higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N1

(15070391)

24 November 2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 12 pages and 1 formula sheet.

201Q1E2224

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ENGINEERING SCIENCE N1
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 section on a new page.
5. Round off answers to THREE decimal places where applicable.
6. All calculations must have the following three steps:
    - The formula
    - The replacement of values
    - The answer and correct SI unit
7. Take gravitational acceleration (g) as 9,8 $m.s^{-2}$.
8. Use only a black or blue pen.
9. Make sketches neatly and in pencil.
10. Write neatly and legibly.

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SECTION A

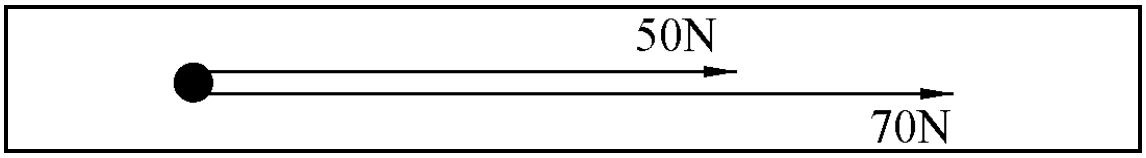
QUESTION 1

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.5 in the ANSWER BOOK.

1.1 Which of ONE the following is not a scalar quantity?

A Velocity
B Potential energy
C Work
D Kinetic energy

1.2 What is the magnitude of the resultant of the vectors shown below?



A 20 N
B 120 N
C 350 N
D -20 N

1.3 Which unit is used for measuring electrical current?

A Electrode
B Volt
C Discharge
D Ampere

1.4 What is the work done by gravity if a 50 kg block is pushed along a 40 m track?

A 392 J
B 0 J
C 490 J
D 2000 J

1.5 The way heat moves from hot coffee to cold milk is called ...

A convection.
B radiation.
C insulation.
D conduction.

(5 × 1) **[5]**

QUESTION 2

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1–2.5) in the ANSWER BOOK.

2.1 The force of gravity acts only while objects are moving downwards.

2.2 An electron is the smallest part of an element.

2.3 Displacement gives the shortest distance between the initial and final positions of an object.

2.4 An insulator conducts electricity very well.

2.5 Alternating current keeps on switching direction.

(5 × 1) **[5]**

QUESTION 3

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–H) next to the question number (3.1–3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1	Force with which the earth attracts an object	A	molecule
3.2	Resisting power of a specified material	B	temperature
3.3	Smallest part into which a substance can be divided without changing its identity	C	work
3.4	Degree of hotness or coldness of a body	D	mass
3.5	Force moving something through a distance	E	resistivity
		F	weight
		G	heat
		H	resistance

(5 × 1) **[5]**

QUESTION 4

Choose ONE term from the list below for each of the following descriptions and write it next to the question number (4.1–4.5) in the ANSWER BOOK.

kinetic energy; resultant; speed; Joule's law; potential energy; force; specific heat capacity; velocity; Ohm's law; heat capacity

4.1 Influence which, when applied to a body, will change or tend to change the state of rest or uniform motion in a straight line

4.2 Rate of change of displacement

4.3 Heat generated in an electrical circuit, proportional to the square of the current, the resistance, and the time the current flows

