
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008
*Peperiksaan Semester Kedua
Sidang Akademik 2007/2008*

April 2008
April 2008

EMM 111/3 – Statics
Statik

Duration : 3 hours
Masa : 3 jam

INSTRUCTIONS TO CANDIDATE:

ARAHAN KEPADA CALON :

Please check that this paper contains **NINE (9)** printed pages and **FOUR (4)** questions before you begin the examination.

*Sila pastikan bahawa kertas soalan ini mengandungi **SEMBILAN (9)** mukasurat dan **EMPAT (4)** soalan yang bercetak sebelum anda memulakan peperiksaan.*

Answer **FOUR (4)** questions.

*Jawab **EMPAT (4)** soalan.*

Answer all questions in **English** OR **Bahasa Malaysia** OR a combination of both.

*Calon boleh menjawab semua soalan dalam **Bahasa Malaysia** ATAU **Bahasa Inggeris** ATAU kombinasi kedua-duanya.*

Each question must begin from a new page.

Setiap soalan mestilah dimulakan pada mukasurat yang baru.

- Q1. [a] Two forces F_A and F_B are subjected on a bracket as shown in Figure Q1[a]. Determine the magnitude and orientation, measured counterclockwise from the positive y axis, of the resultant force acting on the bracket, if $F_B = 600\text{ N}$ and $\theta = 20^\circ$.

Dua daya F_A dan F_B bertindak ke atas pendakap seperti Rajah S1[a]. Tentukan magnitud dan arah daya paduan yang bertindak ke atas pendakap jika $F_B = 600\text{ N}$ dan $\theta = 20^\circ$. Arah daya paduan diukur arah lawan jam dari paksi y positif.

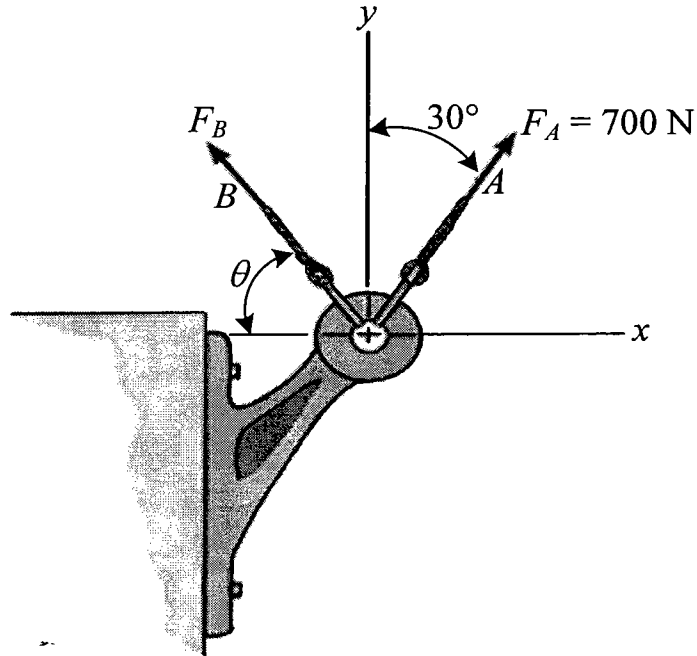


Figure Q1[a]
Rajah S1[a]

(30 marks/30 markah)

- [b] The lug and box wrenches are used in combination to remove the lug nut from the rim as shown in Figure Q1[b]. If the applied force on the end of the box wrench is $F = \{4i - 12j + 2k\}\text{ N}$, determine the magnitude of the moment of this force about the x axis.

Pemegang dan perengkuh kedua-duanya digunakan untuk mengeluarkan nat dari rim seperti dalam Rajah S1[b]. Jika daya kenaan pada hujung perengkuh ialah $F = \{4i - 12j + 2k\}\text{ N}$, tentukan magnitud momen disebabkan daya berkenaan di sekitar paksi x .

