

**UNIVERSITY OF BOLTON**  
**SCHOOL OF THE BUILT ENVIRONMENT &  
ENGINEERING**  
**BSc(HONS) CIVIL ENGINEERING**  
**SEMESTER ONE EXAMINATION 2010/2011**  
**STRUCTURAL ANALYSIS**  
**MODULE NO: BLT1014**

Date: Monday 24 January 2011

Time: 10.00 am – 12.00 noon

---

**INSTRUCTIONS TO CANDIDATES:**

There are **FOUR** questions.

Answer **ALL FOUR** questions.

All questions carry equal marks.

Marks for parts of questions are shown in brackets.

This examination paper carries a total of 100 marks.

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

---

School of the Built Environment & Engineering  
BSc(Hons) Civil Engineering  
Semester One Examination 2010/2011  
Structural Analysis  
Module No. BLT1014

### Question 1

Figure Q1(i) shows 4 different simply supported beams 1a, 1b, 1c and 1d. The beams carry a mix of point loads and uniformly distributed loads (UDLs). The size of the loads and the spans of the beams are not given. For each of the beams, estimate and then sketch the shear force diagram (SFD) and the bending moment diagram (BMD).

(15 marks)

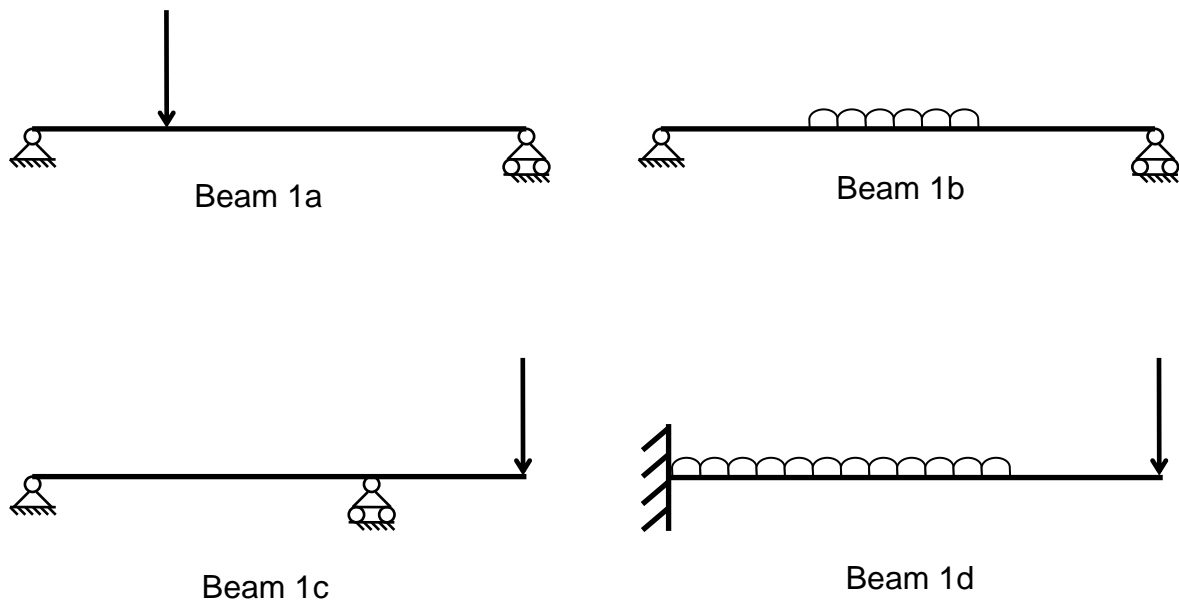


FIGURE Q1(i)