4.4 Amount of heat energy required to raise the temperature of 1 kg with 1 °C

4.5 Energy a body possesses due to its motion

(5 × 1) **[5]**

TOTAL SECTION A: 20

SECTION B

QUESTION 5

5.1 FIGURE 1 shows the route Peter must take from his house to the café.

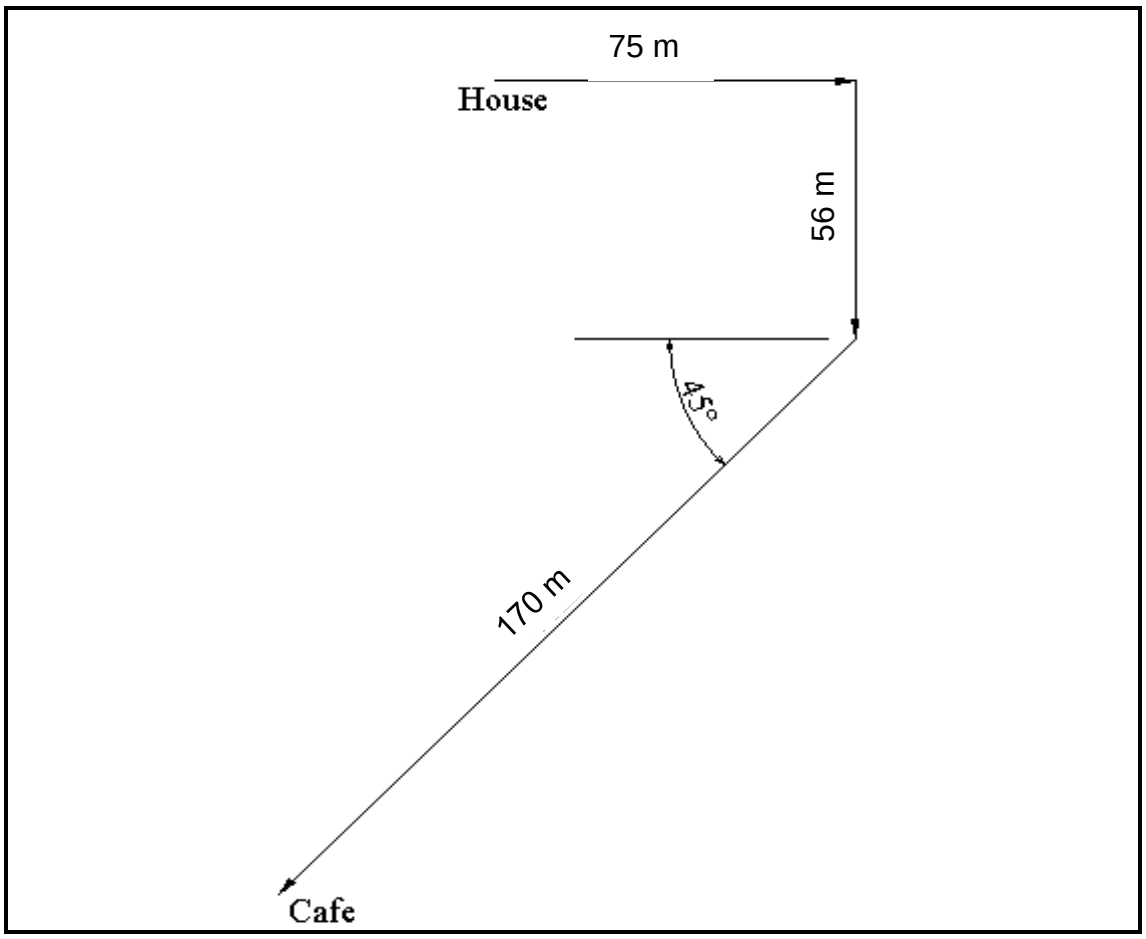


FIGURE 1

Determine:

5.1.1 The distance from the house to the café (2)

5.1.2 The displacement from the house to the café (3)

5.2 Danny drops a rock from the edge of a cliff. It takes 4 seconds for the rock to hit the bottom of the cliff.

5.2.1 Draw a neat, labelled velocity/time graph of the movement of the rock.

HINT: Use scale 9,8 m/s = 10 mm and 1 second = 20 mm (3)