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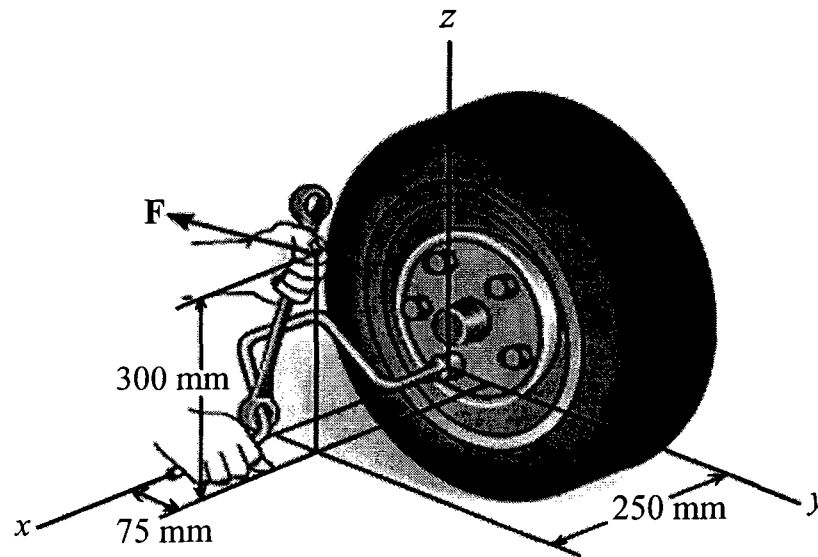


Figure Q1[b]
Rajah S1[b]

(30 marks/30 markah)

- [c] The belt passing over the pulley in Figure Q1[c] is subjected to forces F_1 and F_2 , each having a magnitude of 40 N. F_1 acts in the $-k$ direction. Replace these forces by an equivalent force and couple moment at point A . Express the result in Cartesian vector form. Set $\theta = 0^\circ$, so that F_2 acts in the $-j$ direction.

Talisawt melalui takal dalam Rajah S1[c] dikenakan daya F_1 dan F_2 masing-masing mempunyai magnitud 40 N. Daya F_1 bertindak arah $-k$. Gantikan kedua daya tersebut dengan daya setara dan momen ganding setara pada titik A . Nyatakan jawapan dalam bentuk vektor Cartesian. Setkan $\theta = 0^\circ$ agar daya F_2 bertindak dalam arah $-j$.

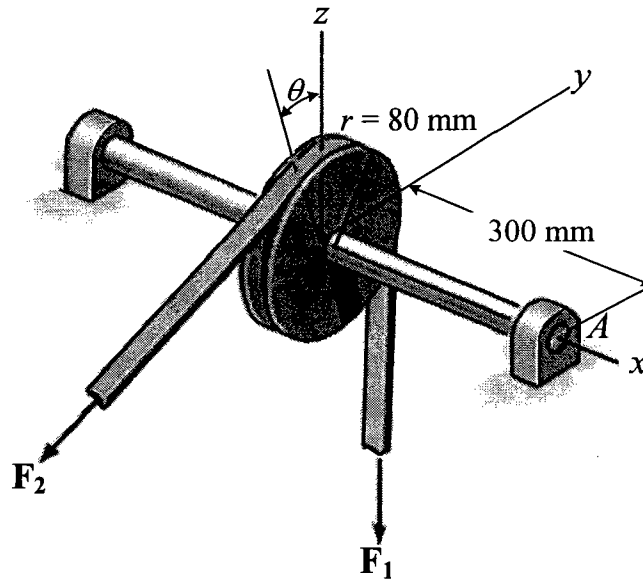


Figure Q1[c]
Rajah S1[c]

(40 marks/40 markah)

- Q2. [a] The power drill in Figure Q2[a] is subjected to two forces F_1 and F_2 which act on the grips. Determine the x, y, z components of force and the y and z components of moment reaction acting on the drill bit at A .

Penebuk kuasa dalam Rajah Q2[a] ditindaki dua daya F_1 dan F_2 pada pemegangnya. Tentukan komponen daya dalam $x, y,$ dan z dan komponen tindakbalas momen dalam y dan z pada mata penebuk di A .

