
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2015/2016

December 2015 / January 2016

EMM 101 – Engineering Mechanics
[Mekanik Kejuruteraan]

Duration : 3 hours
Masa : 3 jam

Please check that this paper contains **TEN** printed pages, **ONE** page Appendix and **FOUR** questions before you begin the examination.

*[sila pastikan bahawa kertas soalan ini mengandungi **SEPULUH** mukasurat beserta **SATU** mukasurat Lampiran dan **EMPAT** soalan yang bercetak sebelum anda memulakan peperiksaan.]*

Appendix/Lampiran :

1. Centroid and Second Moment of Area of Common Shapes [1 page/mukasurat]

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.]

...2/-

Q1. [a] Figure Q1[a] shows a pole that is subjected to two forces.

Rajah S1[a] menunjukkan satu tiang yang dikenakan dua daya.

[i] Express each of the forces in Cartesian vector form.

Tunjukkan setiap daya tersebut dalam bentuk vektor Cartesian.

[ii] Determine the magnitude and coordinate direction angles of the resultant force.

Tentukan magnitud dan arah-arrah koordinat untuk daya paduan tersebut.

[iii] Determine the resultant moment produced by the resultant force about point O. Express the result as a Cartesian vector.

Tentukan momen paduan yang dihasilkan oleh daya paduan ini pada titik O. Nyatakan jawapan dalam vektor Cartesian.

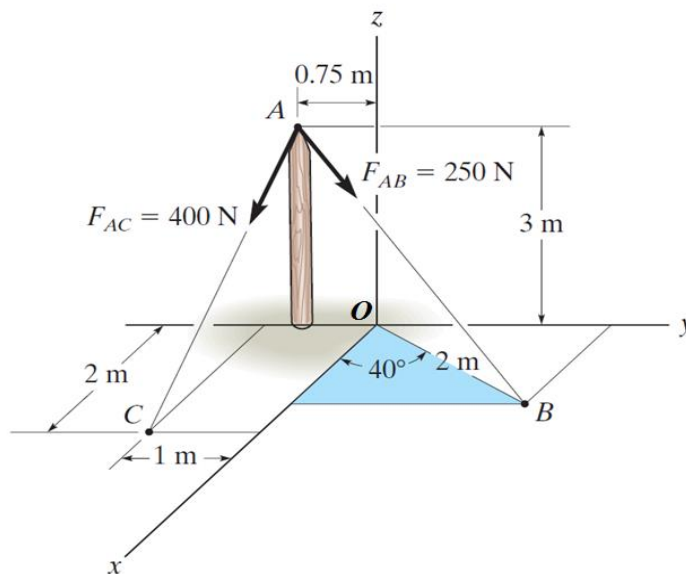


Figure Q1[a]
Rajah S1[a]

(70 marks/markah)

...3/-

- [b] **Figure Q1[b] shows a corbel that is subjected to four forces. If $F_A = 7 \text{ kN}$ and $F_B = 5 \text{ kN}$, represent the force system acting on the corbel by a resultant force, and specify its location on the x - y plane.**

Rajah S1[b] menunjukkan satu sesangga yang dikenai oleh empat daya. Jika $F_A = 7 \text{ kN}$ dan $F_B = 5 \text{ kN}$, wakikan sistem daya yang dikenakan ke atas sesangga itu dengan daya paduan. Tentukan lokasi daya paduan tersebut dalam satah x - y .

