UNIVERSITY OF TORONTO
DEPARTMENT OF CIVIL ENGINEERING

FINAL EXAMINATION - APRIL 2001

CIV 214H1S - STRUCTURAL ANALYSIS I

Examiner: Professor J.A. Packer

NAME: ______________________________

STUDENT NUMBER: ______________________________

GENERAL (G) OR ENVIRONMENTAL (E) STREAM IN 3RD. YEAR: ____

This is a Type C Examination.

The specific aid permitted in the Examination is a single Faculty-approved Aid Sheet.

- Answer all FIVE questions in the space provided. If additional work space is required use the back of the preceding page and note appropriately.
- Do not unstaple pages.
- Questions all have the same value, as shown in the box below.

DO NOT WRITE IN THIS SPACE.

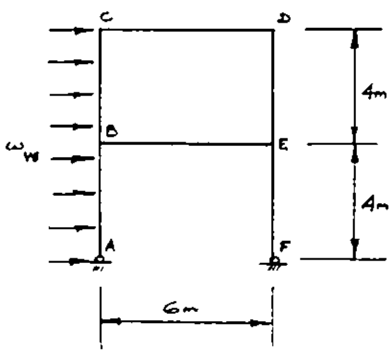
Problem 1	/ 12
Problem 2	/ 12
Problem 3	/ 12
Problem 4	/ 12
Problem 5	/ 12
TOTAL	/ 60

1. The building frame shown below has rigid joints at B, C, D and E, and is pinned at the two bases (A and F). The left wall of the building (ABC) is loaded by a specified (unfactored) positive wind pressure of 1.5 kPa and the planar building frames are spaced at 8 metre centres (perpendicular to the page). The building resists this lateral loading by rigid frame behaviour and the wind loading can be simplified to just point (factored) loads acting at A, B and C. All the members of the building are steel and have the same section properties (I_x, A).

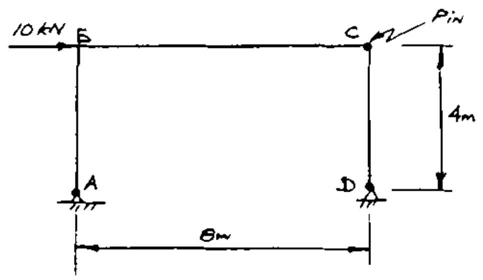
(a) What is the total number of Degrees of Freedom for the frame? ______

(b) What is the number of Unconstrained Degrees of Freedom for the frame, ignoring deformations which are axial to the members (as these are small compared to bending deformations)? _______

(c) Using the **Portal Method** for analysing lateral loads on frames, determine an approximate distribution of bending moments throughout the frame. Plot these neatly, to scale, on a diagram of the frame, with bending moments plotted on the compression side of the member



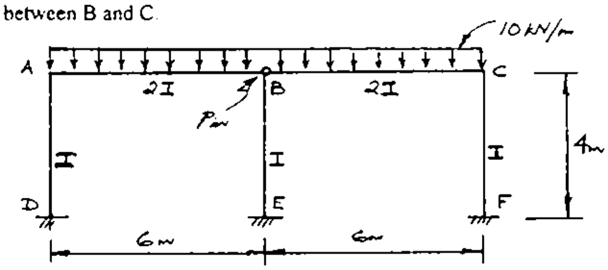
2. The planar frame shown below has a rigid joint at B but pin joints at A, C and D. For the loading shown, determine the rotation at A (in degrees) using the **Method of Virtual Work**. For all members, E = 200,000 MPa and I = 70 x 10^6 mm^4.



3. The planar frame shown below has rigid joints at A, C, D, E and F, but has a pin joint at B. The material (hence E) is the same throughout, but the beams (AB and BC) have a Moment of Inertia which is twice that of the columns (AD, BE and CF). For the loading shown (consider it already factored):

(a) Use **Slope-Deflection Equations** to determine the bending moments at A, D, C and F. Hence plot the bending moments throughout the frame neatly, to scale, on a diagram of the frame, with bending moments plotted on the compression side of the members. Indicate the value of the moment at A, B, C, D, E, F, midway between A and B, and midway between B and C.

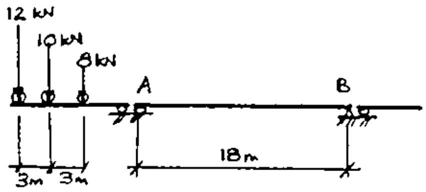
(b) Determine the vertical reaction at E.



4. A vehicle with three wheel loads as shown below (which you can consider already factored), moves across a simply supported bridge, of 18 metre span, from A to B.

(a) Determine the maximum absolute bending moment in the beam AB, and where this occurs.

(b) Determine the maximum absolute shear force in the beam AB, and where this occurs



5. The 3-pin, tied arch roof shown below has a parabolic shape and is subjected to any combination of uniformly-distributed loads (UDL), acting across the whole structure. Types of specified (unfactored) UDL are: Dead Load due to roof self weight of 8 kN/m, Snow Load of 20 kN/m, and Wind *uplift* of 4 kN/m.

(a) Determine the number of degrees of indeterminacy for the structure.

(b) Determine, in accordance with Canadian Limit States Design principles, the maximum bending moment, for design, at points D and E.

(c) Determine, in accordance with Canadian Limit States Design principles, the maximum force for which the member AC needs to be designed.