UNIVERSITI SAINS MALAYSIA

First Semester Examination
2014/2015 Academic Session

December 2014 / January 2015

EMM 101 – Engineering Mechanics
[Mekanik Kejuruteraan]

Duration : 3 hours
Masa : 3 jam

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

*[Sila pastikan bahawa kertas soalan ini mengandungi **TUJUH** mukasurat, **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.]

Please **do not** take this question paper out from the Examination Hall.
*Kertas soalan **tidak** dibenarkan di bawa keluar daripada Dewan Peperiksaan.*

Q1. [a] Figure Q1[a] shows a tower that is held in place by three cables. Each cable is subjected to the force as shown in the figure.

[i] Express each force in a Cartesian vector form.

[ii] Determine the magnitude and coordinate direction angles α, β and γ of the resultant force.

[iii] Determine the resultant moment produced by the forces about point O, and express the result as a Cartesian vector.

Rajah S1[a] menunjukkan pencawang yang disokong oleh tiga kabel. Setiap kabel tersebut dikenakan daya seperti yang ditunjukkan dalam rajah.

[i] Tunjukkan setiap daya tersebut di dalam bentuk vektor Cartesian.

[ii] Tentukan magnitud dan arah koordinat bagi sudut α, β dan γ untuk daya paduan tersebut.

[iii] Tentukan momen paduan yang dihasilkan oleh daya-daya ini pada point O, dan nyatakan jawapan dalam vektor Cartesian.

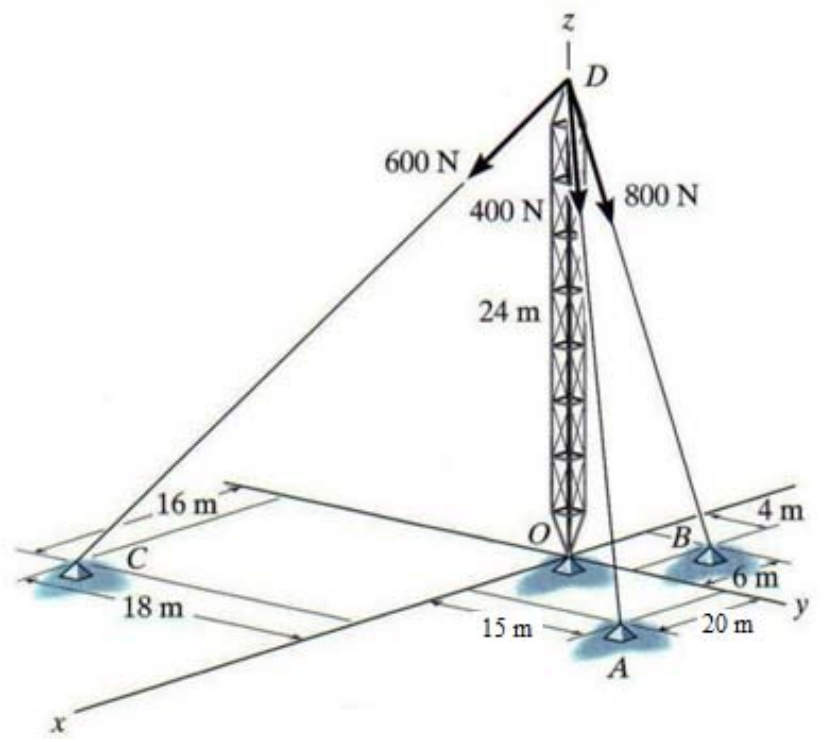


Figure Q1[a]
Rajah S1[a]

(70 marks/*markah*)

[b] **A system consists of force and couple act on the pipe assembly as shown in Figure Q1[b]. Replace this system by an equivalent resultant force and couple moment acting at O. Express the results in Cartesian vector form.**

Satu daya dan ganding dikenakan pada paip berkenaan seperti yang ditunjukkan dalam Rajah S1[b]. Gantikan sistem ini dengan paduan daya yang setara dan momen ganding bertindak pada O. Nyatakan keputusan dalam format vektor Cartesian.

