UNIVERSITI SAINS MALAYSIA

First Semester Examination
2015/2016 Academic Session

December 2015 / January 2016

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 ***SEVEN (7)*** questions. Answer ***FOUR (4)*** questions in Part A and **ONE (1)** question in Part B.
[***Arahan****: Kertas ini mengandungi* ***TUJUH (7)*** *soalan. Jawab* ***EMPAT (4)*** *soalan di Bahagian A dan* ***SATU (1)*** *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: ANSWER ANY FOUR (4) QUESTIONS IN THIS PART

BAHAGIAN A: JAWAB MANA-MANA EMPAT (4) SOALAN DI BAHAGIAN INI

1. A block of weight, *W* is suspended from a 250 mm long cord as shown in **Figure 1** and two springs of which the unstretched lengths are 225 mm. Knowing that the constant values of the springs AB and AC are k_{AB} = 10 N/cm and k_{AC} = 4 N/cm, respectively. Determine

*Satu blok dengan berat, W seperti yang ditunjukkan di dalam **Rajah 1** digantung dengan tali sepanjang 250 mm dan dua spring dengan panjang tanpa regangan adalah 225 mm. Diberikan pemalar spring AB dan AC masing-masing ialah k_{AB} = 10 N/cm dan k_{AC} = 4 N/cm. Tentukan*

[a] Tension in the cord AD
Ketegangan tali AD

[16 marks/*markah*]

[b] Weight of the block, W
Berat blok, W

[4 marks/*markah*]

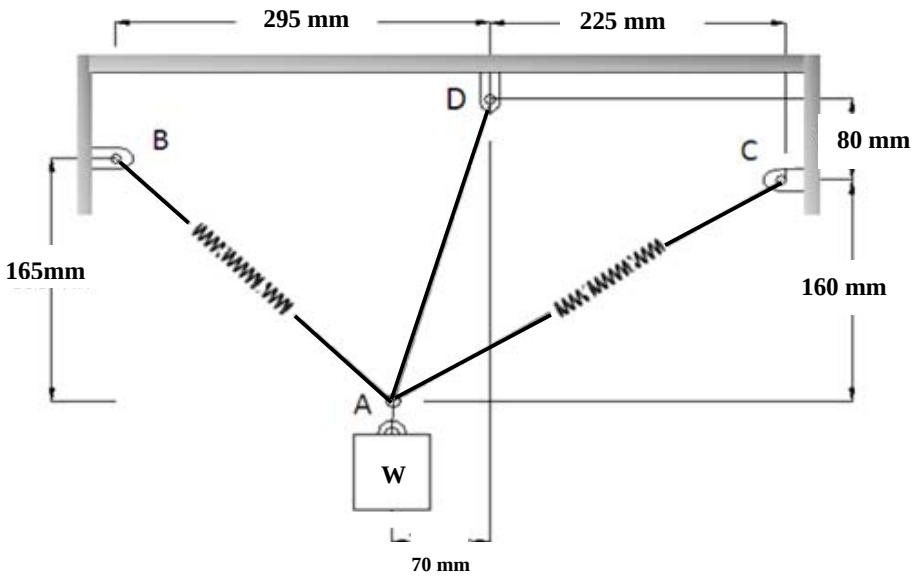

Figure 1 / *Rajah 1*

2. **Figure 2** shows three concentrated forces acting at point *P*. Height of *P* from O is 4 m. Determine an equivalent resultant force and couple moment of the force system at point *S*. Express the results in Cartesian vector form.

Rajah 2 *menunjukkan tiga daya tumpu bertindak di P. Tinggi P dari O ialah 4 m. Tentukan daya paduan setara dan momen ganding bagi sistem daya tersebut di S. Berikan jawapan dalam bentuk vektor Cartesian.*

[20 marks/*markah*]

