



UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of
Mechanical Engineering

RESEARCH UNIVERSITY

**FINAL EXAMINATION
SEMESTER II, SESSION 2014/2015**

COURSE CODE : SKMM 2713 / SME 2713

COURSE NAME : MANUFACTURING PROCESSES

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

DURATION : 3 HOURS

DATE : JUNE, 2015

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 QUESTION IN NEW PAGE OF ANSWERS SCRIPT

WARNING!

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the students to be expelled from the University

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ONLY**

QUESTION 1 (20 MARKS)

A. Resistance spot welding is commonly used in car body assembly. The amount of heat generated in the workpiece can be calculated using equation:

$$Q = I^2 R t$$

Where Q is heat (Joule), I is current (Amp), R is total resistance (Ohm), and t is weld time (s). Given the weld nugget growth curve and weldability range of workpiece in Figure Q1A, workpiece thickness of 2.0 mm, and that the expected weld diameter is 3.0 mm to 4.0 mm, determine the minimum and maximum heat that should be generated (Note: Let the total resistance as R).

(6 marks)

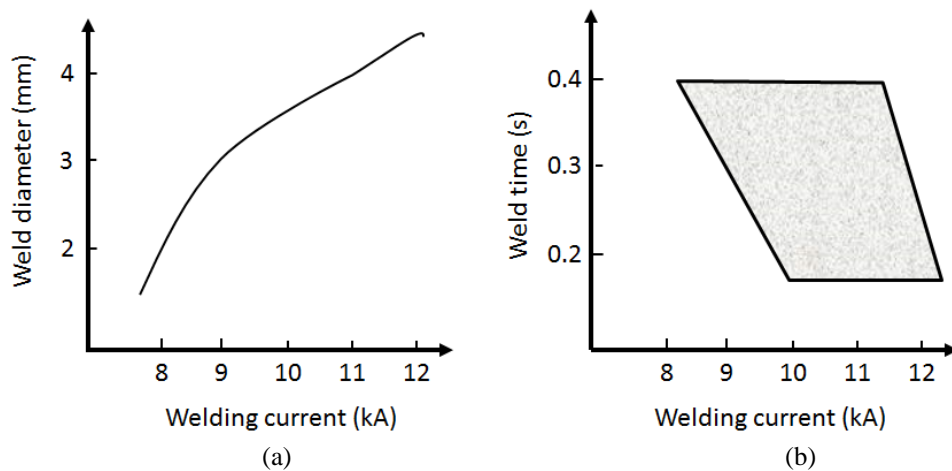


Figure Q1A; (a) Weld nugget growth curve and (b) weldability range

B. In an orthogonal machining experiment, the cutting tool has rake angle of 10° and the average thickness of chips produced is 0.8 mm. The cutting speed is 200 m/min and feed is 0.2 mm/rev. The dynamometer indicates that $F_c = 500$ N and $F_t = 100$ N. Determine the following:

- i. Resultant force.
- ii. Shear angle.
- iii. Friction force.
- iv. Shear force.

(8 marks)

C. A cylindrical-shaped component with 100.0 mm in height and 64.0 mm in diameter is deep drawn from a 1.0 mm thick, aluminum alloy blank with 325.5 mm in diameter. The material characteristics are as the following:

Shear strength = 1.8 N/mm² (annealed), Shear strength = 2.2 N/mm² (hardened),
Tensile strength = 2.0 N/mm² (annealed), Tensile strength = 2.5 N/mm² (hardened),

Initial deep drawing ration $m_1 = 0.6$, and afterwards ratio of n-th drawing $m_n = 0.8$.

- i. Determine the number of draws required.
- ii. Calculate the force required for the first draw.

(6 marks)

QUESTION 2 (20 MARKS)

A. Company TSG Sdn. Bhd. received an order to machine 200 parts. Using CNC milling machine, the engineer in charge tried machining at two (2) cutting speeds (100 m/min and 300 m/min), using two (2) types of cutting fluids/cooling techniques (flood cooling and near dry machining/minimum quantity of lubricant (MQL) and two types of cutting tools (carbide and coated carbide). After cost estimation on total tool cost and cutting fluid cost (including purchase, handling, and disposal costs), the data in Table Q2A is obtained. You know that there are three pillars/major aspects of sustainability, which are economy, society, and environment. From the data in Table Q2A, recommend the type of machining condition to conduct the machining process? Justify your recommendation.

