UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION
JULY 2023 SEMESTER

COURSE CODE	:	**SDD12303**
COURSE NAME	:	**ENGINEERING MECHANICS**
PROGRAMME NAME	:	**DIPLOMA OF ENGINEERING TECHNOLOGY**
DATE	:	**27 SEPTEMBER 2023**
TIME	:	**9.00 AM – 12.00 PM**
DURATION	:	**3 HOURS**

INSTRUCTIONS TO CANDIDATES

1. **Please CAREFULLY read the instructions given in the question paper.**
2. **This question paper consists of TWO (2) sections. Section A and B.**
3. **Answer ONE (1) question in Section A. For Section B, answer only THREE (3) questions from FOUR (4) questions.**
4. **Please write your answers in the answer booklet provided.**
5. **Answer all questions in English language ONLY.**
6. **Formula have been appended.**

THERE ARE 8 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer ONE (1) question in Section A and THREE (3) questions in Section B.

SECTION A (Total: 25 marks)

Question 1

(a) The link in Figure 1a is subjected to two forces F1 and F2. By considering the forces acting on a particle at A, Determine.

i. Sketch the free body diagram (FBD). (5 marks)

ii. magnitude of the resultant force (5 marks)

iii. Direction of the resultant force. (2 marks)

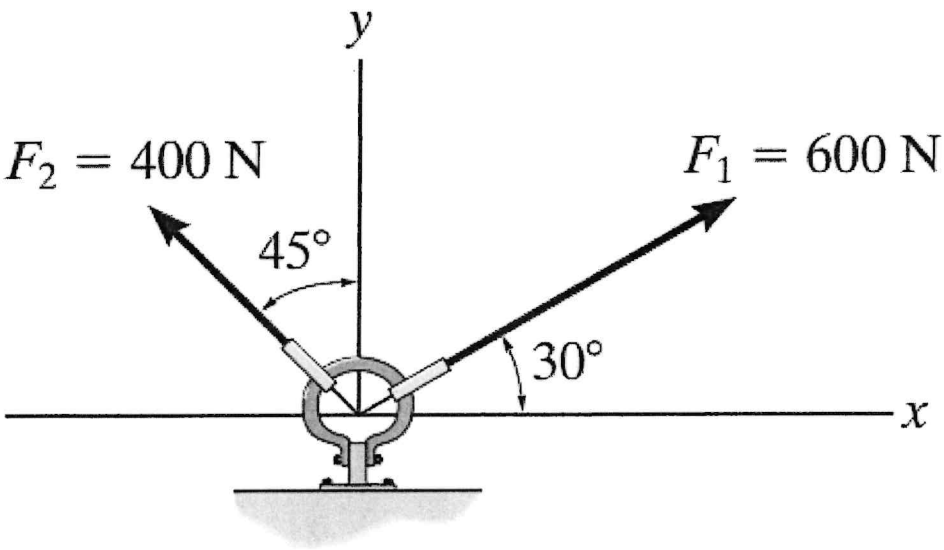

Figure 1a

(b) Figure 1b shows a force in cartesian coordinate system (x,y,z). By using the position vector technique, calculate.

i. Point coordinate of A and point coordinate of B.

(4 marks)

ii. Position vector ($r_B - r_A$)

(3 marks)

iii. Unit vector and Force vector

(6 marks)

