KYPJ
KOLEJ YAYASAN
PELAJARAN JOHOR

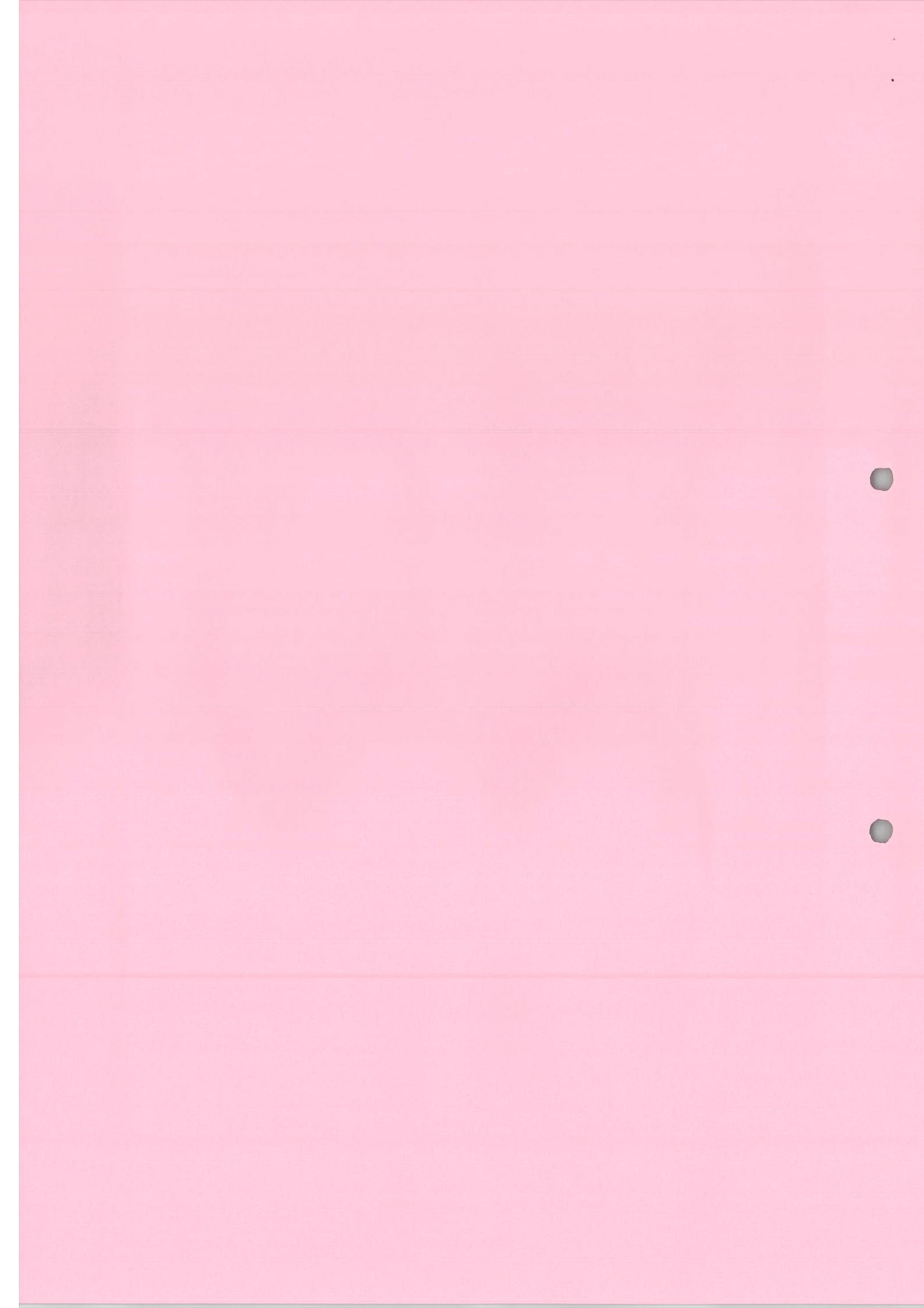KOLEJ YAYASAN PELAJARAN JOHOR
PEPERIKSAAN AKHIR

NAMA KURSUS	:	REKABENTUK KEJURUTERAAN
KOD KURSUS	:	DKM 2153
PEPERIKSAAN	:	JUN 2023
MASA	:	3 JAM

ARAHAN KEPADA CALON

1. Kertas soalan ini mengandungi **SATU (1)** bahagian: BAHAGIAN A (40 markah)

2. Calon tidak dibenarkan membawa masuk sebarang peralatan ke dalam bilik peperiksaan kecuali dengan kebenaran pengawas peperiksaan.

