First Semester Examination
2017/2018 Academic Session

January 2018

EAS151 – Statics and Dynamics

(Statik dan Dinamik)

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of ELEVEN (11) pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEBELAS (11) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: This paper contains **SIX (6)** questions. Answer **THREE (3)** questions in **PART A** and **PART B is COMPULSORY.** All question carry the same marks.

[***Arahan****: Kertas ini mengandungi* ***ENAM (6)*** *soalan. Jawab* ***TIGA (3)*** *soalan di* ***BAHAGIAN A*** *dan* ***BAHAGIAN B WAJIB DIJAWAB****. Semua soalan membawa jumlah markah yang sama.*]

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai].

PART A: Answer **THREE (3)** questions.
BAHAGIAN A : *Jawab* ***TIGA (3)*** *soalan.*

1. (a). **Figure 1** shows a 550 N weight wooden block which is held in equilibrium by two cables, BA and BC.

Rajah 1 *menunjukkan blok kayu seberat 550 N yang dipegang dalam keadaan keseimbangan oleh dua kabel, BA dan BC.*

(i). Draw free body diagram of all the forces involved

Lukiskan gambar rajah jasad bebas setiap daya yang terlibat

[4 marks/*markah*]

(ii). Determine the tension in cables BA and BC

Tentukan tegangan pada kabel BA dan BC

[6 marks/*markah*]

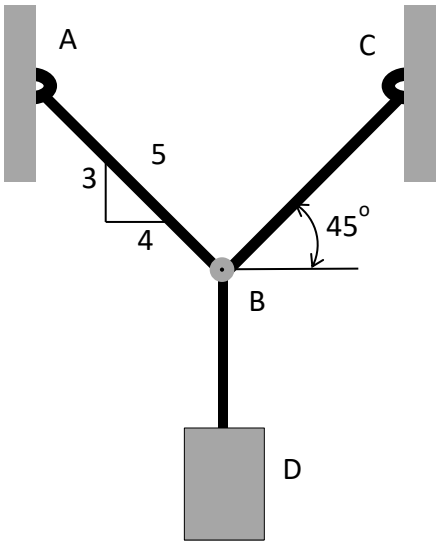

Figure 1/*Rajah 1*

(b). Boom AB in **Figure 2** is held in the position shown by three cables. Tension in cables AC and AD are 1000 N and 1200 N, respectively. If the resultant of the tension exerted at point A of the boom must be directed along AB, determine:

*Penyangga AB dipegang oleh tiga kabel seperti yang ditunjukkan dalam **Rajah 2**. Tegangan pada kabel AC dan AD adalah masing-masing 1000 N dan 1200 N. Sekiranya tegangan paduan pada titik A penyangga adalah pada arah AB, tentukan*

(i). The tension in cable AE

Tegangan pada kabel AE

[6 marks/*markah*]

(ii). The magnitude of the resultant force

Magnitud daya tegangan paduan tersebut

[4 marks/*markah*]

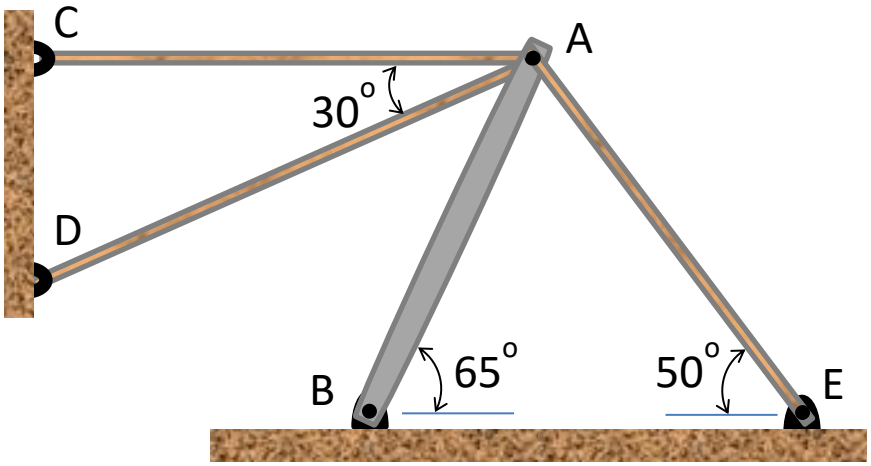

Figure 2/*Rajah 2*

2. A rigid vertical post is hinged at A and held by three cables as shown in **Figure 3**. The tension in cables BD, BE and CF are 200 N, 300 N and 400 N respectively. Height of AB and AC are 2 m and 4 m, respectively.

