higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T200**(E)**(J31)T

AUGUST EXAMINATION

NATIONAL CERTIFICATE

BUILDING SCIENCE N3

(15070023)

31 July 2014 (Y-Paper)
13:00–16:00

Candidates need drawing instruments.

Calculators may be used.

This question paper consists of 6 pages, 2 diagram sheets, and 1 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 according to the numbering system used in this question paper.
4. Start each question on a NEW page.
5. ALL sketches and diagrams must be large, clear, neat and drawn to SCALE. Indicate the scale that you have used.
6. ALL diagrams to be drawn in PENCIL.
7. Keep questions and subsections of questions together.
8. Leave BOTH margins clear.
9. ALL final answers must be approximated accurately to THREE decimal places, i.e. 3,142.
10. Write neatly and legibly.

QUESTION 1

FIGURE 1, DIAGRAM SHEET 1 (attached), shows a loaded cantilever beam.

NOTE: All values of the loaded beam are in kilonewtons (kN).

1.2.1 Make necessary calculations and draw, to a suitable scale, the shear force diagram and bending moment diagram respectively for the loaded beam. (10)

1.2.1 Indicate, on the bending moment diagram and shear force diagram, the values at points A, B, C and D. (5)

[15]

QUESTION 2

A single purchase winch has a pinion gear with 16 teeth which meshes with a main gear having 32 teeth. The diameter of the rope drum attached to the main gear is 220 mm.

The effective length of the handle, connected to the pinion, is 330 mm.

Calculate the following:

2.1 The velocity ratio (4)

2.2 The effort required to lift a mass of 50 kg if the efficiency is 80% (4)

2.3 The mechanical advantage (3)

[11]

QUESTION 3

A lamina (plate) is shown in FIGURE 2, DIAGRAM SHEET 1 (attached).

Calculate the following:

3.1 The area of section marked '1' (1)

3.2 The area of section marked '2' (1)

3.3 The area of section marked '3' (1)

3.4 The area of section marked '4' (1)

3.5 The area of section marked '5' (1)

3.6 The total area of the figure (2)

3.7	The distance from side A-B to the centre of section marked '1'	(1)
3.8	The distance from side A-B to the centre of section marked '2'	(1)
3.9	The distance from side A-B to the centre of section marked '3'	(1)
3.10	The distance from side A-B to the centre of section marked '4'	(1)
3.11	The distance from side A-B to the centre of section marked '5'	(1)
3.12	The distance of the centre of gravity of the figure from side A-B	(2)
3.13	The distance from side A-C to the centre of section marked '1'	(1)
3.14	The distance from side A-C to the centre of section marked '2'	(1)
3.15	The distance from side A-C to the centre of section marked '3'	(1)
3.16	The distance from side A-C to the centre of section marked '4'	(1)
3.17	The distance from side A-C to the centre of section marked '5'	(1)
3.18	The distance of the centre of gravity of the figure from side A-C	(2)

[21]

QUESTION 4

A tripod has 7 metres of length in each of the legs. The feet of the legs form an equilateral triangle with sides of 5 metres in length.

Find the forces in the legs when a weight of 25 kN is suspended from the apex. **[15]**

QUESTION 5

FIGURE 3, DIAGRAM SHEET 2 (attached), shows a frame that is in equilibrium.

5.1 Calculate the reactions at the supports R_L and R_R (using law of moments). (4)

5.2 Draw, to a suitable scale, the frame and force DIAGRAMS.

Copy and complete the following TABLE in the ANSWER BOOK:

MEMBER	MAGNITUDE	NATURE
AF		
BG		
FG		
EF		
HG		
DK		
HJ		
KJ		
CH		
JE		
KE		

22 x ½ (11)
[15]

QUESTION 6

Define the following terms:

6.1 Tensile force

6.2 Compressive force

6.3 Moments

6.4 Centroids

(4 x 2) (8)
[8]

QUESTION 7

FIGURE 4, DIAGRAM SHEET 2 (attached), shows a loaded beam. Assume the left-hand reaction at the roller is vertical and the right-hand reaction at the hinge is at an angle.

