higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T640**(E)**(M30)T

NATIONAL CERTIFICATE

ENGINEERING SCIENCE N1

(15070391)

30 March 2017 (X-Paper)
09:00–12:00

Candidates need drawing instruments.

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. Calculations must contain the following:

   (a) Formula
   (b) Replacement of values
   (c) Answer

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

QUESTION 1

1.1 Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 (Acceleration/Speed) is the rate of change in velocity.

1.1.2 (Distance/Displacement) is the linear distance from starting point to finishing point.

1.1.3 (Speed/Velocity) is the rate of change of distance.

1.1.4 A (scalar/vector) is a quantity which has magnitude and direction.

1.1.5 (Mass/Weight) is the indication of the attraction between the earth and a body.

(5 × 1) (5)

1.2 A ship is sailing at a velocity of 30 m/s in an easterly direction. A current of 6 m/s is flowing in a westerly direction.

Determine graphically the resultant velocity of the ship. (2)

1.3 A plane travelling at a constant velocity takes 50 seconds to reach a distance of 10 km.

1.3.1 Use a scale of 2 cm = 10 sec. and 1 cm = 1 km and draw a displacement/time graph. (3)

1.3.2 Determine from the graph the average velocity of the plane. (2)

1.4 An astronaut weighs 66,3 kg on earth. He travels to the moon, where he weighs 10,8 kg.

Calculate the gravitational acceleration on the moon. (2)

[14]

QUESTION 2

2.1 Give ONE word or term for each of the following descriptions. Write only the word or term next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

equilibrant; velocity ratio; resultant; law of moments; mechanical advantage; force; moment of a force

2.1.1 The ratio of the load overcome as opposed to the corresponding effort applied

2.1.2 That single force which can replace a system of forces and still have the same effect

2.1.3 The ratio between the distance moved by the effort and the distance moved by the load

2.1.4 A system of forces in equilibrium when the sum of the clockwise moments about a point is equal to the sum of the anticlockwise moments about the same point

2.1.5 That effect which changes or tends to change the state of rest or motion in a straight line of a body

(5 × 1) (5)

2.2 Determine, with the aid of the parallelogram method of forces, the size and direction of the resultant of the two forces in FIGURE 1 below. Use a scale of 10 N = 10 mm.

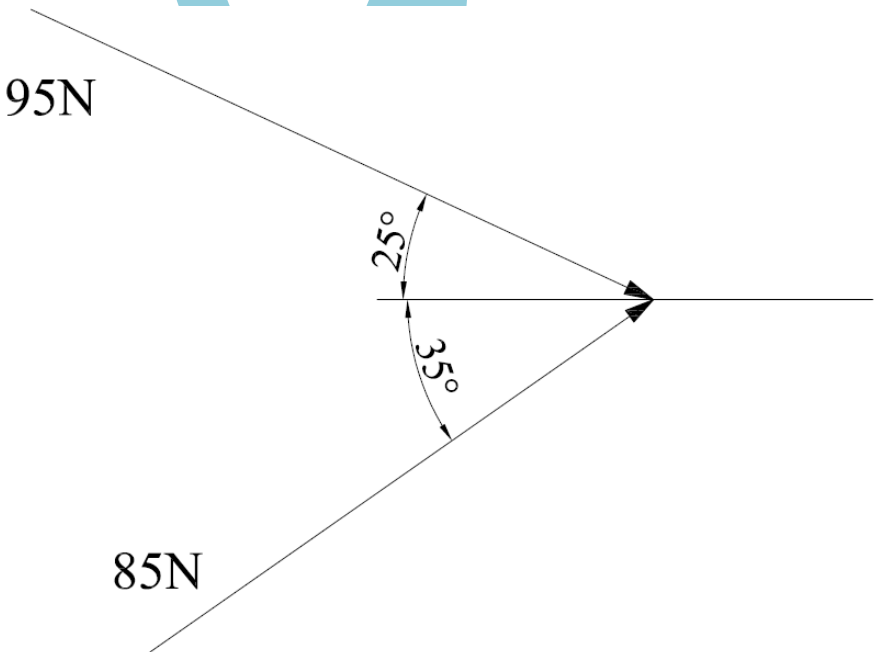

FIGURE 1 (2)