3. Sila pastikan bahan-bahan berikut diperoleh untuk sesi peperiksaan ini:
    i.   Kertas Soalan
    ii.   Buku Jawapan

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

KERTAS SOALAN INI MENGANDUNGI 5 HALAMAN BERCETAK TERMASUK MUKA HADAPAN

Bahagian ini mengandungi **empat (4)** soalan sahaja.
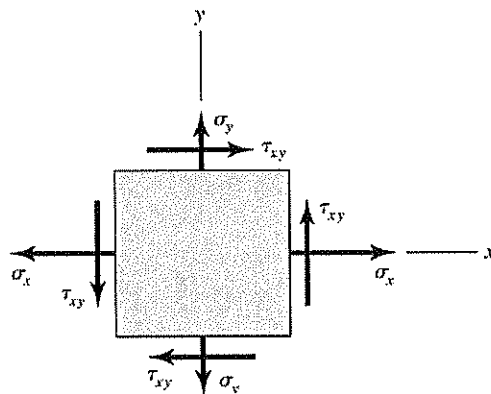
Jawab **semua soalan** di dalam Buku Jawapan.

SOALAN 1

Sebatang rod dengan luas keratan rentas A dan dimuatkan dalam tegangan dengan daya paksi P = 3000 N mengalami tegasan $\sigma = P/A$.

   i. Tentukan kekuatan maksimum tegasan tegangan, S_{ut} bagi bahan SAE1010 Hot-Rolled.

  ii. Dengan menggunakan faktor keselamatan reka bentuk 2.5, tentukan diameter minimum rod bulat pepejal.

 iii. Menggunakan Jadual A–17, pilih diameter yang sesuai dan tentukan faktor keselamatan rod.

(10 markah)

SOALAN 2

Satu unsur tegasan satah mempunyai $\sigma_x = 9MPa$, $\sigma_y = -6MPa$ dan $\tau_{xy} = 3MPa\ cw$, seperti yang ditunjukkan dalam Rajah 2.
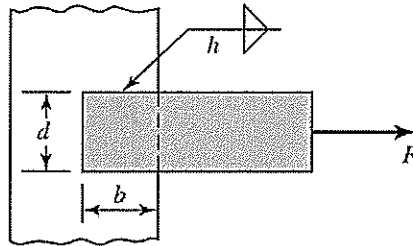

Rajah 2 : Elemen tegasan

   i. Menggunakan bulatan Mohr, cari tegasan dan arah utama, dan tunjukkan ini pada elemen tegasan yang dijajarkan dengan betul berkenaan dengan koordinat xy.

  ii. Tentukan sudut theta, θ.

 iii. Lukis elemen tegasan berdasarkan sudut theta untuk menunjukkan τ_1 dan τ_2, cari tegasan normal yang sepadan dan labelkan lukisan itu sepenuhnya.

(10 markah)

SOALAN 3

Rajah 3 menunjukkan bar keluli mendatar dengan ketebalan h dikimpal kepada plat sokongan menegak dan dikenakan daya tegangan seragam, F. Diberi b = 50mm, d = 50mm dan h = 5mm.

Rajah 3 : Bar keluli

i. Tentukan kekuatan tegangan dan maksimum bagi plat sokongan yang menggunakan bahan 1018 *Hot-Rolled* dan bagi bar mendatar yang menggunakan bahan 1018 *Cold-Drawn*.
ii. Tentukan tegasan ricih yang dibenarkan, τ_{all} .
iii. Cari nilai beban F yang akan menyebabkan tegasan ricih yang dibenarkan mengalami kegagalan.