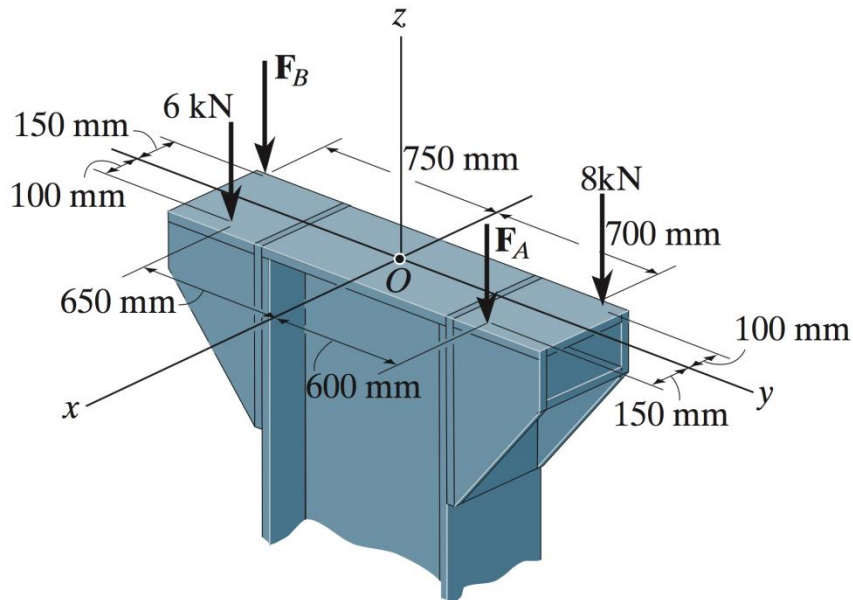


Figure Q1[b]
Rajah S1[b]

(30 marks/markah)

Q2. [a] Draw the free body diagram of each of the following systems in Figure Q2[a]. State the type of support and their corresponding reactions that exists on the system.

Lukis rajah jasad bebas untuk sistem-sistem di bawah dalam Rajah S2[a]. Nyatakan jenis penyokong dan tindakbalas yang berkaitan yang terdapat pada sistem.

(25 marks/markah)

