higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**NATIONAL CERTIFICATE**

# BUILDING SCIENCE N3

(15070023)

**23 November (X-paper)**
**09:00–12:00**

**Drawing instruments and nonprogrammable calculators may be used.**

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

062Q1E2323

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# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
BUILDING SCIENCE N3
TIME: 3 HOURS
MARKS: 100

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**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. Intermediate and final calculations are to be rounded off to 2 decimal places.
5. Start each section on a new page.
6. Assume that acceleration due to gravity $g$, is 9.81 m/s$^2$
7. Use only a black or a blue pen.
8. Write neatly and legibly.

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## QUESTION 1

1.1 What is the purpose of a slump test? (1)

1.2 Define *initial drying shrinkage* with reference to wet concrete. (1)

1.3 FIGURE E below shows a slump cone and tamping rod. Write the correct dimensions for each next to the letters (a–d) in the ANSWER BOOK. (4)

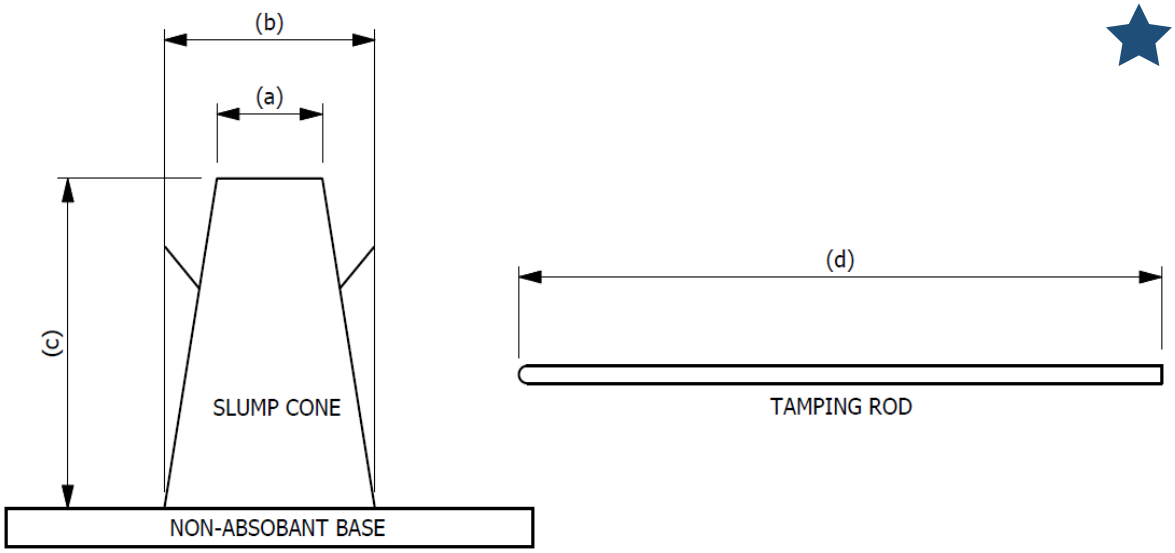


**FIGURE E**

1.4 The FIGURES below shows paint defects. Identity each defect and write only the answer next to the letter (A–D) in your ANSWER BOOK. (4)



A



B



C



D

**[10]**

## QUESTION 2

A beam, ABCDE, with A on the left-hand side and point E on the righthand side, is 10 m long and simply supported at A and D. A point load of 50 kN is exerted at point B which is 2 m from point A and a point load of 30 kN is exerted at point E which is 2 m from point D. Point C is 3 m from point B.

An evenly distributed load of 2 kN/m is exerted from point A to D.

2.1 First draw the beam, then calculate the reaction forces at A and D. (5)

2.2 Calculate the bending moments at B and D and at a point C, halfway between B and D. (3)

2.3 Draw the bending moment and shearing force diagrams with the main values indicated on the diagram. (7)

**[15]**

## QUESTION 3

3.1 A frame structure is loaded as shown in FIGURE 2 below.

3.1.1 Calculate the magnitude of reaction at the left-hand support.

3.1.2 Calculate the reaction at the right-hand support.

3.1.3 Re-draw the space diagram.

(3 × 2) (6)

3.2 Graphically determine the magnitude and nature of all member forces. Use scale 25 mm = 1 KN for the vector diagram. (14)

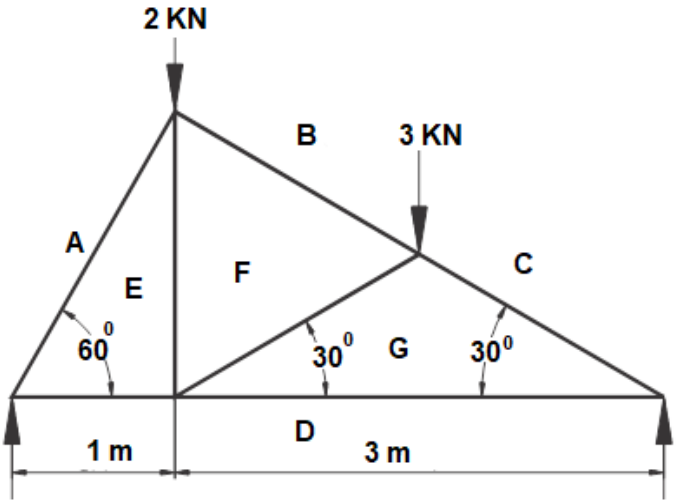


**FIGURE 2**

| MEMBER | MAGNITUDE | NATURE |
|---|---|---|
| AE | | |
| BF | | |
| CE | | |
| DE | | |
| DG | | |
| FG | | |
| EF | | |

**[20]**

## QUESTION 4

FIGURE 3 below shows a plane laminar for which the centroid is to be calculated. Do the necessary calculations to determine the position of the centroid with respect to side AB and AC. Section 1,2,3, is equal to section 4,5,6.