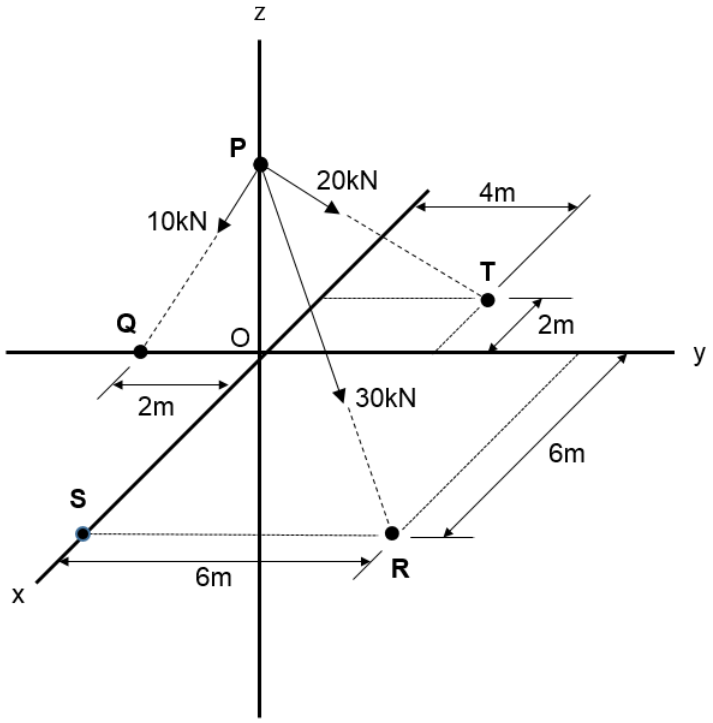

Figure 2 / *Rajah 2*

3. A simply supported beam, AB is subjected to a concentrated load of 150 kN and a distributed loading of 100 kN/m as shown in **Figure 3**. The beam is supported by pin at A and roller at B. The area of the distributed loading diagram is a trapezoid form.

Sebuah rasuk disokong mudah, AB dibebani dengan 150 kN beban tumpu dan 100 kN/m beban teragih seperti ditunjukkan dalam ***Rajah 3****. Rasuk tersebut disokong pin di A dan rola di B. Luas gambarajah beban teragih adalah berbentuk trapezoid.*

[i] Determine the resultant force and specify where it acts on the beam measured from A.

Tentukan beban paduan dan nyatakan kedudukan daya tersebut yang diukur dari A.

[13 marks/*markah*]

[ii] Determine the horizontal and vertical components of reaction at support A and B.

Tentukan komponen tindak balas mengufuk dan menegak di penyokong A dan B.

[7 marks/*markah*]

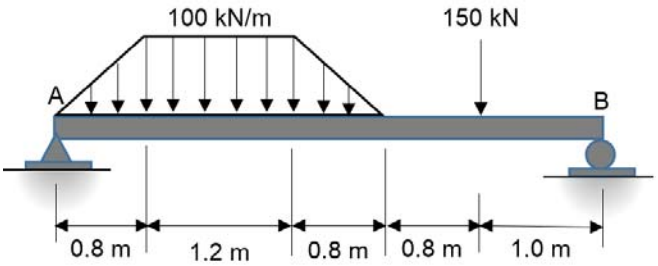

Figure 3 / *Rajah 3*

4. A plane truss is subjected to three concentrated loads at point A and E as shown in **Figure 4**. Determine the force in each member of truss and indicate whether the members are in tension or compression.

*Sebuah kekuda satah ditindaki dengan tiga beban tumpu seperti ditunjukkan dalam **Rajah 4**. Tentukan daya dalam setiap anggota kekuda dan nyatakan samada anggota-anggota tersebut adalah dalam tegangan atau mampatan.*

[20 marks/*markah*]

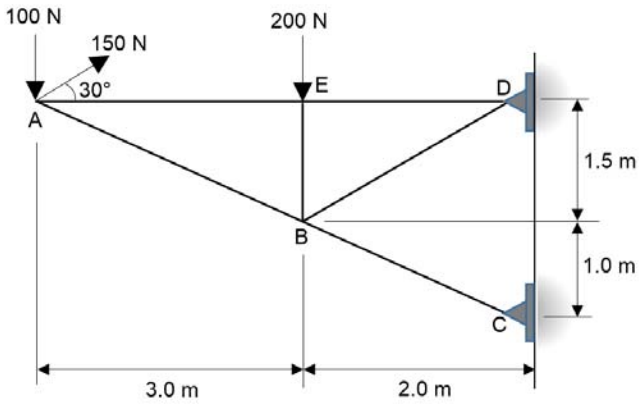

Figure 4 / Rajah 4

5. [a] **Figure 5** shows a concrete gravity wall for embankment. Determine the center of mass, *G* of the wall.

