Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## (ONLINE)
## SEMESTER I
## SESSION 2020/2021

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|---|---|---|
| COURSE NAME | : | MECHANICS OF MATERIALS |
| COURSE CODE | : | DAC 11003 |
| PROGRAMME CODE | : | DAA |
| EXAMINATION DATE | : | JANUARY / FEBRUARY 2021 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | PART A: ANSWER **ALL** QUESTION.<br>PART B: Q1 IS **COMPULSORY**<br>Q2 & Q3 CHOOSE **ONE (1)** ONLY |

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

**PART A (20 marks)**

**Q1** Identify the expression for the bending equation.

[1 mark]

(a) $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$

(b) $\frac{M}{R} = \frac{\sigma}{y} = \frac{E}{I}$

(c) $\frac{M}{y} = \frac{\sigma}{R} = \frac{E}{I}$

(d) $\frac{M}{I} = \frac{\sigma}{R} = \frac{E}{y}$

**Q2** The stress that acts in a direction perpendicular to the area is called _____.

[1 mark]

(a) Shear stress
(b) Normal stress
(c) Bending stress
(d) Allowable stress

**Q3** At any point in the beam, slope and deflection is measured in _____ and ____ respectively.

[1 mark]

(a) meter , radians
(b) kPa , milimeter
(c) radians , meter
(d) radians , centimeter

**Q4** The support that developes support moment is _____ support.

[1 mark]

(a) Fixed
(b) Simple
(c) Pinned
(d) Joint

**Q5** Identify the SI unit for bending moment.

[1 mark]

(a) kN
(b) $kN^2$
(c) kNm
(d) km

**Q6** Identify the SI unit for uniform distributed load (UDL).

[1 mark]

(a) kN/m
(b) kNm
(c) $kNm^2$
(d) kN

**Q7** The difference between Macaulay method and Double Integration method is

[1 mark]

(a) Macaulay use both boundary and continuity conditions
(b) Macaulay use boundary condition only
(c) Macaulay use continuity condition only
(d) Macaulay use boundary, continuity and singularity conditions

**Q8** By referring to SFD shown in **Figure Q8**, determine the maximum bending for the beam.

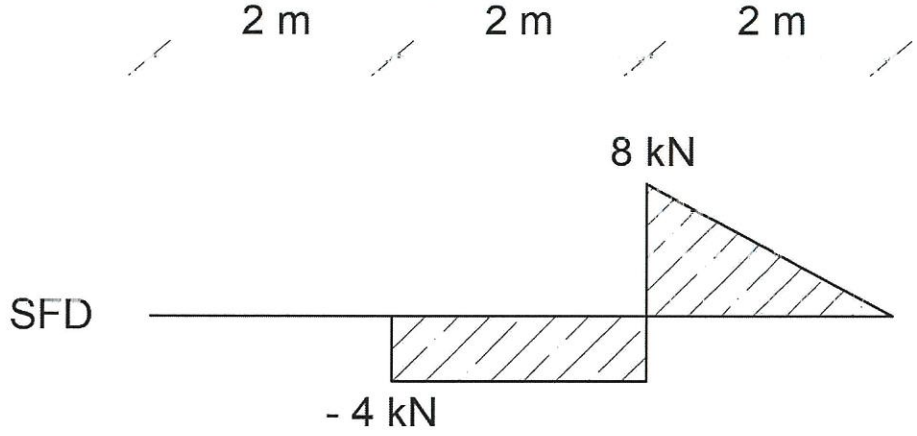



**Figure Q8**

[2 marks]

(a) +8 kNm
(b) -8 kNm
(c) +16 kNm
(d) -16 kNm

**Q9** Based on the **Figure Q9**, identify the maximum tensile bending stress for the T-shape beam.

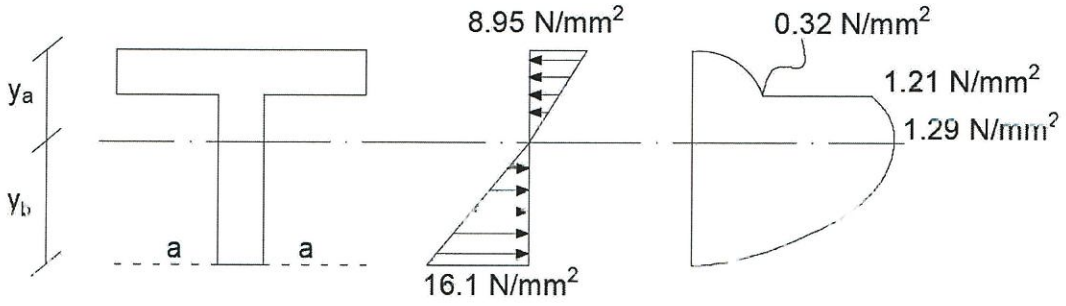



**Figure Q9**

[2 marks]