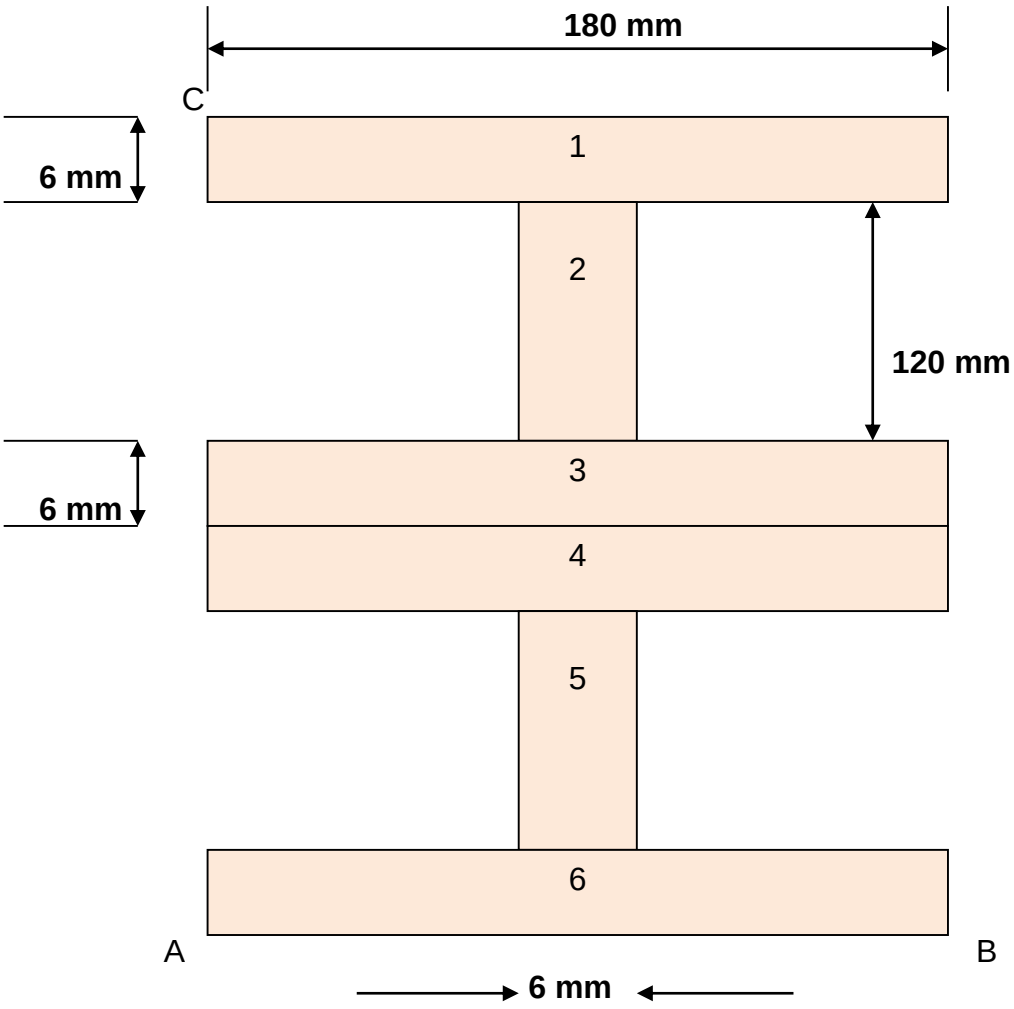


**FIGURE 3**

**[21]**

## QUESTION 5

The coefficient of friction between the surfaces is given as 0,5 where an object with a mass of 33 kg is at rest on an inclined plane 30° to the horizontal.

Calculate the following:

5.1 The component of the weight of the block parallel to the plane (2)

5.2 The component of the weight of the block perpendicular to the plane (2)

5.3 The frictional force (3)

5.4 The smallest parallel force to the plane required to move the object down the plane. (2)

5.5 The smallest parallel force to the plane required to move the body up the plane. (3)

**[12]**

## QUESTION 6

6.1 Explain how the following electrical safety devices provide protection to electrical circuits and/or devices:

6.1.1 MCB

6.1.2 Fuse

(2 × 2) (4)

6.2 State FOUR requirements for the placing of a distribution board in a building. (4)

6.3 Explain the difference between *direct current* and *alternating current*. (2)

**[10]**

## QUESTION 7

A pair of shear legs has legs 8 m long with the bottom ends 5 m apart. The backstay is 14 m long. A load of 50 kN is suspended from the apex with the overhang being 3,5 m.

Graphically determine the force in the back stay and in each of the legs. **[12]**

**TOTAL: 100**

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## FORMULA SHEET

Any other 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. $\bar{x} = \frac{4r}{3\pi}$
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

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