

LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 5

LEFEL 5

EXAMINATION PERIOD
MAY 2016

CYFNOD ARHOLIADAU
MAI 2016

MODULE CODE:
CAE & Stress Analysis (RESIT)

TIME: 2 HOURS

ANSWER THREE OUT OF FOUR QUESTIONS

Equipment or materials required – None

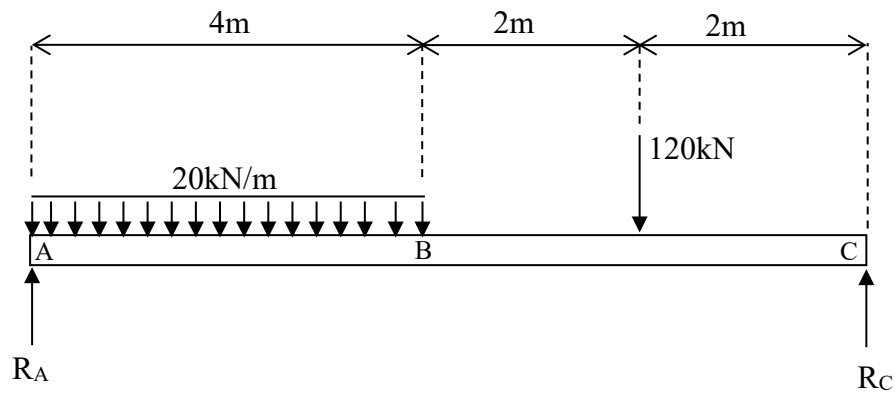
Adnoddau neu ddefnyddiau sydd eu hangen – Dim

A formula sheet is provided for reference.

Calculators are permitted.

Assume 'g' = 9.81 m/s².

ONE



A simply supported beam is loaded as shown above. Show that;

a. The slope at A is given by: $\frac{dy}{dx} = \frac{-540}{EI}$

[14 Marks]

b. The slope at C is given by: $\frac{dy}{dx} = \frac{606.6}{EI}$

[3 Marks]

c. The deflection at B is given by: $y = \frac{-1413.3}{EI}$

[3 Marks]

TWO

a.

In the context of complex stress, explain what is meant by the terms ‘Principal Stress’ and ‘Principal Plane’?

[3 marks]

b.

At a given section a shaft is subjected to a bending stress of 20MPa and a shear stress of 40MPa.

i) Draw a Mohrs circle to represent the above condition. [5 marks]

Hence determine;

ii) The principal stresses and the planes on which these act. [4 marks]

iii) The maximum shear stress and the plane on which this acts [2 marks]

iv) Determine the tensile stress, which acting alone would produce the same maximum shear stress. [3 marks]

v) Determine the shear stress, which acting alone would produce the same maximum tensile principal stress. [3 marks]

THREE

By adopting a recognised design process, such as British Standard BS7000 Part2 (2015), it may be possible to ensure that a manufactured product is 'fit for purpose' and is successfully marketable.

- (a) Briefly explain the core sequential phases employed in most design processes, how these relate to one another, and the importance of an iterative approach when undertaking a design problem. Also discuss the advantages in employing Computer Aided Engineering (CAE) tools within a design problem, when considering a manufactured product.

[14 marks]

- (b) Discuss how a formulated Design for Manufacturing (DfM) activity will aid a design team in reducing the cost and difficulty of manufacturing a product.

[6 marks]