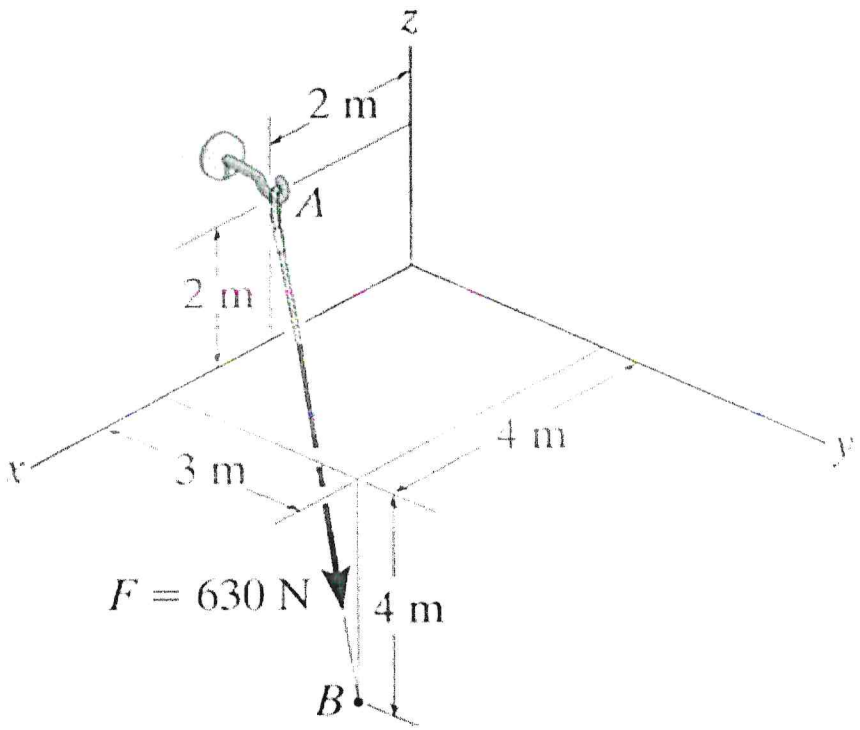

Figure 1b

Question 2

(a) Figure 2a shows an assembly in static equilibrium. If the mass of cylinder C is 40 kg,

i. Sketch the free body diagram.

(5 marks)

ii. Mass of cylinder A.

(4 marks)

iii. Force in cable DE

(4 marks)

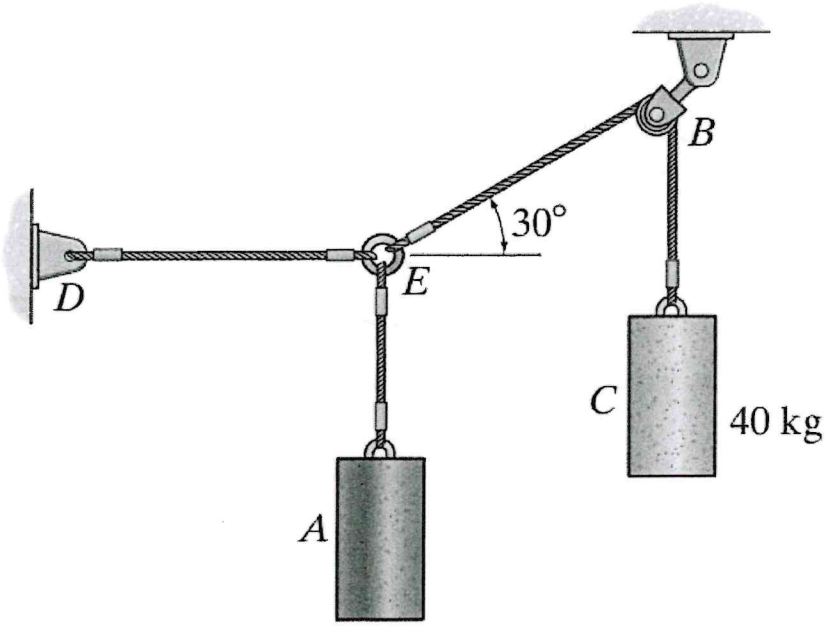

Figure 2a

(b) The rigid body rod as shown in Figure 2b is in equilibrium. The rod is pinned at A and supported by rocker at B. A force of 60 N is imposed at point C and a moment of 90 N-m clockwise at D, determine,

i. Sketch the free body diagram.

(5 marks)

ii. Reaction forces at pin A

(7 marks)

