li><li>• Tekanan tidak diperlukan semasa proses kimpalan.</li></ul>	<ul style="list-style-type: none"><li>• Kimpalan Gas Oksi-Asitelin (OAW)</li><li>• Kimpalan Arka Logam Gas (GMAW)</li><li>• Kimpalan Rintangan Bintik (RSW).</li><li>• Kimpalan Arka Tungsten Gas (GTAW)</li></ul>

i. Namakan SATU (1) proses kimpalan yang paling sesuai berasaskan keterangan yang diberikan. Berbantuan lakaran-lakaran, terangkan dengan jelas prinsip operasi kimpalan tersebut.

(4 markah)

ii. Terangkan SATU (1) masalah dalam proses kimpalan ini dan SATU (1) cara penyelesaiannya.

(2 markah)

- C. Berbantuan lakaran yang bersesuaian, terangkan proses oksi-asitelenanya berhubung perkaraperkara berikut;
- i. Ciri-ciri dan kelebihan sistem oksi-asitelenanya berbanding proses-proses kimpalan lain.
  - ii. Jenis nyalaan api yang digunakan dalam proses oksi-asitelenanya.

(6 markah)

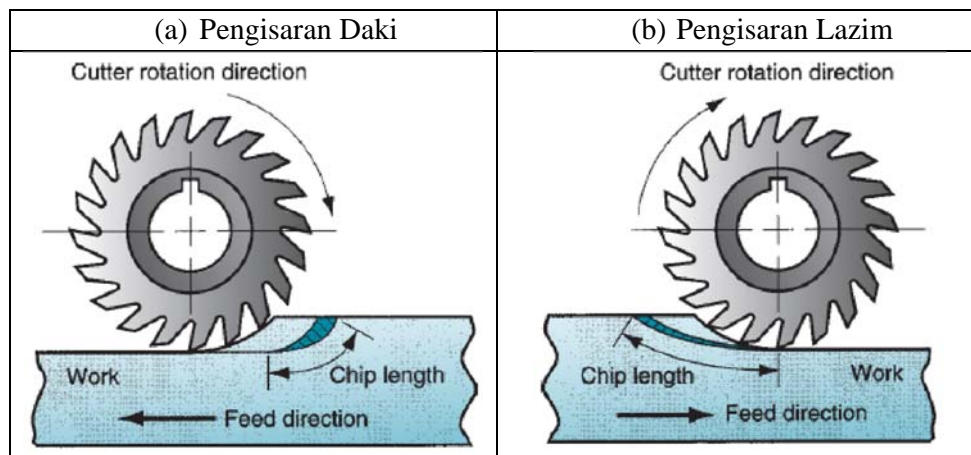
- D. Pilih SATU (1) dari jenis pemeriksaan ujian tanpa musnah (NDT) yang disenaraikan di bawah. Berbantuan lakaran, terangkan proses pemeriksaan yang dipilih.
- i. Ujian Ultrabunyi
  - ii. Ujian Penerapan Cecair
  - iii. Ujian Partikel Magnet

(3 markah)

**BAHAGIAN B (JAWAB HANYA SATU (1) DARI DUA (2) SOALAN)  
(SOALAN 5 ATAU SOALAN 6)**

**SOALAN 5 (20 MARKAH)**

- A. Apakah itu Pinggir Terbina (BUE). Jelaskan TIGA (3) masalah yang disebabkan oleh kewujudan Pinggir Terbina (BUE). (4 markah)
- B. Terangkan TIGA (3) fungsi bendalir pemotongan semasa operasi pemesinan. Senaraikan EMPAT (4) masalah yang timbul sekiranya bendalir pemotongan tidak digunakan semasa pemesinan. (5 markah)
- C. Rujuk kepada Rajah Q5(C);

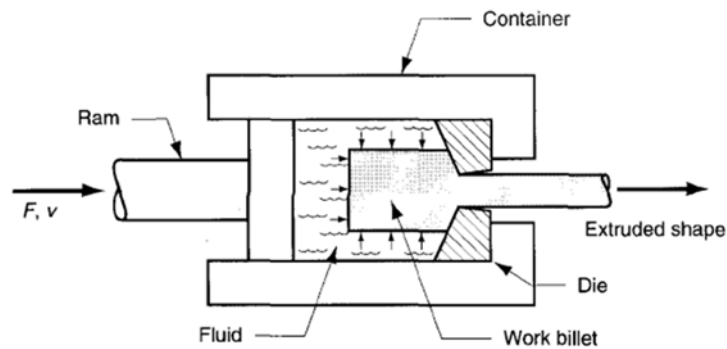


Rajah Q5(C): Proses Mengisar

- i. Terangkan DUA (2) kelebihan mengisar daki dibandingkan dengan mengisar lazim.  
ii. Kenapakah mengisar daki tidak digalakkan jika menggunakan mesin kisar yang telah lama. (5 markah)
- D. Terangkan dengan terperinci fungsi sudut sadak, dan bincangkan sekurang-kurangnya DUA (2) perbezaan diantara sudut sadak positif dan sudut sadak negatif terhadap jangka-hayat mata alat. (6 markah)

