higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

BUILDING SCIENCE N3

(15070023)

20 August 2021 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 6 pages and 1 formula sheet.

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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. Round off intermediate and final calculations to TWO decimal places.
5. Start each question on a new page.
6. Use only a black or blue pen.
7. Take acceleration due to gravity, $g = 9.81\ m/s^2$
8. Write neatly and legibly.

QUESTION 1

Briefly describe how a concrete slump test is carried out. **[10]**

QUESTION 2

2.1 Determine analytically the magnitude of reactions at the supports for a beam loaded as shown in **FIGURE 1** below. (4)

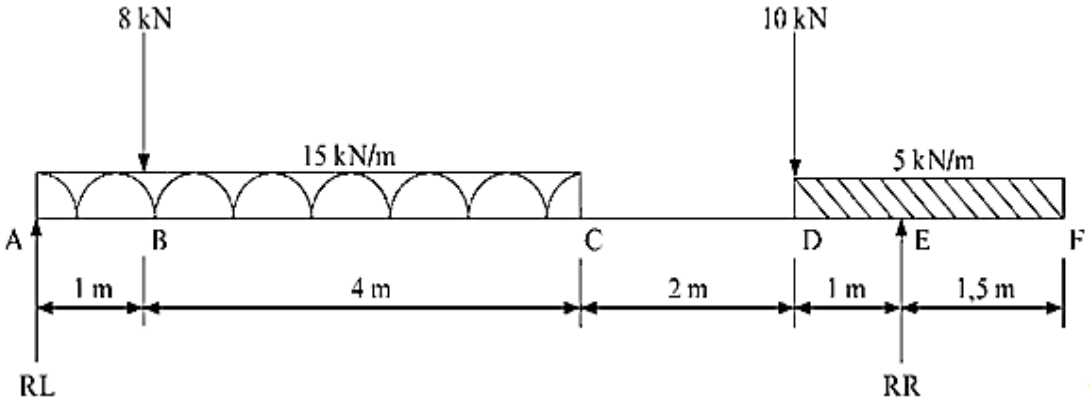

FIGURE 1

2.2 Draw a shearing-force diagram to a suitable linear and force scale. (8)

2.3 Draw a bending-moment diagram to a suitable linear and moment scale. (8)
[20]

QUESTION 3

3.1 A simply supported truss is loaded as shown in FIGURE 2 below.

Determine the magnitude of reactions RL and RR. (4)

