higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T620(**E**)(M29)T

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N1

(15070391)

29 March 2018 (X-Paper)
09:00–12:00

This question paper consists of 10 pages and 1 formula sheet.

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. Answers must be rounded off to THREE decimal places.
5. ALL calculation must have the following three steps:
   - 5.1 Formula
   - 5.2 Replacement of values
   - 5.3 Answer and correct SI-unit
6. Gravitational acceleration (g) should be taken as 9,8 $m.s^{-2}$.
7. Sketches must be neatly done in pencil.
8. Write neatly and legibly.

SECTION A

QUESTION 1

1.1 Choose a description from COLUMN B that matches a term in COLUMN A. Write only the letter (A–F) next to the question number (1.1.1–1.1.6) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1	Potential energy	A	quantity of matter of which a body consists
1.1.2	Mass	B	physical quantity that has only a magnitude
1.1.3.	Vector	C	energy of a body due to gravity and its relative position with respect to a reverence plane
1.1.4	Weight	D	physical quantity that has magnitude and direction
1.1.5	Scalar	E	energy of a body resulting in its motion
1.1.6	Kinetic energy	F	force with which the earth attracts a body

(6 × 1) (6)

1.2 Give ONE word for each of the following descriptions by choosing a term from the list below. Write only the term next to the question number (1.2.1–1.2.4) in the ANSWER BOOK.

temperature; heat; specific heat capacity; matter; atom; electron

1.2.1 Anything that occupies space and has mass

1.2.2 The smallest part of an element

1.2.3 A form of energy

1.2.4 The amount of heat required to change the temperature of an object

(4 × 1) (4)

1.3 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

1.3.1 Temperature is a scalar.

1.3.2 An equilibrant can replace two or more forces and have the same effect on a body.

1.3.3 Mechanical advantage is the ratio between the load moved and the effort applied.

1.3.4 A molecule is the smallest part of an element.

1.3.5 An insulator allows the flow of an electrical current.

(5 × 1) (5)

1.4 Choose the correct symbol for each of the components below. Write only the letter (A–D) next to the question number (1.4.1–1.4.5) in the ANSWER BOOK.

1.4.1 Variable resistor:

A 

B 

C 

D 

1.4.2 Battery:

A 

B 

C 

D 

1.4.3 Resistor:

A 

B 

C 

D 

1.4.4 Galvanometer:

A 

B 

C 

D 

1.4.5 Ammeter:

A 

B 

C 

D 

(5 x 1) (5)
[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2: DYNAMICS

2.1 A ship travels at 68 $m.s^{-1}$ in a southerly direction. A man walks at a velocity of 6 $m.s^{-1}$ from the back to the front of the ship.

Determine the man's resultant velocity. (2)

2.2 A rock falling from a height of 32 m takes 2,5 seconds to hit the ground.

2.2.1 Draw a displacement/time graph of the falling object.

(**HINT**: Use scale 3 cm = 1 s and 1cm = 4 m) (2)

Determine the following from the graph:

2.2.2 Gradient of the graph (1)

2.2.3 Velocity with which the rock hits the ground (1)

2.3 A car travels 52 km due west, then 185 km S 45°W, then 68 km due south.

Graphically determine the displacement from the starting point to the ending point.

(**HINT**: Use scale 10 km = 10 cm) (3)
[9]

QUESTION 3: STATICS

3.1 Determine, with the aid of the parallelogram method, the magnitude and direction of the resultant of the forces in FIGURE 1.

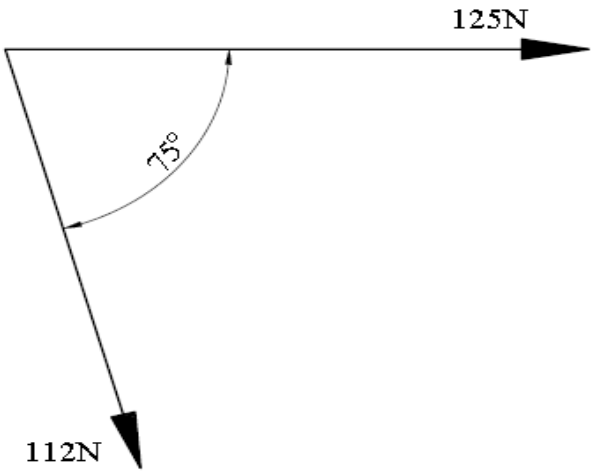

FIGURE 1

(**HINT**: Use scale 1cm = 10 N) (3)

3.2 A lever is used to lift a load of 320 kg. The effort applied is 210 N and it moves through a distance of 1,74 m. The load moves 345 mm.

