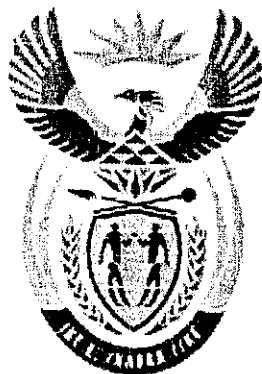# higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T220(E)(J30)T
AUGUST 2010

NATIONAL CERTIFICATE

BUILDING SCIENCE N3

(15070023)

30 July (X-Paper)
09:00 – 12:00

Calculators and drawing instruments may be used.

This question paper consists of 5 pages, 2 diagram sheets and a formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
BUILDING SCIENCE N3
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.

2. Read ALL the questions carefully.

3. Number the answers correctly according to the numbering system used in this question paper.

4. ALL diagrams, sketches and labelling MUST be done in PENCIL.

5. 1 kg = 10 N

6. Write neatly and legibly.

QUESTION 1

1.1 Explain the purpose of a machine. (2)

1.2 Explain velocity ratio. (2)

1.3 Explain mechanical advantage. (2)

1.4 Explain the efficiency of a machine. (2)

1.5 Why are machines not 100% efficient? (2)

[10]

QUESTION 2

A simply supported beam is shown in FIGURE 1, on the attached DIAGRAM SHEET 1.

2.1   Calculate the reactions at the supports RL and RR.   (7)

2.2   Calculate the bending moments at points A, and B.   (4)

2.3   Draw the shear force diagram to scale 3 mm = 1 kN.   (3)

2.4   Draw the bending moment diagram to scale 3 mm = 1 kNm.   (1)
[15]

QUESTION 3

A loaded beam is shown in FIGURE 2, on the attached DIAGRAM SHEET 1. Assume that the left-hand reaction RH is at an angle and the right-hand reaction RR is vertical. Disregard the weight of the beam.

Calculate the following:

3.1   The reaction at RR   (3)

3.2   The sum of the vertical components   (4)

3.3   The sum of the horizontal components   (2)

3.4   The reaction at RH   (3)

3.5   The angle and the direction of the reaction at RH   (3)
[15]

QUESTION 4

FIGURE 3, on the attached DIAGRAM SHEET 2, shows a frame that is in equilibrium.

4.1   Calculate the reactions at the supports.   (2,5)

4.2   Draw the force diagram to scale 1 mm = 1 kN.   (5,5)

PTO

4.3 Copy and complete the following TABLE in the ANSWER BOOK:

MEMBER	MAGNITUDE	NATURE
AE		
BF		
CG		
DG		
DE		
EF		
FG		

(7)
[15]

QUESTION 5

A lamina is shown in FIGURE 4, on the attached DIAGRAM SHEET 2.

Calculate the following:

5.1	The area of SECTION 1	(1)
5.2	The area of SECTION 2	(1)
5.3	The area of SECTION 3	(1)
5.4	The total area of the figure	(1)
5.5	The distance from side AB to the centre of SECTION 1	(1)
5.6	The distance from side AB to the centre of SECTION 2	(1)
5.7	The distance from side AB to the centre of SECTION 3	(1)
5.8	The distance from side AC to the centre of SECTION 1	(1)
5.9	The distance from side AC to the centre of SECTION 2	(1)
5.10	The distance from side AC to the centre of SECTION 3	(1)
5.11	The distance of the centre of gravity of the figure from side AB	(2,5)
5.12	The distance of the centre of gravity of the figure from side AC	(2,5)

[15]

QUESTION 6

6.1   Resistances of 3 and 6 ohms are in parallel and are connected in series with
       a 20 ohms resistance. Calculate the total resistance of the circuit.   (3)

6.2   Calculate the voltage necessary to cause 2 amps of electric current to flow
       through a resistance of 55 ohms.   (2)

6.3   Calculate the electric current flowing in a 2,5 kW electric heater on a 250 volt
       supply.   (2)

6.4   Calculate the energy used in 1 hour when 2 amps of electric current flows due
       to a potential difference of 240 volts.   (3)
                                                                                          [10]

QUESTION 7

7.1   A wooden block having a mass of 80 kg is lying on a horizontal surface. The
       coefficient of friction between the block and the plane is 0,25.