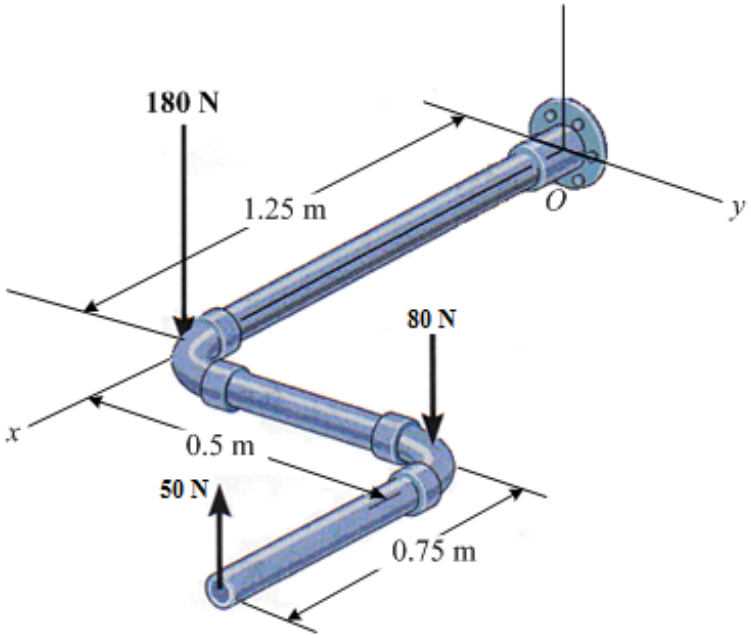


Figure Q1[b]
Rajah S1[b]

(30 marks/*markah*)

Q2. **[a]** **Use the integration method to determine the x and y position of the centroid of the shaded area in Figure Q2[a].**

Gunakan kaedah pengkamiran untuk menentukan kedudukan sentroid x dan y luas berlorek dalam Rajah S2[a].

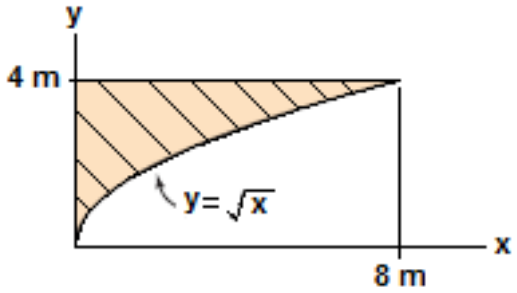


Figure Q2[a]
Rajah S2[a]

(25 marks/*markah*)

[b] Determine the second moment of an area of the cross sectional area in Figure Q2[b] about the x axis.

Tentukan momen luas kedua untuk luas keratan rentas dalam Rajah S2[b] di sekitar paksi x.

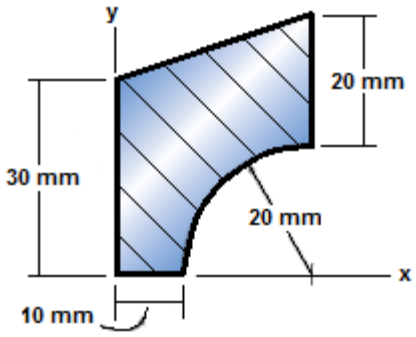


Figure Q2[b]
Rajah S2[b]

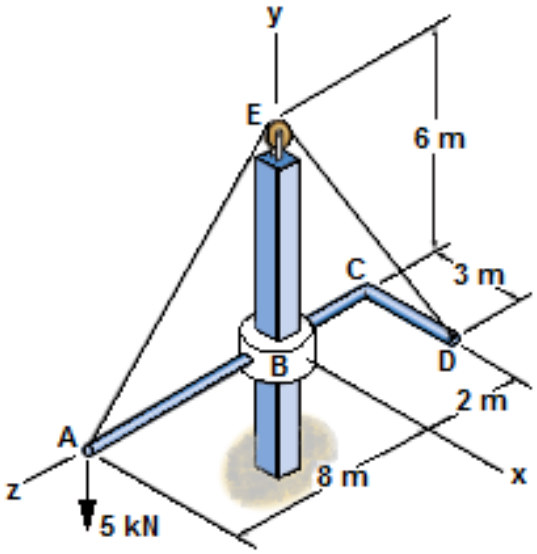
(25 marks/*markah*)

[c] Bar ABCD is supported by a cable AED, which passes over a frictionless pulley at point E, and a collar B that slides without friction on a vertical square shaft. A vertical force of 5 kN is subjected at tip A.

[i] Draw a free body diagram of bar ABCD.
[ii] Using the free body diagram, determine the tension in the cable and all support reactions at collar B.

Bar ABCD disokong oleh kabel AED yang melalui takal tanpa geseran di E dan juga relang B yang menggelongsor tanpa geseran pada syaf tegak bentuk segiempat. Satu daya menegak 5 kN bertindak di hujung A.

[i] Lukis rajah jasad bebas bar ABCD
[ii] Menggunakan rajah jasad bebas, tentukan tegangan kabel dan semua tindak balas penyokong di relang B.



(50 marks/*markah*)

Q3. [a] The *v-t* graph of a car while travelling along a road is shown in Figure Q3[a].

[i] Draw the *s-t* and *a-t* graphs for the motion of the car.
[ii] State the equation of a line for each interval describing the *s-t* and *a-t* graphs.

