Student Name: ☞

Student ID: ☞

PSS Room/Demonstrator: ☞

School of Mechanical and Manufacturing Engineering

MMAN1300 – ENGINEERING MECHANICS 1

2018 S1 Block Test 2

Instructions:

- Time allowed: 45 minutes
- Total number of questions: 3
- Answer all the questions in the test
- Answer all questions in the spaces provided
- The 6 marks allocations shown are worth 6% of the course overall
- Candidates may bring drawing instruments, rulers and UNSW approved calculators to the test
- Print your name, student ID and all other requested details above
- Record your answers (with appropriate units) in the ***ANSWER BOXES*** provided

Notes:

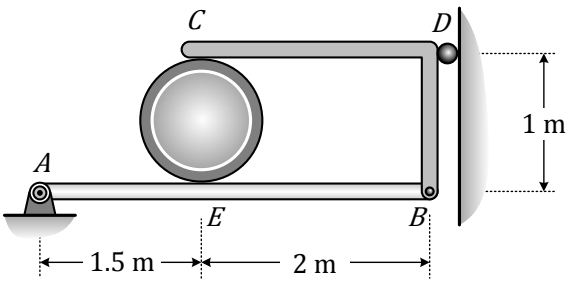
Your work must be complete, clear and logical

Do not skip steps, sign conventions, units and relevant diagrams and clearly state the final answers

No part of this paper is to be retained by candidates until handed back after marking

Question 1: (2 Marks)

The smooth 20 kg cylinder is supported between members *AB* and *CDB* as shown. Determine the following:



Solution:

(a) Determine the support reactions ($A_x and A_y$) at joint A – (Include the free body diagram of your chosen system)

Continue your solution to part (a) here:

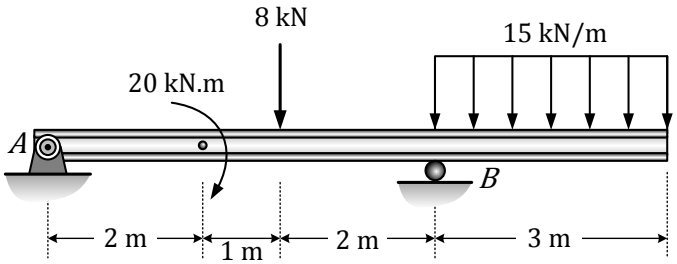
(b) Determine the force (F_{CDB}) exerted by the cylinder on member CDB – (Include the free body diagram of your chosen system)

(c) Determine the force (F_{AB}) exerted by the cylinder on member AB – (Include the free body diagram of your chosen system)

Answers:	$A_X =$	$A_Y =$	$F_{CDB} =$	$F_{AB} =$

Question 2: (2 Marks)

Draw the shear force and bending moment diagrams for the loaded beam shown below. Determine the location ($x_{M_{max}}$) and value of the maximum bending moment (M_{max}).



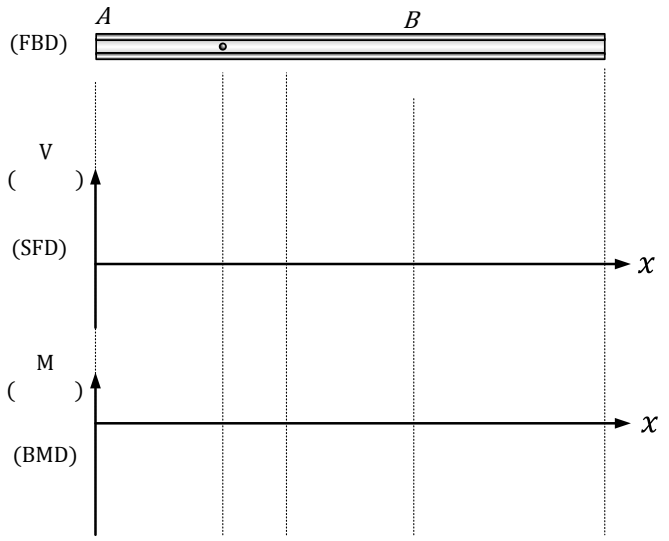
Solution:

(a) Calculate the Support Reactions at A and B

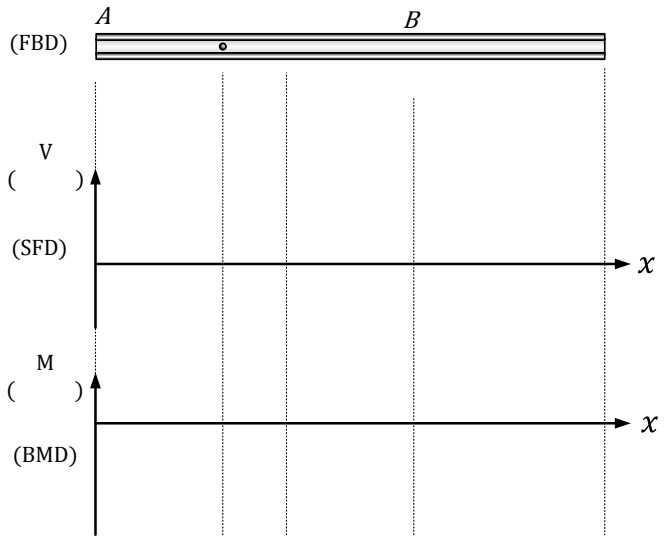
(b) Sketch the complete free body diagram, shear force diagram and bending moment diagram, on the axes provided ***on the next page (cross the attempt you do not want to be marked)****:*

(Use this space for relevant working if needed)

(Use this space for relevant working if needed)



Attempt 1



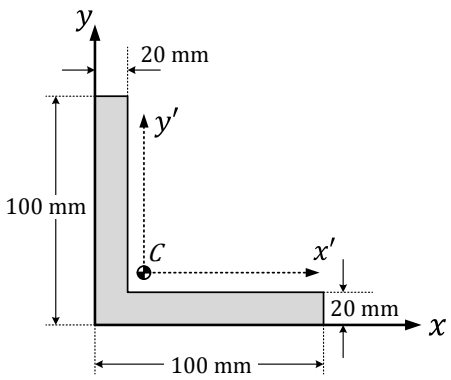
Attempt 2

(c) Find the location and magnitude of the maximum bending moment

Answers:	$x_{M_{max}} =$	$M_{max} =$

Question 3: (2 Marks)

For the cross-section shown, determine the following: (Proceed according to the steps in solution boxes).



Solution:

(a) Determine the coordinates $\bar{x}$ and $\bar{y}$ *to the centroid C*

(b) Calculate the moment of inertia ($I_{x'x'}$) *and* ($I_{y'y'}$) *about the neutral axis:*

Continue your working for part (b) here:

(c) Calculate the product of inertia ($I_{x'y'}$) about C

(d) Draw the Mohr's circle and determine the maximum principle moment of inertia I_{11} and I_{22}

Answers:	$\bar{x} =$	$\bar{y} =$	$I_{x'x'} =$	$I_{y'y'} =$
	$I_{xy} =$	$I_{11} =$	$I_{22} =$	

Useful Formulas

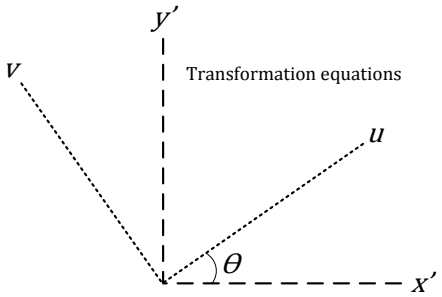
Transformation Equations

$$I_{uu} = \frac{I_{x'x'} + I_{y'y'}}{2} + \frac{I_{x'x'} - I_{y'y'}}{2}\cos 2\theta - I_{x'y'}\sin 2\theta$$

$$I_{vv} = \frac{I_{x'x'} + I_{y'y'}}{2} - \frac{I_{x'x'} - I_{y'y'}}{2}\cos 2\theta + I_{x'y'}\sin 2\theta$$

$$I_{uv} = \frac{I_{x'x'} - I_{y'y'}}{2}\sin 2\theta + I_{x'y'}\cos 2\theta$$

$$I_{11,22} = \frac{I_{x'x'} + I_{y'y'}}{2} \pm \sqrt{\left(\frac{I_{x'x'} - I_{y'y'}}{2}\right)^2 + {I_{x'y'}}^2}$$



Parallel Axis Theorem

$$I_{xx} = I_{x'x'} + A{d_y}^2$$

$$I_{yy} = I_{y'y'} + A{d_x}^2$$

$$I_{xy} = I_{x'y'} + Ad_x d_y$$

Rough work
(Note: No working on this section will be marked)