       Calculate the weight of the block.   (2)

7.2   Calculate the force inclined at 30 degrees to the horizontal required to ...

       7.2.1   push the body along the surface.   (4)

       7.2.2   pull the body along the surface.   (4)
                                                                                          [10]

QUESTION 8

Describe the following terms with reference to water:

8.1   Ph   (2)
8.2   Chlorination   (2)
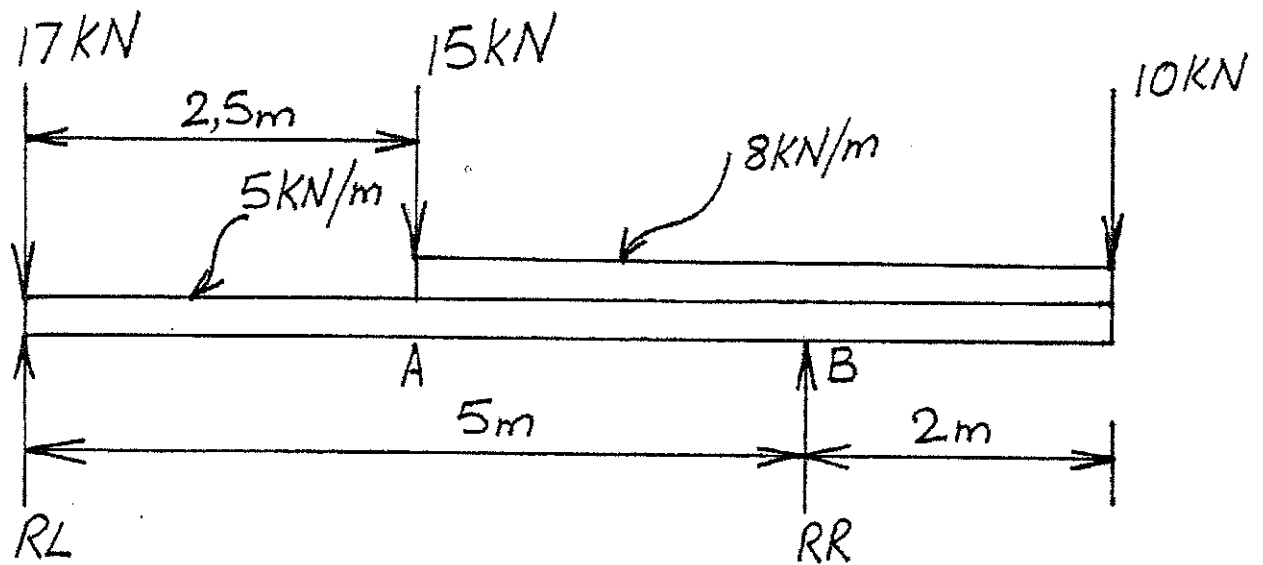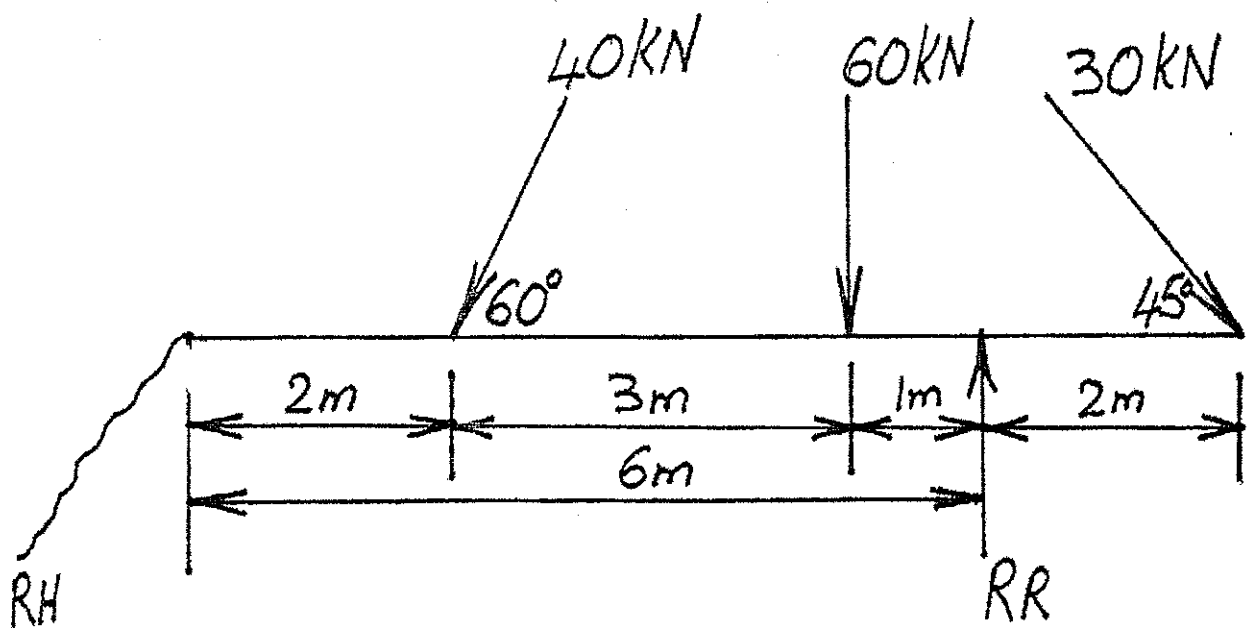8.3   Ultraviolet radiation   (2)
8.4   Aeration   (2)
8.5   Settling tanks   (2)
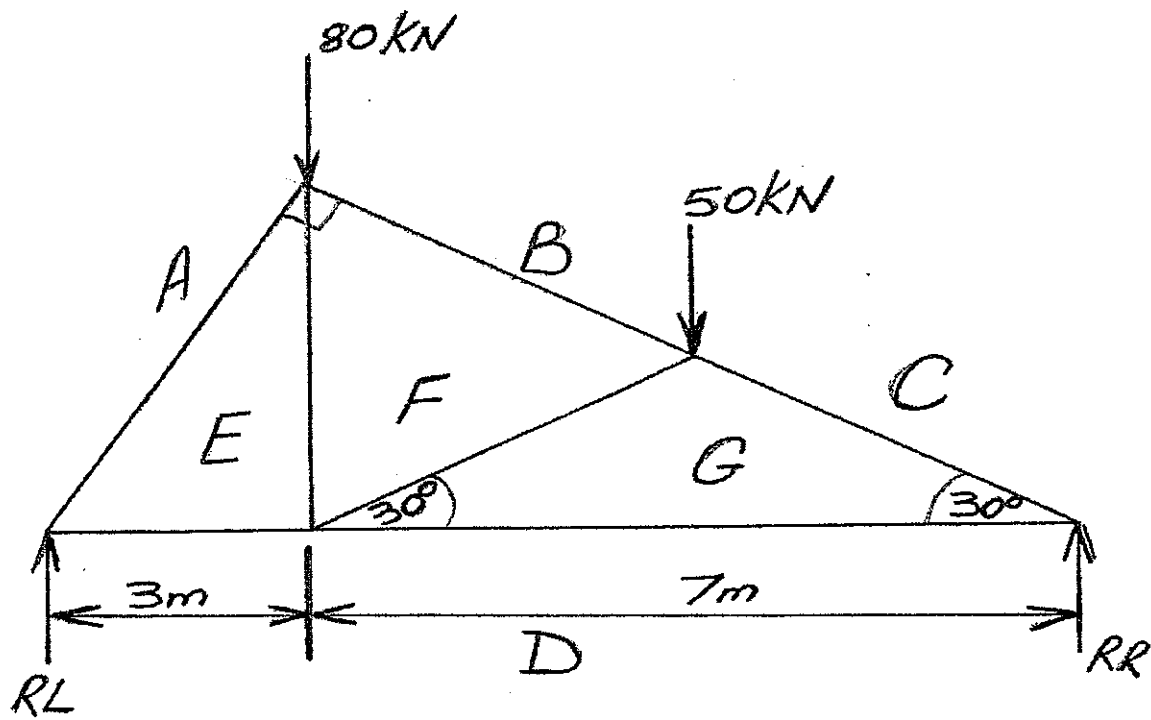   **[10]**