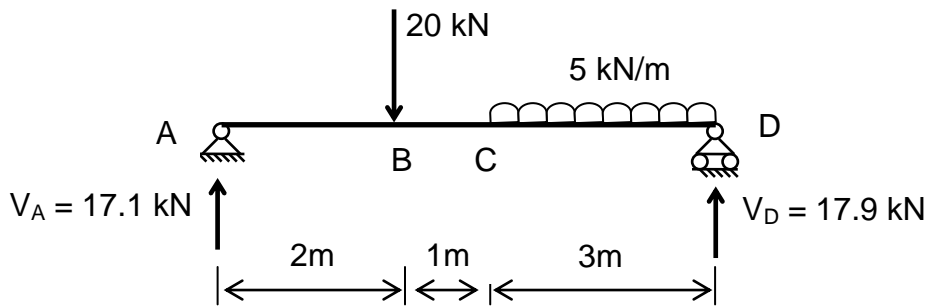
Question 1 continued over the page...

School of the Built Environment & Engineering  
 BSc(Hons) Civil Engineering  
 Semester One Examination 2010/2011  
 Structural Analysis  
 Module No. BLT1014

**Question 1 continued**

Figure Q1(ii) shows a simply supported beam (Beam 1e) A, B, C, D, 6 metres long with a point load at B, a UDL between C and D and its vertical reactions of 17.1 kN at A and 17.9 kN at D. Draw the SFD and BMD. Calculate and show the values of the shear force and bending moment at points A, B, C and D along the beam.

(10 marks)



Beam 1e

FIGURE Q1(ii)

**Total 25 marks**

**Please turn the page**

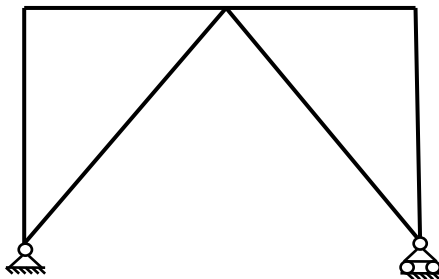
School of the Built Environment & Engineering  
 BSc(Hons) Civil Engineering  
 Semester One Examination 2010/2011  
 Structural Analysis  
 Module No. BLT1014

**Question 2**

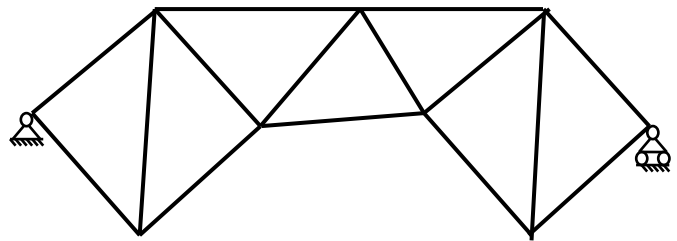
Figure Q2(i) shows two pin jointed frames: 2a and 2b. For each of the frames, show whether or not it is statically determinate using the formula:

$$m + r - 2j = 0$$

(5 marks)



Pin jointed frame 2a



Pin jointed frame 2b

**FIGURE Q2(i)**

Figure 2(ii) shows two pin jointed frames 2c and 2d. The frames carry horizontal point loads. The size of the loads is not given.

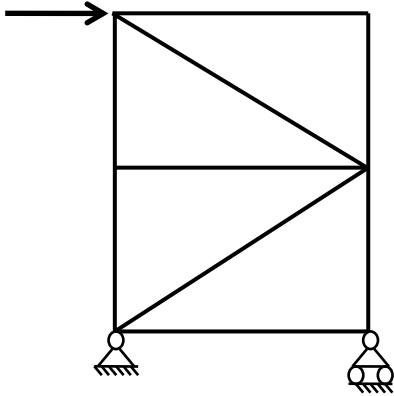
Sketch a diagram of each truss, estimate the directions of all of the reactions and the type of force in each member (compression or tension). Show these on your sketch diagrams.