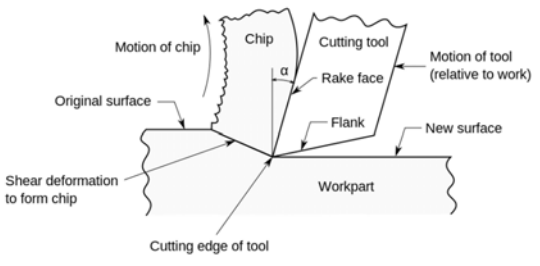
**SOALAN 6 (20 MARKAH)**

- A. Apakah itu Pinggir Terbina (BUE). Jelaskan TIGA (3) masalah yang disebabkan oleh kewujudan Pinggir Terbina (BUE). (4 markah)
- B. Jelaskan TIGA (3) fungsi bendalir pemotongan. (3 markah)
- C. Dalam operasi memotong logam, terdapat DUA (2) jenis kehausan yang berlaku pada alat pemotongan iaitu kehausan rasuk dan kehausan kawah;  
i. Dengan bantuan lakaran yang sesuai, terangkan dengan jelas kedua-dua jenis kehausan tersebut.  
ii. Nyatakan DUA (2) kesan setiap jenis kehausan keatas operasi pemotongan logam. (6 markah)
- D. Terangkan dengan bantuan lakaran, langkah-langkah asas dalam melaksanakan proses pematerian lembut. (3 markah)
- E. Merujuk kepada Rajah Q6(E), namakan jenis proses penyemperitan yang ditunjukkan. Nyatakan DUA (2) kelebihan dan DUA (2) kekurangan bagi proses ini. (4 markah)



Rajah Q6(E): Proses Penyemperitan

**APPENDIX /LAMPIRAN:**

<b>Metal Forming</b>	<b>Machining (Turning)</b>
<p><b>A. Volume (Isipadu):</b></p> <ul style="list-style-type: none"> <li><i>Cylindrical (Selinder):</i> <math>V = \pi/4 (D)^2 \times H</math></li> <li><i>Cone (Kon):</i> <math>V = \pi/12 (D)^2 \times H</math></li> <li><i>Cube (Kiub):</i> <math>V = (a)^3</math></li> <li><i>Rectangular Boxes (Kotak Segiempat tepat)</i> <math>V = L \times W \times H</math></li> </ul> <p><b>B. Drawing Ratio (Nisbah penarikan):</b> Cylindrical Shape, <math>DR = \frac{D_B}{D_p}</math></p> <p><b>C. Reduction (Pengurangan):</b> Cylindrical Shape</p> $r = \frac{D_B - D_p}{D_b}$ <ul style="list-style-type: none"> <li>Value of r should be less than 0.50</li> </ul> <p><b>D. Thickness-to-diameter ratio = <math>t/D_B</math></b></p> <ul style="list-style-type: none"> <li>Desirable for <math>t/D_b</math> ratio to be greater than 1%</li> <li>As <math>t/D_b</math> decreases, tendency for wrinkling increases</li> </ul> <p><b>E. Drawing Force = <math>\pi D_p t (TS) (\frac{D_B}{D_p} - 0.7)</math></b></p> <p><b>F. Blanking Force = <math>\pi D_B t (SS)</math></b></p> <ul style="list-style-type: none"> <li>TS = Tensile Strength</li> <li>SS = Shear Strength</li> </ul>	<ul style="list-style-type: none"> <li><math>V = \pi \times N \times D_{avg}</math> (m/min)</li> <li><math>MRR = V \times f \times d</math> (mm<sup>3</sup>/min)</li> <li><math>t = l/fN</math> (second)</li> <li><math>P = MRR \times \mu = T \times \omega</math> (kW / N.m/min)</li> <li><math>\omega = 2\pi N</math> (radians/min)</li> <li>1 watt = 1 N.m/s = 60 N/min</li> <li><math>T = F_c \times \frac{D_{avg}}{2}</math> (N.m)</li> <li><math>v = fN</math> (mm/min)</li> </ul> 
	<p><b>Welding:</b></p> <ul style="list-style-type: none"> <li><math>v = e \frac{VI}{\mu A}</math></li> <li><math>Q = I^2 R t = U_m V</math></li> <li>Weld Nugget volume, <math>V = \pi/4 (D)^2 \times d</math></li> </ul> 