5.2.2 Use the graph to determine the slope of the graph. (1)
[9]

QUESTION 6

6.1 FIGURE 2 shows a shop sign that is suspended by two ropes.

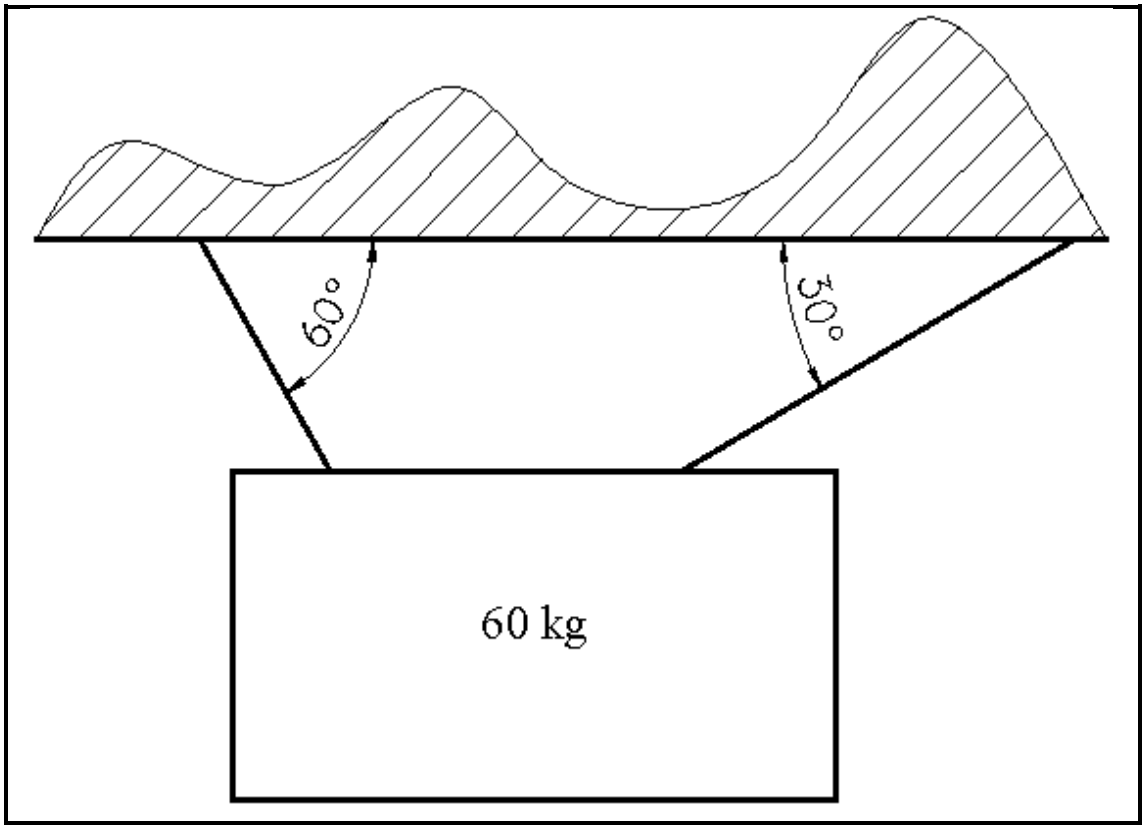


FIGURE 2

6.1.1 Draw, not to scale, a space diagram of the sign and the two ropes. (2)

6.1.2 Use the triangle of forces method to determine the unknown forces in the ropes. (3)

6.2 FIGURE 3 shows two forces (X and Z) that are working in on a body and balanced by a third force (E).

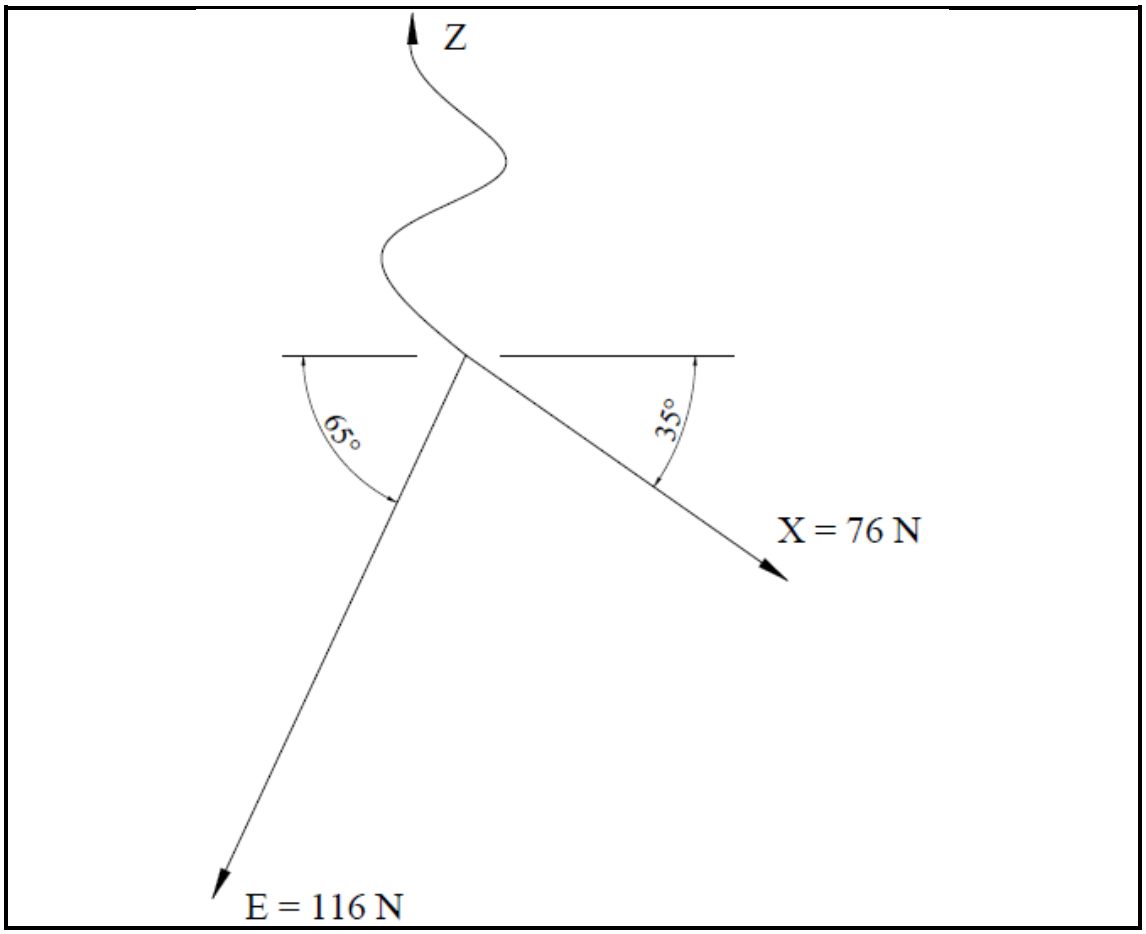


FIGURE 3

Determine the value of the unknown force Z by using the parallelogram of forces method. (3)

6.3 A wheel-and-axle lifting machine is used to lift a load of 1 560 N. The diameter of the wheel is 320 mm and the diameter of the axle is 64 mm. The effort needed to lift the load is 390 N.

6.3.1 Draw a neat, labelled sketch of the wheel-and-axle lifting machine. (3)

6.3.2 Calculate the mechanical advantage of the machine. (2)

6.3.3 Calculate the velocity ratio of the machine. (2)

6.4 A torque spanner with a length of 650 mm is used to tighten a nut. The nut needs to be torqued to a value 494 Nm.

Calculate the force needed to torque the nut. (2)
[17]

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QUESTION 7

7.1 A crane hoists a mass of 250 kg vertically upwards to a height of 15 m.

7.1.1 Draw a neat, labelled force/displacement graph of the movement.

HINT: Use a scale of 1 000 N = 3 cm and 1 m = 1 cm (3)

7.1.2 Calculate the work done from the graph. (2)

