UNIVERSITI SAINS MALAYSIA

KSCP Examination
2016/2017 Academic Session

August 2017

EAS151 – Statics and Dynamics
[Statik dan Dinamik]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **TEN (10)** pages of printed material before you begin the examination.

[*Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*]

[Instructions: This paper contains ***SIX (6)*** questions. Answer ***THREE (3)*** questions in **Part A** and **TWO (2)** questions in **Part B**.

[***Arahan**: Kertas ini mengandungi **ENAM (6)** soalan. Jawab **TIGA (3)** soalan di **Bahagian A** dan **DUA (2)** soalan di **Bahagian B**.*

All questions **MUST BE** answered on a new page.

[*Semua soalan **MESTILAH** dijawab pada muka surat baru.*]

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

[*Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.*]

Part A (60 Marks): Answer any THREE (3) questions in this part.

Bahagian A (60 Markah): Jawab mana-mana TIGA (3) soalan di bahagian ini.

1. Knowing that portions of AC and BC of cable ABC as shown in **Figure 1** must be equal, determine the shortest length of the cable that can be used to support the load shown if the tension in the cable is not to exceed 850 N.

   *Diketahui bahawa bahagian kabel AC dan BC pada kabel ABC seperti yang ditunjukkan dalam **Rajah 1** mestilah sama, tentukan panjang terpendek kabel tersebut yang boleh digunakan untuk menampung beban yang ditunjukkan sekiranya tegangan kabel tidak melebihi 850 N.*

   [20 marks/*markah*]

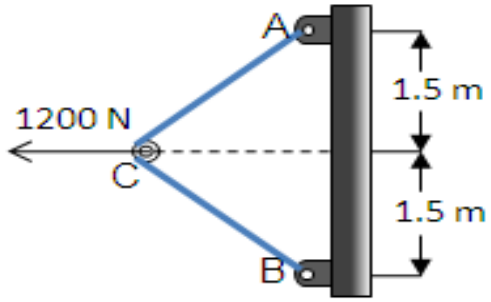

Figure 1/*Rajah 1*

2. A beam as shown in **Figure 2** supports two concentrated forces of 2 kN and 1.5 kN at C and D, respectively. The beam that is supported by pin at A and roller at B also supports a uniformly distributed load and a triangular load on the beam along AC and CD, respectively.

   *Sebuah rasuk yang ditunjukkan dalam **Rajah 2** menyokong dua daya tumpu iaitu 2 kN dan 1.5 kN masing-masing di C dan D. Rasuk tersebut yang disokong pin di A dan rola di B juga menyokong beban teragih seragam dan beban segitiga masing-masing di atas rasuk sepanjang AC dan CD.*

   [a] Replace the load acting on the beam by an equivalent resultant force.

   Gantikan beban yang bertindak di atas rasuk dengan daya paduan setara.

   [5 marks/*markah*]

[b] Determine the location of action and direction of the equivalent force calculated in (i), measured from A.

Tentukan kedudukan dan arah daya paduan setara yang telah dikira dalam (i) diukur dari A.

[3 marks/*markah*]

[c] Determine the support reactions at pin support A and the roller support B.

Tentukan daya tindak balas di penyokong pin A dan penyokong rola B.

[4 marks/*markah]*

[d] If support B is replaced by a supporting cable AE as shown in **Figure 3**, determine the tension developed in these cables. Beam ABCD supports the same forces as shown in **Figure 2**. For this question, find the answer using vector analysis.

*Sekiranya penyokong B digantikan dengan kabel penyokong AE seperti ditunjukkan dalam **Rajah 3**, tentukan daya tegangan yang terhasil dalam kabel tersebut. Rasuk ABCD menyokong daya yang sama seperti yang ditunjukkan dalam **Rajah 2**. Untuk soalan ini, cari jawapan menggunakan analisis vektor.*

[8 marks/*markah*]

