

SULIT



First Semester Examination
2024/2025 Academic Session

February 2025

EBP 105 – Introduction to Statics and Dynamics
[Pengenalan kepada Statik dan Dinamik]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains ELEVEN (11) printed pages before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEBELAS (11) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instruction: Answer **FOUR (4)** questions. Answer **ALL** questions from PART A, **ONE (1)** question from PART B and **ONE (1)** question from PART C. All questions carry the same marks.

[Arahan: Jawab **EMPAT (4)** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A, **SATU (1)** soalan dari BAHAGIAN B dan **SATU (1)** soalan dari BAHAGIAN C. Semua soalan membawa jumlah markah yang sama.]

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

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai].

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SULIT

PART A / BAHAGIAN A

- (1). (a). The 500-N force F is applied to the vertical pole as shown in Figure 1. Write F in terms of a cartesian vector with i and j .

Daya F sebanyak 500-N dikenakan kepada sebatang tiang seperti ditunjukkan dalam Rajah 1. Nyatakan F dalam vektor kartesian dengan i dan j .

(5 marks/markah)

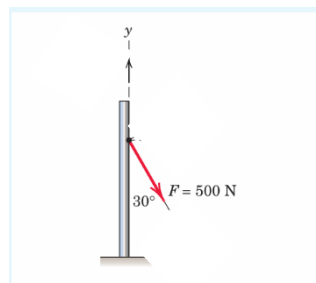


Figure 1 / Rajah 1

- (b). Combine the two forces P and T , which act on the fixed structure at B , into a single equivalent force R with its magnitude and direction (angle). Sketch to help indicate the magnitude and direction. Draw the free body diagram (FBD) to determine a single requirement force R . And also determine the magnitude and direction due to forces act on it.

Gabungkan dua daya P dan T yang bertindak atas struktur tetap pada B , sebagai daya tunggal R dengan magnitud dan arah. Lukiskan rajah badan bebas untuk menentukan daya R setara. Juga tentukan magnitud dan arah daya ke atas beban tersebut.

(20 marks/markah)

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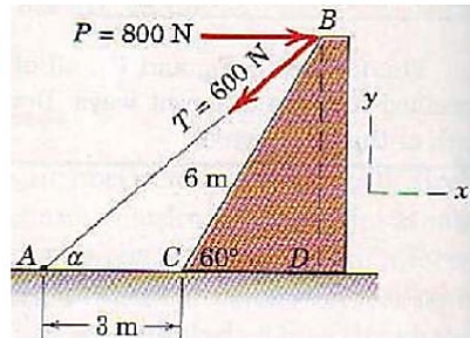


Figure 2 / Rajah 2

- (2). (a). Differentiate between speed and velocity. In your answer, provide the definitions of both terms and mention the appropriate units used to measure them. Highlight the key distinction between the two concepts.

Bezakan antara kelajuan dan halaju. Dalam jawapan anda, berikan definisi bagi kedua-dua istilah tersebut dan nyatakan unit yang sesuai untuk mengukurnya. Jelaskan juga perbezaan utama antara kedua-dua konsep ini.

(5 marks/markah)

- (b). A two-stage missile is fired vertically from the rest with the acceleration shown in Figure 3. In 15 second the first stage A burns out and the second stage B ignites. Plot the $v - t$ and $s - t$ graphs which describe the two-stage motion of the missile for $0 \leq t \leq 20$ s.

Sebuah peluru berpandu dua-peringkat dilancarkan secara menegak dari keadaan rehat dengan pecutan yang ditunjukkan Rajah 3. Dalam tempoh 15 saat, peringkat pertama A habis terbakar dan peringkat kedua B dinyalakan. Lukiskan graf $v-t$ dan $s-t$ yang menggambarkan pergerakan dua peringkat peluru berpandu tersebut bagi $0 \leq t \leq 20$ saat.

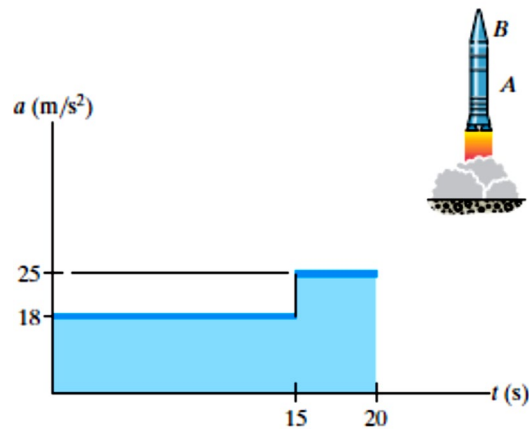


Figure 3 / Rajah 3

(10 marks/markah)

- (c). Figure 4 shows the loading car of minerals starts from rest at A and its speed increases at $a_t = (6 - 0.06s) \text{ m/s}^2$. Determine the magnitude of its acceleration when it reaches B where $s_B = 40 \text{ m}$.