Rajah 5 *menunjukkan dinding graviti konkrit untuk tembok benteng. Tentukan pusat jisim, G bagi dinding tersebut.*

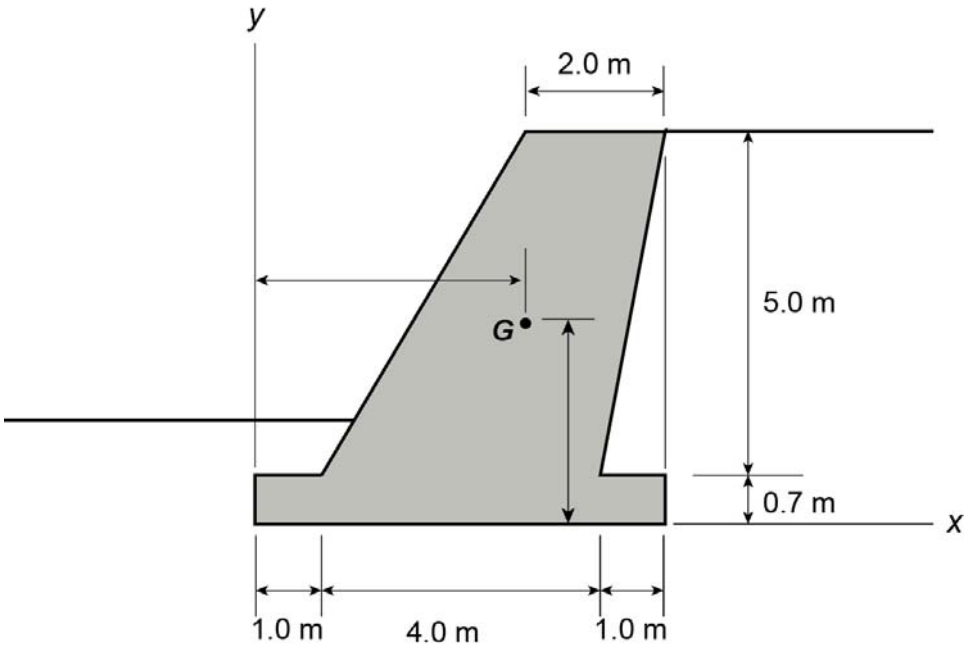

Figure 5 / *Rajah 5*

[10 marks/*markah*]

[b] Determine the moments of inertia of the cross-sectional area shown in **Figure 6** with respect to the *x* and *y* axes.

Tentukan momen sifat tekun bagi luas keratan rentas yang ditunjukkan dalam ***Rajah 6*** *dengan merujuk kepada paksi x dan y.*

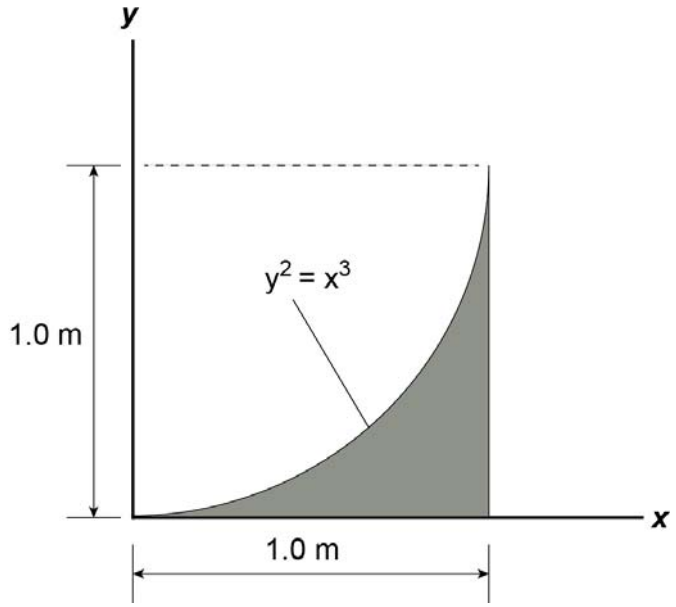

Figure 6 / Rajah 6

[10 marks/*markah*]

PART B: ANSWER ONE (1) QUESTION IN THIS PART

BAHAGIAN B: JAWAB SATU (1) SOALAN DI BAHAGIAN INI

6. [a] A particle starts from rest with an acceleration of 7.5 m/s^2. The acceleration then decreases linearly with time to zero in 15 seconds. After that, the particle continues to move at a constant speed. Determine the time required for the particle to travel 750 m from the start.

Satu zarah bermula dari keadaan rehat dengan pecutan 7.5 m/s^2. Pecutan zarah kemudiannya berkurang secara lelurus dengan masa ke nilai kosong dalam masa 15 saat. Selepas itu, zarah terus bergerak pada kelajuan tetap. Tentukan masa yang diperlukan untuk zarah berkenaan berjalan sejauh 750 m dari mula.