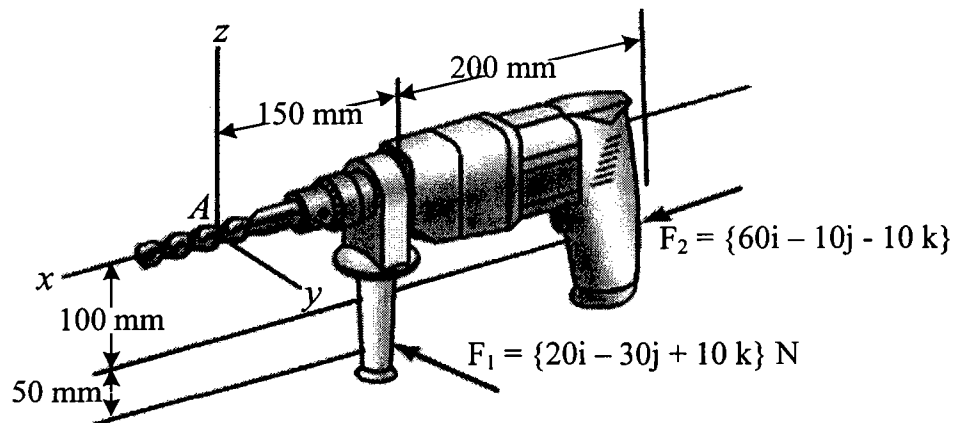


Figure Q2[a]
Rajah S2[a]

(50 marks/50 markah)

[b] The jib crane is pin-connected at A and supported by a smooth collar at B . A load of 5 kN is placed at a distance x from post AB as shown in Figure Q2[b]. Neglect the weight of the crane. Given $1 \text{ m} \leq x \leq 2.5 \text{ m}$.

- (i) Determine the roller placement x of the 5 kN load so that it gives the maximum and minimum reactions at the supports.
- (ii) Calculate the reactions at A and B in each case.

Kren 'jib' disambung pin di A dan disokong oleh relang licin di B . Beban 5 kN di gantung pada jarak x dari tiang AB seperti Rajah S2[b]. Abaikan berat kren. Diberi $1 \text{ m} \leq x \leq 2.5 \text{ m}$.

- (i) Tentukan kedudukan rola x bagi beban 5 kN agar menghasilkan tindakbalas maksimum dan minimum pada penyokong.
- (ii) Tentukan tindakbalas di A dan B untuk kedua kes berkenaan.

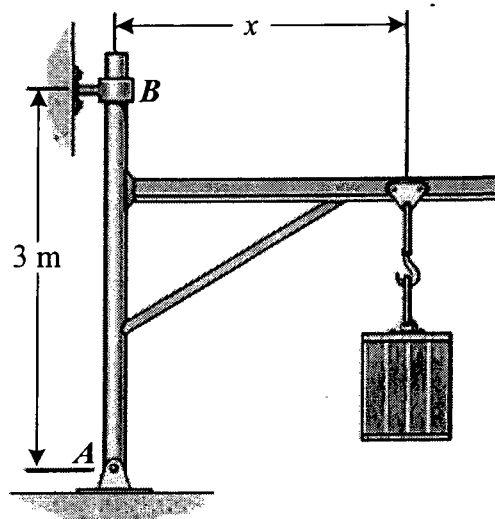


Figure Q2[b]
Rajah S2[b]

(50 marks/50 markah)

Q3. [a] Figure Q3[a] shows a truss which is supported by pin at E and by roller at A . Four external forces are subjected at F , G , H and I .

Rajah S3[a] menunjukkan sebuah kekuda yang disokong pin di E dan disokong rola di A . Empat daya luaran dikenakan di F , G , H dan I .

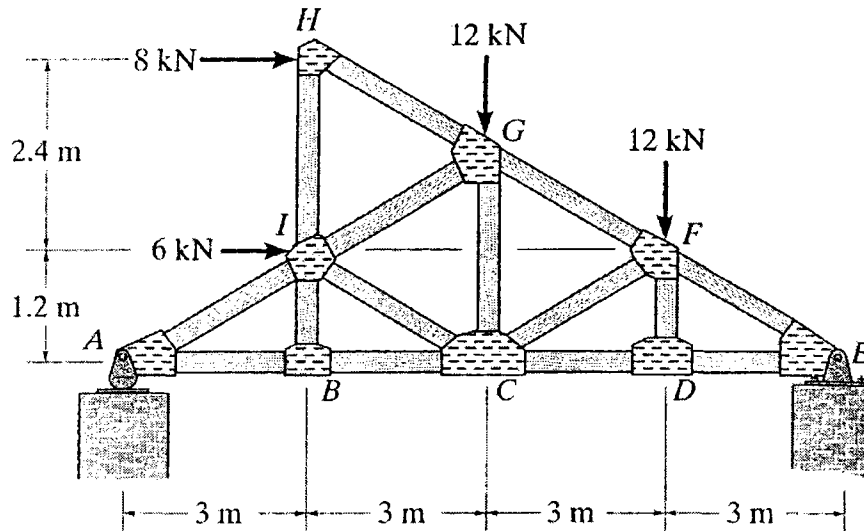


Figure Q3[a]
Rajah S3[a]