(10 marks)

Table Q2A; Costing estimate for machining 200 parts

Machining Condition	Cutting Speed (M/Min)	Cooling Technique	Tool Type	Tool Cost (RM)	Cutting Fluid Cost (RM)
P	100	MQL	Carbide	900	400
Q	100	MQL	Coated Carbide	800	400
R	100	Flood	Carbide	800	800
S	100	Flood	Coated Carbide	600	800
T	300	MQL	Carbide	1200	200
U	300	MQL	Coated Carbide	1000	200
V	300	Flood	Carbide	1000	400
W	300	Flood	Coated Carbide	800	400

B. Knowing the principles of welding process, propose at least four (4) methods or activities to improve the process's sustainability. (Note: *Briefly describe the current/common practice and how that practice should be improved. You may choose one or more types of welding processes*)

(4 marks)

C. Company CS Engineering has the option to manufacture 200 pieces of stainless steel part as shown in Figure Q2A by either machining or metal forming. Considering at least two (2) sustainability aspects, suggest which process the company should choose. (Note: *Justify your reasons by comparing between the two processes.*)

(6 marks)

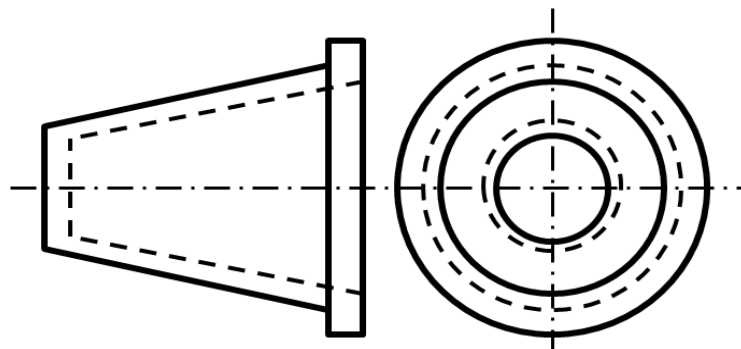


Figure Q2A; Schematic of part to be manufactured

QUESTION 3 (20 MARKS)

- A. Explain briefly, two (2) differences between cold working and hot working in metal forming processes. (2 marks)
- B. Explain with the help of sketches, how a drop forging will produce parts in Figure Q3A. State also one (1) major factor why forging maybe subjected to one or more subsequent operations. (6 marks)

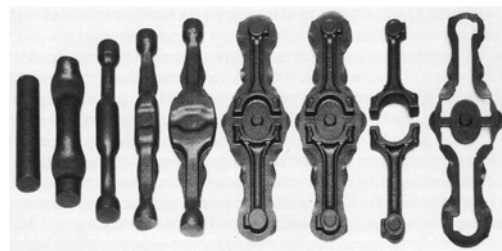
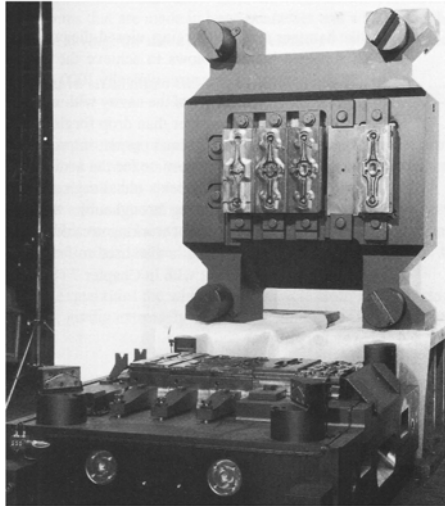


