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UNIVERSITI SAINS MALAYSIA

First Semester Examination  
Academic Session 2016/2017

December 2016 / January 2017

**EMM 101 – Engineering Mechanics**  
*[Mekanik Kejuruteraan]*

Duration : 3 hours  
*Masa : 3 jam*

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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.]*

**INSTRUCTIONS** : Answer **ALL** questions.

*[**ARAHAN** : Jawab **SEMUA** soalan.]*

Answer questions in English OR Bahasa Malaysia.

*[Jawab soalan dalam Bahasa Inggeris ATAU Bahasa Malaysia.]*

Answer to each question must begin from a new page.

*[Jawapan bagi setiap soalan mestilah dimulakan pada mukasurat yang baru.]*

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

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

**Q1. [a] Figure Q1[a] shows two forces  $F_1$  and  $F_2$  that are acting on the support.**

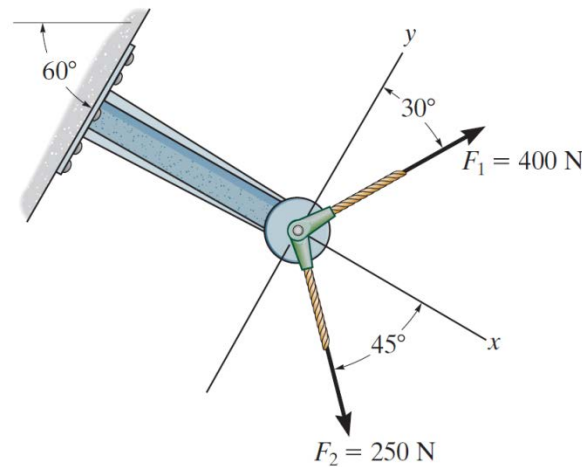
*Rajah S1[a] menunjukkan dua daya  $F_1$  dan  $F_2$  yang bertindak ke atas penyokong.*

- (i) Resolve  $F_1$  and  $F_2$  into their scalar  $x$  and  $y$  components. Express  $F_1$  and  $F_2$  in vector notation.**

*Leraikan  $F_1$  dan  $F_2$  kepada komponen skalar dalam arah  $x$  dan  $y$ . Nyatakan  $F_1$  dan  $F_2$  dalam perwakilan vektor.*

- (ii) Determine the magnitude of the resultant force and its direction measured counter clockwise from the positive  $x$  axis.**

*Tentukan magnitud daya paduan dan arahnya yang diukur mengikut arah lawan jam dari paksi positif  $x$ .*



**Figure Q1[a]**

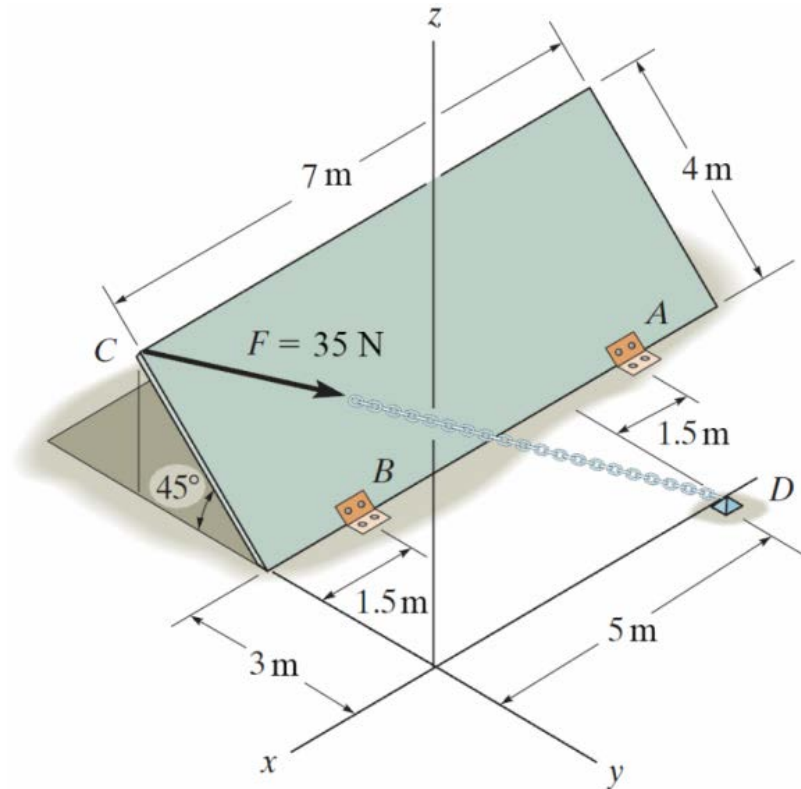
*Rajah S1[a]*

**(40 marks/markah)**

...3/-

[b] A door that is supported by a chain from point C to point D is shown in Figure Q1[b]. Determine the moment of force F about the door hinge at A and B respectively. Express the results in Cartesian vector.