(10 markah)

SOALAN 4

Dua galas bebola daripada pengeluar yang berbeza sedang dipertimbangkan untuk diaplikasikan pada satu projek. Galas A mempunyai penarafan katalog 2.0kN berdasarkan sistem penarafan katalog 3000jam pada 500putaran/min. Bearing B mempunyai penarafan katalog 7.0kN berdasarkan katalog yang berkadar pada 10^6 kitaran.

i. Nyatakan persamaan bagi galas menggunakan *Basic Load Rating*.
ii. Tentukan nilai *Basic Load Rating* bagi galas A dan B.
iii. Tentukan galas yang boleh membawa beban yang lebih besar bagi projek tersebut.

(10 markah)

[40 markah]

KERTAS SOALAN TAMAT

LAMPIRAN

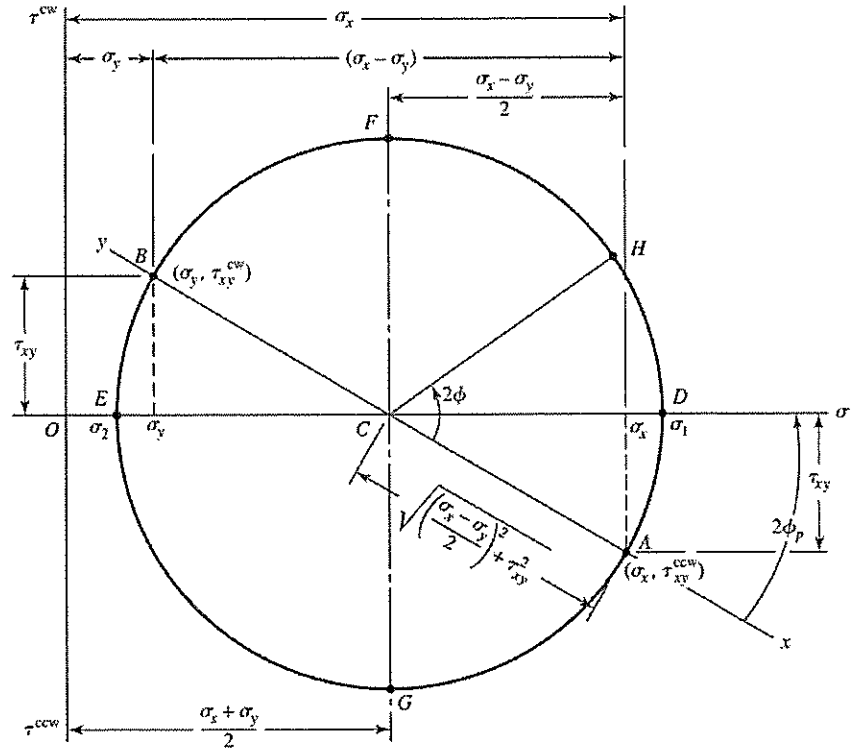## Figure 3-10

Mohr's circle diagram.

Table A-17

Preferred Sizes and Renard (R-Series) Numbers
(When a choice can be made, use one of these sizes; however, not all parts or items are available in all the sizes shown in the table.)

Fraction of Inches

$\frac{1}{64}, \frac{1}{32}, \frac{1}{16}, \frac{3}{32}, \frac{1}{8}, \frac{5}{32}, \frac{3}{16}, \frac{1}{4}, \frac{5}{16}, \frac{3}{8}, \frac{7}{16}, \frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{11}{16}, \frac{3}{4}, \frac{7}{8}, 1, 1\frac{1}{4}, 1\frac{1}{2}, 1\frac{3}{4}, 2, 2\frac{1}{4}, 2\frac{1}{2}, 2\frac{3}{4}, 3,$

$3\frac{1}{4}, 3\frac{1}{2}, 3\frac{3}{4}, 4, 4\frac{1}{4}, 4\frac{1}{2}, 4\frac{3}{4}, 5, 5\frac{1}{4}, 5\frac{1}{2}, 5\frac{3}{4}, 6, 6\frac{1}{2}, 7, 7\frac{1}{2}, 8, 8\frac{1}{2}, 9, 9\frac{1}{2}, 10, 10\frac{1}{2}, 11, 11\frac{1}{2}, 12,$

$12\frac{1}{2}, 13, 13\frac{1}{2}, 14, 14\frac{1}{2}, 15, 15\frac{1}{2}, 16, 16\frac{1}{2}, 17, 17\frac{1}{2}, 18, 18\frac{1}{2}, 19, 19\frac{1}{2}, 20$