- (i) Determine zero force member in the truss and state the applicable general rule

Tentukan anggota daya sifar dalam kekuda dan nyatakan syarat umum yang dipakai.

(10 marks/10 markah)

- (ii) Draw the free body diagram for the whole truss and also the left side section of the truss where the section cuts through FG, CF and CD members.

Lukis rajah badan bebas keseluruhan kekuda dan juga rajah badan bebas keratan bahagian kiri di mana keratan melalui anggota FG, CF dan CD.

(10 marks/10 markah)

- (iii) By using the left side section as in question (ii), determine the internal force in CF and GF members. State whether the force are in tension or compression.

Dengan menggunakan keratan bahagian kiri dalam soalan (ii), tentukan daya dalam anggota GF dan CF. Nyatakan samada daya tersebut dalam tegangan atau mampatan.

(30 marks/30 markah)

- [b] Figure Q3[b] shows a composite area that consists of sections 1, 2 and 3 where section 3 is of quarter circle shape.

Rajah S3[b] menunjukkan satu luas komposit terdiri dari bahagian 1, 2 dan 3 dan bahagian 3 berbentuk seperempat bulat.

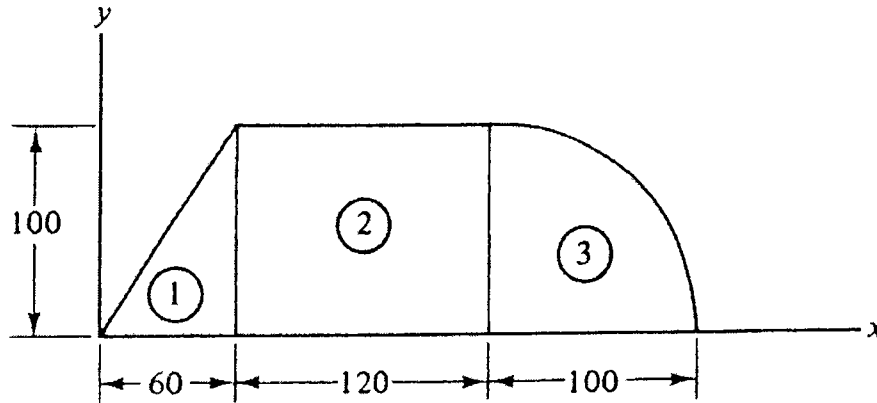


Figure Q3[b]
Rajah S3[b]

- (i) Determine the centroid of the composite area.

Tentukan sentroid luas komposit tersebut.

(15 marks/15 markah)

- (ii) Find the second moment of area of the composite area about the y axis.

Dapatkan momen luas kedua bagi luas komposit di sekitar paksi y.

(35 marks/35 markah)

- Q4. [a] The clevis in Figure Q4[a] is connected by a pin of 12.5 mm diameter. For the joint shown, determine:

Satu 'clevis' dalam Rajah S4[a] disambung dengan pin berdiameter 12.5 mm. Untuk sambungan yang ditunjukkan, tentukan:

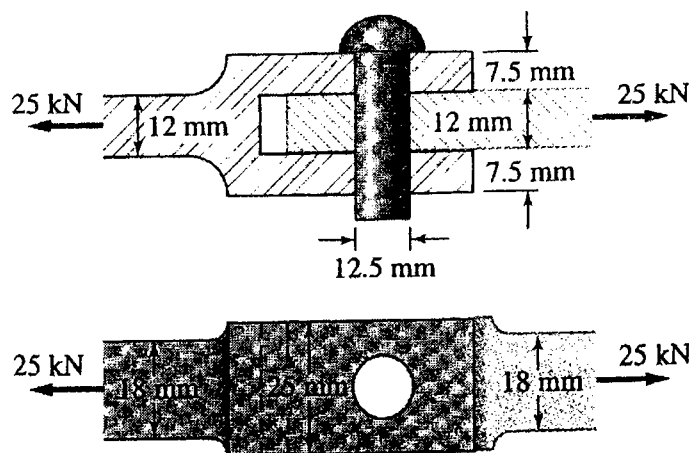


Figure Q4[a]
Rajah S4[a]

- (i) the largest bearing stress between the pin and the members.

tegasan galas terbesar antara pin dan anggota.