*Pintu yang disokong oleh satu rantai dari titik C ke titik D ditunjukkan dalam Rajah S1[b]. Tentukan momen yang disebabkan oleh daya F pada engsel pintu di A dan B masing-masing. Nyatakan jawapan dalam perwakilan vektor Cartesian.*



**Figure Q1[b]**  
*Rajah S1[b]*

(60 marks/markah)

**Q2. [a]** Figure Q2[a] shows the rod AB which supported by two cables BC, BD and a connection of ball-and-socket at joint A.

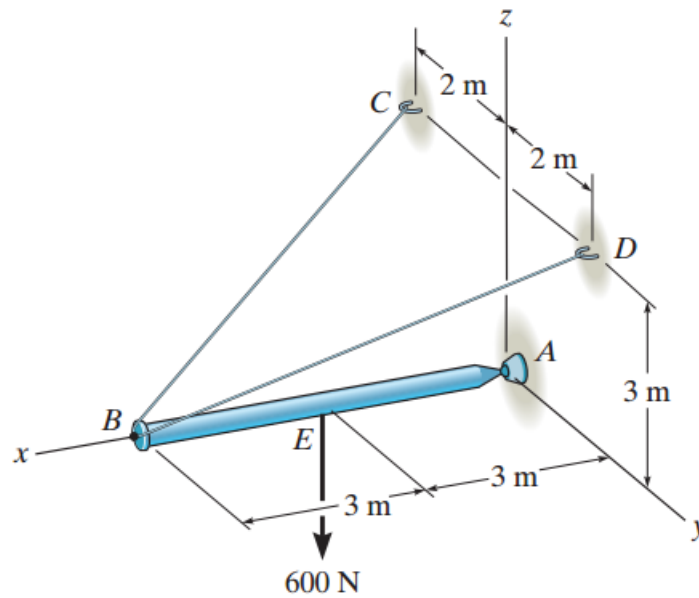
*Rajah S2[a] menunjukkan rod AB yang disokong oleh dua kabel BC, BD dan sambungan bola dan soket di sendi A.*

**(i)** Draw the free body diagram of the assembly of Figure Q2[a].

*Lukis rajah jasad bebas pemasangan Rajah S2[a].*

**(ii)** Determine the components of reaction at the ball-and-socket joint A and the tension in each cable necessary for equilibrium of the rod.

*Tentukan kesemua komponen tindak balas pada bola dan soket A dan ketegangan pada setiap kabel untuk keseimbangan rod.*



**Figure Q2[a]**  
*Rajah S2[a]*

**(60 marks/markah)**

...5/-

**[b] Figure Q2[b] shows the composite area cross sectional of the C-shape beam.**

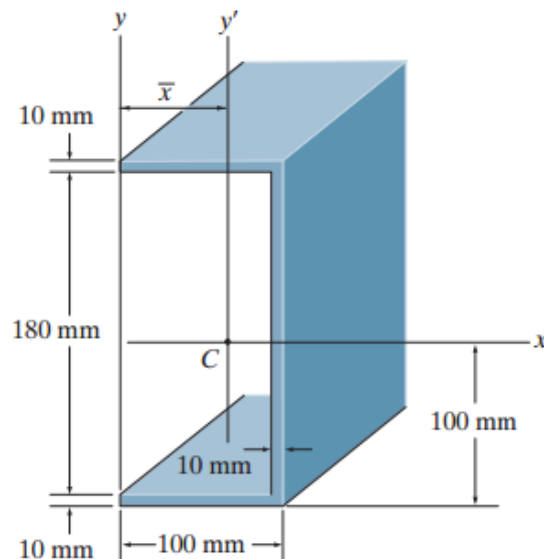
*Rajah S2[b] menunjukkan luas keratan komposit rasuk berbentuk C.*

- (i) Determine the moment of inertia of the cross sectional area about the  $x$  axis.**

*Tentukan momen inersia bagi luas keratan rentas pada paksi  $x$ .*

- (ii) Locate the centroid  $\bar{x}$  of the beam's cross sectional area and then determine the moment of inertia of the area about the centroidal  $y'$  axis.**