NOTE: Ignore the self-weight of the beam.

Calculate the following:

7.1	The reaction at the roller R^L	(3)
7.2	The sum of vertical components	(3)
7.3	The sum of the horizontal components (R^H)	(5)
7.4	The direction of the reaction at the hinge	(4)
		[15]

TOTAL: 100

DIAGRAM SHEET 1

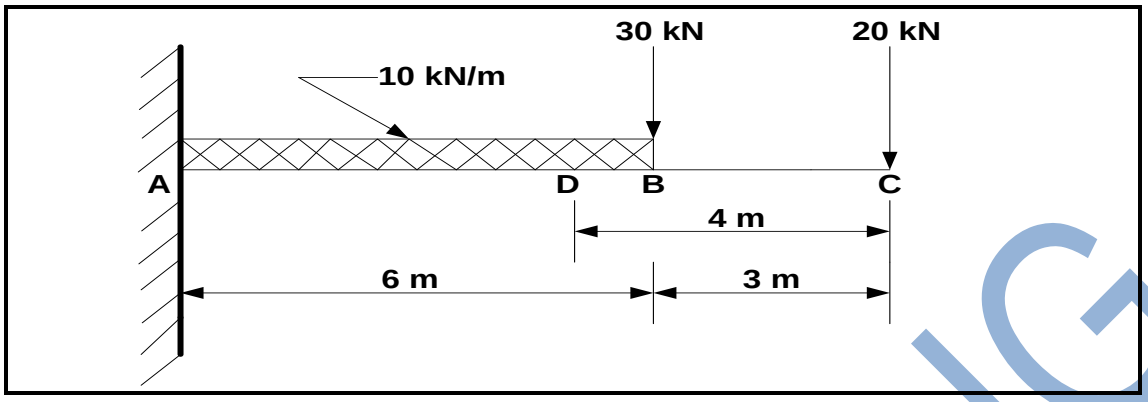

FIGURE 1

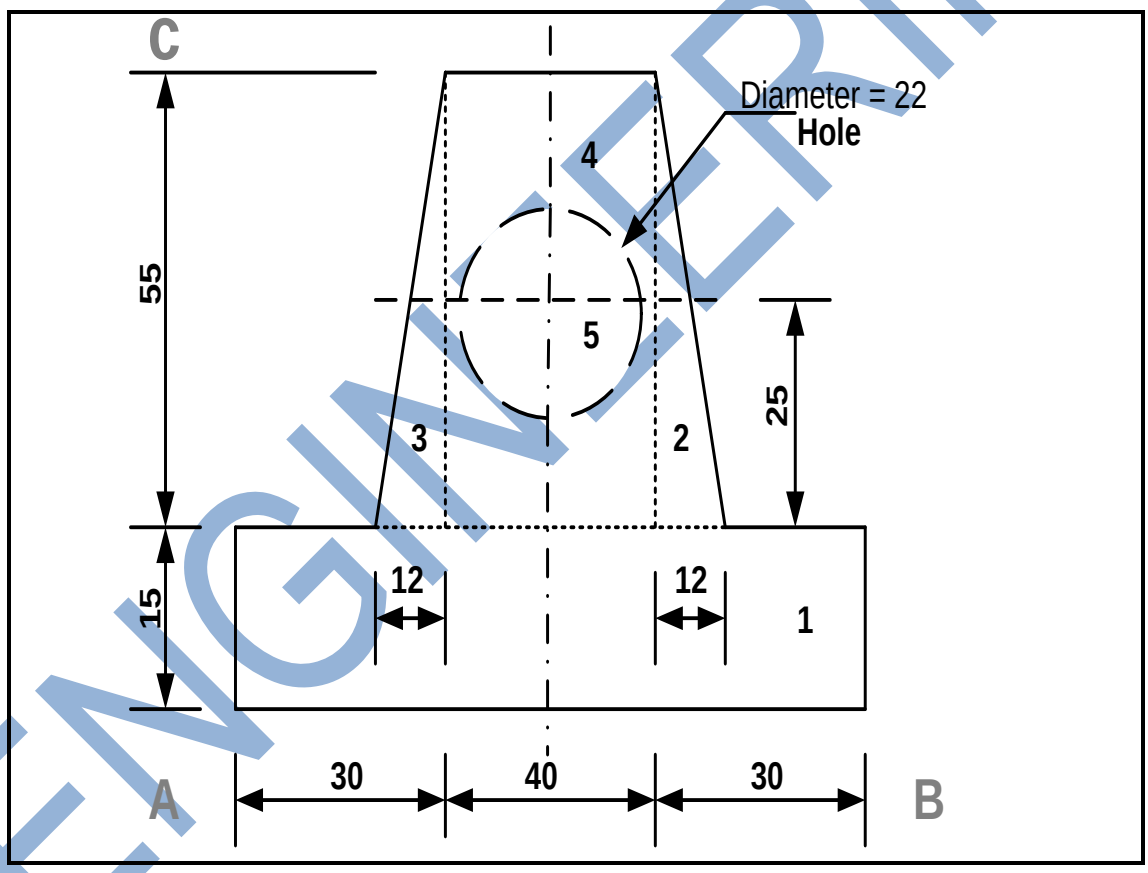

FIGURE 2

DIAGRAM SHEET 2

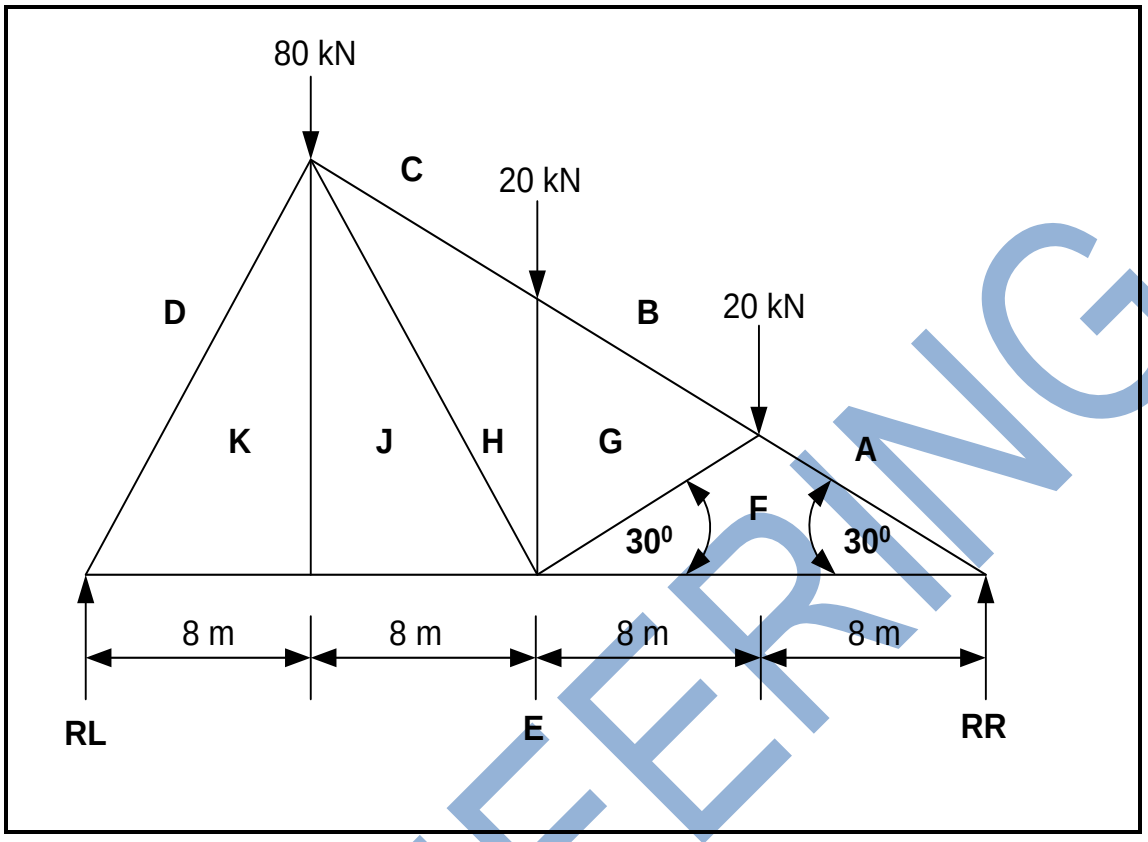

FIGURE 3

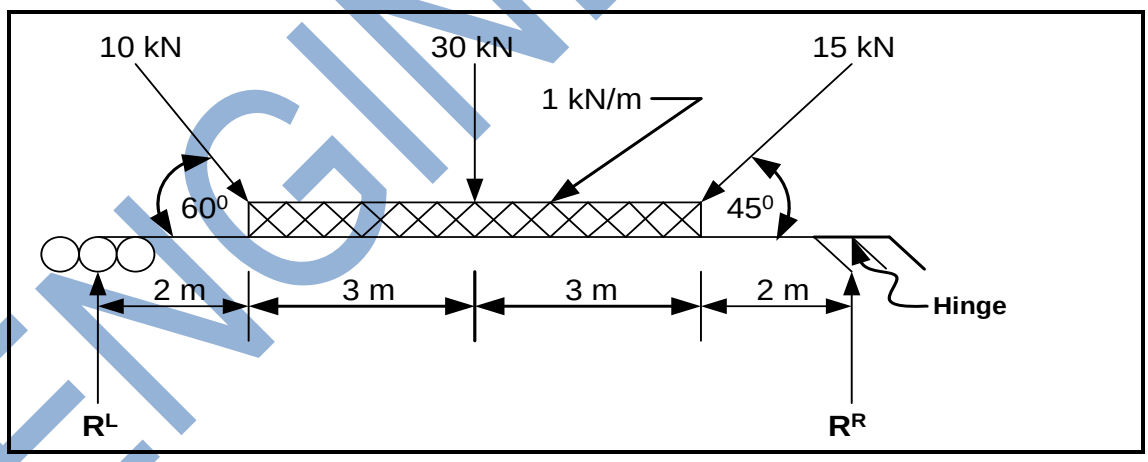

FIGURE 4

FORMULA SHEET