Rajah 4 menunjukkan sebuah kereta pengangkut mineral bermula dari keadaan rehat di A dan kelajuannya meningkat pada kadar $a_t = (6 - 0.06s) \text{ m/s}^2$. Tentukan magnitud pecutannya apabila ia tiba di B di mana $s_B = 40 \text{ m}$.

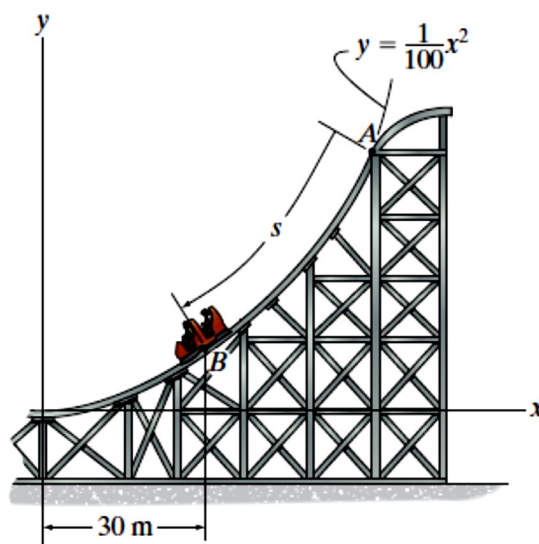


Figure 4 / Rajah 4

(10 marks/markah)

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PART B / BAHAGIAN B

- (3). (a). Determine the magnitudes of the resultant force at A.
Tentukan magnitud daya paduan pada A.

(5 marks/markah)

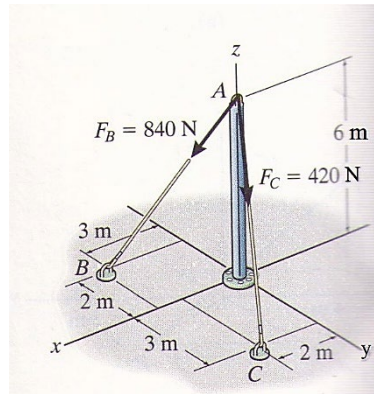


Figure 5 / Rajah 5

- (b). A jib crane AB is shown below in Figure 6. It is pin-connected at A and supported by cable BC. Neglect its weight. Find the reaction force at A and the cable tension.

Sebatang kren jib AB ditunjukkan seperti di bawah Rajah 6. Ia disambungkan dengan pin di A dan disokong oleh kabel BC. Abaikan beratnya. Cari daya tindak balas di A dan tegangan kabel.

(20 marks/markah)

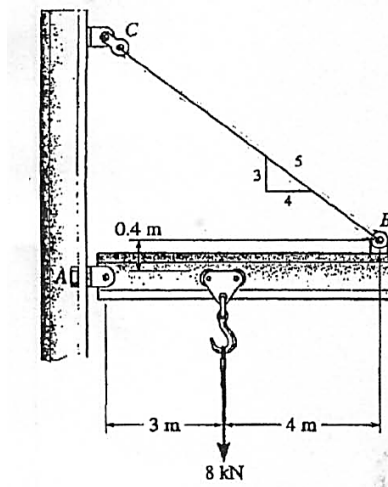


Figure 6 / Rajah 6

- (4). (a). Identify the centroid $(\bar{x}, \bar{y})$ for the cross sectional area of the beam shown in Figure 7.

Kenalpasti sentroid $(\bar{x}, \bar{y})$ bagi kawasan seksyen rentas sebatang rasuk yang ditunjukkan dalam Rajah 7.

(10 marks/markah)

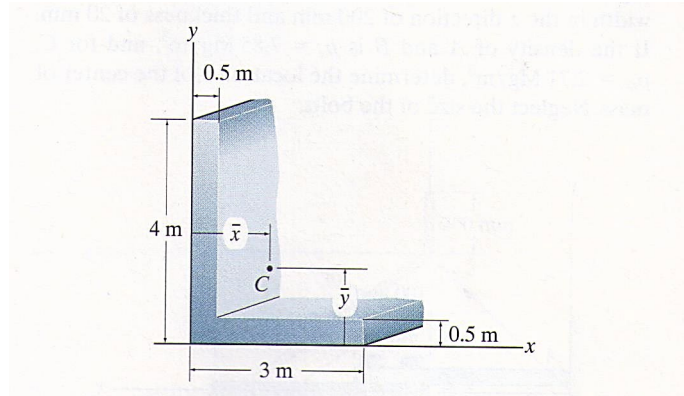


Figure 7 / Rajah 7

- (b). If the couple moment acting on the pipe has a magnitude of $400 \text{ N}\cdot\text{m}$, determine the magnitude F of the vertical force applied to each wrench.