*Sebatang tiang pugak tegar diengsel di A dan dipegang dengan tiga kabel seperti yang ditunjukkan dalam **Rajah 3**. Tegangan dalam kabel BD, BE dan CF masing-masing ialah 200 N, 300 N dan 400 N. Ketinggian AB dan AC masing-masing ialah 2 m dan 4 m.*

(a). Replace the forces with resultant and couple moment at point A. Express the results in Cartesian vector form.

Gantikan beban tersebut dengan daya paduan setara dan momen ganding di titik A. Nyatakan keputusan dalam bentuk vektor Cartesian.

[14 marks/*markah*]

(b). If the end of cable CF needs to be changed to new position BF, calculate tension in this cable so that the resultant couple moment at point A is the same with answer calculated in Question 2(a). Express the results in Cartesian vector form.

Sekiranya, hujung kabel CF perlu diubah ke kedudukan baharu BF, kira tegangan kabel supaya momen ganding di titik A sama seperti jawapan yang telah dikira dalam Soalan 2(a).

[6 marks/*markah*]

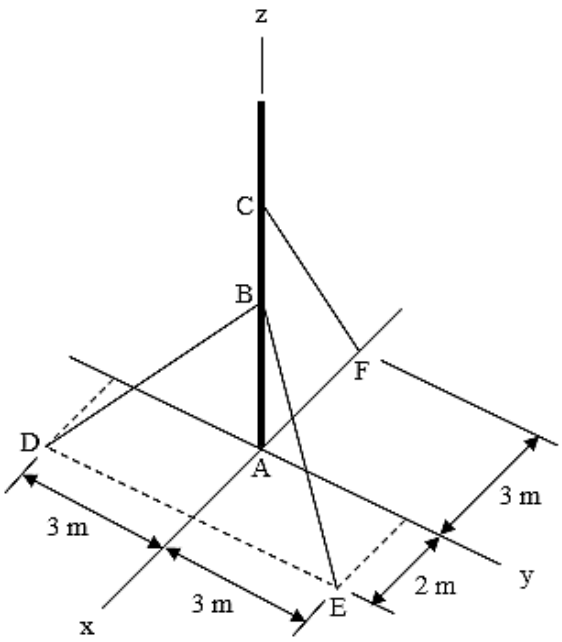

Figure 3/*Rajah 3*

3. (a). A single overhanging beam is supported by a pin at A and roller at B as shown in **Figure 4**. Determine the horizontal and vertical components of reaction at A and the reaction at B on the beam.

*Sebuah rasuk terjulur disokong pin di A dan rola di B seperti ditunjukkan dalam **Rajah 4**. Tentukan komponen tindak balas ufuk dan pugak di A dan tindak balas di B pada rasuk tersebut.*

[6 marks/*markah*]

(b). If support B is replaced by a supporting cables BD as shown in **Figure 5**, determine the tension in this cables using vector analysis. Beam ABC supports the same forces as shown in **Figure 4**.

*Sekiranya penyokong B digantikan dengan sebuah kabel penyokong BD seperti ditunjukkan dalam **Rajah 5**, tentukan daya tegangan dalam kabel tersebut menggunakan analisis vektor. Rasuk ABC menyokong daya yang sama seperti yang ditunjukkan dalam **Rajah 4**.*

[14 marks/*markah*]