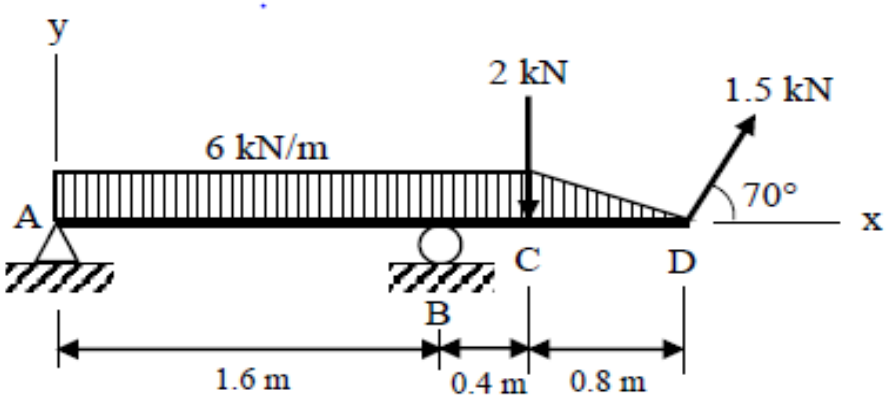

Figure 2/*Rajah 2*

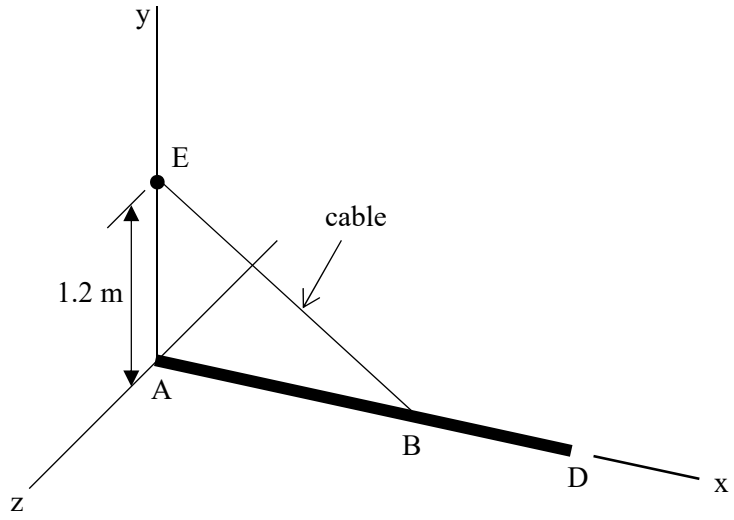

Figure 3/*Rajah 3*

3. [a] **Figure 4** shows a concentrated force of 10 kN acting at point A. Determine the moment produced by the force 10 kN about axis y and axis OB using Cartesian vector formulation.

Rajah 4 *menunjukkan satu daya tumpu 10 kN bertindak di A. Tentukan momen yang dihasilkan oleh daya 10 kN terhadap paksi y dan paksi OB.*

[6 marks/*markah*]

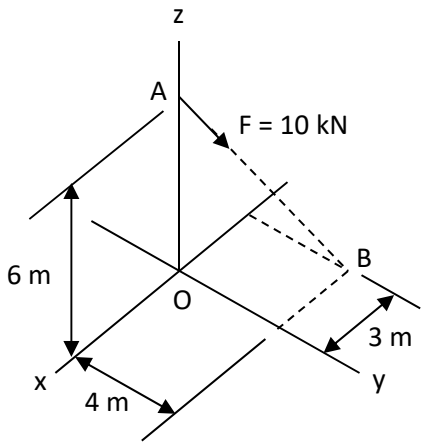

Figure 4/*Rajah 4*

[b] **Figure 5** shows three concentrated forces namely F_{AB} (10 kN), F_{AC} (15 kN) and F_{AD} (20 kN) acting at point A. Determine an equivalent resultant force and couple moment of the force system at point E. Express the results in Cartesian vector form.