[7 marks/*markah*]

[b] The curvilinear motion of a particle is defined by $v_x = 55 - 15t$ and $y = 125 - 5t^2$, where v_x is in m/s, y in meter 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 $v_x = 55 - 15t$ dan $y = 125 - 5t^2$, yang di mana v_x adalah dalam m/s, y dalam meter dan t dalam saat. Diberi juga x=0 apabila t=0. Tentukan vektor halaju zarah berkenaan apabila kedudukan y=0 dicapai.

[7 marks/*markah*]

[c] Downward velocity of block B (in m/s) in **Figure 7** is given by $v_B = t^2/2 + t^3/6$, where t is in sec. Calculate the velocity and acceleration of block A at time t=2s.

*Halaju ke bawah blok B (dalam m/s) dalam **Rajah 7** diberi oleh persamaan $v_B = t^2/2 + t^3/6$, di mana t adalah dalam unit saat. Kirakan halaju dan pecutan blok A pada masa t=2s.*

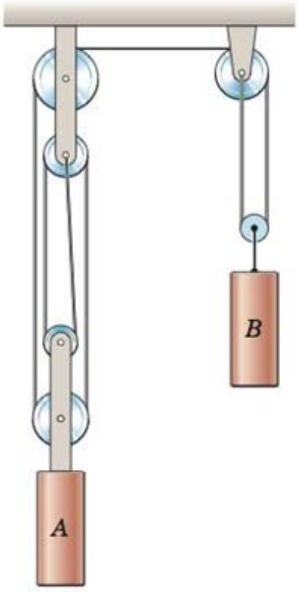

Figure 7 / Rajah 7

[6 marks/*markah*]

7. [a] A 5 kg slider is released from rest at A and slides down the circular rod with negligible friction as shown in **Figure 8**. Determine:

[i] the velocity v_B of the slider as it reaches the bottom of the circular rod at B
[ii] the maximum deformation d_{max} of the spring

*Satu peluncur seberat 5 kg dilepaskan dari keadaan rehat pada A dan meluncur mengikuti rod bulat dengan geseran yang boleh diabaikan seperti yang ditunjukkan dalam **Rajah 8**. Tentukan:*

[i] halaju v_B peluncur apabila ia berada di kedudukan bawah rod bulat pada B
[ii] pesongan maksimum d_{max} pegas

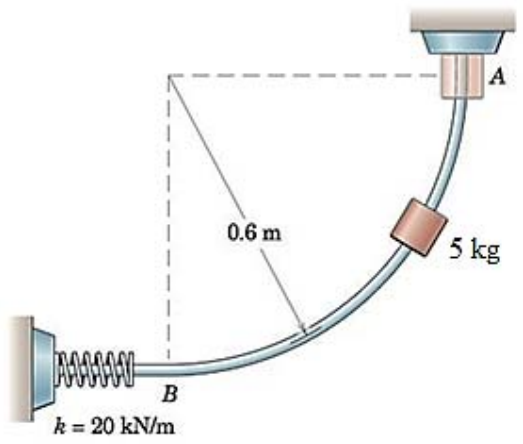

Figure 8 / Rajah 8

[10 marks/*markah*]

[b] A 15 kg cylinder is latched in place with the 85kN/m spring compressed by 30 mm as shown in **Figure 9**. The cylinder is released suddenly from its latched position. Note that the cylinder is not attached to the spring. Determine:

[i] the maximum height reached by the cylinder

[ii] the velocity of the cylinder when the spring has moved up by 15 mm.

Satu silinder 15 kg ditambat pada kedudukan dengan satu 85 kN/m pegas yang termampat sebanyak 30 mm seperti yang ditunjukkan dalam ***Rajah 9****. Silinder berkenaan dilepaskan secara tiba-tiba daripada kedudukan tertambat. Dinyatakan bahawa silinder tidak ditambat kepada pegas. Tentukan:*

[i] tinggi maksimum yang dicapai oleh silinder

[ii] halaju silinder apabila pegas telah bergerak 15 mm ke atas.

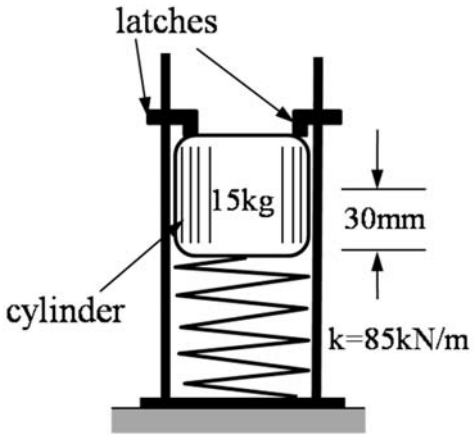

Figure 9 / Rajah 9

[10 marks/*markah*]

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