Figure Q3A; Schematic of cold forging of a part

- C. In a cold extrusion operation, there are two (2) types of extrusion methods, both the processes named forward extrusion and backward extrusion. Explain with the help of sketches both processes. (6 marks)
- D. With the help of sketch, describe the process of wire drawing. Your description should include the type of die and equipment used and two (2) precautions taken to reduce the tendency for wire breakage during drawing. (6 marks)

QUESTION 4 (20 MARKS)

- A. Explain two (2) situations in which brazing or soldering process is preferable to be used as compared with fusion welding. List two (2) advantages of brazing or soldering as compared with welding process. (4 marks)
- B. With the aid of appropriate sketches, explain the oxy-acetylene process with regards to the following aspects:
- The oxy-acetylene system, its characteristics and advantages compared to other welding processes.
 - Type of flames used in oxy-acetylene process.
- (4 marks)

C. Sketch a detail or complete circuit and explain the characteristics, advantages, limitations and applications of the Gas Tungsten Arc Welding (GTAW). Then, states two (2) major differences of Gas Tungsten Arc Welding (GTAW) as compared with Gas Metal Arc Welding (GMAW),

(8 marks)

D. Choose any two (2) of the types of non-destructive welding inspection listed below. Explain with simple sketches to illustrate your explanation.

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

(4 marks)

PART B

QUESTION 5 (20 MARKS)

- A. What is Built-Up-Edge (BUE)? Explain three (3) problems caused by the presence of Built-Up-Edge (BUE). (5 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)
- C. Describe the turning process and with the help of simple sketches define the terms speed, feed, and depth of cut as related to turning operation. (5 marks)
- D. The cutting tool materials must possess a number of important properties to avoid excessive wear, fracture failure and withstand high temperatures during metal cutting operation. The list below shows three (3) characteristics of the cutting tool materials should have, to produce good machining quality.
- i. Hardness.
 - ii. Toughness.
 - iii. Wear resistance.
- Briefly explain the importance of these characteristics and list any four (4) types of cutting tool materials. (5 marks)

QUESTION 6 (20 MARKS)

- A. Briefly discuss the differences between traditional machining and non-traditional machining. List down two (2) processes under each category. (4 marks)
- B. Explain briefly the meaning of terms listed below. Use neat sketches to assist your explanation if necessary.
- i. Chip Breaker.
 - ii. Diagonal Cutting.
- (4 marks)
- C. In metal cutting operation, there are two (2) types of wear occurring on the cutting tool that is the 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.
 - iii. By referring to the sketch of the graph of flank wear against cutting time, briefly explain the stages of formation of the flank wear.
- (8 marks)

D. Refer to Figure Q6A;

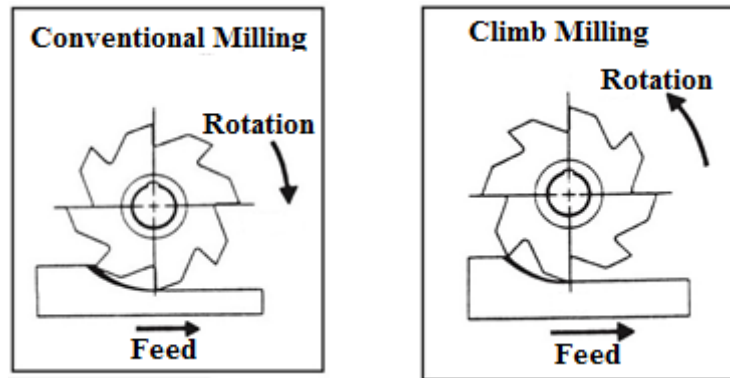


Figure Q6A; Schematic of milling processes

- 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?