Rajah 5 *menunjukkan tiga daya tumpu iaitu* F_{AB} *(10 kN),* F_{AC} *(15 kN) dan* F_{AD} *(20 kN) bertindak di A. Tentukan daya paduan setara dan momen ganding bagi sistem daya tersebut di E. Berikan jawapan dalam bentuk vektor Cartesian.*

[14 marks/*markah*]

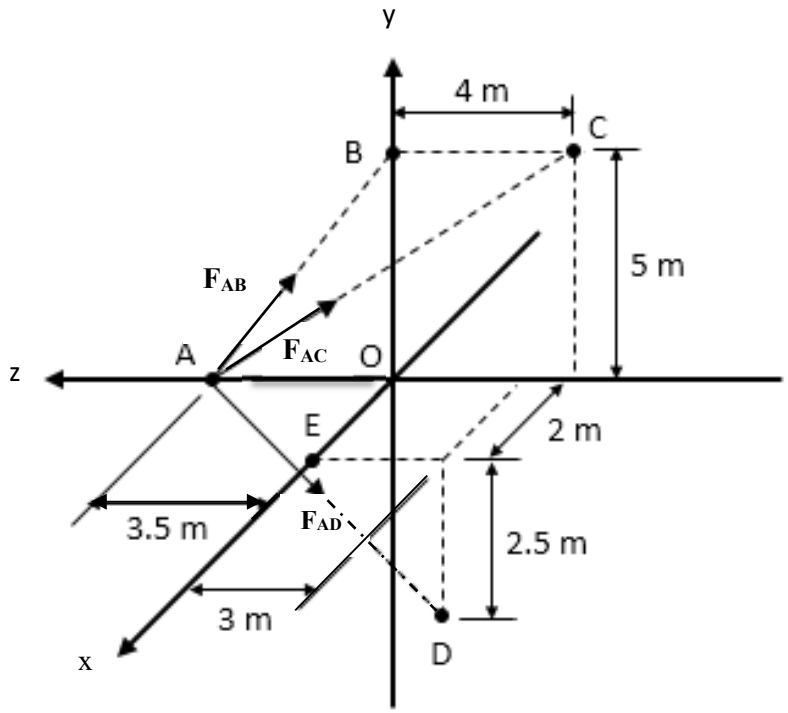

Figure 5/*Rajah 5*

4. [a] **Figure 6(a)** shows a gravity wall which is made of concrete. Locate the location of the center of mass ***G*** of the wall.

Rajah 6(a) *menunjukkan satu dinding graviti yang diperbuat daripada konkrit. Cari lokasi kedudukan pusat jisim* ***G*** *bagi dinding graviti itu.*

[8 marks/*markah*]

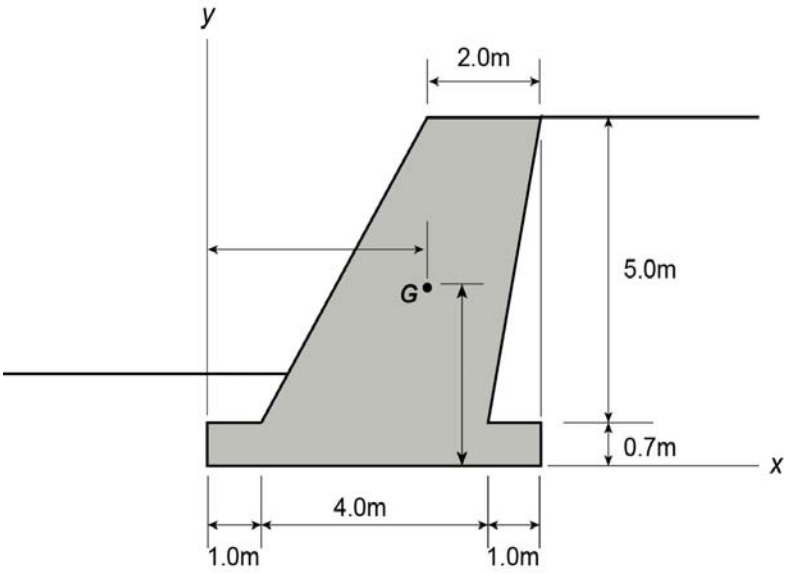

Figure 6(a)/*Rajah 6(a)*

[b] **Figure 6(b)** shows the cross-section of an I-beam. Determine the moments of inertia of the cross-sectional area with respect to the *x* and *y* axes.

