Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	STATICS
COURSE CODE	:	BDA 10203
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. PART A: ANSWER **TWO (2)** QUESTIONS FROM THREE (3) QUESTIONS ONLY. PART B: ANSWER ALL QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

PART A

Q1 (a) Express each of the three forces acting on the column shown in **Figure Q1.1** in Cartesian vector form and compute the magnitude of the resultant force.

(6 marks)

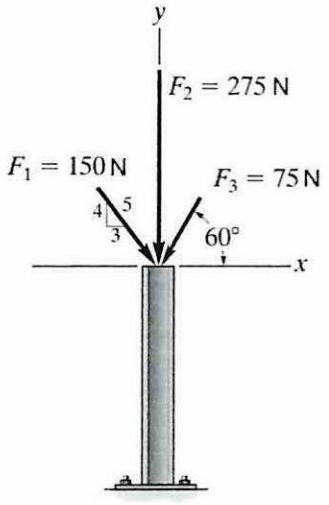


Figure Q1.1 Forces acting on a column.

(b) The crate shown in **Figure Q1.2** is subjected to the action of the three forces. Determine the magnitude of F_1 and its direction θ so that the resultant force is directed vertically upward and has a magnitude of 800 N.

(14 marks)

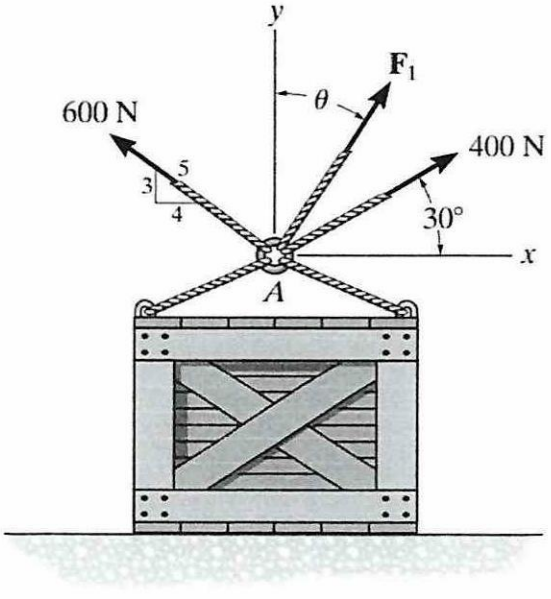


Figure Q1.2 A crate subjected to three forces.

Q2 (a) **Figure Q2.1** shows the overhead traffic-signal assembly. Each traffic signal has a mass of 36 kg, while the masses of members OC and AC are 50 kg and 55 kg, respectively.

(i) Sketch the free body diagram of the overhead traffic-signal assembly.

(3 marks)

(ii) Calculate the force reactions at the bolted base *O*.

(3 marks)

(iii) Calculate the moment reactions at the bolted base *O*.

(2 marks)

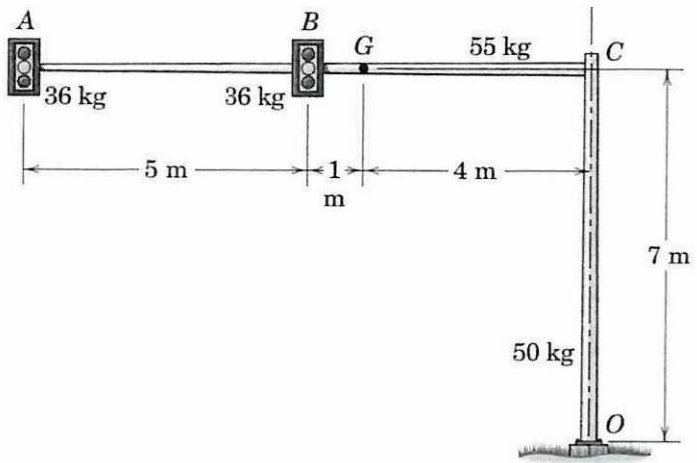


Figure Q2.1 Overhead traffic-signal assembly.

(b) Five forces act on a link in the gear-shifting mechanism of a lawn mower as shown in **Figure Q2.2**. The vector sum of the five forces on the bar is zero. The sum of their moments about the point where the forces A_x and A_y act is zero.

(i) Determine the forces A_x, A_y, and B.

(9 marks)

(ii) Determine the sum of the moments of the forces about the point where the force B acts.

