higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T560**(E)**(A6)T
APRIL EXAMINATION

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N1

(15070391)

6 April 2016 (X-Paper)
9:00–12:00

This question paper consists of 10 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. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. You may start with any question but sub-questions must be kept in order and not split or separated.
5. Calculations must contain the following:

   5.1 Formula
   5.2 Substitution and conversion of values
   5.3 Answer

6. Answers to calculations must at all times be given correctly to three decimal numbers.
7. Neat, labelled line sketches must be drawn with the necessary drawing equipment.
8. Use g = 9,8 $m.s^{-1}$.
9. Write neatly and legibly.

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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 (1.1.1–1.1.4) in the ANSWER BOOK.

1.1.1 A vector can be defined as …

A a physical quantity having no magnitude as well as no direction.
B a physical quantity having a specific magnitude only and no specific direction.
C a physical quantity having a specific magnitude as well as direction.
D the attraction between the earth and a body.

1.1.2 Displacement can be defined as …

AB actual route a body followed.
C a physical quantity having a specific magnitude as well as
D direction.
the amount of matter a body consists of.
the straight line route a body followed from starting point to ending point.

1.1.3 Mass can be defined as …

A a physical quantity having a specific magnitude as well as direction.
B the amount of matter a body consists of.
C the rate of change of distance.
D the attraction between the earth and a body.

1.1.4 Velocity can be defined as …

A the rate of change of displacement.
B the attraction between the earth and a body.
C the rate of change of distance.
D a physical quantity having a specific magnitude only and no specific direction.

(4 x 1) (4)

1.2 In soccer practice Thato runs 74 m in a direction of W30°S, he turns around and walks 22 m in a direction of 30° North of East.

Graphically determine the resultant displacement of Thato by means of addition of vectors. (2)

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1.3 An aeroplane flies due east for 15 min at an average velocity of 375 km/h.

1.3.1 Calculate the displacement of the aeroplane.

1.3.2 How long will it take the pilot to do the same flight if the average velocity of the aeroplane is increased by 25%?

(2 x 2) (4)

1.4 The following readings were taken while testing a machine part:

Velocity in m/s:	0	15	20	25	30	35	40
Time taken in seconds:	0	5	10	15	20	25	30

1.4.1 Draw a velocity-time graph according to the following scale: 5 sec = 2 cm and 5 m/s = 1 cm. (3)

1.4.2 Calculate from the graph the average acceleration of the machine part. (2)

[15]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 Force is a scalar.

2.1.2 The resultant of a system of forces is that single force which balances two or more forces.

2.1.3 The moment of a force about a point is the sum of the force and the perpendicular distance from the point of action.

2.1.4 Mechanical advantage is the ratio between the load and the effort of the machine.

2.1.5 The equilibrant is the single force that has the same effect as the combined effect of the forces.

(5 x 1) (5)

2.2 A pulley system with a velocity ratio of 3 is used to lift a weight of 550 N, 3,5 m high.

2.2.1 Calculate the effort distance.

2.2.2 If the mechanical advantage is 2,5 what is the magnitude of the effort?

(2 x 2) (4)

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2.3 A lathe with a weight of 7,5 kN hangs from a crane hook by two chains. The two chains form angles of 40° and 50° respectively with the horizontal plane.

Determine the tensile forces in the chains. (3)

2.4 Determine the value of the unknown force which will keep the system in equilibrium as shown in FIGURE 1.

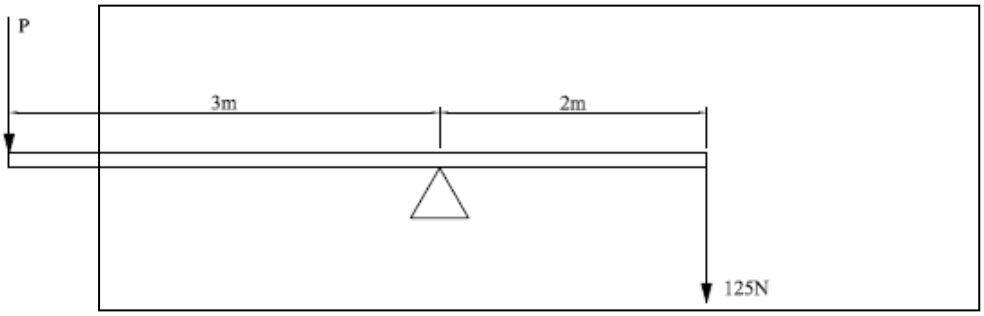

FIGURE 1 (2)

