higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T620(**E**)(J26)T

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N1

(15070391)

26 July 2018 (X-Paper)
09:00–12:00

This question paper consists of 11 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 in SECTION A.
2. Answer ALL the questions in SECTION B.
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 calculation must have the following three steps:

   6.1 The formula.
   6.2 The replacement of values.
   6.3 The answer and correct SI-unit.

7. Gravitational acceleration (g) should be taken as 9,8 $m.s^{-2}$.
8. Sketches must be drawn neatly and with pencil.
9. Write neatly and legibly.

SECTION A

QUESTION 1

1.1 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 (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 The unit for specific heat capacity.

A N.m
B J/kg°C
C Kelvin
D J

1.1.2 The symbol for an incandescent lamp.

A 
B 
C 
D 

1.1.3 What is the charge of the nucleus of an atom?

A Negative
B Neutral
C Positive
D None of the above

1.1.4 What type of material's resistance will stay the same if the temperature rises?

A Alloy
B Conductor
C Insulator
D Compound

1.1.5 FIGURE 1 below shows a system of forces. Identify the resultant of the system of forces.

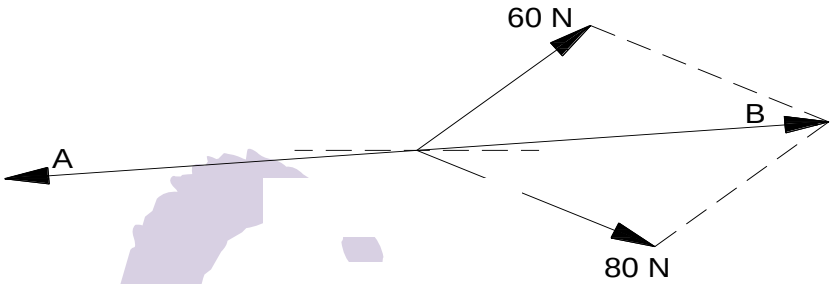

FIGURE 1

A A
B B
C A and B
D None of the above

(5 × 1) (5)

1.2 Give ONE word for each of the following descriptions by choosing a word from the list below. Write only the word/term next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

torque; power; specific heat capacity; solidification; matter

1.2.1 The rate that work is done

1.2.2 Anything that occupies space and has mass

1.2.3 The amount of heat needed to raise the temperature of 1kg of a substance with 1 °C

1.2.4 The tendency of a force to cause or change rotational motion of a body

1.2.5 When a substance changes from a liquid to a solid

(5 × 1) (5)

1.3 Choose a description from COLUMN B that matches a word in COLUMN A. Write only the letter (A–E) next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.3.1	The law of moments	A	the distance an object moves during a time interval
1.3.2	Speed	B	the heat developed by an electrical current, is directly proportional to the resistance, the time and the square of the current
1.3.3	The law of conservation of energy	C	material that cannot conduct electricity
1.3.4	Joule's law	D	a system of forces are in equilibrium if the clockwise moments about a point is equal to the anti-clockwise moments about the same point
1.3.5	Insulator	E	energy cannot be created or destroyed but can be converted from one form to another form

(5 × 1) (5)

1.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.4.1–1.4.5) in the ANSWER BOOK.

1.4.1 A lifting machine is a device that uses a small force over a long distance to move a large weight over a small distance.

1.4.2 Time is a vector.

1.4.3 Mass is measured in kilograms.

1.4.4 An equilibrant has the same effect on a body than two or more forces.

1.4.5 A force has magnitude and direction.

(5 × 1) (5)
[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2: DYNAMICS

2.1 A traveler travelled from A to B according to the route in FIGURE 2. The route took 1 hour to complete.

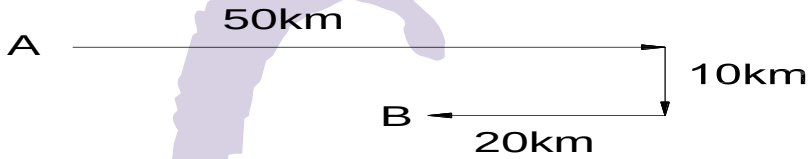

FIGURE 2

Calculate the following:

2.1.1 The distance traveled from A to B. (1)

2.1.2 The displacement between A and B by means of vector adding.

(HINT: Use a scale 1 cm = 5 km.) (2)

2.2 A man with a mass of 95 kg walks to the back of a train at a velocity of 1,3 m/s while the train moves at a constant velocity of 45 km/h in an easterly direction.