2.3 A simple lifting machine has a mechanical advantage of 10 and a displacement ratio of 20.

Calculate the following:

2.3.1 The distance moved by the load if the effort moved 5 m

2.3.2 The load lifted if an effort of 10 N is applied

(2 × 2) (4)

2.4 FIGURE 2 below shows the skeleton diagram of a crane used in a warehouse.

Determine the size of the tensile forces used in ropes A and B.

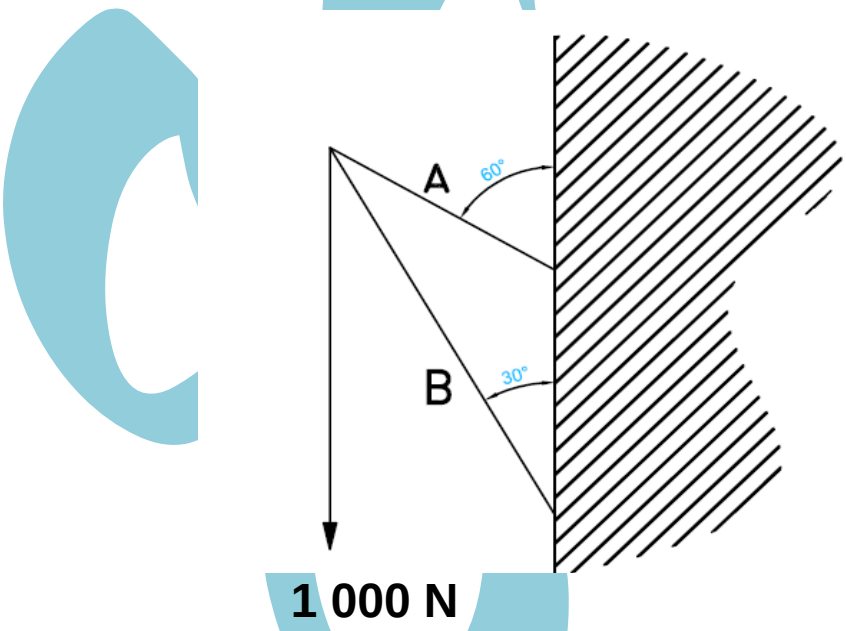

FIGURE 2 (3)

2.5 Calculate the torque of the spanner in FIGURE 3 below.

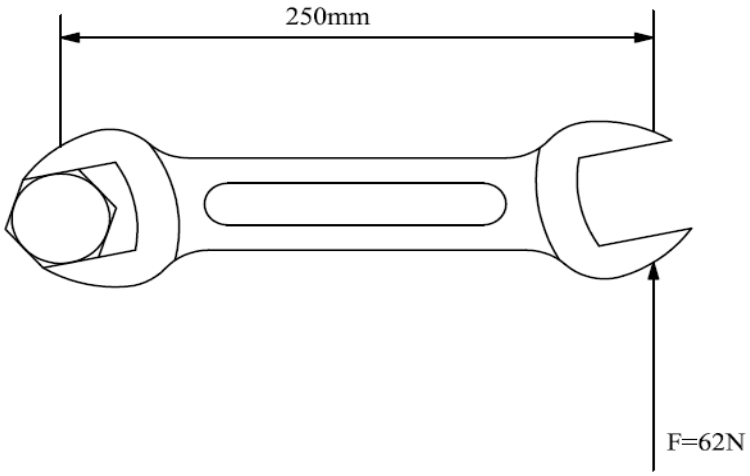

FIGURE 3 (2)