(3 marks)

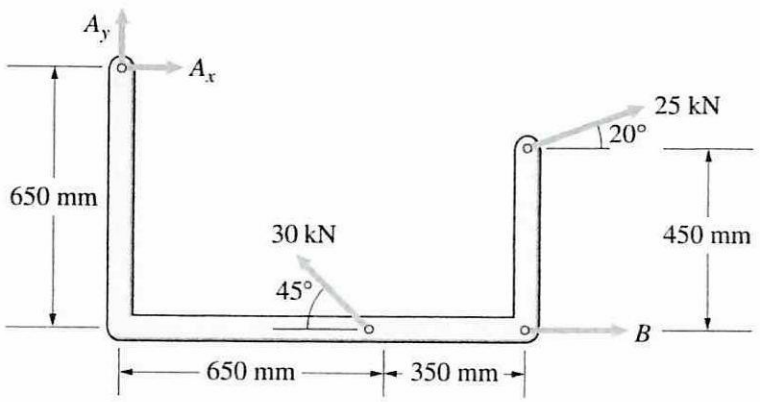


Figure Q2.2 Link in the gear-shifting mechanism of a lawn mower

Q3 **Figure Q3.1** shows a cantilever truss exerted to 14 kN force.

(a) Determine the support reaction at point *A* and *G*.

(6 marks)

(b) Calculate the forces in members *BC, BE and EF*.

(11 marks)

(c) State either the members *BC, BE* and *EF* are in tension or compression.

(3 marks)

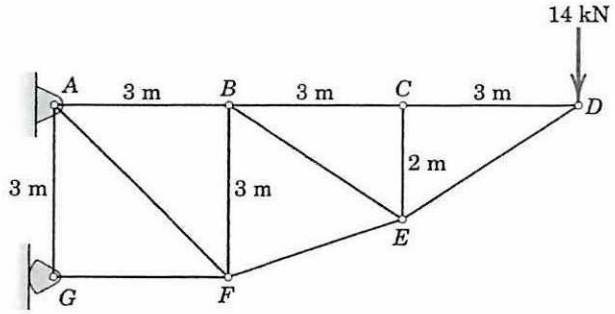


Figure Q3.1 Cantilever truss with pin and rocker supports.

PART B

Q4 (a) All physical quantities in engineering mechanics are measured using either scalars or vectors. What are the definitions of scalar and vector units?

(4 marks)

(b) The pascal (Pa) is actually a very small unit of pressure. With referring to **Table Q4.1**,

(i) Convert 1 Pa = 1 N/m^2 to lb/ft^2

(ii) Atmosphere pressure at sea level is 14.7 lb/in^2. How many pascals is this?

(6 marks)

Table Q4.1 Unit conversion factors

Length
1 m = 3.281 ft = 39.37 in
1 km = 0.6214 mi
1 in = 0.08333 ft = 0.02540 m
1 ft = 12 in = 0.3048 m
1 mi = 5280 ft = 1.609 km
1 nautical mile = 1852 m = 6080 ft
Force
1 N = 0.2248 lb
1 lb = 16 oz = 4.448 N
1 kip = 1000 lb = 4448 N
1 ton = 2000 lb =8896 N

(c) A surveyor determines that the distance from *A* to *B* is 400 m and the distance from A to C is 600 m as shown in **Figure Q4.1**. The corresponding angles are also shown in his rough map. Determine: -

(i) the magnitude of the vector $\mathbf{r}_{BC}$.

(6 marks)

(ii) the angle α

(4 marks)

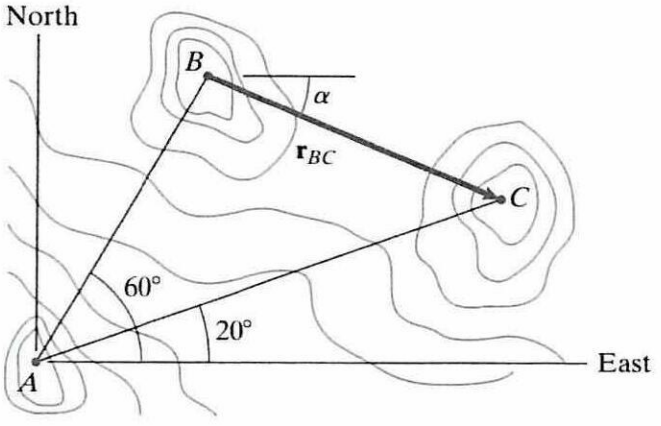


Figure Q4.1 Recorded distances from A to B and A to C on a map.

Q5 A homogeneous and thin steel plate is cut to form a machine part with the shape as shown in **Figure Q5.1**. Determine the centroid's location.