3.2 Draw a vector diagram to determine the magnitude and nature of all member forces tabulated in TABLE 1 below. (16)

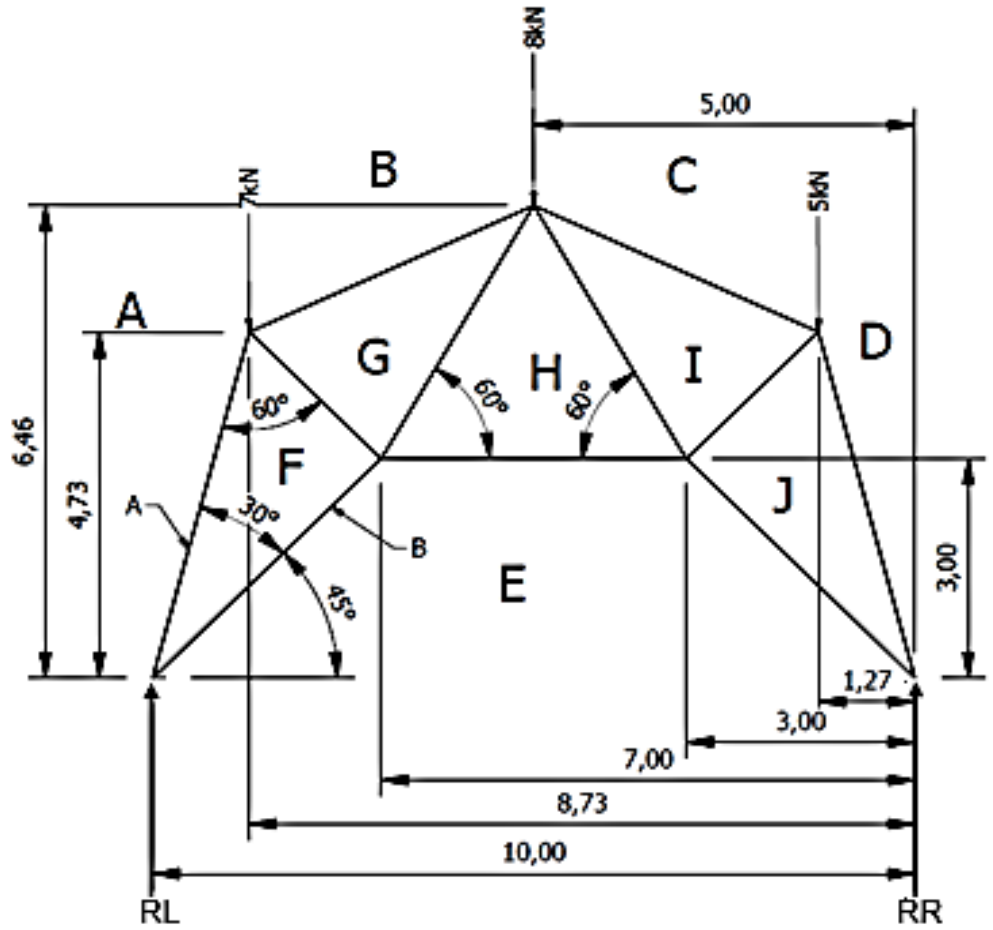

FIGURE 2

MEMBER	MAGNITUDE	NATURE
AF		
BG		
CI		
DJ		
EJ		
EH		
EF		
FG		
GH		
HI		
IJ		

TABLE 1 **[20]**

QUESTION 4

4.1 State TWO methods used to determine the centroid of a plane lamina. (2)

4.2 FIGURE 3 (below) shows a plane lamina, for which the centroid is to be calculated. Do the necessary calculation to determine the position of the centroid with respect to side AB and AC. All measurements are in millimetres. The hole centre is 300 mm from the bottom of shape D and 1 100 mm from the left edge of shape A.

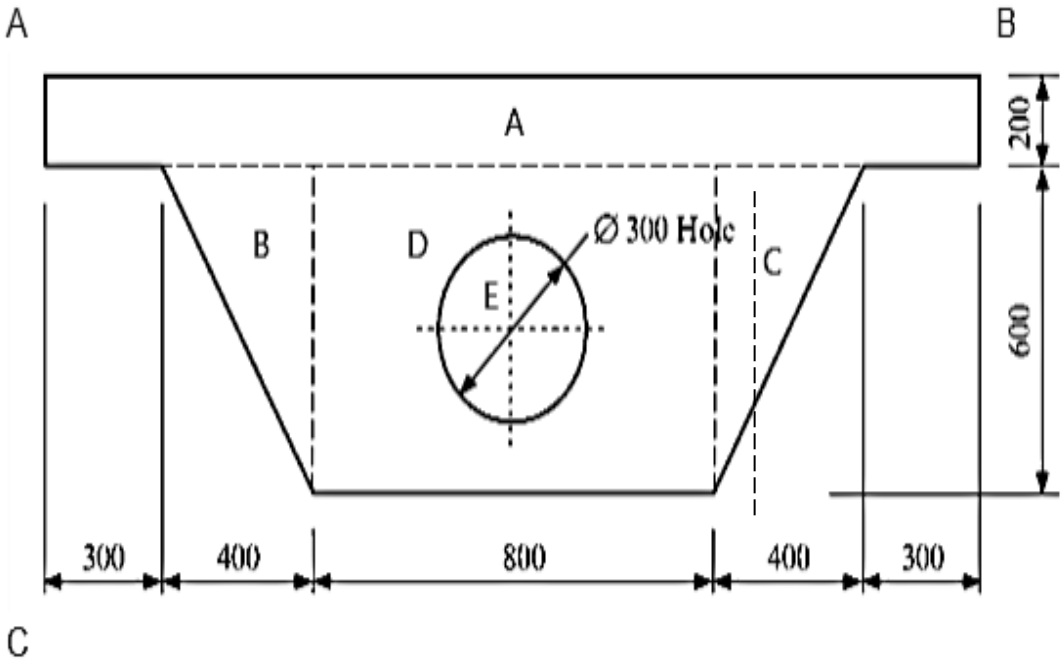

FIGURE 3

(18)
[20]

QUESTION 5

Practical applications for simple machines are found daily. One such application is on a winch for a mine shaft used to bring ore to the ground on a mine in Rustenburg. The winch has the following dimensions for its wheel and axle:

- Wheel diameter – 400 mm
- Axle diameter – 55mm
- A mass of 50 kg should be lifted assuming an efficiency of 94%.

Calculate the following:

5.1 The velocity ratio

5.2 Effort

5.3 Mechanical advantage

(3 × 3) **[9]**

QUESTION 6

The legs of a tripod are 8 m long, and the lower-end feet are at the same level, forming an equilateral triangle with 6 m sides.

Determine graphically the forces acting on each leg due to a 10 kN load suspended from the apex of the tripod. **[11]**

QUESTION 7

7.1 State FOUR good electricity conductors. (4)

7.2 Name TWO types of circuit breakers. (2)

7..3 State TWO good insulators of electricity. (2)

7.4 A bulb is marked 60W 220V.

What current does it draw? (2)
[10]

TOTAL: 100

BUILDING SCIENCE N3

FORMULA SHEET

Any applicable formula may 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. $s = ut + ½at^2$
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. $A = ½\ bh\ /\ ½ab\sin C$
28. $A = 4\pi r^2$
29. $\bar{x} = \frac{4r}{3\pi}$
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

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