(10 marks)

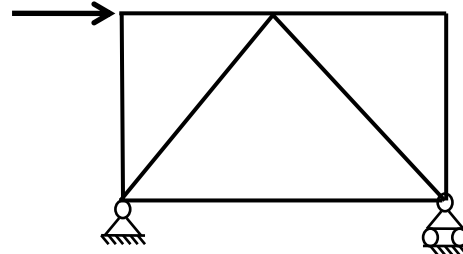
**Question 2 continued over the page...**

School of the Built Environment & Engineering  
 BSc(Hons) Civil Engineering  
 Semester One Examination 2010/2011  
 Structural Analysis  
 Module No. BLT1014

**Question 2 continued**



Pin jointed frame 2c

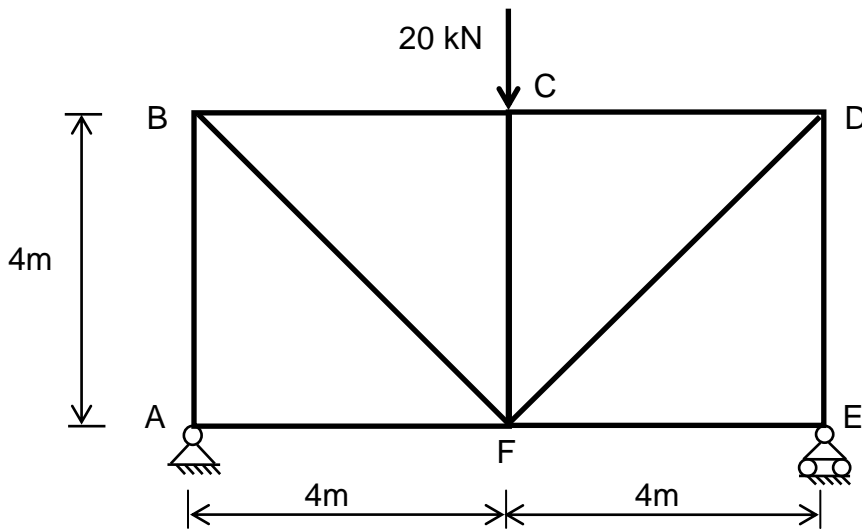


Pin jointed frame 2d

**FIGURE Q2(ii)**

Figure 2(iii) shows a pin jointed truss with a pinned support at A and a roller support at E. The truss supports one vertical load of 20 kN at C. Use the method of joints to calculate the value and type of force in each member of the truss. Sketch a diagram of the truss and summarise your answer on it.

(10 marks)



**FIGURE Q2(iii)**

**Total 25 marks**

**Please turn the page**

School of the Built Environment & Engineering  
 BSc(Hons) Civil Engineering  
 Semester One Examination 2010/2011  
 Structural Analysis  
 Module No. BLT1014

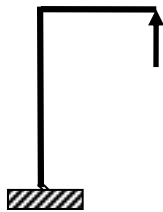
**Question 3**

Figure Q3 shows four different frames 3a, 3b, 3c and 3d. Each frame supports a single point load. The size of the point loads and the dimensions of the frames are not given. For each of the frames, estimate and then sketch the reactions, the shear force diagram (SFD) and the bending moment diagram (BMD).

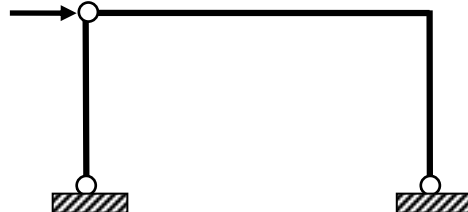
(20 marks)

The three pin frame 3b is 6m long and 4m high. The load applied to the top corner of the frame is 15kN. Calculate the maximum bending moments and shear forces in frame 3b and add these onto your sketches showing the SFD and BMD.