(a) 1.21 N/mm$^2$
(b) 1.29 N/mm$^2$
(c) 8.95 N/mm$^2$
(d) 16.1 N/mm$^2$

**Q10** Determine the support reaction at D for the **Figure Q10.**

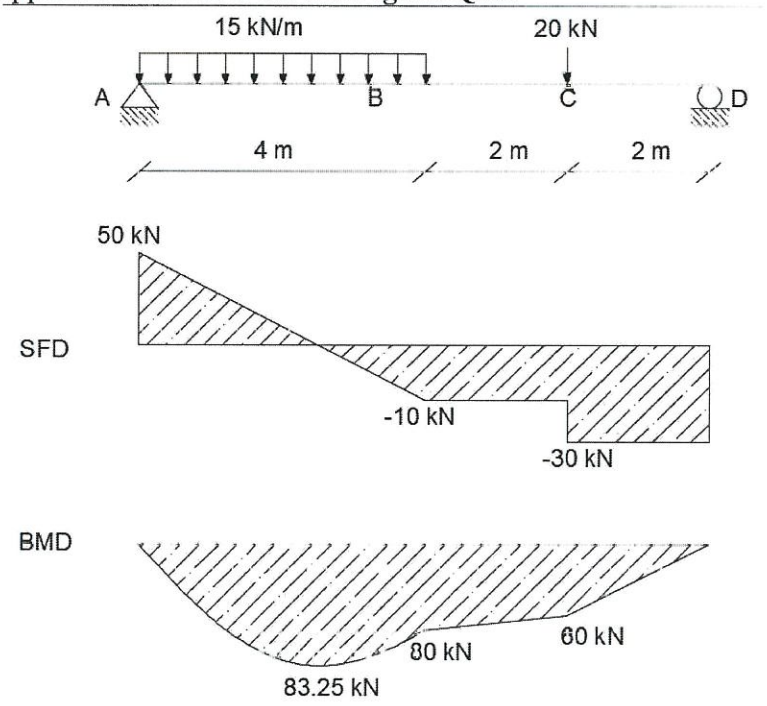



**Figure Q10**

[3 marks]

(a) 30 kN
(b) -60 kN
(c) 50 kN
(d) -30 kN

**Q11** **Figure Q11** shows calculated support reaction of 20 kN and 10 kN at A and C of a beam in determining slope and deflection using Macaulay method. Identify the slope and deflection curve equation for the beam.

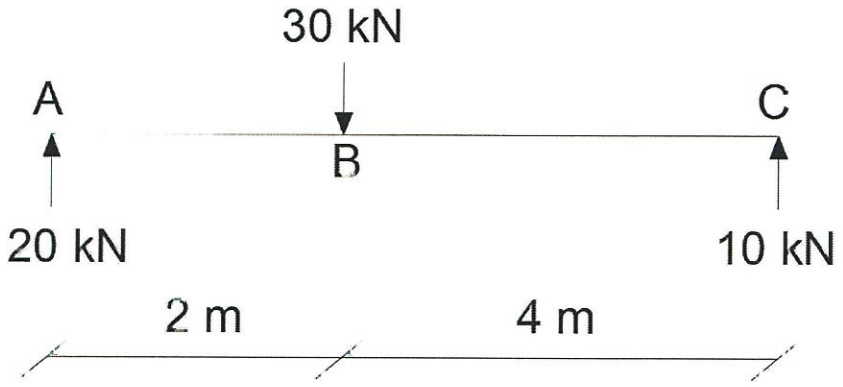



**Figure Q11**

[3 marks]