(4 marks)

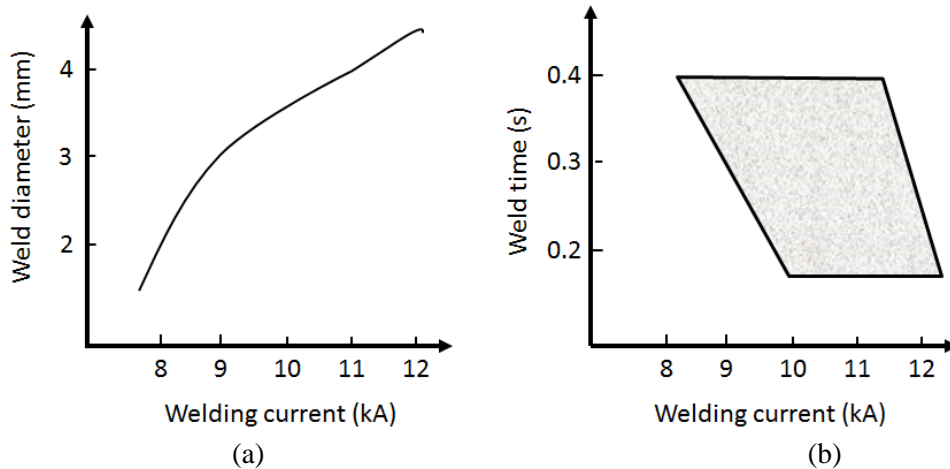
SOALAN 1 (20 MARKAH)

A. Kimpalan bintang biasa digunakan untuk pemasangan badan kereta. Jumlah haba yang dijana pada benda kerja boleh dikira dengan menggunakan persamaan:

$$Q = I^2 R t$$

di mana Q ialah haba (Joule), I ialah arus (Amp), R ialah jumlah rintangan (Ohm), dan t ialah masa pengimpalan (s). Jika diketahui lengkung pertumbuhan nugget kimpalan dan kawasan kebolehkimpalan bendakerja dalam Rajah Q1A, ketebalan bendakerja ialah 2.0 mm, dan diameter kimpalan yang dikehendaki adalah dari 3.0 mm ke 4.0 mm, tentukan haba minimum dan maksimum yang perlu dijana. (Catatan: Nyatakan jumlah rintangan sebagai R)

(6 markah)



Rajah Q1A; Lengkung Pertumbuhan Nugget Kimpalan dan (b) Kawasan Kebolehkimpalan

B. Dalam satu eksperimen pemesinan ortogonal, mata alat memiliki sudut sadak 10° dan ketebalan purata serpihan yang dihasilkan 0.8 mm. Laju pemetongan adalah 200 m/min dan suapan adalah 0.2 mm/pus. Dinamometer menunjukkan bahawa $F_c = 500$ N dan $F_t = 100$ N. Tentukan:

- i. Daya paduan.
- ii. Sudut ricih.
- iii. Daya geseran dan daya ricih.
- iv. Kadar pembuangan bahan.

(8 markah)

C. Sebuah komponen berbentuk silinder dengan ketinggian 100.0 mm dan diameter 64.0 mm ditarik dalam daripada sekeping aloi aluminium dengan ketebalan 1.0 mm dan diameter 325.5 mm. Ciri-ciri bahan adalah seperti berikut:

Kekuatan Tarik = 1.8 N/mm² (lembut), Kekuatan Tarik = 2.2 N/mm² (keras),
Kekuatan Ricih = 2.0 N/mm² (lembut), Kekuatan Ricih = 2.5 N/mm² (keras),

Nisbah penarikan dalam awal $m_1 = 0.6$ dan seterusnya nisbah penarikan ke-n $m_n = 0.8$.

- i. Tentukan bilangan penarikan yang diperlukan.
- ii. Kira daya yang diperlukan untuk penarikan pertama.

(6 markah)

SOALAN 2 (20 MARKAH)

A. Syarikat TSG Sdn. Bhd. menerima tempahan untuk memesis 200 komponen. Dengan menggunakan mesin kisar CNC, jurutera yang bertanggung jawab cuba memesis pada dua (2) kelajuan pemotongan (100 m/min and 300 m/min), menggunakan dua (2) jenis cecair pemotongan / teknik penyejukan (*flood cooling* dan pemesinan hampir kering/pelincir kuantiti minimum (MQL)), dan dua (2) jenis mata alat (karbida dan karbida bersalut). Selepas anggaran kos untuk kos keseluruhan mata alat dan kos cecair pemotongan (termasuk pembelian, pengendalian dan kos pelupusan), data dalam Jadual Q2A diperolehi. Anda tahu bahawa terdapat tiga (3) aspek utama kelestarian iaitu ekonomi, masyarakat, dan alam sekitar. Dari data Jadual Q2A, cadangkan teknik penyejukan untuk proses pemesinan tersebut. Jelaskan cadangan anda.