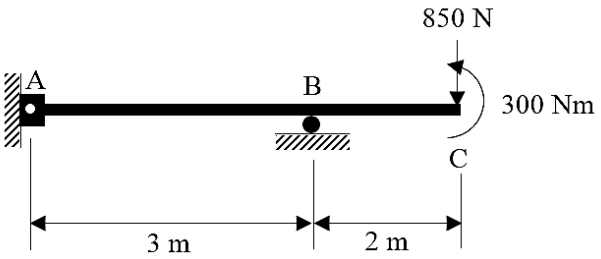

Figure 4/*Rajah 4*

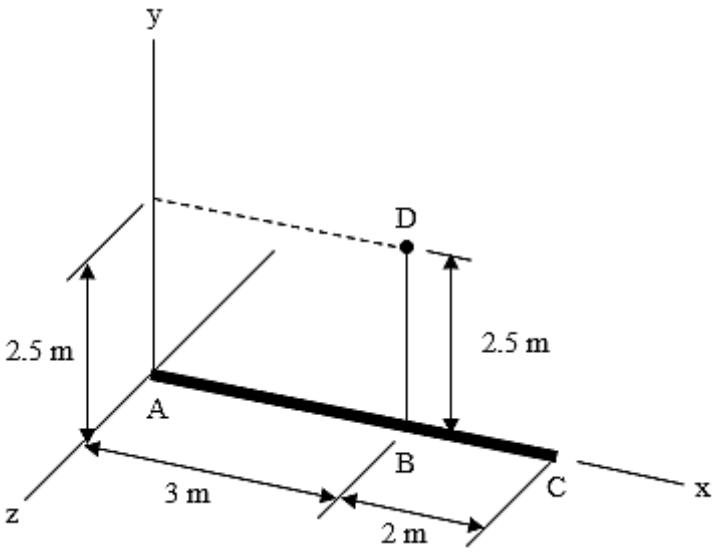

Figure 5/*Rajah 5*

4. (a). Define the centroid of the body and at which condition the centroid coincides with the center of mass.

Takrifkan sentroid bagi sesuatu jasad dan di keadaan yang bagaimana sentroid bertindih dengan pusat jisim.

[4 marks/*markah*]

(b). Calculate the centroid $\bar{y}$ of the geometry shown in **Figure 6** with respect to its base.

*Kira titik sentroid bagi geometri yang ditunjukkan di dalam **Rajah 6** berpandukankan dasarnya.*

[10 marks/*markah*]

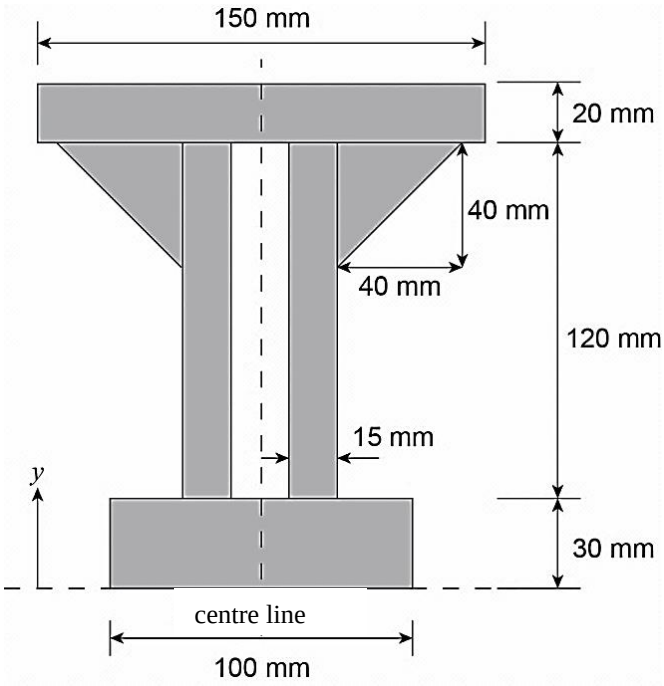

Figure 6/*Rajah 6*

(c). Given that $I_{x_1-x_1}$ for the T-section depicts in **Figure 7** is equal to $83.16 \times 10^6 \text{mm}^4$. Determine $I_{x_2-x_2}$.

*Diberi nilai $I_{x_1-x_1}$ bagi seksyen-T dalam **Rajah 7** bersamaan dengan $83.16 \times 10^6 \text{mm}^4$. Tentukan nilai $I_{x_2-x_2}$.*

[6 marks/*markah*]

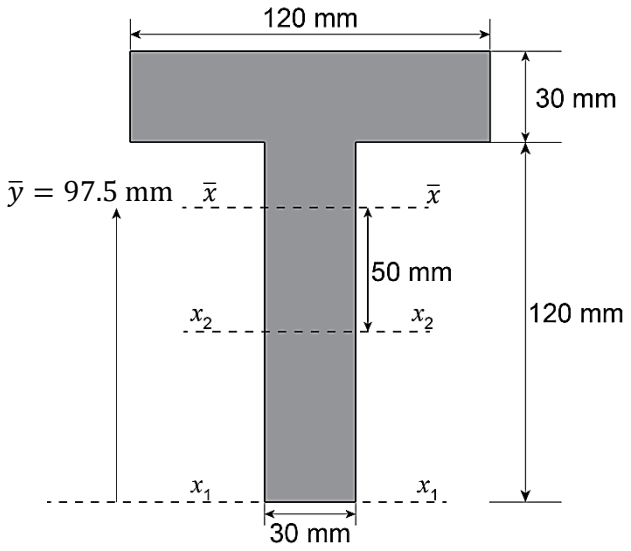

Figure 7/*Rajah 7*

PART B: Answer **ALL** questions.
BAHAGIAN B: *Jawab* ***SEMUA*** *soalan.*

5. (a). The compressed spring as shown in **Figure 8** is released from rest and accelerates block *A* attached to it. The acceleration of the block has an initial value of 125 m/s^2 which then decreases linearly and becomes zero at time t = 0.0534 sec. Calculate the time when the velocity of block *A* first reaches *v* = 2 mm/s.