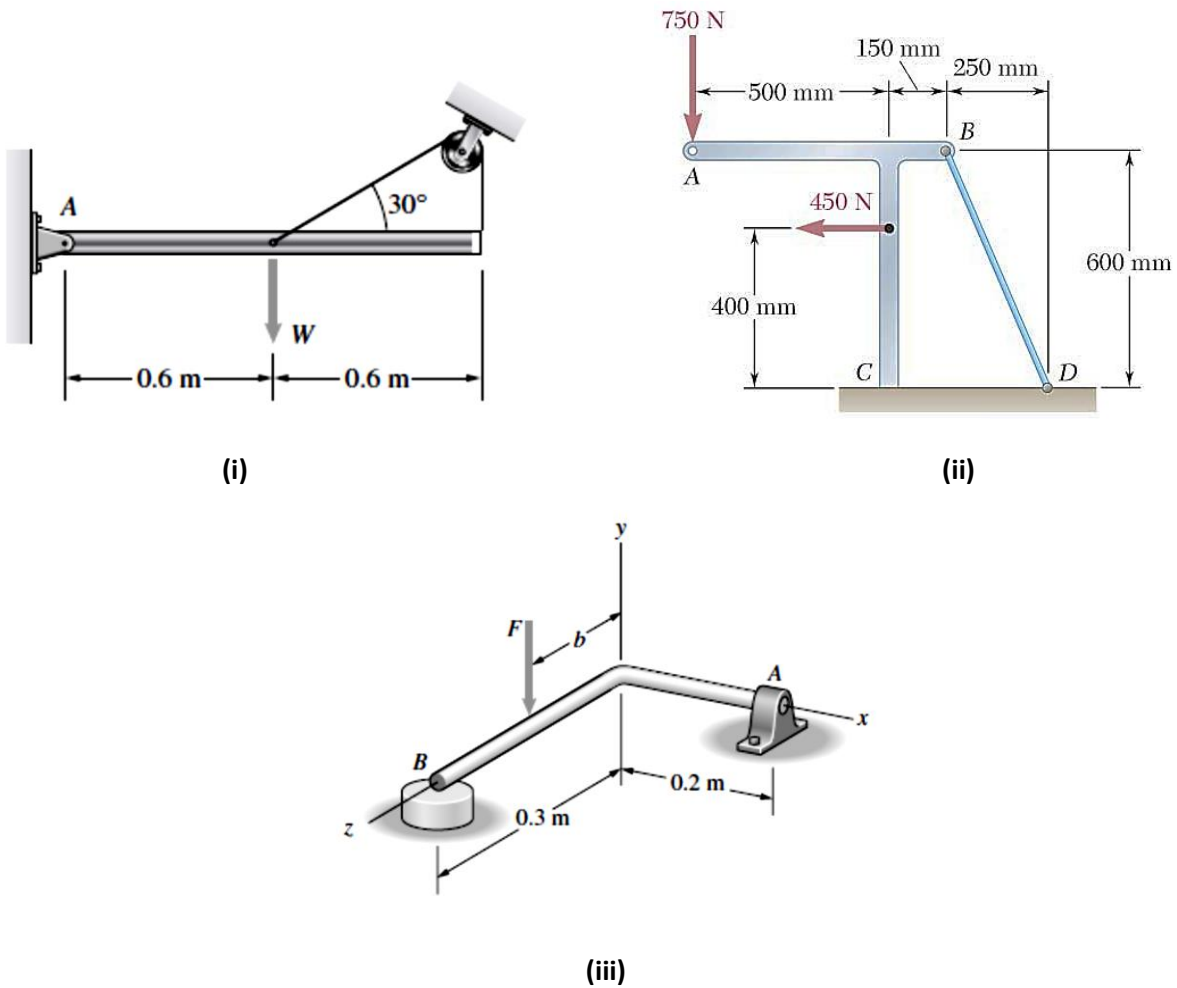


Figure Q2[a]
Rajah S2[a]

- [b] **Figure Q2[b] shows an assembly welded to a round collar A which fits on the vertical post. The assembly is supported by cables CF and DE, and lies in a horizontal plane x-z. A downward load of 480 N is loaded at C.**

Rajah S2[b] menunjukkan satu pemasangan dikimpal pada relang bulat A yang dipadan pada tiang menegak. Pemasangan disokong oleh kabel CF dan DE, dan berkedudukan pada satah mendatar x-z. Satu beban 480 N ke bawah dikenakan di C.

- [i] **Draw a free body diagram of the assembly.**

Lukis rajah jasad bebas pemasangan berkenaan.

- [ii] **Determine the forces in cable CF and DE and also all support reactions at A.**

Tentukan daya dalam kabel CF dan DE serta semua tindakbalas pada penyokong di A.

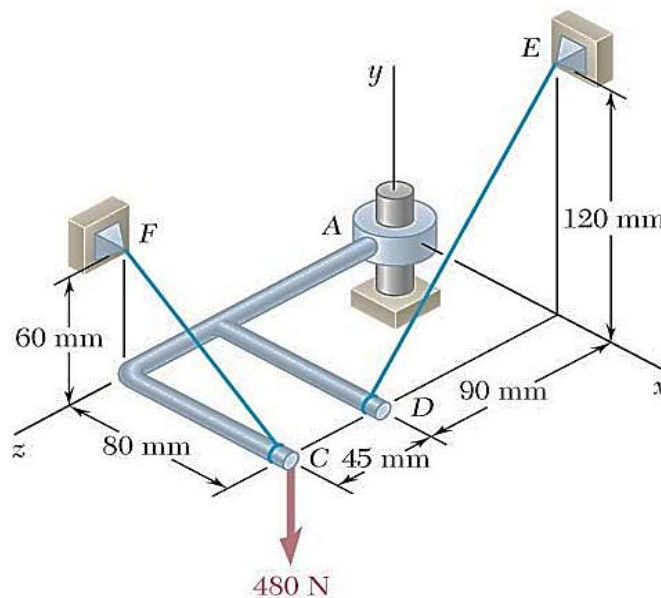


Figure Q2[b]

Rajah S2[b]

(40 marks/markah)

...6/-

- [c] For the area shown in Figure Q2[c], use composite shapes to determine the x and y positions of the centroid and moment of inertia about the x -axis.

Untuk luas yang ditunjukkan dalam Rajah S2[c], gunakan bentuk komposit untuk tentukan kedudukan x dan y bagi sentroid dan momen inersia di sekitar paksi x .

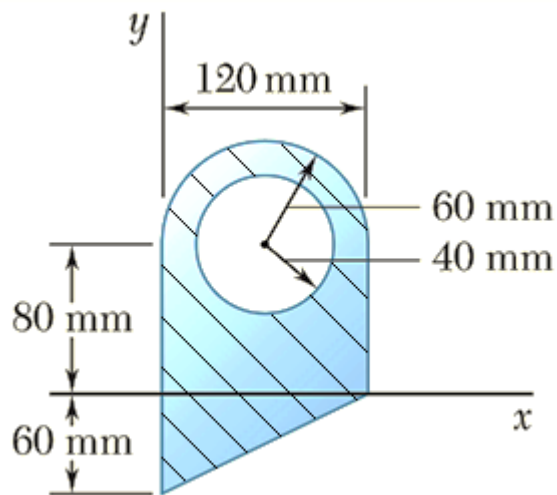


Figure Q2[c]
Rajah S2[c]

(35 marks/markah)

- Q3. [a] Figure Q3[a] shows a ball is fired in a projectile motion from platform B. The shooter fires his gun from point A at an angle of 30° . Determine the speed v_a of the bullet if it hits the ball at C.