7.2 A motor vehicle travels at a constant speed of 100 km/h. To keep the speed constant, a force of 2,85 kN must be applied.

Calculate:

7.2.1 The speed of the vehicle in m/s (1)

7.2.2 The power to maintain the speed (2)

[8]

QUESTION 8

8.1 Give TWO advantages of a mercury thermometer. (2)

8.2 A kettle contains 2,75 kg of water at a temperature of 22 °C. In Johannesburg the water boils at 91 °C and the specific heat capacity of water is 4 187 J/kg °C.

8.2.1 Calculate the difference in temperature. (1)

8.2.2 Calculate the heat energy required for the temperature increase. (2)

8.3 Explain the working principle of a bimetallic strip. (2)

8.4 An aluminium conductor has a length of 135 m at a temperature of 18 °C. The temperature rises to 36 °C. The length of the cable is increased by 12,6 mm.

8.4.1 Calculate the difference in temperature. (1)

8.4.2 Calculate the final length of cable in meters. (2)

8.5 Explain the working principle of a thermocouple. (2)

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8.6 Explain how heat is propagated in each of the following materials:

8.6.1 Steel

8.6.2 Water

(2 × 1) (2)

8.7 Give ONE example of each of the following effects that heat can have on different materials:

8.7.1 Change in colour

8.7.2 Change in phase

(2 × 1) (2)

[16]

QUESTION 9

9.1 Explain the movement of matter particles in each of the following phases of matter:

9.1.1 Gas phase

9.1.2 Solid phase

(2 × 1) (2)

9.2 Give ONE term for each of the following descriptions by writing it next to the question number (9.2.1–9.2.2) in the ANSWER BOOK.