*Graf **v-t** kereta semasa dalam perjalanan di jalan adalah seperti yang dipaparkan dalam Rajah S3[a].*

*[i] Lukiskan graf **s-t** dan **a-t** untuk pergerakan kereta itu.*
*[ii] Nyatakan persamaan garis pada setiap selangan masa yang menggambarkan graf **s- t** dan **a-t.***

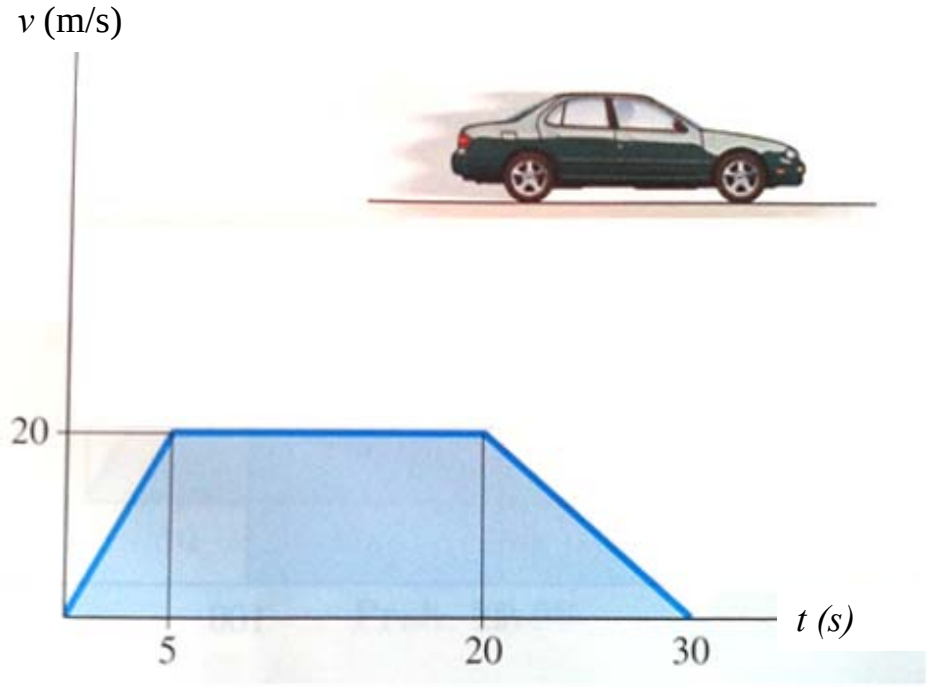


Figure Q3[a]
Rajah S3[a]

(50 marks/*markah*)

[b] If the 50-kg crate starts from rest and travels a distance of 6 m up the plane in 4 s, determine the magnitude of force P acting on the crate in Figure Q3[b]. The coefficient of kinetic friction(μ_k) between the crate and the ground is $\mu_k = 0.25$.

Sekiranya peti 50-kg bergerak dari rehat dan melintasi jarak 6 m melalui permukaan condong dalam 4 s, tentukan magnitud daya P yang bertindak pada peti dalam Rajah S3[b]. Pekali geseran kinetik (μ_k) antara peti dan permukaan tapak ini sebagai $\mu_k = 0.25$.

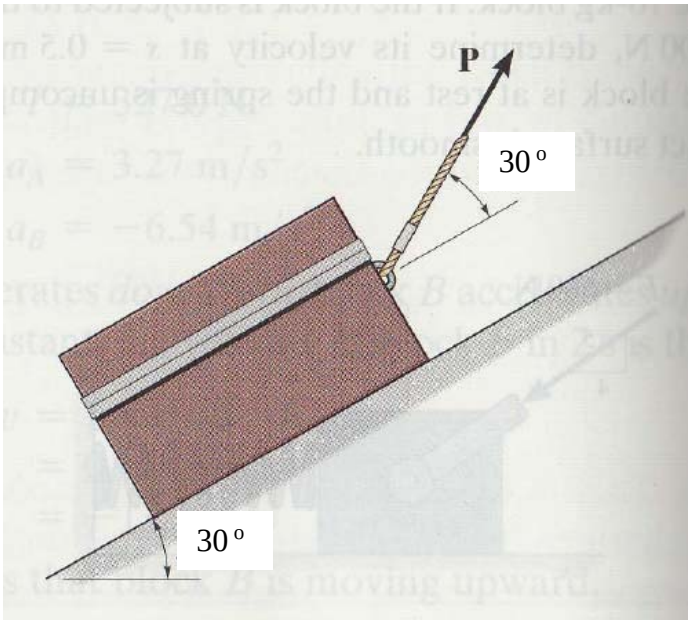


Figure Q3[b]
Rajah S3[b]

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

Q4. [a] When the driver applies the brake of a pickup truck travelling at 40 km/hr, it skids 3m before stopping. How far will the truck skid if it is travelling at 80 km/hr when the brakes are applied?