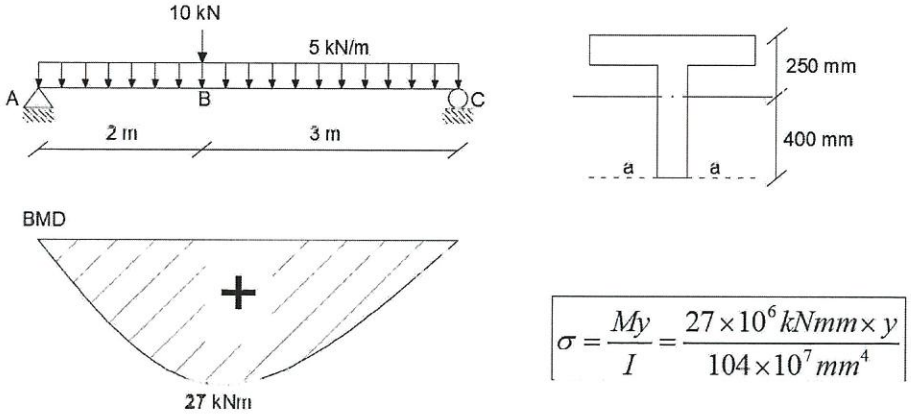
(a) $EI\frac{d^2y}{dx^2} = M = 20x \quad 30\langle x-2\rangle$

(b) $EI\frac{d^2y}{dx^2} - M - 20x$

(c) $FI\frac{d^2y}{dx^2} = M = 20x - 30\langle x-2\rangle - 10\langle x-4\rangle$

(d) $EI\frac{d^2y}{dx^2} = M = -20x + 30\langle x-2\rangle$

**Q12** Based on the **Figure Q12** and information given, identify the value of y for compression bending stress.




$$\sigma = \frac{My}{I} = \frac{27\times10^6\,kNmm\times y}{104\times10^7\,mm^4}$$

**Figure Q12**

[3 marks]

(a) 250mm
(b) 300mm
(c) 400mm
(d) 650mm

**PART B 80 Marks**

**Q1** **(a)** A simply supported beam subjected to loads as shown in **Figure Q1(a)**. A T-shape beam is located for AC span and rectangular is located for CD span.

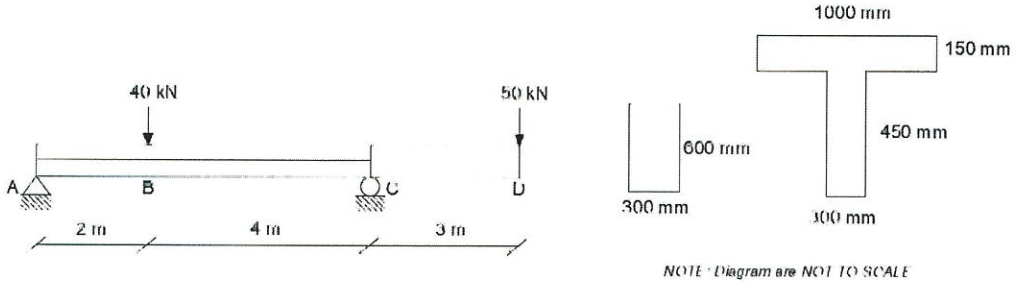



**Figure Q1(a)**

(i) Calculate the reaction support

(4 marks)

(ii) Draw the shear force and bending moment diagram

(4 marks)

(iii)

(iv) Determine the maximum bending stress of the beam and draw its diagram

(8 marks)

(i) Determine the shear stress in rectangular beam ONLY.

(4 marks)

**(b)** A simply supported beam subjected to loads as shown in **Figure Q1(b)**.

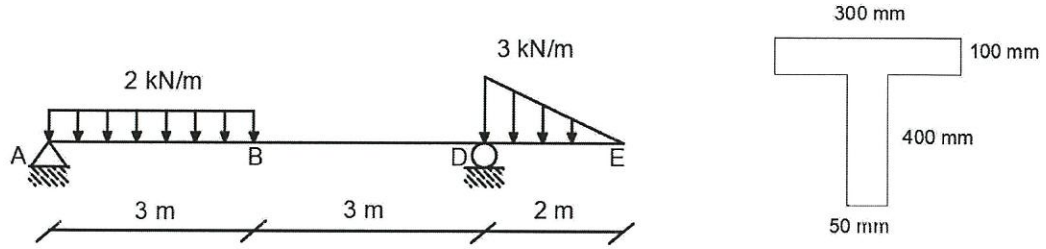



**Figure Q1(b)**

(i) Calculate the reaction support

(4 marks)

(ii) Draw the shear force and bending moment diagram.

(4 marks)

(iii) Determine the neutral axis measured from the bottom of the beam

(4 marks)

(iv) Determine the maximum bending stress at both tensile and compression region on the beam.