(10 marks/10 markah)

- (ii) the average shear stress in the pin.

tegasan ricih purata dalam pin.

(10 marks/10 markah)

- (iii) the largest average normal stress in the members.

tegasan normal purata terbesar dalam anggota

(10 marks/10 markah)

For each case, sketch the affected area in which the stress is induced.

Untuk setiap kes, lakarkan luas terkesan oleh tegasan yang terjana.

(15 marks/15 markah)

- [b] A compound bar 3 m long in Figure Q4[b] is made of two bars, one of copper having $E = 105$ GPa and the other of steel having $E = 210$ GPa. The cross section of each bar is 25 mm wide and 12.5 mm thick. The compound bar is stretched by a load of 50 kN.

Satu bar majmuk panjang 3 m dalam Rajah S4[b] terdiri dari dua bar. Satu bar iaitu kuprum, $E = 105$ GPa manakala yang satu lagi adalah keluli, $E = 210$ GPa. Setiap bar berkeratan rentas lebar 25 mm dan tebal 12.5 mm. Bar majmuk diregang oleh beban 50 kN.

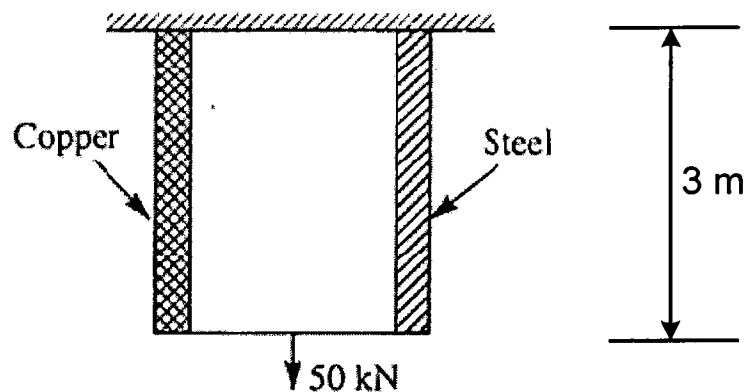


Figure Q4[b]
Rajah S4[b]

Find the increase in length of the compound bar and the stress produced in the steel and copper.

Dapatkan penambahan panjang bar majmuk dan tegasan yang dihasilkan dalam keluli dan kuprum.

(25 marks/25 markah)

- [c] An aluminium specimen in Figure Q4[c] has a diameter of $d_o = 25$ mm and a gauge length of $L_o = 250$ mm. If a force of 165 kN elongates the gauge length 1.20 mm, determine the modulus of elasticity. Also, determine by how much the force causes the diameter of the specimen to contract. Take $G_{al} = 26$ GPa and $\sigma_y = 440$ MPa.

Spesimen aluminium dalam Rajah S4[c] mempunyai diameter $d_o = 25$ mm dan panjang tolok $L_o = 250$ mm. Jika daya 165 kN memanjangkan panjang tolok sebanyak 1.20 mm, tentukan modulus kekenyalan spesimen. Juga tentukan kecutan pada diameter spesimen disebabkan oleh daya berkenaan. Ambil $G_{al} = 26$ GPa dan $\sigma_y = 440$ MPa.

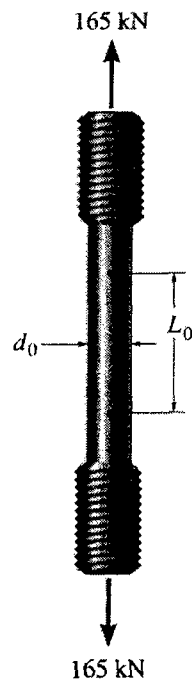


Figure Q4[c]
Rajah S4[c]

(30 marks/30 markah)