(10 markah)

Jadual Q2A;. Anggaran kos untuk memesis 200 komponen

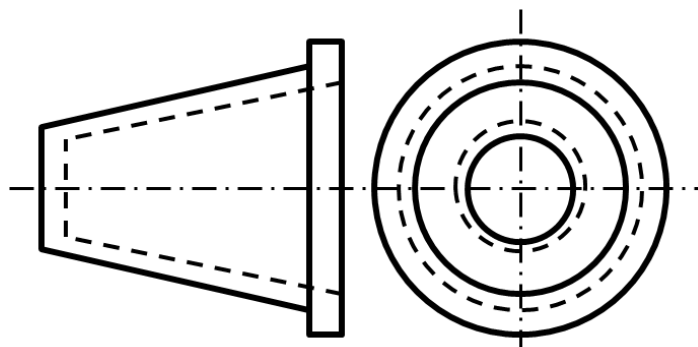
Keadaan Pemotongan	Laju Pemotongan (m/min)	Teknik Penyejukan	Jenis Mata Alat	Kos Mata Alat (RM)	Kos Cecair Pemotongan (RM)
P	100	MQL	Karbida	900	400
Q	100	MQL	Karbida bersalut	800	400
R	100	<i>Flood</i>	Karbida	800	800
S	100	<i>Flood</i>	Karbida bersalut	600	800
T	300	MQL	Karbida	1200	200
U	300	MQL	Karbida bersalut	1000	200
V	300	<i>Flood</i>	Karbida	1000	400
W	300	<i>Flood</i>	Karbida bersalut	800	400

B. Dengan mengetahui asas proses kimpal, cadangkan sekurang-kurangnya empat (4) kaedah atau aktiviti untuk meningkatkan kelestarian dalam proses berkenaan. (Catatan: *Jelaskan secara ringkas amalan yang biasa yang mesti ditingkatkan. Anda boleh memilih beberapa jenis proses kimpal*)

(4 markah)

C. Syarikat CS Engineering mempunyai pilihan untuk mengeluarkan 200 keping komponen keluli tahan karat seperti yang ditunjukkan dalam Rajah Q2A sama ada menggunakan proses pemesinan atau pembentukan logam. Dengan menggunakan dua (2) aspek kelestarian, cadangkan proses manakah yang perlu dipilih oleh pihak syarikat. (Catatan: *Jelaskan jawapan anda dengan membandingkan kedua-dua proses tersebut*)

(6 markah)



Rajah Q2A; Rajah komponen yang hendak dikeluarkan

SOALAN 3 (20 MARKAH)

- A. Terangkan secara ringkas dua (2) perbezaan di antara kerja sejuk dan kerja panas bagi proses pembentukan logam. (2 markah)
- B. Dengan bantuan lakaran, terangkan secara terperinci bagaimana untuk menghasilkan bahagian yang ditunjukkan dalam Rajah Q3A. Nyatakan juga satu (1) faktor kenapa penempaan harus dihasilkan melalui kaedah berperingkat. (6 markah)

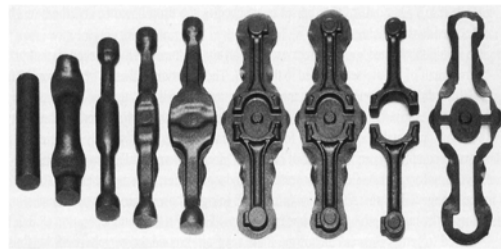
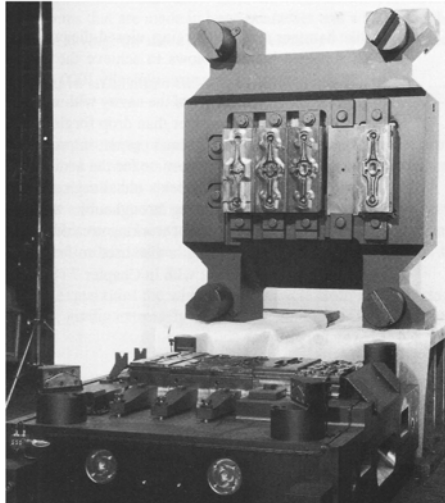


