higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N1

(15070391)

1 December 2023 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 7 pages and 1 formula sheet.

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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. Start each section on a new page.
3. Read all the questions carefully.
4. Number the answers according to the numbering system used in this question paper.
5. Answers to calculations must be given correctly to three decimal places after the comma.
6. All calculations must include the following three steps:

   1: The formula.
   2: The replacement of values.
   3: The answer and correct SI-unit.

7. Gravitational acceleration (g) should be taken as 9.8 m.s-2.
8. Use only a black or blue pen.
9. Write neatly and legibly.

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QUESTION 1: DYNAMICS

1.1 Classify the following as a vector or a scalar:

1.1.1 Money

1.1.2 10 girls

1.1.3 50 Newton east

1.1.4 120 km/h north

(4 × 1) (4)

1.2 A bus travels from bus stop A in a NW direction for 3,3 km to reach bus stop B. It travels another 2,1 km in the same direction to reach bus stop C. It still travels in the same direction for another 1 km to reach bus stop D.

Determine the total distance and direction of the bus from stop A to stop D. (Do not use a drawing.) (2)

1.3 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

1.3.1 A scalar is a physical quantity with magnitude and direction.

1.3.2 The mass of an object is the amount of matter that an object contains and is independent upon its gravitational field.

1.3.3 Mass is the amount of matter that a body consists of.

1.3.4 Distance can be defined as the true route that an object travels.

1.3.5 Velocity is the rate of change of displacement.

(5 × 1) (5)

1.4 A man travels 90 km in 1 hour.

Calculate the man's average speed. (2)

1.5 A rock with a mass of 4,2 kg falls from a building.

Calculate the force with which the rock hits the ground. (1)

[14]

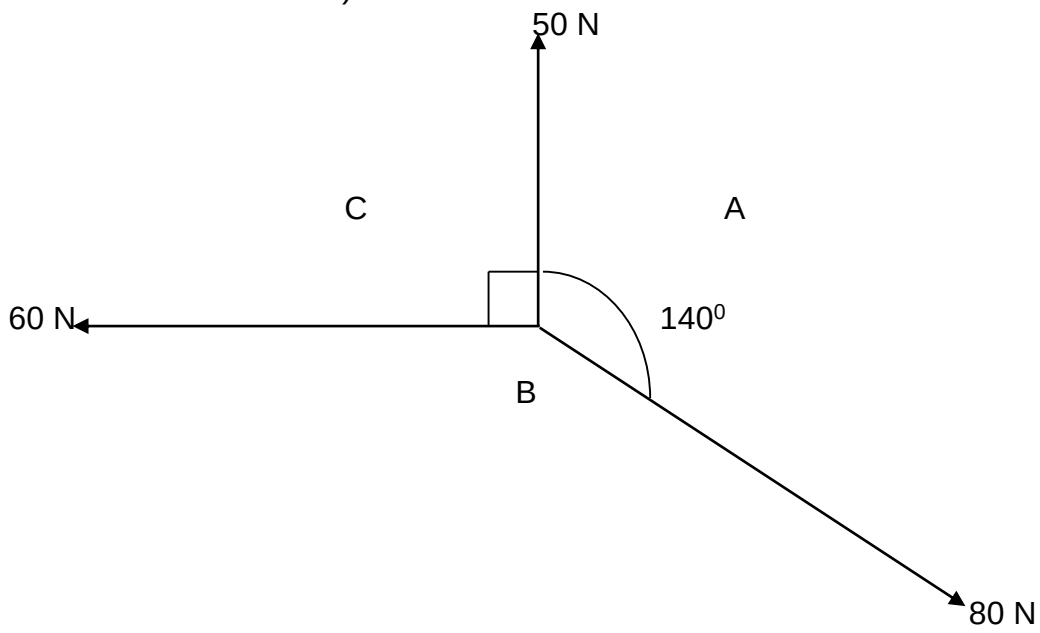
QUESTION 2: STATICS

2.1 Define the term, *triangle of forces*. (2)

2.2 Define the term, *torque* (2)

2.3 Use Bow's notation to draw and label the triangle of forces of the THREE forces shown in the following diagram:

(Use a scale of 10 N = 1 cm)



(3)

2.4 A bolt is tightened using a spanner of 400 mm long. A force of 50 N is applied to the end of the spanner.

Calculate the torque at which the bolt is fastened. (2)

2.5 A lever is used to lift a motorcar engine with a mass of 230 kg through a height of 330 mm. An effort of 445 N is applied at the other end of the lever and moves through a distance of 4 m.