Rajah 6(b) *menunjukkan luas keratan rentas rasuk-I. Tentukan momen sifat tekun bagi luas keratan rentas yang ditunjukkan dengan merujuk kepada paksi x dan y.*

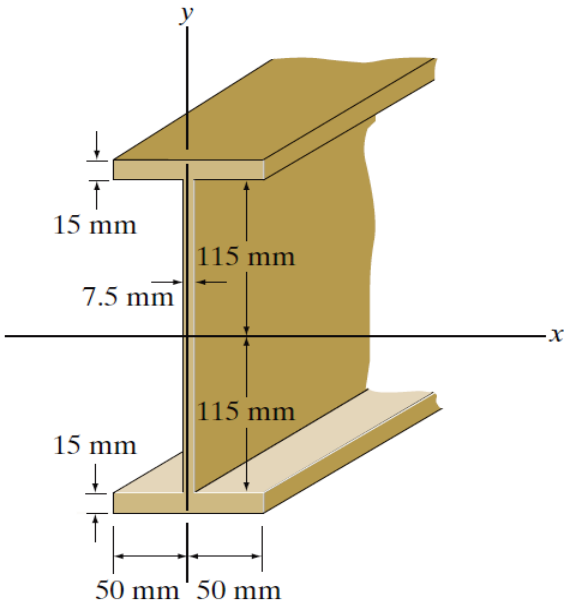

Figure 6(b)/*Rajah 6(b)*

[12 marks/*markah*]

Part B (40 Marks): Answer ALL questions in this part.

Bahagian B (40 markah): Jawab SEMUA soalan di bahagian ini.

5. [a] A particle moves along the x-axis with an initial velocity v_{x0}=65 m/s at the origin when t=0. For the first 5 sec, it has no acceleration. After 5 sec, a retarding force acts on the particle and gives the particle a constant acceleration a_x= - 15 m/s^2. Calculate the velocity and the x-coordinate of the particle for the conditions of t=8 sec and t=12 sec.

Satu zarah bergerak di sepanjang paksi x dengan halaju awal v_{x0}=65 m/s pada asal paksi apabila t=0. Untuk 5 saat pertama, ia tiada pecutan. Selepas 5 saat, satu daya pelambat bertindak ke atas zarah dan memberikan zarah berkenaan satu pecutan seragam a_x= - 15 m/s^2. Kira halaju dan koordinat x zarah berkenaan pada masa t=8 saat and t=12 saat.

[8 marks/*markah*]

[b] The curvilinear motion of a particle is defined by v_x= 60 – 15t and y= 125 – 4t^2, where v_x is in m/s, y in m and t in sec. It is also given that x=0 when t=0. Determine the velocity vector of the particle when the position y=0 is reached.

Pergerakan melengkung satu zarah ditakrifkan oleh v_x= 60 – 15t dan y= 125 – 4t^2, di mana v_x adalah dalam m/s, y dalam m dan t dalam saat. Diberi juga x=0 apabila t=0. Tentukan vektor halaju zarah berkenaan apabila kedudukan y=0 dicapai.

[6 marks/*markah*]

[c] For the assemblage shown in **Figure 7**, derive the expression for the velocity v_A of box A sliding down the inclined surface in terms of upward velocity v_B of block B.

*Untuk sistem terpasang seperti yang ditunjukkan dalam **Rajah 7**, terbitkan persamaan untuk halaju kotak A v_A yang meluncur ke bawah atas permukaan condong dalam sebutan halaju ke atas blok B v_B.*

[6 marks/*markah*]