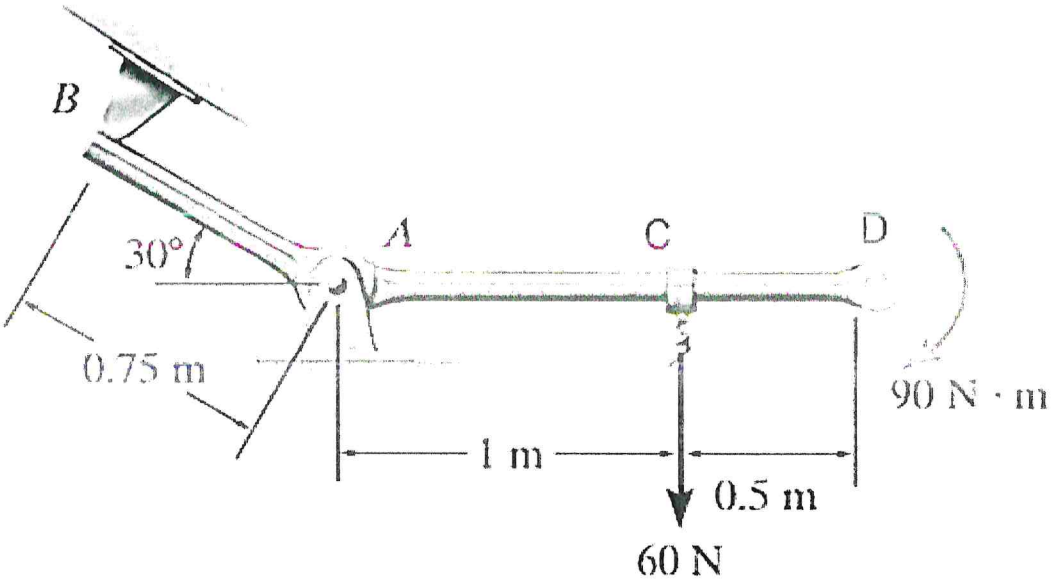

Figure 2b

SECTION B (Total: 75 marks):
Answer only THREE (3) questions.

Question 3

A basketball player needs to throw a ball from location A to the basket at B. The horizontal distance of 10 meter and 3-meter-high position of basket net at B from player as shown in Figure 3. The throwing angle of 30^0 is chosen by player to throw the ball, determine,

i. Vertical and horizontal component of speed V_A

(6 marks)

ii. Time required to reach basket at B

(10 marks)

iii. Throwing speed V_A

(4 marks)

iv. Maximum height the ball can reach before entering basket.

(5 marks)

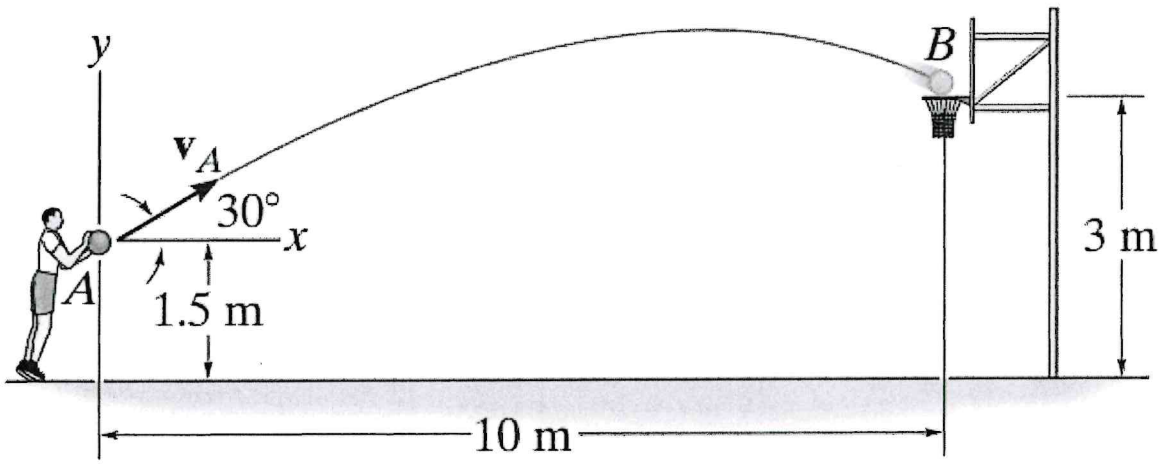

Figure 3

Question 4

A truss structure as shown in Figure 4 is exerted with P_1 = 45 kN, P_2 = 30 kN at C and D respectively. Determine.

i. Sketch the free body diagram.

(6 marks)

ii. Reaction force at support B.

(8 marks)

iii. Force in member CB, CD, DB and their conditions

(11 marks)