2.5 Determine the equilibrant of the two forces given in FIGURE 2 by using the parallelogram method.

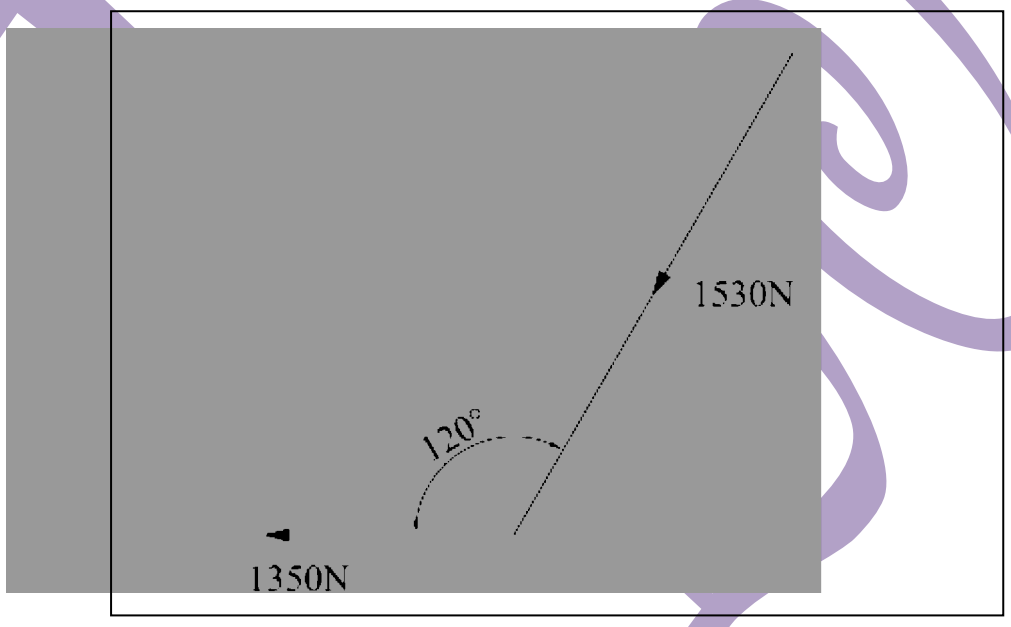

FIGURE 2 (3)

[17]

QUESTION 3

3.1 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 (3.1.1–3.1.5) in the ANSWER BOOK.

3.1.1 The definition of potential energy can be stated as …

A the energy that is produced by the movement of electrons in a circuit.
B the energy a body possesses due to its position above the ground plane.
C the energy a body possesses due to a chemical reaction taking place.
D the energy that is created by the generation of heat.

3.1.2 Work can be defined as …

A when a force moves through a distance.
B the energy a body possesses due to its position above the ground plane.
C the rate of doing work.
D the energy that is produced by the movement of electrons in a circuit.

3.1.3 The definition of kinetic energy can be stated as …

A when a force moves through a distance.
B the energy a body possesses due to its motion.
C the energy that is created by the generation of heat.
D the energy that is produced by the movement of electrons in a circuit.

3.1.4 Power is defined as …

A the rate of doing work.
B the energy a body possesses due to a chemical reaction taking place.
C the energy a body possesses due to its position above the ground plane.
D when a force moves through a distance.

3.1.5 Electrical energy can be defined as …

A the energy a body possess due to a chemical reaction taking place.
B the energy that is produced by the movement of electrons in a circuit.
C the energy that is created by the generation of heat.
D the energy a body possess due to its motion.