                                                      TOTAL: 100

DIAGRAM SHEET 1

FIGURE 1

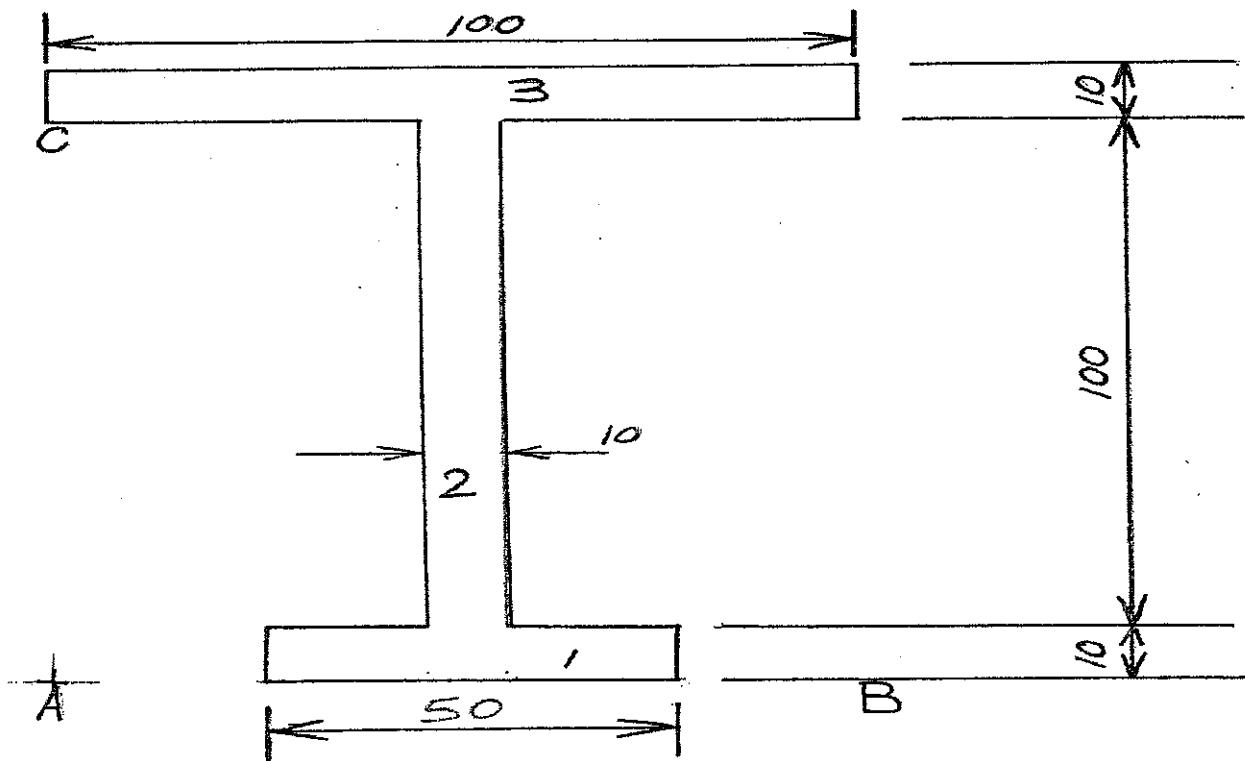**FIGURE 2**

DIAGRAM SHEET 2

FIGURE 3

FIGURE 4

BUILDING SCIENCE N3

FORMULA SHEET

Any applicable formula may also be used.

1. $F = m \times g$

2. $A = \dfrac{\pi D^2}{4}$

3. $F\mu = \mu \times W$

4. $\mu = \tan \phi$

5. Comp. $\parallel = W \sin \phi$

   Komp. $\parallel = W \sin \phi$

6. Comp. $\perp = W \cos \phi$

   Komp. $\perp = W \cos \phi$

7. $F1 = \mu\, W \cos \phi + W \sin \phi$

8. $F\mu = \mu\, W \cos \phi$

9. $F2 = \mu\, W \cos \phi - W \sin \phi$

10. $s = ut + \frac{1}{2}at^2$

11. $v = u \pm 2\,as$

12. $v = u^2 \pm at$

13. $M = m\_ \times v$

14. $m \times u = m \times v$

15. $VR = \dfrac{Effort\ distance}{Load\ distance}$

    $SV = \dfrac{Magafstand}{Lasafstand}$

16. $MA = \dfrac{Load}{Effort}$

    $HV = \dfrac{Las}{Mag}$

17. $n = \dfrac{HV}{SV} \times 100$

18. $V = I \times R$

19. $R_T = R_1 + R_2 + R_3$

20. $\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

21. $P = V \times I$

22. $W = P \times t$

23. $AV = F \times S$

    $WD = F \times S$

24. $MOM = F \times \perp S$

25. $A = L \times B$

26. $A = \pi r^2$

27. $A = \frac{1}{2}\,bh\ /\ \frac{1}{2}ab\sin C$

28. $A = 4\pi r^2$

29. $\bar{x} = \dfrac{4r}{3}$

30. $\bar{x} = \dfrac{1}{3}h$

31. $R = \sqrt{HK^2 + VK^2}$

    $R = \sqrt{HC^2 + VC^2}$

32. $\mathrm{TAN}\,\phi = \dfrac{VC}{HC} / \dfrac{VK}{HK}$

33. Mass of water in mixture = water:cement ratio × mass of cement

    Massa van water in mengsel = water:sementverhouding × massa sement

34. Work done by effort in raising the load = effort × velocity ratio (VR)× load distance

    Werk wat deur mag gedoen is om die las te lig = mag × snelheidsverhouding × las-afstand