Calculate the resultant velocity of the man in $m.s^{-1}$. (2)

2.3 An athlete takes 12 seconds to run 100 m at a constant velocity.

2.3.1 Draw a displacement time graphic of the athlete's movement.

(HINT: Use scale 1 cm = 10 m and 1 cm = 1s.) (3)

2.3.2 Read from the graphic the distance the athlete has travelled in FOUR seconds. (1)

[9]

QUESTION 3: STATICS

3.1 FIGURE 3 below shows a system of forces. Determine graphically the size and direction of the resultant and equilibrant of the system of forces.

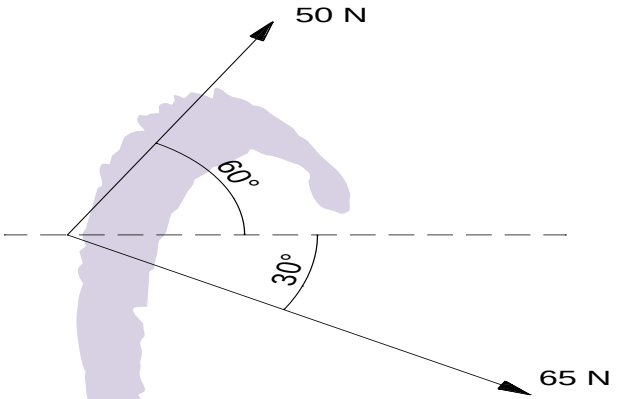

FIGURE 3

(HINT: Use scale 10 N=10 mm.) (3)

3.2 A wheel and axle lifting machine is used to lift a mass of 350 kg. The effort applied is 550 N, the wheel has a diameter of 350 mm and the axle has a diameter of 250 mm.

Calculate the following:

3.2.1 Mechanical advantage (2)

3.2.2 Displacement ratio (1)

3.3 A force of 850 N is applied on the one end of a spanner 300 mm long.

Calculate the torque applied on the nut. (3)

3.4 FIGURE 4 below, shows a signboard with a weight of 400 N. Determine with the aid of a triangle of forces the force F in the cable and force S in the support beam.

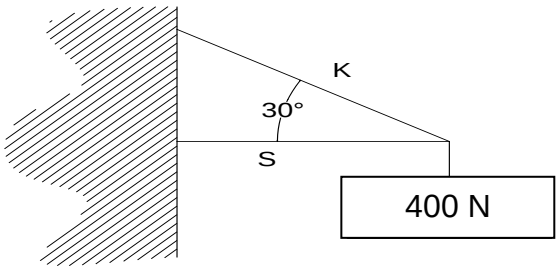

FIGURE 4

(HINT: Use scale 10 N = 5 mm.) (3)

3.5 FIGURE 5, below shows a beam in equilibrium.

Calculate the force F.

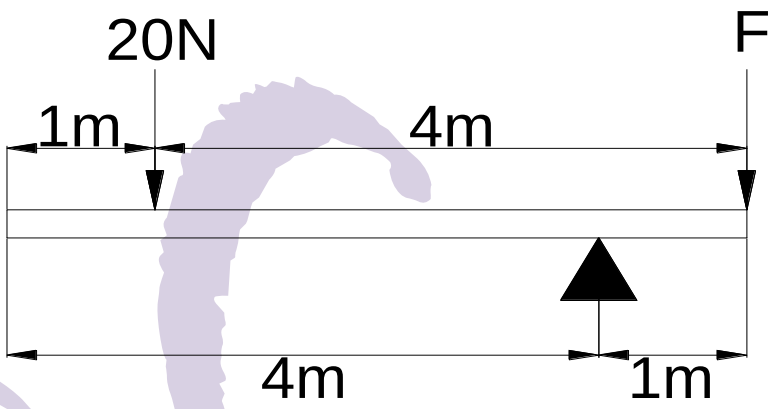

FIGURE 5

(3)
[15]

QUESTION 4: ENERGY WORK AND POWER

4.1 A lifting machine is used to hoist a bucket of water with a mass of 25 kg out of a well, 35 m deep.

4.1.1 Calculate the weight of the water. (1)

4.1.2 Draw the force/distance graph of this work done.

(HINT: Use a scale 20 N = 10 mm and 5 m = 10 mm.) (3)

4.1.3 Use the graph and determine the work done. (1)

4.2 A motor car travels at a speed of 115 km/h on a horizontal road. The force needed to keep the motorcar speed constant is 1200 N.