(8 marks)

**Q2** (a) An overhang beam with pinned support at A and roller support at B is subjected to loads as shown in **Figure Q2(a)**. By using Macaulay method determine the followings;

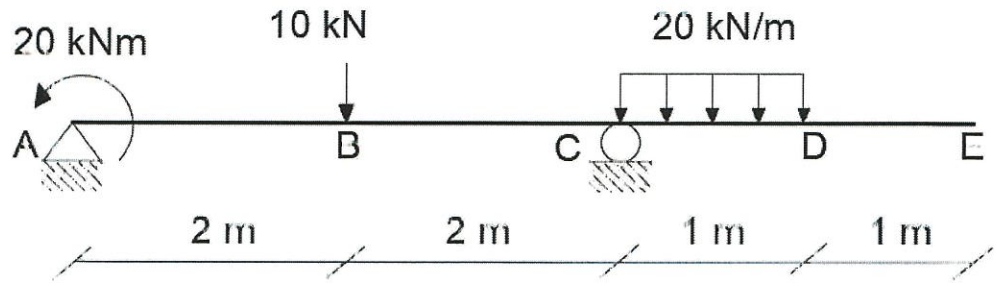



**Figure Q2(a)**

(i) Determine support reactions

(4 marks)

(ii) Determine the boundary condition for the beam.

(2 marks)

(iii) Construct the equation for slope and deflection.

(8 marks)

(iv) Determine the deflection and slope occurs at A.

(4 marks)

(b) A simply supported beam is subjected to loads as shown in **Figure Q2(b)**. By using Double Integration method detemine the followings;

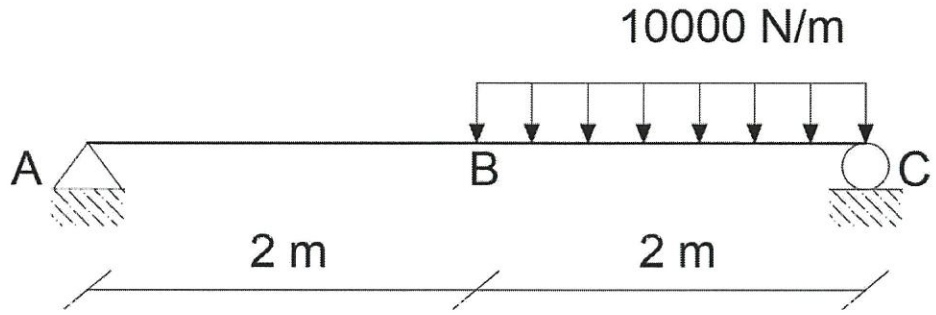



**Figure Q2(b)**

(i) Determine support reactions

(4 marks)

(ii) Determine the boundary and compactibility condition for the beam

(4 marks)

(iii) Construct the equation for slope and deflection.

(8 marks)

(iv) Determine the deflection and slope occurs at 1m and 3m from point A.

(6 marks)

**Q3** (a) An overhang beam is subjected to the loads as shown in **Figure Q3(a)**.

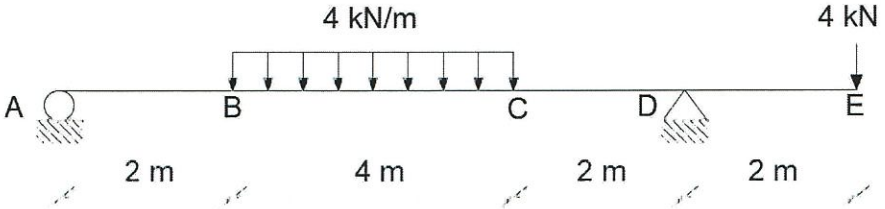



**Figure Q3(a)**

(i) Determine the reaction support

[4 marks]

(ii) Draw the shear force and bending moment diagram.

[4 marks]

(iii) Construct the equation for slope and deflection.

[8 marks]

(iv) Determine the deflection and slope occurs at A

[4 marks]

(b) Based the **Figure Q3(a)**, the pinned and roller support has been removed and replaced with fixed support at A.

(i) Determine the maximum bending moment.

[4 marks]

(ii) Determine the boundary and compactibility condition for the beam

[4 marks]

(iii) Construct the slope and deflection equation.

[8 marks]

(iv) Determine the deflection at 10m to the right from point A.

[4 marks]

**-END OF QUESTIONS-**