*Cari sentroid  $\bar{x}$  bagi kawasan keratan rentas rasuk dan kemudian tentukan momen inersia bagi kawasan sekitar sentroid paksi  $y'$ .*



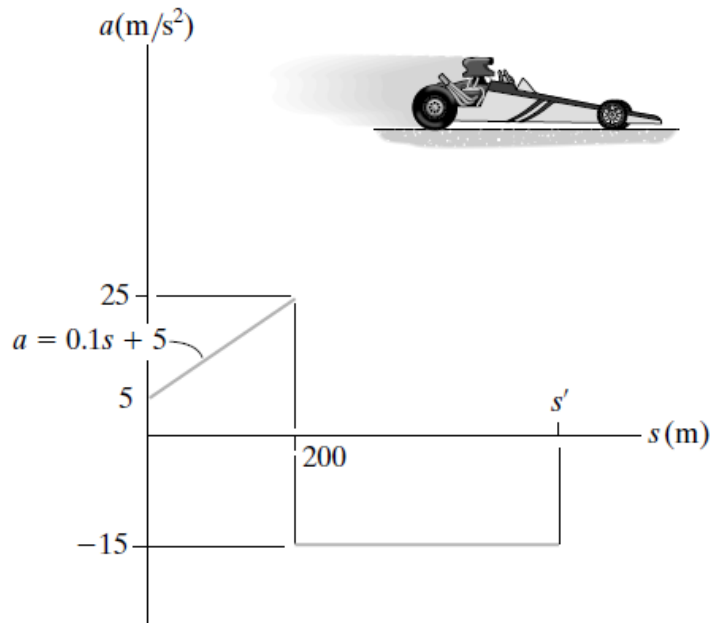
**Figure Q2[b]**  
*Rajah S2[b]*

**(40 marks/markah)**

...6/-

**Q3. [a]** Figure Q3[a] show a dragster starts from rest and travels along a straight track with an acceleration-deceleration described by the graph. Construct the  $v$ - $s$  graph for  $0 \leq s \leq s'$  and determine the distance  $s'$  travelled before the dragster again comes to rest.

*Rajah S3[a] menunjukkan pemecut bermula dari keadaan pegun dan bergerak di atas landasan yang lurus dengan pecutan-nyah pecutan digambarkan oleh graf. Bina graf  $v$ - $s$  untuk  $0 \leq s \leq s'$  dan tentukan jarak  $s'$  yang telah dilalui sebelum pemecut itu sekali lagi berhenti.*

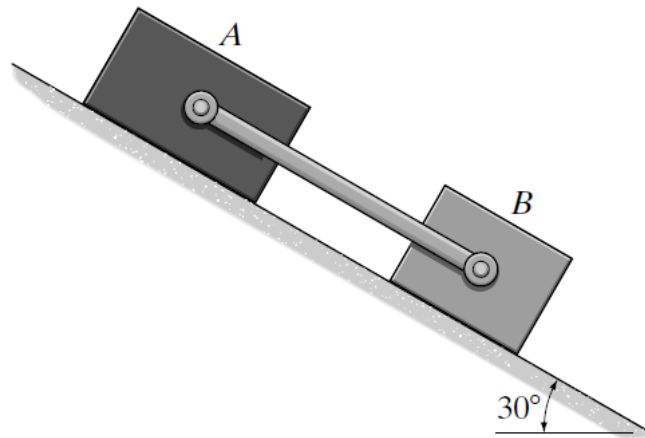


**Figure Q3[a]**  
*Rajah S3[a]*

**(50 marks/markah)**

- [b] **Figure Q3[b] shows blocks A and B of mass 10 kg and 6 kg respectively, are placed on the inclined plane and released. Determine the force developed in the link. The coefficients of kinetic friction between the blocks and the inclined plane are  $\mu_a = 0.1$  and  $\mu_b = 0.3$ . Neglect the mass of the link.**

*Rajah S3[b] menunjukkan blok A dan B berjisim 10 kg dan 6 kg, masing-masing diletakkan pada satah condong dan dibebaskan. Tentukan daya yang terbina dalam pautan. Pekali geseran kinetik antara blok dan satah condong adalah  $\mu_a = 0.1$  dan  $\mu_b = 0.3$ . Abaikan jisim pautan.*



**Figure Q3[b]**  
*Rajah S3[b]*

**(50 marks/markah)**

Q4.