Decimal Inches

0.010, 0.012, 0.016, 0.020, 0.025, 0.032, 0.040, 0.05, 0.06, 0.08, 0.10, 0.12, 0.16, 0.20, 0.24, 0.30,
0.40, 0.50, 0.60, 0.80, 1.00, 1.20, 1.40, 1.60, 1.80, 2.0, 2.4, 2.6, 2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2,
4.4, 4.6, 4.8, 5.0, 5.2, 5.4, 5.6, 5.8, 6.0, 7.0, 7.5, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5,
13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20

Millimeters

0.05, 0.06, 0.08, 0.10, 0.12, 0.16, 0.20, 0.25, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.0, 1.1, 1.2,
1.4, 1.5, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 8.0, 9.0, 10, 11, 12, 14,
16, 18, 20, 22, 25, 28, 30, 32, 35, 40, 45, 50, 60, 80, 100, 120, 140, 160, 180, 200, 250, 300

Renard Numbers*

1st choice, R5: 1, 1.6, 2.5, 4, 6.3, 10

2d choice, R10: 1.25, 2, 3.15, 5, 8

3d choice, R20: 1.12, 1.4, 1.8, 2.24, 2.8, 3.55, 4.5, 5.6, 7.1, 9

4th choice, R40: 1.06, 1.18, 1.32, 1.5, 1.7, 1.9, 2.12, 2.36, 2.65, 3, 3.35, 3.75, 4.25, 4.75, 5.3, 6, 6.7, 7.5, 8.5, 9.5

*May be multiplied or divided by powers of 10.

Table A-20

Deterministic ASTM Minimum Tensile and Yield Strengths for Some Hot-Rolled (HR) and Cold-Drawn (CD) Steels [The strengths listed are estimated ASTM minimum values in the size range 18 to 32 mm ($\frac{3}{4}$ to $1\frac{1}{4}$ in). These strengths are suitable for use with the design factor defined in Sec. 1–10, provided the materials conform to ASTM A6 or A568 requirements or are required in the purchase specifications. Remember that a numbering system is not a specification.] *Source:* 1986 SAE Handbook, p. 2.15.

1	2	3	4	5	6	7	8
			Tensile	Yield			
UNS No.	SAE and/or AISI No.	Process-ing	Strength, MPa (kpsi)	Strength, MPa (kpsi)	Elongation in 2 in, %	Reduction in Area, %	Brinell Hardness
G10060	1006	HR	300 (43)	170 (24)	30	55	86
		CD	330 (48)	280 (41)	20	45	95
G10100	1010	HR	320 (47)	180 (26)	28	50	95
		CD	370 (53)	300 (44)	20	40	105
G10150	1015	HR	340 (50)	190 (27.5)	28	50	101
		CD	390 (56)	320 (47)	18	40	111
G10180	1018	HR	400 (58)	220 (32)	25	50	116
		CD	440 (64)	370 (54)	15	40	126
G10200	1020	HR	380 (55)	210 (30)	25	50	111
		CD	470 (68)	390 (57)	15	40	131
G10300	1030	HR	470 (68)	260 (37.5)	20	42	137
		CD	520 (76)	440 (64)	12	35	149
G10350	1035	HR	500 (72)	270 (39.5)	18	40	143
		CD	550 (80)	460 (67)	12	35	163
G10400	1040	HR	520 (76)	290 (42)	18	40	149
		CD	590 (85)	490 (71)	12	35	170
G10450	1045	HR	570 (82)	310 (45)	16	40	163
		CD	630 (91)	530 (77)	12	35	179
G10500	1050	HR	620 (90)	340 (49.5)	15	35	179
		CD	690 (100)	580 (84)	10	30	197
G10600	1060	HR	680 (98)	370 (54)	12	30	201
G10800	1080	HR	770 (112)	420 (61.5)	10	25	229
G10950	1095	HR	830 (120)	460 (66)	10	25	248

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KOLEJ YAYASAN PELAJARAN JOHOR
FINAL EXAMINATION

COURSE NAME	:	ENGINEERING MATHEMATICS III
COURSE CODE	:	MAT2033
SESSION	:	JUNE 2023
DURATION	:	3 HOURS

INSTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON

1. This examination paper consists of **ONE (1)** part : /   PART A (60 Marks) /
   Kertas soalan ini mengandungi SATU (1) bahagian: *BAHAGIAN A (60 Markah)*

2. Candidates are not allowed to bring any material to the examination room except with the permission from the invigilator. The formula was attached at the back question paper. /
   Calon tidak dibenarkan untuk membawa sebarang bahan/nota ke bilik peperiksaan tanpa arahan/kebenaran daripada pengawas. Rumus dilampirkan di belakang kertas soalan peperiksaan.