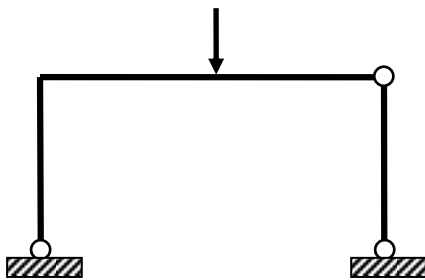
(5 marks)



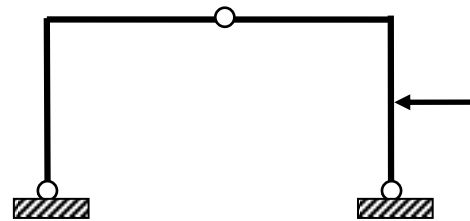
Three pin frame 3a



Three pin frame 3b



Three pin frame 3c



Three pin frame 3d

**FIGURE Q3**

**Total 25 marks**

**Please turn the page**

School of the Built Environment & Engineering  
BSc(Hons) Civil Engineering  
Semester One Examination 2010/2011  
Structural Analysis  
Module No. BLT1014

**Question 4**

Figure Q4(i) shows a cross-section of a timber beam spanning 5 metres as shown in Figure Q4(ii). The beam carries a uniformly distributed load (UDL) of 4 kN/m. Calculate the stress in the timber beam at mid span.

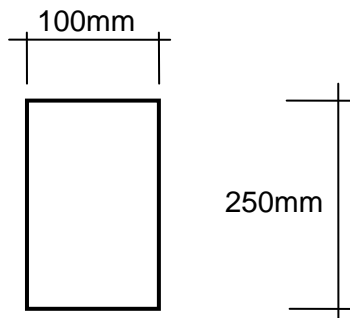
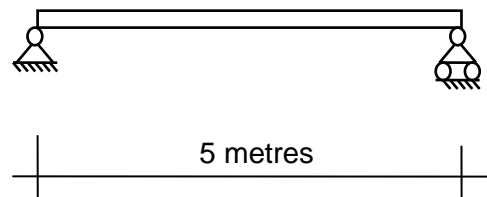
(8 marks)

Figure Q4(iii) shows a cross section of a timber column made out of the same size piece of timber. The column supports a point load 50 kN applied at location A. Calculate the maximum compressive stress in the column.

(9 marks)

Figure Q4(iv) shows a cross section of a Tee beam. Determine the position of the horizontal neutral axis of the beam.

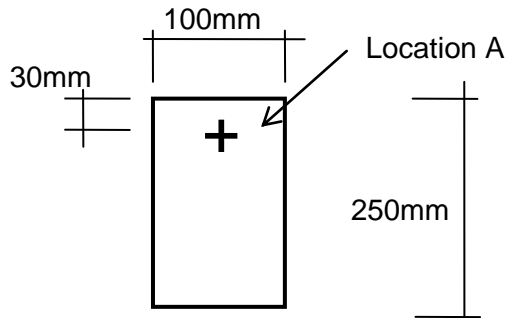
(8 marks)

**FIGURE Q4(i)****FIGURE Q4(ii)**

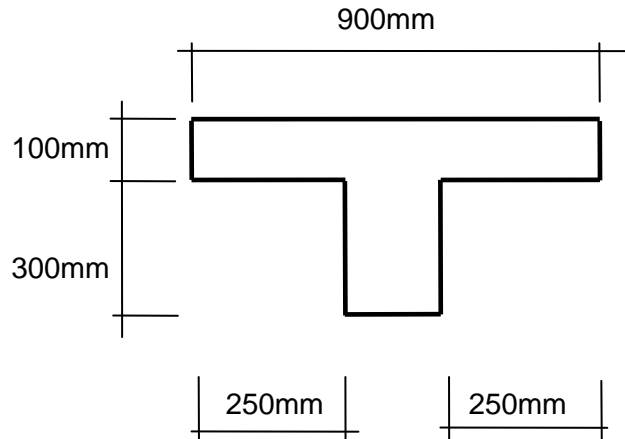
Question 4 continued over the page...

School of the Built Environment & Engineering  
BSc(Hons) Civil Engineering  
Semester One Examination 2010/2011  
Structural Analysis  
Module No. BLT1014

**Question 4 continued**



**FIGURE Q4(iii)**



**FIGURE Q4(iv)**

Formula that may be helpful in this question:

— — —

**Total 25 marks**

**END OF QUESTIONS**