(20 marks)

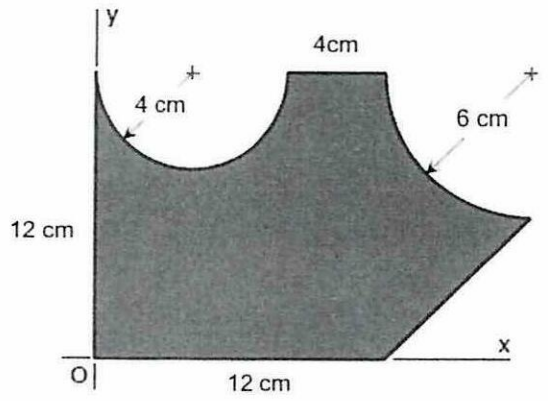


Figure Q5.1 A machine part made of homogeneous steel plate.

Q6 (a) The uniform crate shown in **Figure Q6.1** has a mass of 20 kg. If a force P = 80 N is applied to the crate, determine if it remains in equilibrium.

(10 marks)

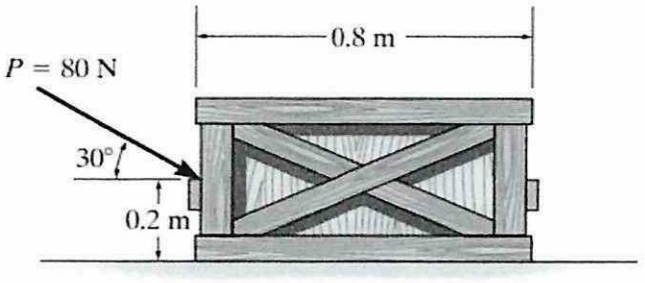


Figure Q6.1 A crate with a mass of 20 kg

(b) **Figure Q6.2** shows the weights of the blocks are $W_A = 100$ N and $W_B = 25$ N. The friction coefficients between all the contacting surfaces are $\mu_s = 0.32$ and $\mu k = 0.30$. Calculate force F, which is necessary to move B to the left at a constant rate.

(10 marks)

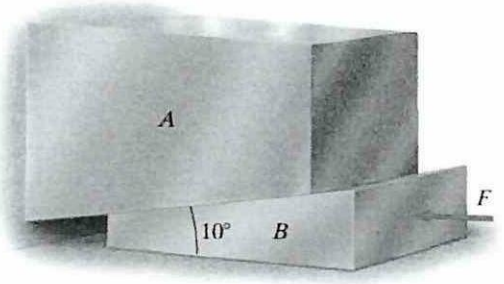
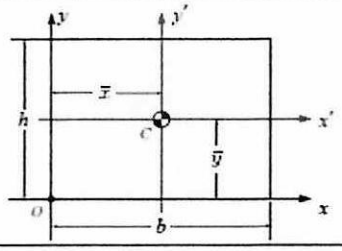
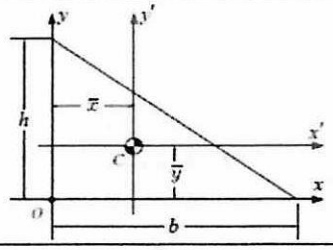
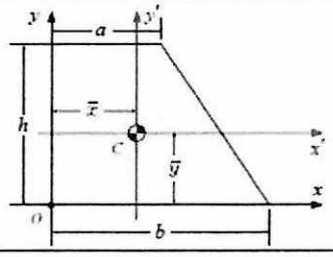
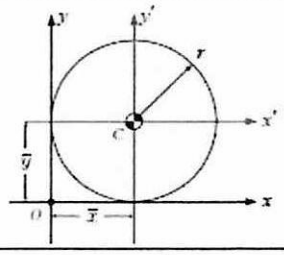
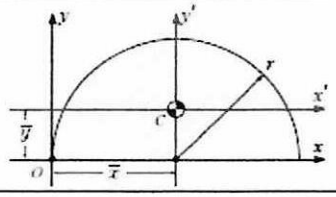
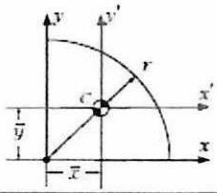


Figure Q6.2 The 25 N wedge B and 100 N block A.

- END OF QUESTIONS -

APPENDIX A

Table APPENDIX A.1

Shape	Area	$\bar{x}$	$\bar{y}$
	$A = bh$	$b/2$	$h/2$
	$\frac{bh}{2}$	$b/3$	$h/3$
	$\frac{(a+b)h}{2}$	$\frac{a^2+ab+b^2}{3(a+b)}$	$\frac{h(2a+b)}{3(a+b)}$
	πr^2	r	r
	$\frac{\pi r^2}{2}$	r	$\frac{4r}{3\pi}$
	$\frac{\pi r^2}{4}$	$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$