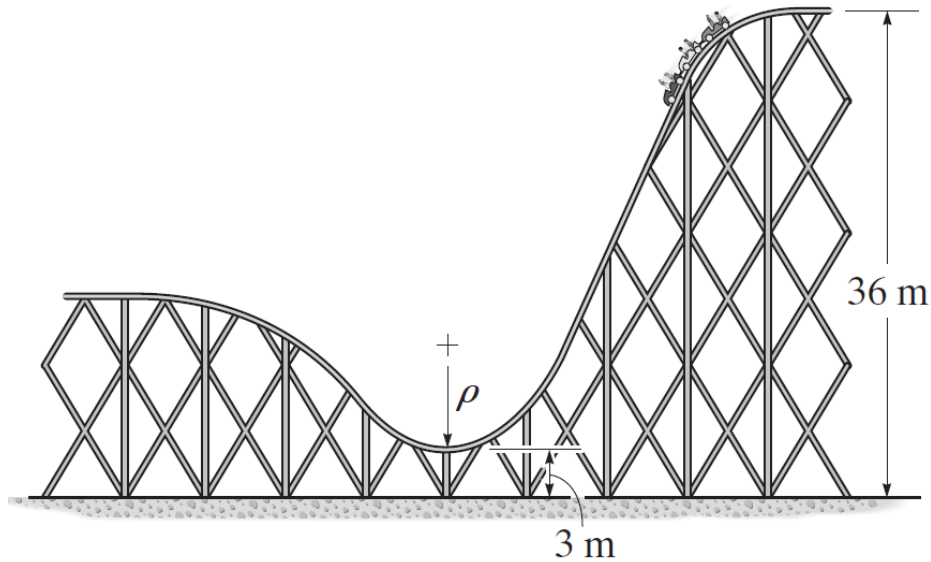


Figure 4[a]  
Rajah 4[a]

- [a] A roller coaster car drops with initial speed of 1.5 m/s from the highest point of the track to the lowest. Neglecting friction, determine:

*Sebuah kereta 'roller coaster' turun dengan kelajuan mulaan 1.5 m/s dari tempat yang tertinggi ke tempat yang terendah. Dengan mengabaikan geseran, tentukan:*

- (i) The speed of the car at its lowest point.

*Kelajuan kereta di tempat terendah.*

(25 marks/markah)

- (ii) The smallest radius of curvature such that the passengers will not experience a normal force that is more than 3.5 times their weight against the seat of the car.

*Jejari lengkungan terkecil supaya penumpang tidak akan mengalami daya normal yang lebih daripada 3.5 kali berat badan mereka terhadap kerusi kereta.*

(25 marks/markah)



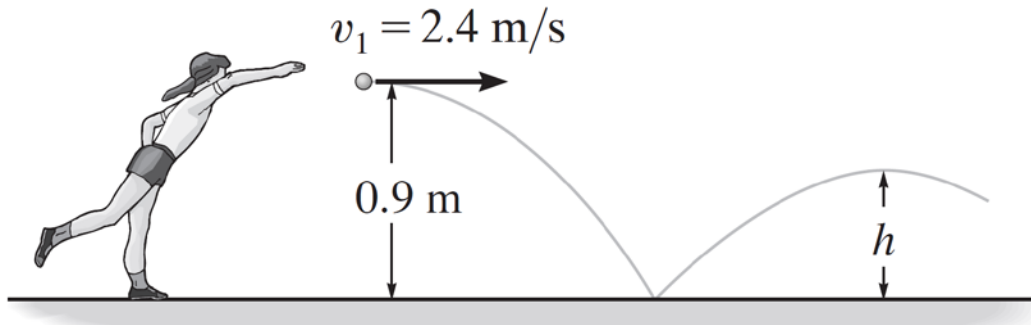


Figure 4[b]  
Rajah 4[b]

- [b] A girl throws a ball with a horizontal velocity of  $v_1 = 2.4 \text{ m/s}$ . If the coefficient of restitution between the ball and the ground is  $e = 0.8$ , determine:

*Seorang gadis melemparkan bola dengan halaju mendatar  $v_1 = 2.4 \text{ m/s}$ . Jika pekali pengembalian antara bola dan tanah adalah  $e = 0.8$ , tentukan:*

- (i) The velocity (magnitude and direction) of the ball just after it rebounds from the ground.

*Halaju (magnitud dan arah) bola selepas ia melantun dari tanah.*

(25 marks/markah)

- (ii) The maximum height to which the ball rises after the first bounce.

*Ketinggian maksimum bola tersebut selepas lantunan pertama.*

(25 marks/markah)