Jika momen gandingan bertindak atas paip mempunyai magnitud sebanyak $400 \text{ N}\cdot\text{m}$. Kirakan magnitud F untuk daya tegak dikenakan pada setiap sepana.

(10 marks/markah)

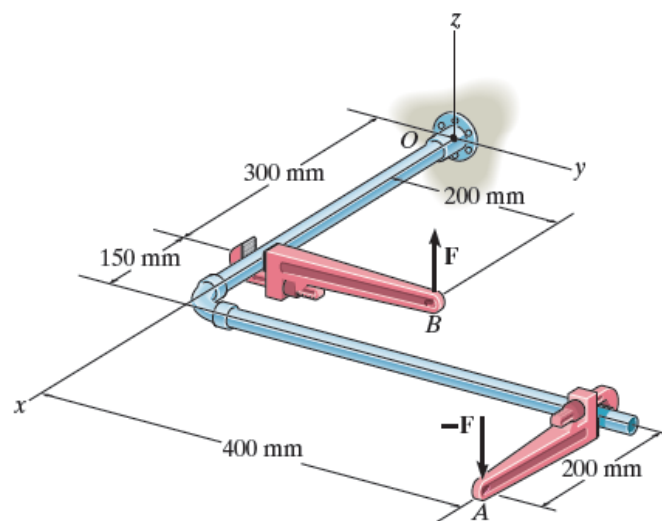


Figure 8 / Rajah 8

PART C / BAHAGIAN C

- (5). (a). In the field of materials, mineral, or polymer engineering, explain your understanding of the work, and principle of work and energy. Define each term, specify their respective units of measurement, and explain their practical relevance in engineering systems.

Dalam bidang kejuruteraan bahan, mineral, atau polimer, jelaskan pemahaman anda mengenai kerja, prinsip kerja dan tenaga.. Nyatakan definisi bagi setiap istilah, spesifikkan unit pengukurannya, dan terangkan kepentingan praktikalnya dalam sistem kejuruteraan.

(5 marks/markah)

- (b). Figure 9 displays the pendulum ball, made from aluminum, has a mass of 0.3 kg and a velocity of $v = 4 \text{ m/s}$ when it reaches its lowest point ($\theta = 0^\circ$). Calculate the tension in the cord and the rate at which the ball's velocity decreases at an angular position of $\theta = 20^\circ$. For the purposes of this analysis, the dimensions of the ball are considered negligible.

Rajah 9 menunjukkan bandul bola yang diperbuat daripada aluminium, mempunyai jisim 0.3 kg dan halaju $v = 4 \text{ m/s}$ apabila ia berada di titik terendahnya ($\theta=0^\circ$). Hitung tegangan pada tali dan kadar penurunan halaju bola pada kedudukan sudut $\theta = 20^\circ$. Dalam analisis ini, saiz bola dianggap tidak signifikan.

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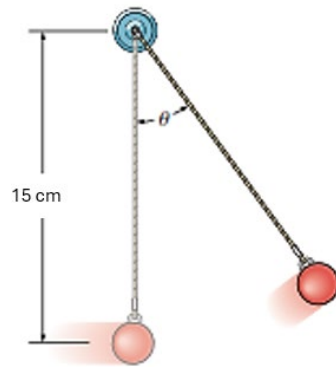
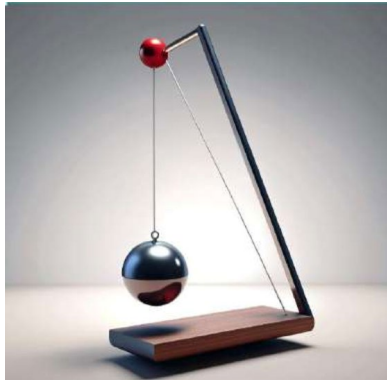


Figure 9 / Rajah 9

(10 marks/markah)

- (c). A young innovator is investigating the behavior of polymer-based marbles (Figure 10), each with a mass of 5 g, as they are released from rest at point A and travel through a smooth plastic tube, eventually accumulating in a plastic bucket at point C. Determine the horizontal placement R of the plastic bucket relative to the tube's exit and the velocity at which the marbles enter the bucket. For this analysis, the size of the bucket and the height of kid are considered negligible.

Seorang inovator muda sedang mengkaji tingkah laku bebola berasaskan polimer (Rajah 10), setiap satu mempunyai jisim 5 g, apabila ia dilepaskan dari keadaan rehat di titik A dan bergerak melalui tiub plastik licin, sebelum terkumpul dalam baldi plastik di titik C. Tentukan kedudukan mendatar R baldi plastik relatif kepada hujung tiub dan halaju guli ketika memasuki baldi. Untuk analisis ini, saiz baldi dan ketinggian kanak-kanak dianggap tidak penting.