Rajah S3[a] menunjukkan sebiji bola dilancarkan dalam gerakan meluncur dari platform B. Penembak melepaskan tembakan dari pistol di titik A pada sudut 30° . Tentukan kelajuan peluru v_a jika ia mengenai bola di C.

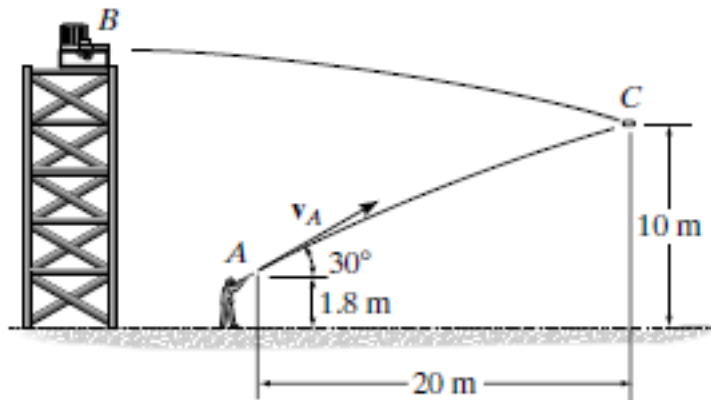


Figure 3[a]
Rajah 3[a]

(40 marks/markah)

- [b] **The ball has a mass of 30kg and a speed $v = 4\text{m/s}$ at the instant it is at its lowest point, $\theta = 0$. Neglect the size of the ball in this calculation.**

Sebiji bola mempunyai jisim 30kg dan bergerak pada kelajuan $v = 4\text{ m / s}$ pada ketika ia berada pada titik terendah, $\theta = 0$. Saiz bola diabaikan dalam kiraan ini.

- [i] **Determine the tension in the cord at $\theta = 0^\circ$.**

Tentukan ketegangan pada tali ketika $\theta = 0^\circ$.

- [ii] **The rate at which the ball's speed is decreasing (deceleration) at the instant $\theta = 20^\circ$.**

Kadar pengurangan kelajuan bola (nyahpecutan) pada ketika $\theta = 20^\circ$.

- [iii] **Determine the angle θ , in which the velocity of the ball is zero.**

Tentukan sudut θ pada ketika kelajuan bola ialah sifar.

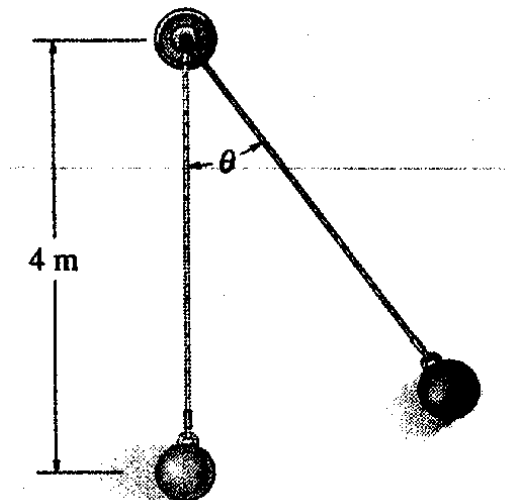


Figure 3[b]

Rajah 3[b]

(60 marks/markah)

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- Q4. [a]** The roller-coaster car in Figure Q4[a] has a mass of 800 kg (including passengers) starts from top of the hill A with speed of $v_a = 3$ m/s. Neglect friction, mass of the wheels and size of the car.

Kereta roller-coaster dalam Rajah S4[a] mempunyai jisim 800 kg (termasuk penumpang) bermula dari atas bukit A dengan kelajuan $v_a = 3$ m/s. Geseran, jisim roda dan saiz kereta di abaikan.

