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.*

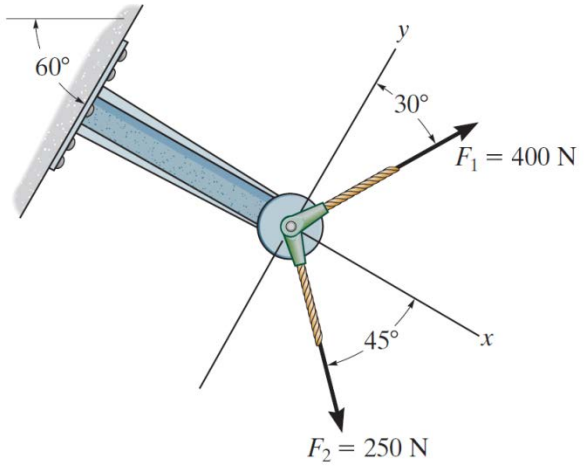


**Figure Q1[a]**
*Rajah S1[a]*

(**40 marks**/*markah*)

**[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.*

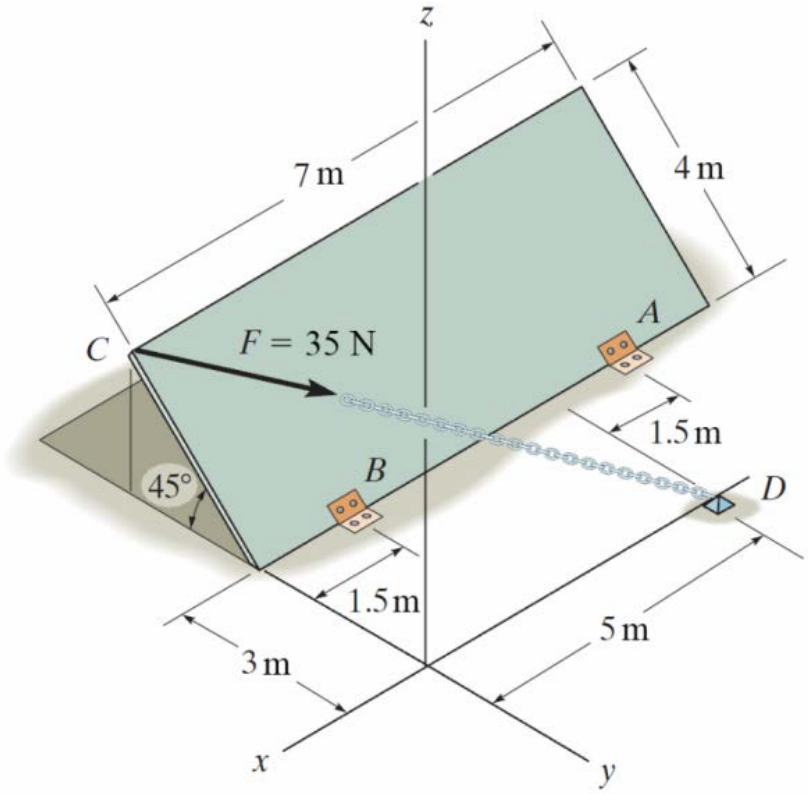


**Figure Q1[b]**
*Rajah S1[b]*

(**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 pepasangan 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.*