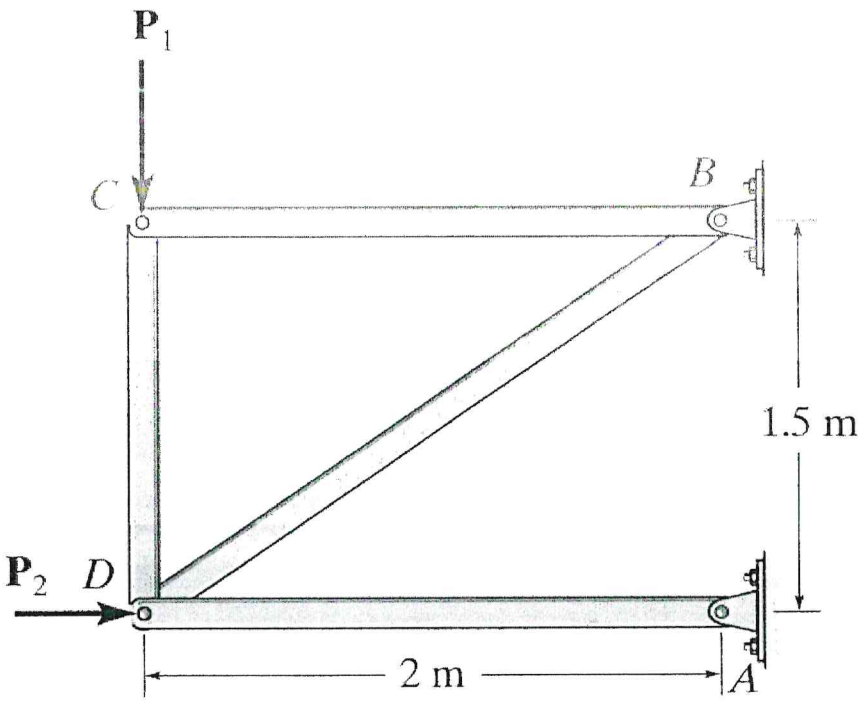

Figure 4

Question 5

The cart has a total load of 100 kg concentrating at centroid G as shown in Figure 5. It is initially at rest. A force of 200 N is applied to the handle to move the cart. Determine,

i. Sketch the free body diagram (FBD)

(10 marks)

ii. The acceleration of the cart.

(5 marks)

iii. The normal reaction force at wheel A and B (neglect the mass of wheel)

(10 marks)

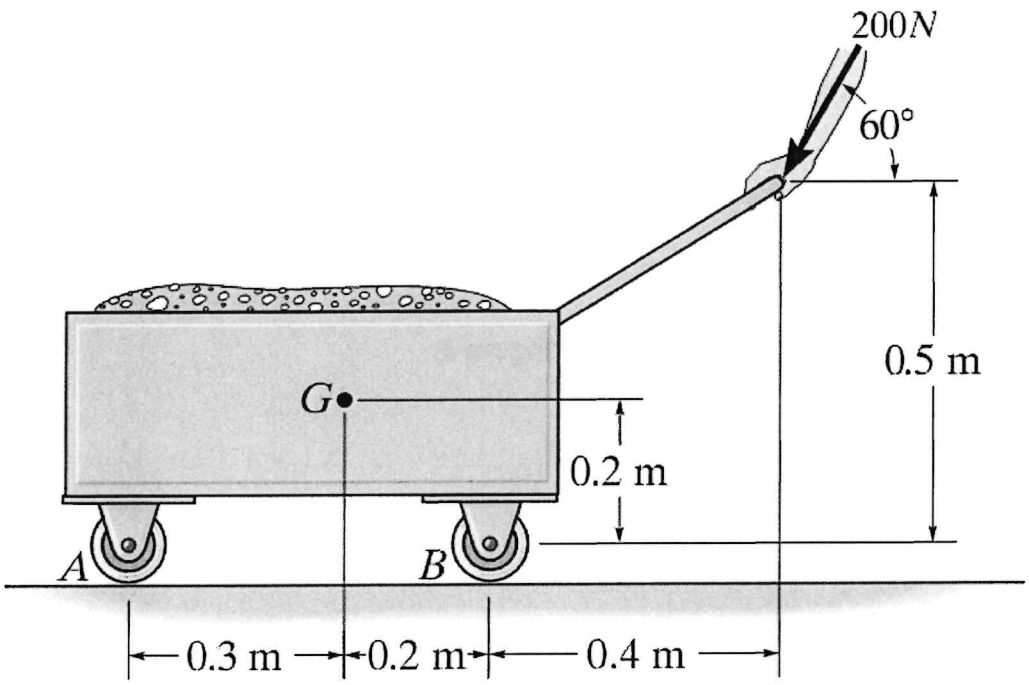

Figure 5

Question 6

Determine and locate the x- and y-coordinates of the centroid of the composite shape as shown in Figure 6. Solve using table format.