(5 x 1) (5)

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3.2 A man has to push his car for 200 m to get it to start. The force needed to push the car is 525 N.

Calculate the work done by the man. (2)

3.3 A crane lifts a load of 6,5 kN vertically upwards to a height of 10 m.

3.3.1 Draw a graph representing the work done by the crane.
Scale: 1 kN = 1 cm and 1 m = 1 cm (3)

3.3.2 From the graph calculate the work done. (2)
[12]

QUESTION 4

4.1 Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

4.1.1 Mercury has a (higher/lower) boiling point compared to alcohol.

4.1.2 Alcohol has a (higher/lower) freezing point compared to mercury.

4.1.3 When a substance changes from a liquid to a solid heat is (added/removed).

4.1.4 A (thermocouple/radiation pyrometer) can measure temperatures above 600 °C.

4.1.5 Heat is measured in (Joule/°C).

(5 x 1) (5)

4.2 Draw a neat labelled sketch of a clinical thermometer. (3)

4.3 Heat transfer can take place differently in the different phases of matter.

Write the correct transfer method for the following phases:

4.3.1 Solid

4.3.2 Liquid

4.3.3 Gas

(3 x 1) (3)

4.4 Calculate the quantity of heat energy released by 250 kg of water that is cooled down from 55 °C to 15 °C. The specific heat capacity of water is 4 187 J/kg °C. (2)

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4.5 A copper pipe in a hot water system is 36 m long at a temperature of 85 °C. The temperature decreases to 25 °C and the length decreases to 35,105 m.

4.5.1 Calculate the change in length of the copper pipe.

4.5.2 Calculate the change in temperature.

(2 x 1) (2)

4.6 Consider the following: a hot ball of lead is dropped into a container with cold water. Assume no heat loss.

4.6.1 What happened between the two substances?

4.6.2 What law has been satisfied?

4.6.3 What happened ultimately to the temperature?

(3 x 1) (3)
[18]

QUESTION 5

5.1 Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (5.1.1–5.1.5) in the ANSWER BOOK.

5.1.1 The smallest part of an element.

5.1.2 Anything that occupies space and has mass.

5.1.3 The smallest part of a chemical compound.

5.1.4 The process when a solid turns into a liquid.

5.1.5 The process when a gas turns into a liquid.

(5 x 1) (5)

5.2 Particles are arranged differently in the different phases of matter.

Describe the arrangement of particles in the three different phases. (3)

5.3 Name the THREE particles of an atom and the charge of each. (3)

5.4 What do you understand by the term *ion*? (1)
[12]

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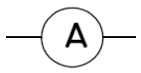
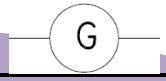
QUESTION 6

6.1 Choose an item from COLUMN B that matches a word in COLUMN A. Write only the letter (A–D) next to the question number (6.1.1–6.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
6.1.1	Battery	A	
6.1.2	Resistor	B	
6.1.3	Ammeter	C	
6.1.4	Galvanometer	D	
6.1.5	Switch	E	

(5 x 1) (5)

6.2 Define the following terms:

6.2.1 Insulator

6.2.2 Resistance

6.2.3 Potential difference

6.2.4 Joule' s law

(4 x 1) (4)

6.3 Two resistors of 125 Ω and 230 Ω respectively are connected in parallel with a battery of 24 V.

6.3.1 Calculate the total resistance of the circuit.

6.3.2 Calculate the total current in the circuit.

6.3.3 Calculate the total power of the circuit.

(3 x 2) (6)

6.4 The resistance of a conductor can be influenced by certain factors.

Briefly discuss the way in which these factors will influence the resistance of a conductor under the following headings:

6.4.1 Resistivity

6.4.2 Length

(2 x 1) (2)

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6.5 Temperature has different influences on different materials.

Under the following headings describe the effect of temperature on the different materials.

6.5.1 Alloys like brass

6.5.2 Insulators like PVC

(2 x 1) (2)

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

6.7 Draw a neat labelled sketch of a single stroke electrical bell. (4)

[26]

TOTAL: 100

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ENGINEERING SCIENCE N1

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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