3. Please check to make sure that this examination pack consists of: /
   Pastikan kertas soalan peperiksaan ini mengandungi:
   i. Question Paper /
       Kertas Soalan.
   ii. Answering Booklet /
       Buku Jawapan.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

This examination paper consists of **9** printed pages including front page
Kertas soalan ini mengandungi 9 muka surat termasuk kulit hadapan

This part contains of **SIX (6)** questions. Answer **ALL** questions in the Answering Booklet.

*Bahagian ini mempunyai **ENAM (6)** soalan. Jawab **SEMUA** soalan di dalam Buku Jawapan.*

QUESTION 1/ *SOALAN 1*

a)   Differentiate, $\frac{dy}{dx}$ for the function below:

Bezakan, $\frac{dy}{dx}$ bagi fungsi-fungsi di bawah:

i. $3x^2 + xy - 3y = 7$ (by using Implicit Functions/ *menggunakan Fungsi Tersirat*)

ii. $x = sin(t + 3)$ and / *dan* $y = t^3$ (by using Parametric Functions/ *menggunakan Fungsi Berparameter*)

(7 marks / *markah*)

b)   Find the equation of the normal line for the curve

Dapatkan persamaan garis normal untuk lengkung

$$y = 3x^2 - 6x + 2 \text{ at the point / } pada \ titik \ x = 2$$

(5 marks / *markah*)

QUESTION 2/ SOALAN 2

a)   Integrate the following functions:

   Kamirkan fungsi-fungsi berikut:

   i)
   $$\int_0^2 (x + 3x^2 - 4x^3)dx$$

   ii) $\int x^3 e^{x^4-1}dx$ by substitutions method.

   dengan kaedah gantian.

(5 marks / *markah*)

b)   Find the area of the region bounded by the curve $y = x(2 - x)$ and $y = x$ the line as shown in figure 1.

   Dapatkan luas rantau yang dibatasi oleh lengkungan $y = x(2 - x)$ dan garis $y = x$ yang ditunjukkan pada rajah 1.
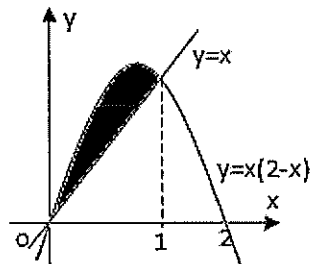

Figure 1 / *Rajah 1*

(3 marks / *markah*)

QUESTION 3/ *SOALAN 3*

Use the method of separation of variables to solve the equation:

Gunakan kaedah pemisahan pemboleh ubah untuk menyelesaikan persamaan:

$$x^2 \frac{dy}{dx} = 2x + xy, \qquad y(1) = 0$$

(4 marks / *markah*)

QUESTION 4/ *SOALAN 4*

a) Use the method of undetermined coefficients to solve the nonhomogeneous differential equation:

Gunakan kaedah pekali tak ditentukan untuk menyelesaikan persamaan tak homogen:

$$y''-10y'+25y = 30x + 3$$

(8 marks / *markah*)

b) Find the inverse Laplace Transforms of :
Dapatkan Jelmaan Laplace Songsang berikut :

$$L^{-1}\left\{ \frac{s}{s^2 + 4s + 5} \right\}$$

(4 marks / *markah*)

QUESTION 5/ *SOALAN 5*

a) If $z = x^2 y - y^2$, $x = t^2$ and $y = 2t$, use the chain rule to find $\dfrac{\partial z}{\partial t}$.

   Jika $z = x^2 y - y^2$, $x = t^2$ *dan* $y = 2t$ *gunakan aturan rantaian untuk*

   mendapatkan $\dfrac{\partial z}{\partial t}$.