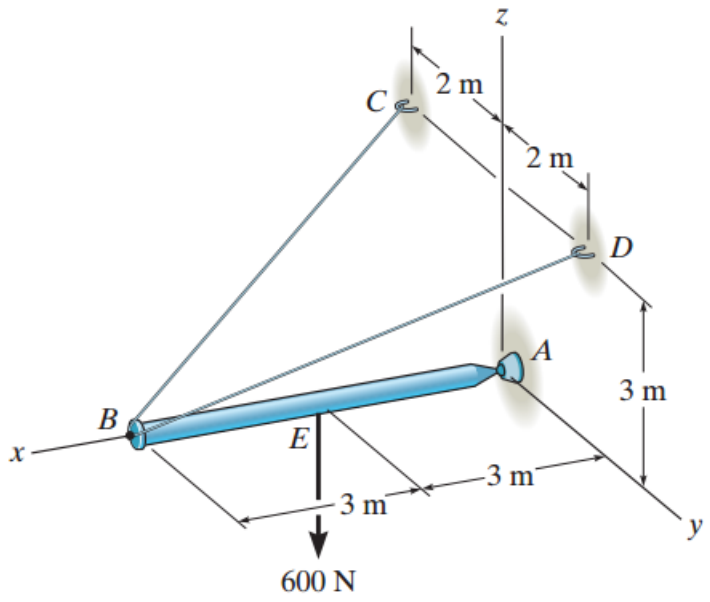


**Figure Q2[a]**
*Rajah S2[a]*

**(60 marks/*markah*)**

**[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'.*

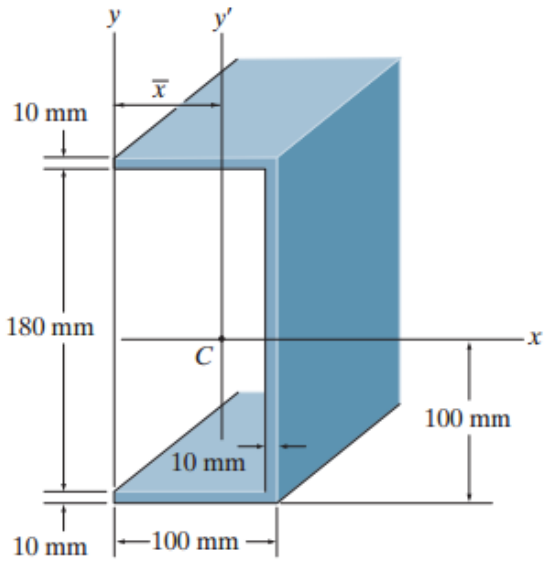


**Figure Q2[b]**
*Rajah S2[b]*

**(40 marks/*markah*)**

**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.*

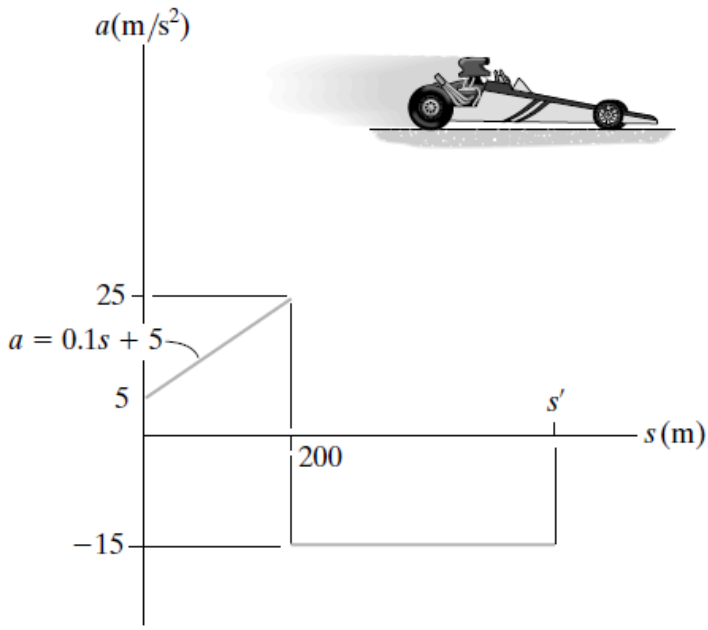


**Figure Q3[a]**
*Rajah S3[a]*

(**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 $\boldsymbol{\mu_a = 0.1}$ and $\boldsymbol{\mu_b = 0.3}$. 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.*