Figure Q3A; Rajah proses penempaan untuk menghasilkan sesuatu bahagian

- C. Pada penyemperitan sejuk, terdapat dua (2) kaedah, iaitu penyemperitan ke hadapan dan penyemperitan ke belakang. Dengan bantuan lakaran, terangkan kedua-dua proses tersebut. (6 markah)
- D. Dengan bantuan lakaran, jelaskan proses penarikan wayar. Penjelasan anda seharusnya melibatkan jenis dai dan peralatan yang digunakan, dan dua (2) langkah penjagaan bagi mengurangkan kemungkinan berlaku wayar putus semasa penarikan. (6 markah)

SOALAN 4 (20 MARKAH)

- A. Jelaskan dua (2) keadaan di mana proses pateri lembut atau keras adalah lebih sesuai digunakan berbanding kimpalan lakuran. Senaraikan dua (2) kelebihan proses pateri berbanding proses kimpalan. (4 markah)
- B. Berbantuan lakaran yang bersesuaian, terangkan proses oksi-asitelen berhubung perkara-perkara berikut;
i. Ciri-ciri dan kelebihan sistem oksi-asitelen berbanding proses-proses kimpalan lain.
ii. Jenis nyalaan api yang digunakan dalam proses oksi-asitelen. (4 markah)

C. Terangkan dengan jelas ciri-ciri, kelebihan dan aplikasi bagi proses Kimpalan Arka Tungsten Gas (GTAW). Lakarkan litar yang lengkap. Seterusnya, nyatakan dua (2) perbezaan utama Kimpalan Arka Tungsten Gas (GTAW) dengan Kimpalan Arka Logam Gas (GMAW).

(8 markah)

D. Pilih dua (2) jenis pemeriksaan ujian tanpa musnah yang disenaraikan di bawah. Berbantuan lakaran, terangkan proses pemeriksaan yang dipilih.

- i. Ujian partikel magnet
- ii. Ujian ultrabunyi
- iii. Ujian penerapan cecair

(4 markah)

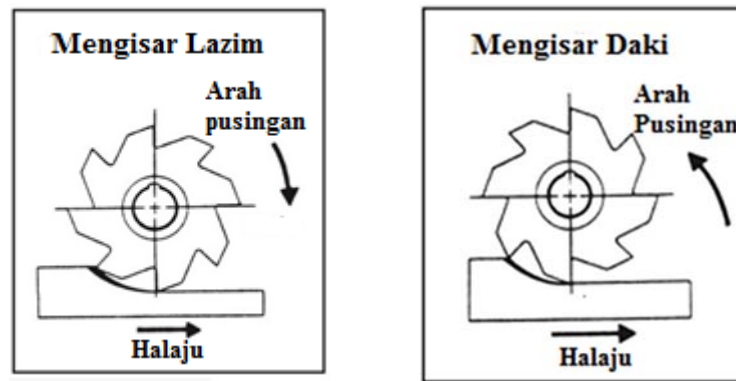
SOALAN 5 (20 MARKAH)