FOUR

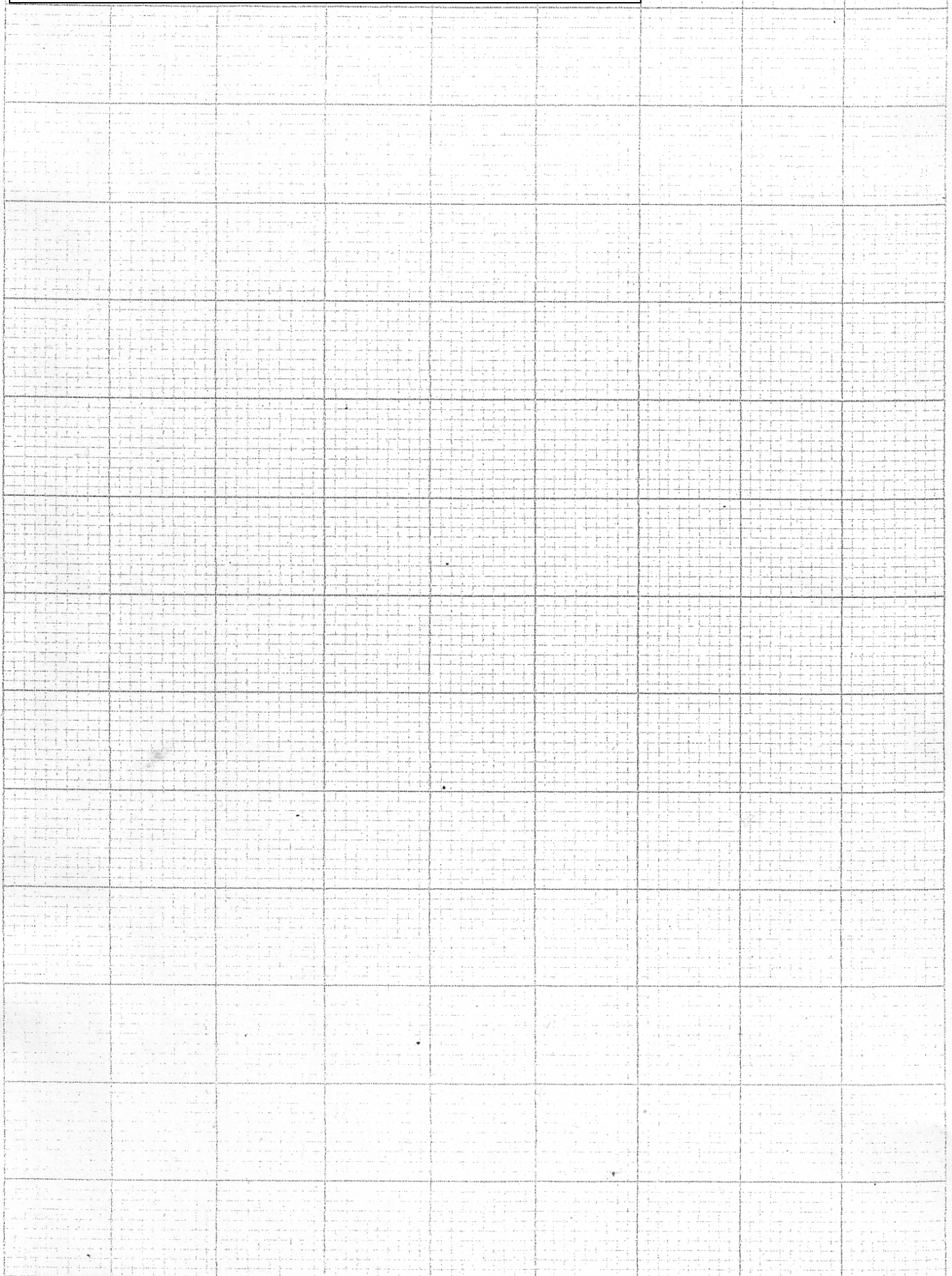
A widely used method for determining stress analysis data for a loaded component is applying computational numerical methods in the form of the Finite Element Method (FEM). This CAE tool is used where analytical solutions cannot be obtained.

- (a) Discuss the fundamental principles of FEM, covering such concepts as; governing equations, boundary conditions, stiffness matrix, and the general three stage procedure for Finite Element Analysis (FEA). Also mention any disadvantages / limitations of this method.

[12 marks]

- (b) FEM may be applied to numerical analysis of engineering problems other than stress analysis. State two other physical quantities that can be analysed using FEM, as well as the associated 'actions', 'property', and 'behaviour' determined by the appropriate set of simultaneous algebraic equations.

[8 marks]



Formula Sheet

Slope and deflection of beam theory;

$$EI \frac{d^2 y}{dx^2} = M \quad \text{Bending moment.}$$

$$Q = EI \frac{d^3 y}{dx^3} \quad \text{Shear Force}$$

$$w = EI \frac{d^4 y}{dx^4} \quad \text{Load}$$

Diwedd/End