Pegas yang termampat seperti yang ditunjukkan dalam ***Rajah 8*** *dilepaskan dari keadaan rehat dan memecut blok A. Pecutan blok A mempunyai nilai awal 125 m/s^2 yang kemudiannya berkurang secara lelurus dan mencapai nilai kosong pada masa t = 0.0534 sec. Kirakan masa apabila halaju blok A mula-mula mencapai 2 mm/s.*

[7 marks/*markah*]

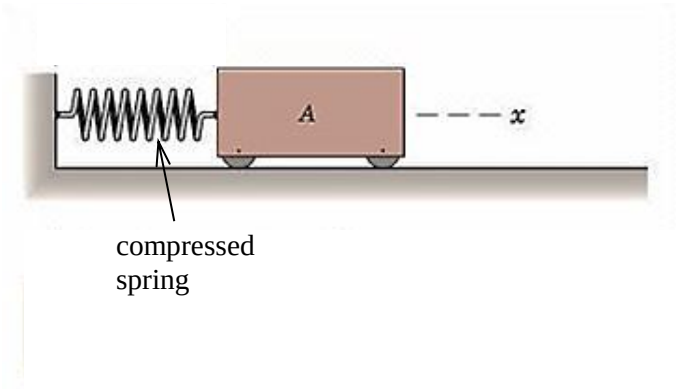

Figure 8/*Rajah 8*

(b). **Figure 9** shows a projectile being launched with a speed v_0 = 25 m/s from the floor of a 5-m high tunnel. If it is given that the launch angle θ = 20^0, determine with proof of calculation whether the projectile will hit the ceiling of the tunnel.

Rajah 9 *menunjukkan satu projektil yang dilancarkan dengan kelajuan v_0 = 25 m/s dari lantai satu terowong setinggi 5 m. Sekiranya diberi bahawa sudut lancaran θ=20^0, tentukan beserta bukti pengiraan samada projektil tersebut akan menghentam siling terowong berkenaan.*

[7 marks/*markah*]

...9/-

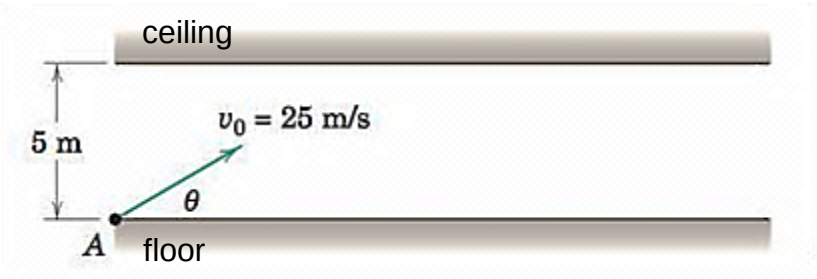

Figure 9/*Rajah 9*

(c). For the pulley system shown in **Figure 10**, derive the relationship between the velocity of B and the velocity of A in term of *y*. Neglect the diameters of the small pulleys.

*Untuk sistem pulley yang ditunjukkan dalam **Rajah 10**, terbitkan hubungan antara halaju B dan halaju A dalam sebutan y. Abaikan garispusat pulley kecil.*

[6 marks/*markah*]

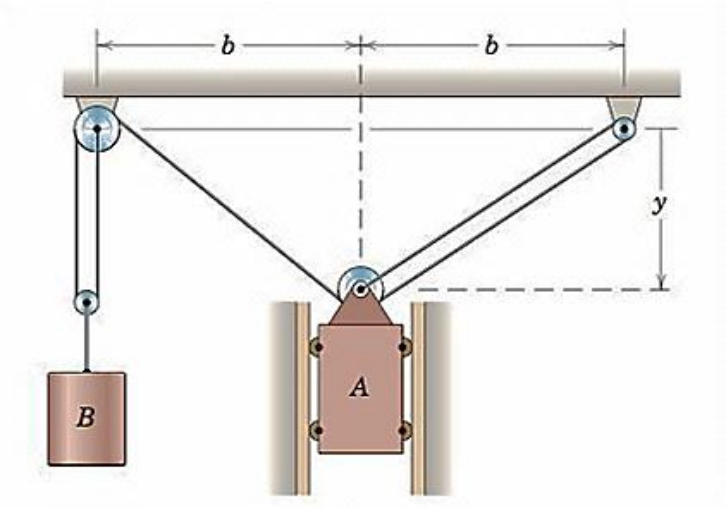

Figure 10/*Rajah 10*

6. (a) **Figure 11** shows a 3 kg collar which is released from rest at A and then slides down the inclined fixed rod. The coefficient of kinetic friction is 0.45. Calculate:

***Rajah 11** menunjukkan satu gegelang seberat 3 kg dilepaskan dari keadaan rehat pada A dan kemudian meluncur ke bawah mengikuti rod condong yang dipegang tegar. Pekali geseran kinetik adalah 0.45. Tentukan:*

(i) the velocity, *v* of the collar as it strikes the spring

Halaju, v gegelang apabila ia menghentam pegas

(ii) the maximum deformation, x_{max} of the spring

pesongan maksimum, x_{max} pegas

[12 marks/*markah*]

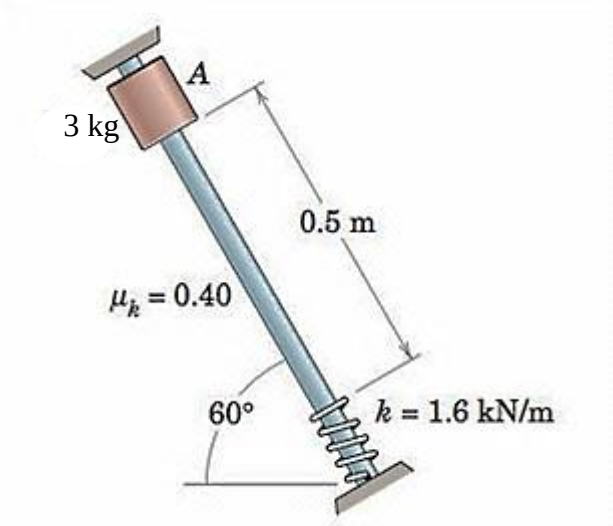

Figure 11/*Rajah 11*

(b) The collar in **Figure 12** has a mass of 1.5 kg and it is attached to the light spring which has a stiffness of 30 N/m. The unstretched length of the spring is 1.5 m. The collar is released from rest at A and slides up the rod under the action of a constant 50- N force. Coefficient of kinetic friction of the rod is 0.35. Calculate the velocity of the collar as it passes through B.

*Gegelang dalam **Rajah 12** mempunyai jisim 1.5 kg dan ia diikat kepada pegas ringan yang mempunyai kekukuhan 30 N/m. Panjang tanpa regangan pegas adalah 1.5 m. Gegelang berkenaan dilepaskan daripada kedudukan rehat pada A dan menggelongsor ke atas rod di bawah tindakan satu daya malar 50-N. Pekali geseran kinetik rod adalah 0.35. Kirakan halaju gegelang apabila ianya melepasi titik B.*

[8 marks/*markah*]

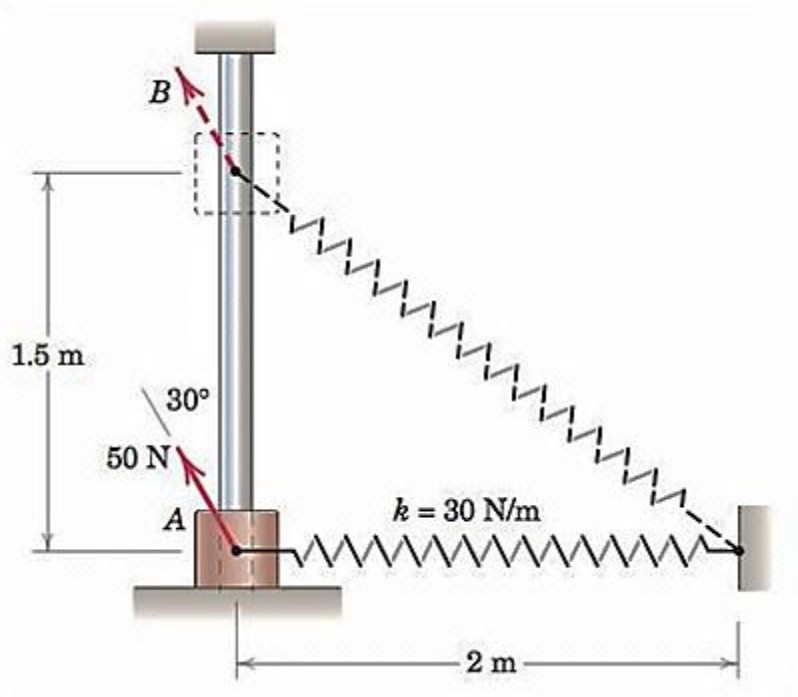

Figure 12/*Rajah 12*

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