Any applicable formula may also be used.

1. $F = m \times g$
2. $A = \frac{\pi D^2}{4}$
3. $F\mu = \mu \times W$
4. $\mu = \tan \phi$
5. Comp. $* = W \sin \phi$

   Komp. $* = W \sin \phi$
6. Comp. $\zeta = W \cos \phi$

   Komp. $\zeta = W \cos \phi$
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. $v = u \pm 2as$
12. $v = u^2 \pm at$
13. $M = m\_ \times v$
14. $m \times u = m \times v$
15. $VR = \frac{Effort\ distance}{Load\ distance}$

    $SV = \frac{Magafstand}{Lasafstand}$
16. $MA = \frac{Load}{Effort}$

    $HV = \frac{Las}{Mag}$
17. $n = \frac{HV}{SV} \times 100$
18. $V = I \times R$
19. $R_T = R_1 + R_2 + R_3$
20. $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
21. $P = V \times I$
22. $W = P \times t$
23. $AV = F \times S$

    $WD = F \times S$
24. $MOM = F \times \zeta S$
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. $\bar{x} = \frac{4r}{3}$
30. $\bar{x} = \frac{1}{3}h$
31. $R = \sqrt{HK^2 + VK^2}$

    $R = \sqrt{HC^2 + VC^2}$
32. $\text{TAN}\,\phi = \frac{VC}{HC} / \frac{VK}{HK}$
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