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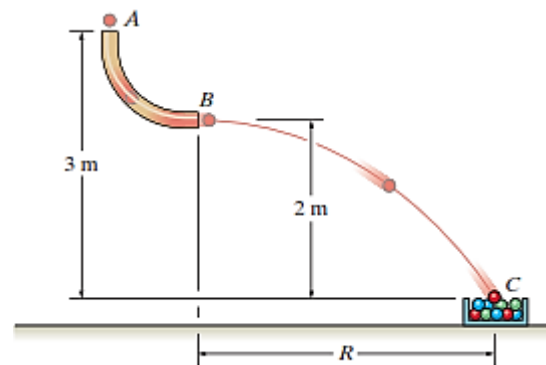


Figure 10 / Rajah 10

(10 marks/markah)

- (6). (a). Differentiate between momentum and the principle of linear impulse and momentum by emphasizing their definitions along with their respective units. Provide applications to support your explanation.

Bezakan antara momentum dan prinsip impuls linear serta momentum dengan menekankan definisi masing-masing berserta unitnya. Sertakan aplikasi untuk menyokong penjelasan anda.

(5 marks/markah)

- (b). An engineer is analyzing the dynamics of a tennis ball during a professional match featuring Novak Djokovic. The ball, with an initial horizontal velocity of $v = 15 \text{ m/s}$, is struck by Djokovic's racket. After impact, the ball travels at an angle of $\theta = 25^\circ$ from the horizontal and reaches a maximum altitude of $h = 10 \text{ m}$, measured from the height of the racket. Determine the magnitude of the net impulse exerted by the racket on the ball. The ball has a mass of 180 g . For this analysis, the weight of the ball during the time of contact with the racket is neglected.

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Seorang jurutera sedang menganalisis dinamik bola tenis semasa perlawanan profesional yang melibatkan Novak Djokovic. Bola, dengan halaju mendatar awal $v=15\text{ m/s}$, dipukul oleh raket Djokovic. Selepas impak, bola bergerak pada sudut $\theta=25^\circ$ dari garis mendatar dan mencapai ketinggian maksimum $h = 10\text{ m}$, diukur dari ketinggian raket. Tentukan magnitud impuls bersih yang dikenakan oleh raket ke atas bola. Bola mempunyai jisim 180 g . Dalam analisis ini, berat bola semasa tempoh sentuhan dengan raket diabaikan.

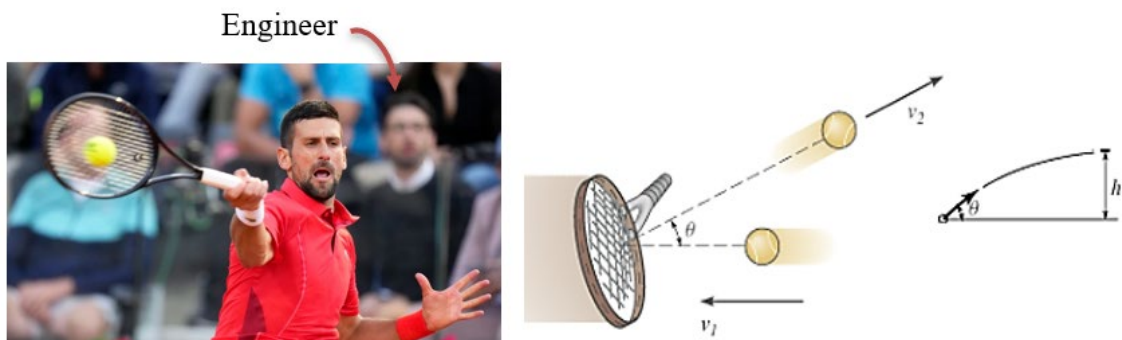


Figure 11 Djokovic with free body diagram

Rajah 11 Djokovic dengan rajah badan bebas

(10 marks/markah)

- (c). During a football match, Mo Salah kicks a 300-g ball with an initial velocity of $v_A = 25\text{ m/s}$ at point A, as shown in Figure 12. Upon striking the field, the ball rebounds, and with a coefficient of restitution $e = 0.4$ between the ball and the field, determine the magnitude and direction θ of the ball's velocity as it rebounds at point B.

Dalam perlawanan bola sepak, Mo Salah menyepak bola seberat 300 g dengan halaju awal $v_A = 25\text{ m/s}$ pada titik A, seperti yang ditunjukkan dalam Rajah 12. Apabila bola melantun dari padang, dengan pekali pemulihan $e = 0.4$ antara bola dan padang, tentukan magnitud dan arah θ halaju bola semasa ia melantun semula di titik B.

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Figure 12 / *Rajah 12*(10 marks/*markah*)

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