(25 marks)

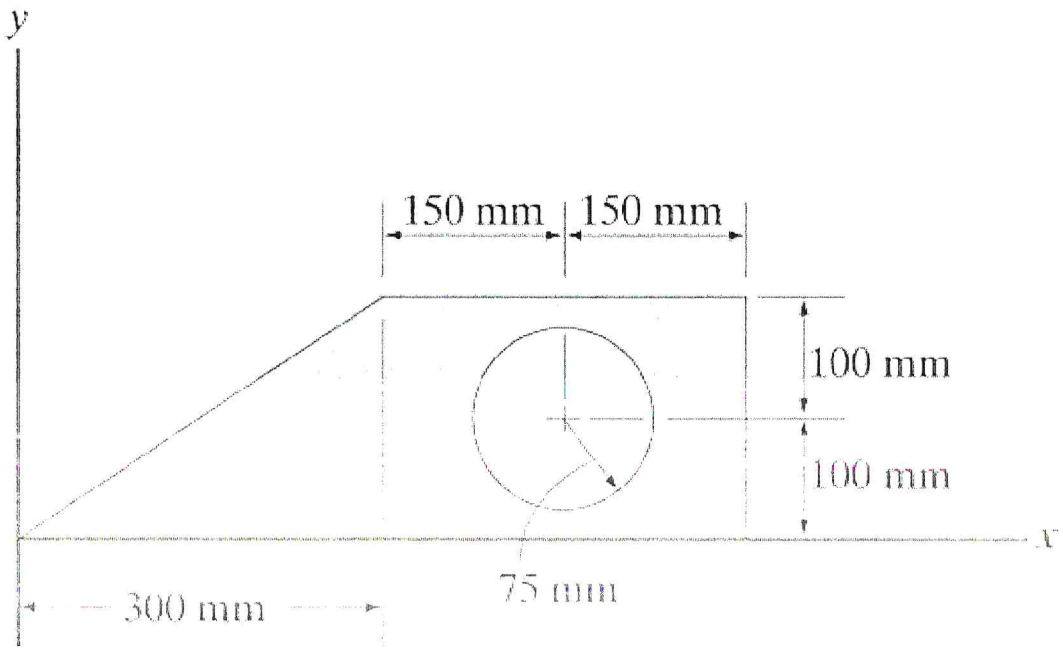

Figure 6

END OF EXAMINATION PAPER

APPENDIX

$$C = \sqrt{A^2 + B^2 - 2AB\cos C}$$

$$\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$$

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2} \quad \text{and} \quad \theta = \tan^{-1}\left|\frac{F_{Ry}}{F_{Rx}}\right|$$

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

$$\cos\alpha = \frac{A_x}{A} \qquad \cos\beta = \frac{A_y}{A} \qquad \cos\gamma = \frac{A_z}{A}$$

$$F = \sqrt{F_x^2 + F_y^2 + F_z^2}$$

$$\vec{M}_O = \vec{r}X\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

$$F_s = \mu_s N$$

$$\phi_s = \tan^{-1}\left(\frac{F_s}{N}\right) = \tan^{-1}\left(\frac{\mu_s N}{N}\right) = \tan^{-1}\mu_s$$

$$\sum F_x = ma_x$$
$$\sum F_y = ma_y$$
$$\sum F_z = ma_z$$

$$\vec{v}_B = \vec{v}_A + \vec{v}_{B/A}$$
$$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A}$$

$$v = v_0 + a_c t$$
$$s = s_0 + v_0 t + \frac{1}{2}a_c t^2$$
$$v^2 = v_0^2 + 2a_c(s - s_0)$$
$$v\,dv = a\,ds$$

$$v = v_0 + a_c t; \qquad v_x = (v_0)_x$$
$$x = x_0 + v_0 t + \frac{1}{2}a_c t^2; \qquad x = x_0 + (v_0)_x t$$
$$v^2 = v_0^2 + 2a_c(s - s_0); \qquad v_x = (v_0)_x$$

$$v = v_0 + a_c t; \qquad v_y = (v_0)_y - gt$$
$$y = y_0 + v_0 t + \frac{1}{2}a_c t^2; \qquad y = y_0 + (v_0)_y t - \frac{1}{2}gt^2$$
$$v^2 = v_0^2 + 2a_c(y - y_0); \qquad v_x = (v_0)_y^2 - 2g(y - y_0)$$

$$\sum F_t = ma_t$$
$$\sum F_n = ma_n$$
$$\sum F_b = 0$$

$$a = \sqrt{a_t^2 + a_n^2} \qquad a_n = \frac{v^2}{\rho}$$

$$\omega = \frac{d\theta}{dt} \qquad \alpha = \frac{d\omega}{dt} \qquad \alpha = \frac{d^2\theta}{dt^2}$$

$$\omega = \omega_0 + \alpha_c t$$
$$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha_c t^2$$
$$\omega^2 = \omega_0^2 + 2\alpha_c(\theta - \theta_0)$$
$$\alpha\,d\theta = \omega\,d\omega$$

$$a = \sqrt{a_t^2 + a_n^2}$$

$$v = r\omega \qquad a_t = \alpha r \qquad a_n = \omega^2 r$$