Calculate the following:

4.2.1 The speed in m/s. (1)

4.2.2 The power developed through the engine of the motor in kW. (1)

4.3 Name the type of energy in each of the following instances:

4.3.1 A rock rolling down an incline

4.3.2 An ice cube melting

4.3.3 A battery

(3 × 1) (3)
[10]

QUESTION 5: HEAT

5.1 Distinguish in your own words the difference between temperature and heat. (2)

5.2 How is heat propagated in the following phases (conditions):

5.2.1 Solids

5.2.2 Liquids

5.2.3 Gases

5.2.4 Vacuum

(4 ×½) (2)

5.3 Draw a neat, labelled diagram of an optical pyrometer (disappearing filament pyrometer). (4)

5.4 A substance changes when heat is added or removed.

Name TWO changes that can take place (The effects of heat). (2)

5.5 A bi-metallic strip consists of two different types of materials.

What principle does the bi-metallic strip represent? (1)

5.6 60,5 kJ of heat energy is absorbed by a copper cylinder which has a mass of 3 kg. The initial temperature was 18 °C and the specific heat capacity of copper is 390 J/kg°C.

Calculate the following:

5.6.1 The rise in temperature (The change in temperature) (2)

5.6.2 The final temperature (1)

5.7 A copper pipe, 4,6 m long at an initial temperature of 13 °C, expands by 5,45 mm when the temperature increases to 85 °C.

Calculate the following:

5.7.1 The final length of the pipe (1)

5.7.2 The difference in temperature (1)

[16]

QUESTION 6: PARTICLE STRUCTURE OF MATTER

6.1 What causes matter to change phase? (1)

6.2 Matter can be found in three phases namely solids, liquids and gasses.

Name ONE example of each of these phases. (3)

6.3 Name the process that happens when the following phase changes takes place:

6.3.1 A solid changes to a liquid

6.3.2 A gas changes to a liquid

6.3.3 A liquid changes to a solid

(3 × 1) (3)

6.4 FIGURE 6 below, shows the structure of an atom. Name each part of the atom. Write only the answer next to the question number (6.4.1–6.4.4) in the ANSWER BOOK.

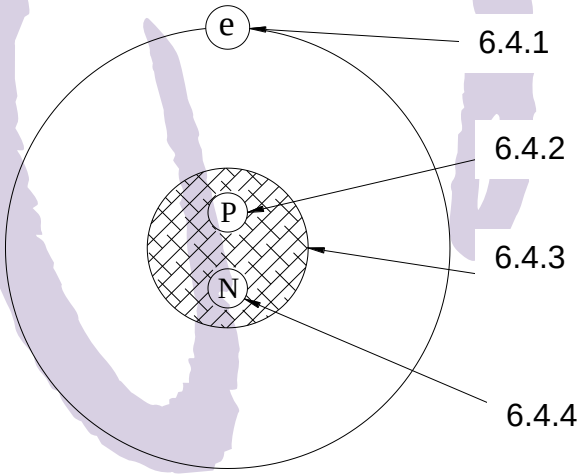

FIGURE 6 (4 × ½) (2)

[9]

QUESTION 7: ELECTRICITY

7.1 Name ONE of the factors that will influence the resistance of a conductor. (1)

7.2 Calculate the current that flow through the element of an electric toaster with a resistance of 26 Ω if it is connected to a 220 V supply. (2)

7.3 Three resistors of 7 Ω, 9 Ω and 15 Ω are connected in parallel across a 12 V supply.

Calculate the following:

7.3.1 Total resistance of the circuit. (2)

7.3.2 The current drawn from the supply. (2)

7.4 Name ONE way to strengthen the magnetic field around a coil. (1)

7.5 A stove plate has a resistance of 125 Ω and draws a current of 22,6 A from the supply.

Determine the time required to generate 1579 kJ of heat energy. (2)

7.6 When a current of 8 A flows through an incandescent lamp the power consumption is 120 W.

Determine the voltage across the lamp. (2)

7.7 Draw a neat labelled drawing of the magnetic field around a current-carrying conductor. (3)

7.8 Name ONE practical example where solenoids are used. (1)

7.9 If the temperature rises, what effect will there be on the resistance of the following substances?

7.9.1 A conductor such as copper (1)

7.9.2 Isolation materials such as mica (1)

7.10 Describe the working of a single-stroke doorbell in words. (3)
[21]

TOTAL SECTION B: 80
GRAND TOTAL: 100

FORMULEBLAD / FORMULA SHEET

Enige toepaslike formule kan ook gebruik word / 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.	$R_t = R_1 + R_2 + \ ...$
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.	$P = I^2.R$