   (6 marks / *markah*)

b) Find the maximum, minimum and saddle points of the function:

   Dapatkan titik maksimum, titik minimun dan titik pelana bagi fungsi:

   $$f(x,y) = 4x^3 - 2x^2 y + y^2$$

   (10 marks / *markah*)

QUESTION 6/ *SOALAN 6*

a) Sketch the region of integration and reverse the order of integration:

   Lakarkan rantau kamiran dan tukarkan tertib kamiran:

   $$\int_0^1 \int_2^{4-2y} f(x,y)\, dx dy$$

   (4 marks / *markah*)

b) Use polar coordinates to evaluate the integral $\iint\limits_R 3y\, dA$ where R is the region in

   the first quadrant enclosed by the circle $x^2 + y^2 = 25$ and the coordinate axes.

   Gunakan kamiran kutub untuk menilaikan $\iint\limits_R 3y\, dA$ *dengan R ialah rantau dalam*

   sukuan pertama dikelilingi oleh bulatan $x^2 + y^2 = 25$ *dan paksi koordinat.*

   (4 marks / *markah*)

   [60 MARKS / *MARKAH*]

   END OF QUESTION PAPER/ *KERTAS SOALAN TAMAT*

LIST OF FORMULA
SENARAI RUMUS

Basic Identities

Trigonometric Identities

$$\cos^2 x + \sin^2 x = 1$$

$$\sin 2x = 2\sin x \cos x$$

$$\cos 2x = \cos^2 x - \sin^2 x$$

$$\cos 2x = 2\cos^2 x - 1$$

$$\cos 2x = 1 - 2\sin^2 x$$

Hyperbolic Identities

$$\sinh x = \frac{e^x - e^{-x}}{2}$$

$$\cosh x = \frac{e^x + e^{-x}}{2}$$

$$\cosh^2 x - \sinh^2 x = 1$$

$$\sinh 2x = 2\sinh x \cosh x$$

$$\cosh 2x = \cosh^2 x + \sinh^2 x$$

$$\cosh 2x = 2\cosh^2 x - 1$$

$$\cosh 2x = 1 + 2\sinh^2 x$$

Derivatives Formulas

First Principle: $f'(x) = \lim\limits_{\partial x \to 0} \dfrac{f(x + \partial x) - f(x)}{\partial x}$

$$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\dfrac{du}{dx} - u\dfrac{dv}{dx}}{v^2}$$

$$\frac{d}{dx}x^n = nx^{n-1}$$

$$\frac{d}{dx}e^x = e^x$$

$$\frac{d}{dx}\sin x = \cos x$$

$$\frac{d}{dx}\cos x = -\sin x$$

$$\frac{d}{dx}\tan x = \sec^2 x$$

$$\frac{d}{dx}\sec x = \sec x \tan x$$

$$\frac{d}{dx}\operatorname{cosec} x = -\operatorname{cosec} x \cot x$$

$$\frac{d}{dx}\cot x = -\operatorname{cosec}^2 x$$

$$\frac{d}{dx}\ln x = \frac{1}{x}$$

$$\frac{d}{dx}(\log_a x) = \frac{1}{x\log_e a} = \frac{1}{x\ln a} \; .$$

$$\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1 - x^2}}, \quad where \; |x| < 1$$

$$\frac{d}{dx}(\cos^{-1} x) = \frac{-1}{\sqrt{1 - x^2}}, \quad where \; |x| < 1$$

$$\frac{d}{dx}(\tan^{-1} x) = \frac{1}{1 + x^2}$$

Integrals Formulas

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + c \quad , \qquad n \neq -1$$

$$\int e^x dx = e^x + c$$

$$\int \sin x \, dx = -\cos x + c$$

$$\int \cos x \, dx = \sin x + c$$

$$\int \sec^2 x \, dx = \tan x + c$$

$$\int \sec x \tan x \, dx = \sec x + c$$

$$\int \cos ec \, x \cot x \, dx = -\cos ec \, x + c$$

$$\int \cos ec^2 x \, dx = -\cot x + c$$

$$\int \tan x \, dx = \ln|\sec x| + c$$

$$\int \cot x \, dx = \ln|\sin x| + c$$

$$\int \cos ec \, x \, dx = \ln|\cos ec \, x - \cot x| + c$$

$$\int u \, dv = uv - \int v \, du$$

$$\int x^{-1} \, dx = \int \frac{1}{x} \, dx = \ln|x| + c$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} \, dx = \sin^{-1}\left(\frac{x}{a}\right) + c$$

$$\int \frac{1}{a^2 + x^2} \, dx = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + c$$

$$\int \frac{1}{a^2 - x^2} \, dx = \frac{1}{2a} \ln\left|\frac{x+a}{x-a}\right| + c$$

$$\int \frac{1}{x \sqrt{x^2 - a^2}} \, dx = \frac{1}{a} \sec^{-1}\left|\frac{x}{a}\right| + c$$