9.2.1 Smallest part of an element

9.2.2 Smallest part of a substance

(2 × 1) (2)

9.3 Draw a neat, labelled sketch of an atom. (4)

9.4 Write down the charges of each of the following parts of an atom:

9.4.1 Electron

9.4.2 Proton

(2 × 1) (2)

[10]

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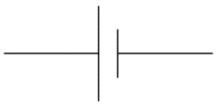
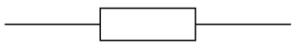
QUESTION 10

10.1 Identify each of the following IEC circuit symbols:

10.1.1 

10.1.2 

10.1.3 

(3 × 1) (3)

10.2 FIGURE 4 shows three resistors connected in parallel over a 12 V power supply.

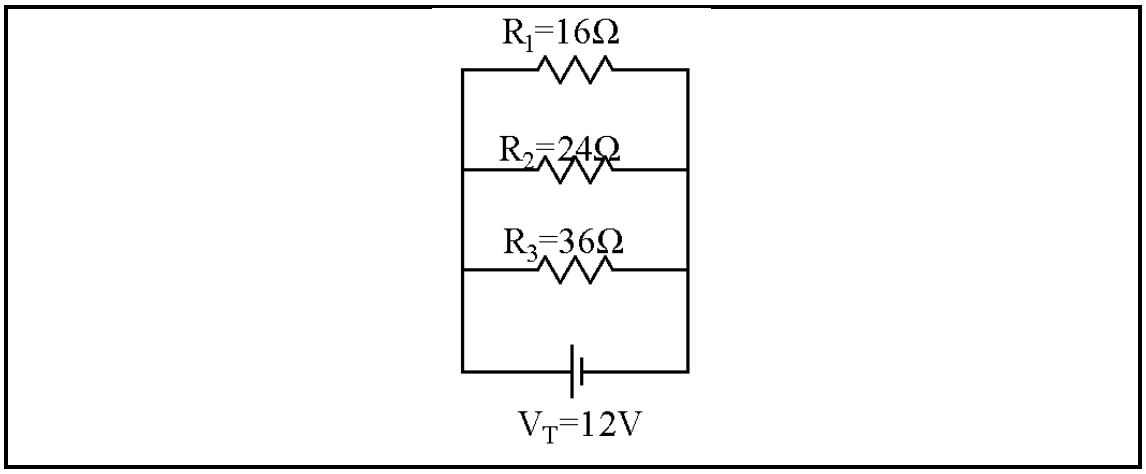


FIGURE 4

10.2.1 Calculate the total resistance of the circuit. (2)

10.2.2 Calculate the total current of the circuit. (2)

10.3 What will happen to the resistance of each of the following materials if the temperature is reduced?

10.3.1 Insulators like PVC

10.3.2 Alloys like Berlin silver

(2 × 1) (2)

10.4 List THREE factors that determine the resistance of a material. (3)

10.5 A steam iron is connected to a 220 V supply.

If a current of 12 A is flowing through the steam iron, calculate the amount of heat energy generated in 6 minutes. (2)

10.6 Draw a neat, labelled sketch of the magnetic field around a current-carrying conductor. (3)

10.7 The following is printed on an electrical kettle:

1 200 W; 230 V

Calculate the current flowing through the kettle. (2)

10.8 Give ONE practical application for an electromagnet. (1)
[20]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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FORMULA SHEET

Any applicable formula may also be used.

1. $v = \frac{s}{t}$
2. $F = m.g$
3. $DR = \frac{E_{dist.}}{L_{dist.}}$ $VV = \frac{M_{afst.}}{L_{afst.}}$
4. $MA = \frac{L}{E}$ $HV = \frac{L}{M}$
5. $VR = \frac{D}{d}$ $SV = \frac{D}{d}$
6. $Moment = F.s$
7. $T = F.R$
8. $W = F.S$
9. $P = \frac{W}{t}$
10. $P = F.v$
11. $Q = m.c.\Delta t$
12. $L_f = L_o + \Delta L$
13. $L_f = L_o - \Delta L$
14. $P = V.I$
15. $P = I^2.R$
16. $P = \frac{V^2}{R}$
17. $Q = P.t$
18. $I = \frac{V}{R}$
19. $R_t = R_1 + R_2 \ldots$
20. $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} \ldots$

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