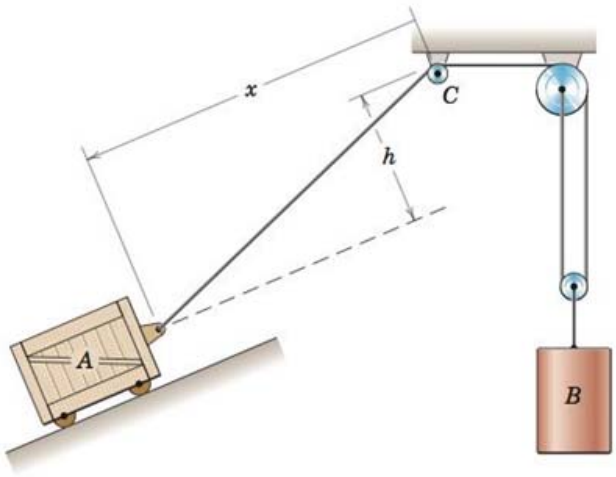

Figure 7/*Rajah 7*

6. [a] The 125-kg concrete block A is released from rest in the position shown in **Figure 8**. It pulls the 200 kg log up the 20^0 ramp. If the coefficient of kinetic friction μ_k between the log and the ramp is 0.40, determine the velocity of the concrete block when it hits the ground at B which is 7.5 m below concrete block A.

*Blok konkrit A dengan berat 125-kg dilepaskan dari keadaan rehat seperti yang ditunjukkan dalam **Rajah 8**. Ia menarik balak kayu seberat 200 kg naik permukaan condong 20^0. Sekiranya pekali geseran μ_k antara balak kayu dan permukaan condong adalah 0.40, tentukan halaju blok konkrit apabila ia menghentam permukaan tanah pada B yang berada pada jarak 7.5 m di bawah blok konkrit A.*

[12 marks/*markah*]

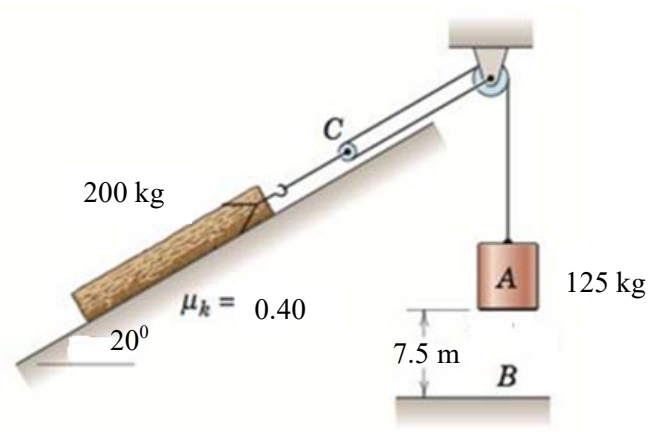

Figure 8/*Rajah 8*

[b] The 10.0 kg cylinder is released from the position as shown in **Figure 9**. The cylinder compresses the spring with stiffness k = 2.5 kN/m. Determine:

*Silinder seberat 10.0 kg dilepaskan daripada keadaan rehat seperti yang ditunjukkan dalam **Rajah 9**. Silinder berkenaan memampat pegas dengan kekukuhan k = 2.5 kN/m. Tentukan:*

[i] maximum compression x_{max} of the spring

mampatan maksimum x_{max} pegas

[ii] maximum velocity of the cylinder v_{max}

halaju maksimum silinder v_{max}

[8 marks/*markah*]

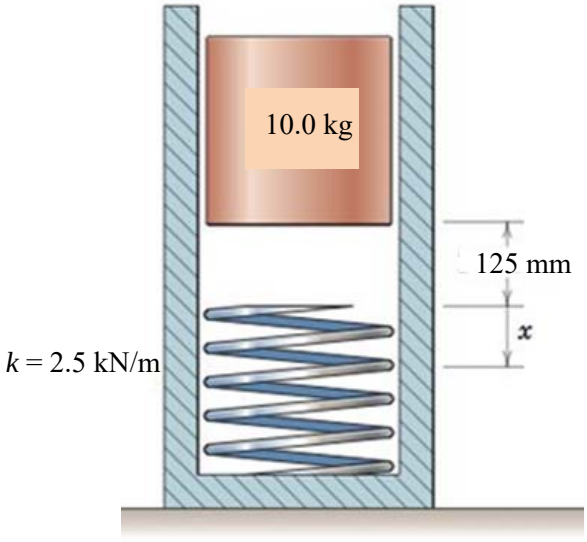

Figure 9/*Rajah 9*

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