Calculate the following:

2.5.1 Mechanical advantage of the lever.

2.5.2 Velocity ratio of the lever.

(2 × 2) (4)

2.6 Define the *law of moments*. (2)

[15]

QUESTION 3: ENERGY, WORK AND POWER

3.1 What can be defined as the rate of doing work? (1)

3.2 Name TWO conditions that must be fulfilled before we can say that work is done. (2)

3.3 Define the term, *energy*. (1)

3.4 Define the term, *power*. (1)

3.5 A mine shaft is 250 m deep. A hoist cage weighing 4 400 kg is hoisted up from the bottom to the surface in 6 minutes.

Calculate the following:

3.5.1 Work done (3)

3.5.2 Power of the hoist motor (2)

3.6 Give FOUR examples of kinetic energy. (4)

[14]

QUESTION 4: HEAT

4.1 A few ice cubes are put in a warm cup of coffee for a few minutes.

In your own words explain what will happen with the temperature of the cup of coffee and the temperature of the ice. (2)

4.2 Describe the operation of a thermocouple. (2)

4.3 Draw a neat, labelled sketch of a mercury thermometer. (3)

4.4 A steel pipe with a mass of 5 kg is heated from a temperature of -2 °C to 35 °C. The specific heat capacity of steel is 486 J/kg °C.

Calculate the heat energy required to raise the temperature of the steel pipe from -2 °C to 35 °C. (2)

4.5 A water pipe has a length of 22 m at a temperature of 2 °C. The temperature of the water rises to 95 °C. The length of the pipe increases by 30 mm.

4.5.1 Calculate the change in temperature

4.5.2 Calculate the final length

(2 × 2) (4)

4.6 Name THREE advantages of a mercury thermometer (3)

4.7 Define the term, *specific heat capacity*. (2)

[18]

QUESTION 5: PARTICLE STRUCTURE OF MATTER

5.1 Complete the following paragraph by using the words provided in the list below. Write only the word or words next to the question number (5.1.1–5.1.3) in the ANSWER BOOK

melting; solidifying; condensation; evaporation; gas; solid; liquid

When a gas (vapour) is cooled down, it changes to a liquid and the process is called (5.1.1) … .

When heat is added to a solid, it changes to (5.1.2) … and the process is called (5.1.3) … . (3)

5.2 Define the term, *molecule*. (1)

5.3 Name THREE properties of a gas. (3)

5.4 Define the term, *ion*. (1)

5.5 Particles are arranged in different phases of matter. Describe the arrangement of particles in the three different phases. (3)

5.6 Make a neat, labelled sketch of an atom. (3)
[14]

QUESTION 6: ELECTRICITY

6.1 State Ohm's law. (2)

6.2 Define the term, insulator. (2)

6.3 Define the term, conductor. (2)

6.4 THREE resistors of 6 Ω, 7 Ω and 8 Ω respectively are connected in series with a battery of 12 V.

Calculate the following:

6.4.1 Total resistance of the circuit (2)

6.4.2 Total current of the circuit (2)

6.4.3 Total power of the circuit (2)

6.4.4 Voltage drop across the 6 Ω resistor (2)

6.4.5 Voltage drop across the 7 Ω resistor (2)

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6.4.6 Voltage drop across the 8 Ω resistor (2)

6.4.7 The heat energy developed in the 8 Ω resistor in 2 minutes (3)

6.5 Name TWO factors that will influence the heat effect of an electric current. (2)

6.6 Describe the influence of a change in temperature on the resistance of a metal like silver or gold. (2)

[25]

TOTAL: 100

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ENGINEERING SCIENCE N1

FORMULA SHEET

Any applicable formula can be used.

1.	$v = \frac{s}{t}$
2.	$F = m.g$
3.	$VV = \frac{M_{afst}}{L_{afst}}$ $DR = \frac{E_{dist}}{L_{dist}}$
4.	$HV = \frac{L}{M}$ $MA = \frac{L}{E}$
5.	$SV = \frac{D}{d}$ $VR = \frac{D}{d}$
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.	$I = \frac{V}{R}$
15.	$R_t = R_1 + R_2 + \ldots$
16.	$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$
17.	$Heat = I^2.R.t$
18.	$P = V.I$
19.	$P = \frac{V^2}{R}$
20.	$P = I^2.R$

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