Determine the following:

3.2.1 Mechanical advantage

3.2.2 Displacement ratio

(2 × 2) (4)

3.3 Draw a neat, labelled sketch of a single-rope pulley system with three pulleys in the upper block and two pulleys in the lower block. (3)

3.4 Determine the value of the perpendicular force P that will produce equilibrium in the system in FIGURE 2.

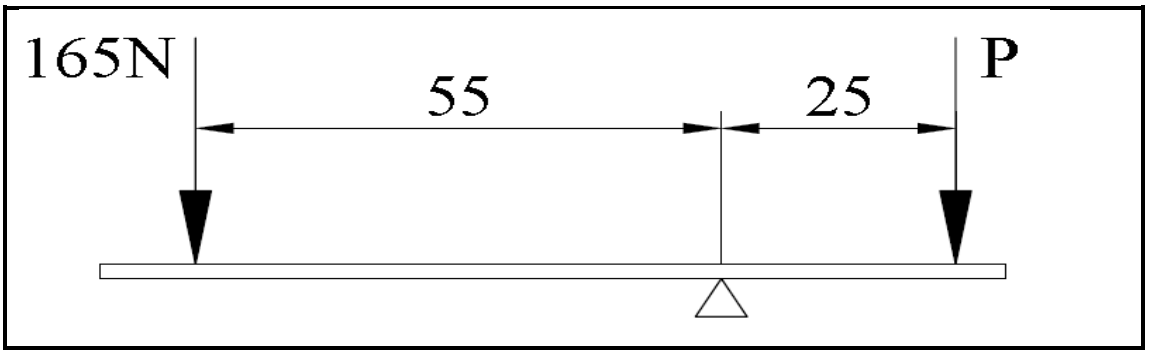

FIGURE 2 (2)

3.5 Two fishermen are pulling a boat out of the water. Fisherman A pulls with a force of 620 N and fisherman B with a force of 530 N. The angle between the ropes which they use is 45°.

Determine the magnitude and direction of the resultant force of the two men.

(**HINT**: Use a scale 10 mm = 20 N) (3)

3.6 What is meant by a *triangle of forces*? (1)
[16]

QUESTION 4: ENERGY WORK AND POWER

4.1 A vehicle moves at 110 km/h with the aid of a 62 kW engine.

Calculate each of the following:

4.1.1 Force applied on the vehicle by the engine

4.1.2 Displacement that the vehicle undergoes in the first 18 seconds

(2 × 2) (4)

4.2 A body with a mass of 47 kg is lifted vertically through a height of 4,6 m.

4.2.1 Draw a force/displacement graph

(**HINT**: Use scale 1 cm = 50 N and 2 cm = 1 m) (3)

Determine from the graph the work done by doing the following:

4.2.2 Lifting the body to the top

4.2.3 Lifting the body for the first 1,5 m

(2 × 2) (4)
[11]

QUESTION 5: HEAT

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

5.2 A steam pipe has a length of 1959 m at a temperature of 23°. Wet steam at a temperature of 185 °C flows through the pipe and the pipe expands to a length of 2001,695 m.

Calculate each of the following:

5.2.1 Increase in length (Δℓ)

5.2.2 The change in temperature (Δt) (2 × 1) (2)

5.3 Explain the difference between *heat capacity* and *specific heat capacity.* (2)

5.4 Name the THREE factors that influence the linear expansion of substances. (3)

5.5 Name TWO effects of heat on substances. (2)

5.6 75,6 kJ heat energy is absorbed by a copper cylinder which has a mass of 1,85 kg. The initial temperature was 21°C and the specific heat capacity of copper is 390kJ/kg °C.

Calculate each of the following:

5.6.1 Rise in temperature

5.6.2 Final temperature

(2 × 1) (2)
[14]

QUESTION 6: PARTICLE STRUCTURE OF MATTER

6.1 What causes a substance to change phase? (1)

6.2 Make a neat, labelled sketch of an atom consisting of 1 proton, 1 neutron and 1 electron. Show the charge of each component. (3)

6.3 Give the term for each of the following phase changes:

6.3.1 Solid changes to liquid

6.3.2 Liquid changes to solid

6.3.3 Liquid chances to gas

. (3 × 1) (3)

6.4 Define *molecules.* (1)
[8]

QUESTION 7: ELECTRICITY

7.1 Define *Ohm's law*. (1)

7.2 Write down the abbreviations AC and DC in full. (½ × 2) (1)

7.3 Three resistors of 8 Ω, 5 Ω and 14 Ω respectively are connected in series in an electrical circuit. Two cells of 3 V each are connected in parallel in the circuit.

Draw the circuit diagram. (2)

7.4 Use the information in QUESTION 7.3 and calculate the following:

7.4.1 Total resistance of the circuit (1)

7.4.2 Total current in the circuit (1)

7.4.3 Voltage drop across the 5 Ω resistance (1)

7.4.4 Power in the 14 Ω resistance (1)

7.5 Name the TWO factors that influence the resistivity of a conductor. (2)

7.6 How will the increase in the applied voltage affect the current flow in a circuit if the resistance stays the same? (1)

7.7 Draw a neat, labelled sketch of a single-stroke electric bell. (3)

7.8 Draw a neat, labelled sketch of the magnetic field lines around a permanent bar magnet. (3)

7.9 If the temperature of the following materials is lowered, what effect will it have on the resistance of each of the materials?

7.9.1 PVC

7.9.2 Silver

(2 × 1) (2)

7.10 An electrical lamp has a voltage drop of 220 V and a current of 1,45 A flows through it.

Calculate the following:

7.10.1 Resistance of the lamp (2)

7.10.2 Power of the lamp (1)

[22]

TOTAL SECTION B: 80
GRAND TOTAL: 100

ENGINEERING SCIENCE N1

FORMULA SHEET

Any other applicable formula may also 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. $P = I^2.R$