Apabila pemandu menekan brek trak pikapnya yang sedang meluncur pada 40 km/j, trak tersebut tergelincir sejauh 3m sebelum berhenti. Berapa jauhkah kenderaan tersebut akan tergelincir jika brek ditekan pada kelajuan 80 km/j?

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

[b] Block A has a mass of 5 kg slides on a rough horizontal surface with a velocity of $(v_A)_1$= 3m/s when it makes a direct collision with block B, which has a mass of 4 kg and is originally at rest. Collision is perfectly elastic (*e*=1). The coefficient of kinetic friction between the blocks and plane is 0.35

Blok A berjisim 5kg meluncur di atas permukaan kasar dengan halaju $(v_A)_1$= 3m/s, dan melanggar dengan blok B yang berjisim 4kg pada keadaan rehat. Perlanggaran tersebut ialah kenyal (e=1). Pekali geseran kinetik antara blok dan permukaan kasar tersebut ialah 0.35

[i] Determine the velocity of each block (block A and B) just after collision
Tentukan halaju setiap blok (blok A dan B) ketika selepas perlanggaran

(25 marks/*markah***)**

[ii] Determine the distance between the blocks when they stop sliding
Tentukan jarak blok semasa berhenti meluncur

(25 marks/*markah***)**

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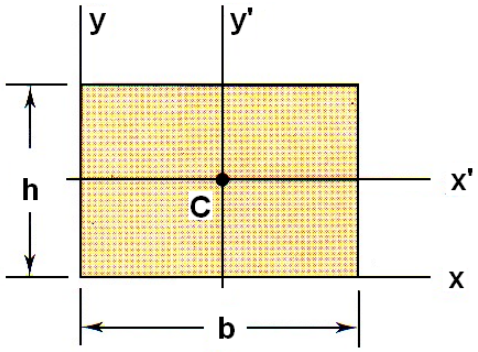
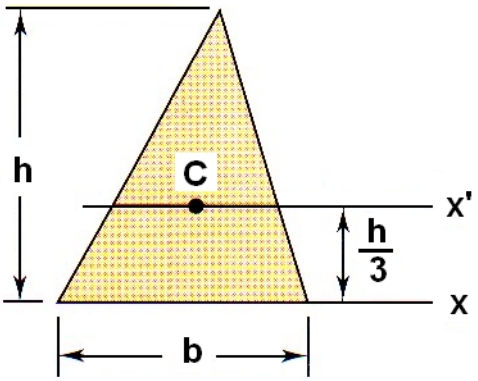
Centroid and Second Moment of Area of Common Shapes

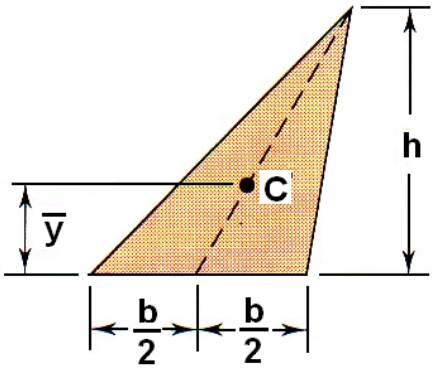


Rectangular

$$\bar{I}_{x'} = \frac{bh^3}{12}, \qquad I_x = \frac{bh^3}{3}$$

$$J_C = \frac{bh}{12}\left(b^2 + h^2\right)$$



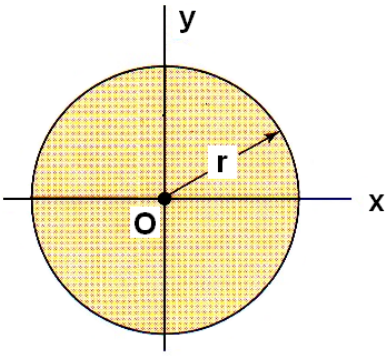


Triangular

$$\bar{I}_{x'} = \frac{bh^3}{36},$$

$$I_x = \frac{bh^3}{12}$$

$$\bar{y} = h/3$$



Circular

$$\bar{I}_x = \bar{I}_y = \frac{\pi r^4}{4}, \qquad J_o = \frac{\pi r^4}{2}$$

Semicircular

$$I_x = I_y = \frac{\pi r^4}{8}, \qquad J_o = \frac{\pi r^4}{4}$$

$$\bar{y} = \frac{4r}{3\pi}$$

Quarter-circular

$$I_x = I_y = \frac{\pi r^4}{16}, \qquad J_o = \frac{\pi r^4}{8}, \qquad \bar{x} = \bar{y} = \frac{4r}{3\pi}$$