- A. Apakah itu Pinggir Terbina (BUE)? Jelaskan tiga (3) masalah yang disebabkan oleh kewujudan Pinggir Terbina (BUE).
(5 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. Jelaskan proses melarik dan berbantuan lakaran yang mudah definisikan istilah kelajuan, suapan, dan kedalaman pemotongan dengan merujuk kepada operasi melarik.
(5 markah)
- D. Bahan mataalat pemotong perlu mempunyai beberapa ciri penting untuk mengelakan kehausan berlebihan, kegagalan patah dan menahan suhu yang tinggi semasa operasi pemotongan logam. Senarai di bawah menunjukkan tiga (3) ciri-ciri bahan mataalat pemotong yang harus dipunyai untuk menghasilkan kualiti pemesinan baik.
- i. Keliatan
 - ii. Rintangan haus
 - iii. Kekerasan
- Terangkan secara ringkas kepentingan ciri-ciri ini dan senaraikan empat (4) jenis bahan alat memotong.
(5 markah)

SOALAN 6 (20 MARKAH)

- A. Secara ringkas bincangkan perbezaan antara pemesinan tradisional dan pemesinan moden. Senaraikan dua (2) proses-proses di bawah setiap kategori.
(4 markah)
- B. Terangkan secara ringkas maksud istilah di bawah. Gunakan lakaran kemas bagi membantu penerangan anda, jika perlu.
- i. Pemutus serpihan.
 - ii. Pemotongan serong.
- (4 markah)
- C. Di dalam operasi pemotongan logam terdapat dua (2) jenis kehausan yang berlaku pada mataalat iaitu kehausan rusuk dan kehausan lekuk.
- i. Dengan menggunakan lakaran yang sesuai, terangkan dengan jelas kedua jenis kehausan tersebut.
 - ii. Berikan dua (2) kesan setiap kehausan tersebut terhadap operasi pemotongan logam.
 - iii. Dengan merujuk kepada lakaran graf bagi kehausan rusuk dengan masa pemotongan, terangkan dengan ringkas peringkat-peringkat pembentukan kehausan tersebut.
- (8 markah)

D. Rujuk kepada Rajah Q6A;

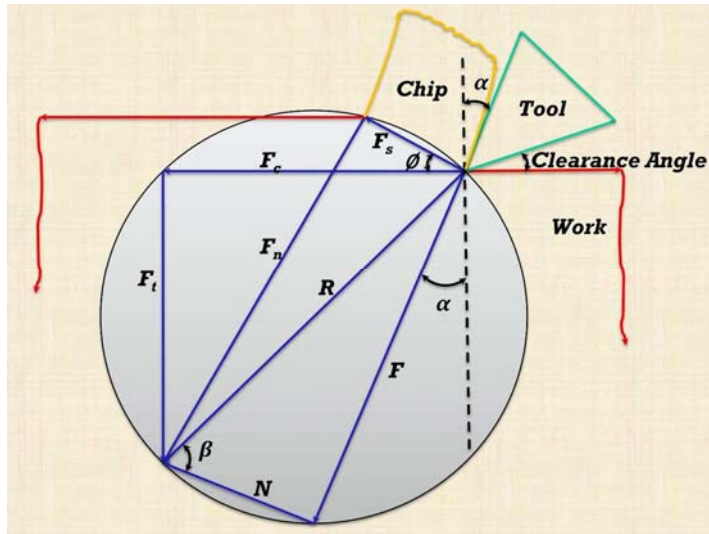


Rajah Q6A; Proses Mengisar

- i. Terangkan dua (2) kelebihan mengisar daki dibandingkan dengan mengisar lazim.
- ii. Kenapakah mengisar daki tidak digalakkan jika menggunakan mesin kisar yang telah lama?
(4 markah)

APPENDIX /LAMPIRAN

MACHINING/PEMESINAN:



$$F = F_c \sin \alpha + F_t \cos \alpha$$

$$N = F_c \cos \alpha - F_t \sin \alpha$$

$$F_s = F_c \cos \phi - F_t \sin \phi$$

$$F_n = F_c \sin \phi + F_t \cos \phi$$

$$\tan \phi = \frac{(r \cos \alpha)}{(1 - r \sin \alpha)}$$

$$r = t_0/t_1$$

DEEP DRAWING/PENARIKAN DALAM:

$$F = A\sigma$$

$$m_n = d_n / d_{n-1}$$

$$D = \sqrt{(d^2 + 4dh)}$$

WELDING/PENGIMPALAN

$$Q = I^2 R t$$