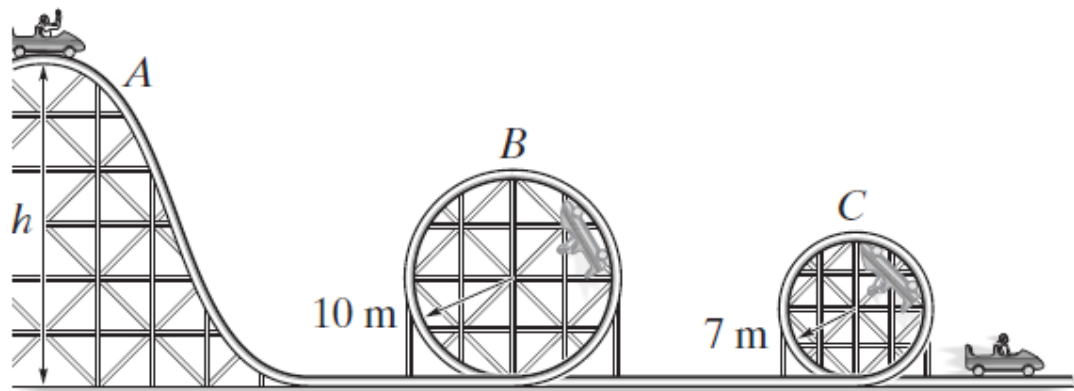


Figure Q4[a]
Rajah S4[a]

- [i]** Determine the minimum height h of the hill so that the car travels around both inside loops without leaving the track.

Tentukan ketinggian h minimum bukit supaya kereta itu bergerak di kedua-dua gelung tanpa meninggalkan trek.

(25 marks/markah)

- [ii]** What is the normal reaction on the car at B and C.

Apakah tindak balas normal pada kereta itu di B dan C.

(25 marks/markah)

- [b] The 15 kg suitcase A is released from rest at C (Figure Q4[b]). After it slides down the smooth ramp, it strikes the 10 kg suitcase (originally at rest). If the coefficient of restitution between the suitcases is $e = 0.3$ and the coefficient of kinetic friction between floor DE and suitcases is $\mu_k = 0.4$, determine:

Sebuah beg berjisim 15 kg A dilepaskan dari pegun di C (Rajah S4[b]). Selepas ia menuruni jalan licin, ia melanggar beg berjisim 10 kg (asalnya pegun). Jika pekali pengembalian antara beg pakaian adalah $e = 0.3$ dan pekali geseran kinetik antara lantai DE dan beg pakaian yang $\mu_k = 0.4$, tentukan:

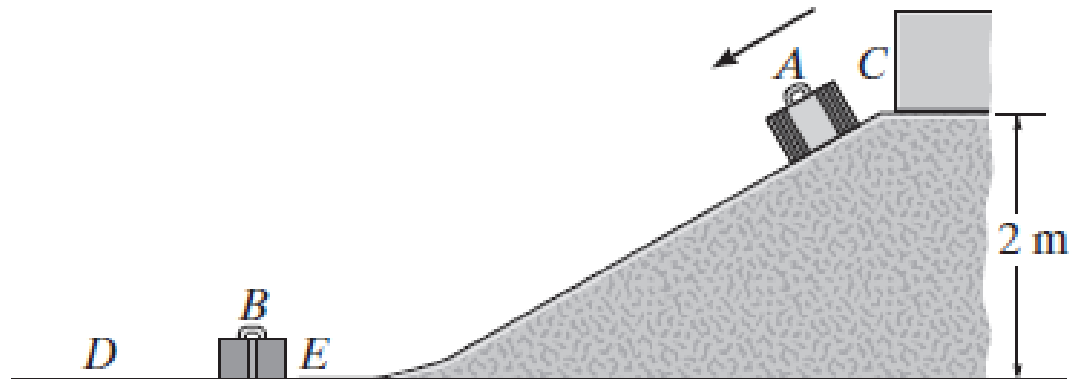


Figure Q4[b]
Rajah S4[b]

- [i] The velocity of suitcase A just before impact.
Halaju beg A sebelum pelanggaran. (10 marks/markah)
- [ii] The velocity of A and B suitcases just after impact.
Halaju beg A dan B selepas pelanggaran. (25 marks/markah)
- [iii] The distance of suitcase B slides before coming to rest.
Jarak peluncuran beg B sebelum ia berhenti. (15 marks/markah)