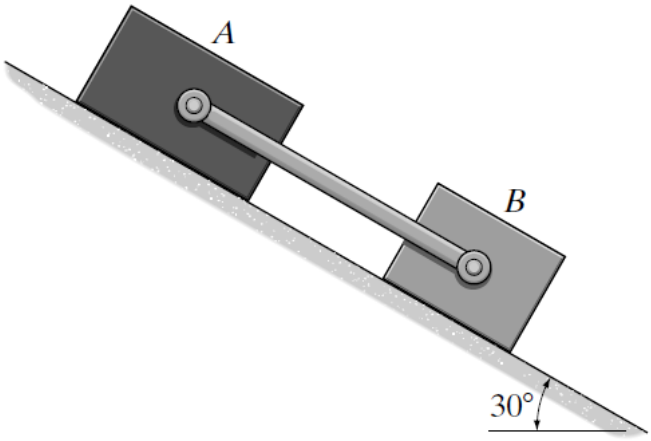


**Figure Q3[b]**
*Rajah S3[b]*

(**50 marks**/*markah*)

**Q4.**

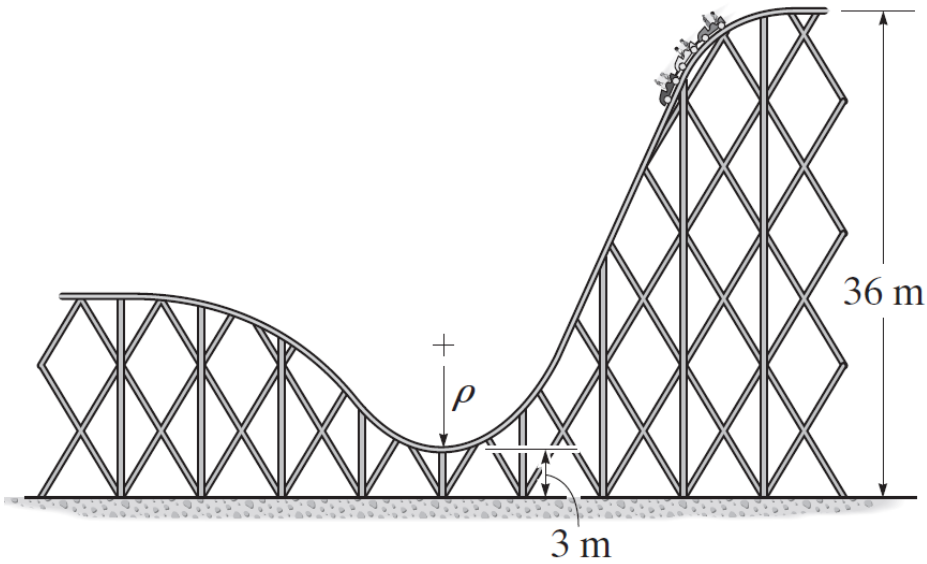


**Figure 4[a]**
*Rajah 4[a]*

**[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*)

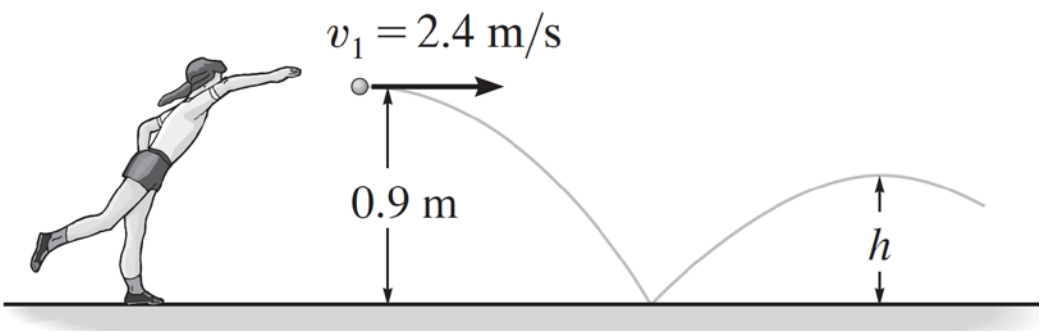


**Figure 4[b]**
*Rajah 4[b]*

**[b] A girl throws a ball with a horizontal velocity of $v_1$= 2.4 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 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*)

**-oooOooo-**