The method of undetermined coefficients

Solution of homogeneous equation: $ay''+by'+cy = 0$

Auxiliary equation: $am^2 + bm + c = 0$

Roots of $am^2 + bm + c = 0$	General Solution, y_c
1. real and different: m_1 and m_2	$y_c = Ae^{m_1 x} + Be^{m_2 x}$
2. real and equal: $m_1 = m_2$	$y_c = Ae^{mx} + Bxe^{mx}$
3. complex numbers: $m_1 = \alpha + \beta i$, $m_2 = \alpha - \beta i$	$y_c = e^{\alpha x}\left(A\cos \beta x + B\sin \beta x\right)$

Particular integrals of inhomogeneous equation: $ay''+by'+cy = f(x)$

$f(x)$	Roots of auxiliary equation: m_1, m_2	y_p
$A_n x^n + A_{n-1}x^{n-1} + \cdots + A_1 x + A_0$	$m_1 \neq 0$ and $m_2 \neq 0$	$B_n x^n + B_{n-1}x^{n-1} + \cdots + B_1 x + B_0$
	$m_1 = 0$ or $m_2 = 0$	$\left(B_n x^n + B_{n-1}x^{n-1} + \cdots + B_1 x + B_0\right)x$
$Ke^{\alpha x}$	$m_1 \neq \alpha$ and $m_2 \neq \alpha$	$Be^{\alpha x}$
	$m_1 = \alpha$ or $m_2 = \alpha$	$Bxe^{\alpha x}$
	$m_1 = \alpha$ and $m_2 = \alpha$	$Bx^2 e^{\alpha x}$
$K \cos \beta x$ or $K \sin \beta x$	$m_1 \neq \beta i$ and $m_2 \neq \beta i$	$B_1 \cos \beta x + B_2 \sin \beta x$
	$m_1 = \beta i$ or $m_2 = \beta i$	$\left(B_1 \cos \beta x + B_2 \sin \beta x\right)x$

Table of Laplace Transform $L\{f(t)\}= F(s)$

	$f(t)$	$F(s)$
1	a	$\dfrac{a}{s}$
2	e^{at}	$\dfrac{1}{s-a}$
3	$\sin at$	$\dfrac{a}{s^2+a^2}$
4	$\cos at$	$\dfrac{s}{s^2+a^2}$
5	$\sinh at$	$\dfrac{a}{s^2-a^2}$
6	$\cosh at$	$\dfrac{s}{s^2-a^2}$
7	$e^{at}f(t)$	$F(s-a)$
8	$e^{at}\sin bt$	$\dfrac{b}{(s-a)^2+b^2}$
9	$e^{at}\cos bt$	$\dfrac{(s-a)}{(s-a)^2+b^2}$
10	$e^{at}\sinh bt$	$\dfrac{b}{(s-a)^2-b^2}$
11	$e^{at}\cosh bt$	$\dfrac{(s-a)}{(s-a)^2-b^2}$
12	$t\sin at$	$\dfrac{2as}{(s^2+a^2)^2}$
13	$t\cos at$	$\dfrac{s^2-a^2}{(s^2+a^2)^2}$
14	$t\sinh at$	$\dfrac{2as}{(s^2-a^2)^2}$
15	$t\cosh at$	$\dfrac{s^2+a^2}{(s^2-a^2)^2}$
16	$t^n, n=1,2,3...$	$\dfrac{n!}{s^{n+1}}$
17	$t^n e^{at}$	$\dfrac{n!}{(s-a)^{n+1}}$
18	$y'(t)$	$sY(s)-y(0)$ with $Y(s)=L\{y\}$
19	$y''(t)$	$s^2Y(s)-sy(0)-y'(0)$