2.6 Determine the value of the unknown force in FIGURE 4 below.

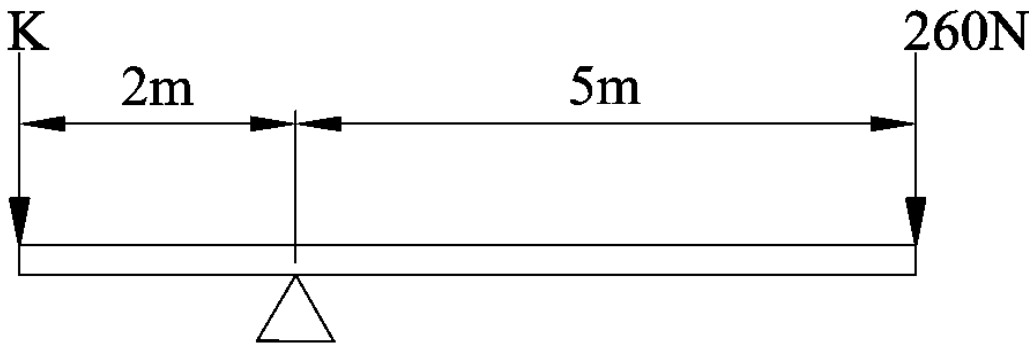

FIGURE 4

(2)
[18]

QUESTION 3

3.1 Complete the following sentences by filling in the missing word(s). Write only the word(s) next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

joule; energy; kinetic energy; work; power; potential energy

3.1.1 The energy a body possesses by virtue of its positions or state of strain is called ...

3.1.2 ... is done when a force moves through a distance.

3.1.3 The rate of doing work is called ...

3.1.4 The capacity to do work is called ...

3.1.5 1 ... is when a force of 1 N moves through a distance of 1 m.

(5 × 1) (5)

3.2 A load of cement weighs 980 N and is raised up to a height of 6 m.

3.2.1 By using a scale of 1 cm = 100 N and 2 cm = 1 m, draw a neat force/distance graph. (3)

3.2.2 From the graph calculate the work done of raising the body 6 m. (2)

3.3 The power needed to pull a trailer at a constant speed of 120 km/h on a level road is 250 kW.

Determine the force needed to keep the speed constant. (2)
[12]

QUESTION 4

4.1 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–E) next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
4.1.1	The hotness or coldness of a body	A	coefficient of linear expansion
4.1.2	The increase in length per unit length of a material per degree rise in temperature	B	specific heat capacity
4.1.3	Instrument used to measure temperatures above 500 °C	C	temperature
4.1.4	The amount of energy in a body	D	heat
4.1.5	The amount of heat energy required to raise the temperature of 1 kg of a substance with 1 °C	E	pyrometer

(5 × 1) (5)

4.2 When heat is added to a substance it will have certain effects on the substance.

Name THREE of these effects and give an example of each. (3 × 1) (3)

4.3 Tabulate the advantages of a mercury thermometer and the disadvantages of an alcohol thermometer.

ADVANTAGES OF A MERCURY THERMOMETER		DISADVANTAGES OF AN ALCOHOL THERMOMETER	
4.3.1		4.3.5	
4.3.2		4.3.6	
4.3.3		4.3.7	
4.3.4		4.3.8	

(8 × ½) (4)

4.4 Calculate the amount of heat required to heat up 800 mℓ of water that has a specific heat capacity of 4 200 J/kg °C from 15 °C to 90 °C. (2)

4.5 A ball of lead that was heated up to a temperature of 250 °C is dropped into a container of cold water. Assume heat is conserved.

4.5.1 What will happen between the two substances?

4.5.2 What type of transfer will take place?

4.5.3 What will ultimately (at equilibrium) happen to their final temperatures?

(3 × 1) (3)

4.6 A conductor has a length of 125 m when it spans between two pylons at a temperature of 12 °C during the night. During the day the temperature rises to 36 °C. The length increases by 59,6 mm.

Calculate the final length of the conductor at daytime. (1)

[18]

QUESTION 5

5.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (5.1.1–5.1.5) in the ANSWER BOOK.

5.1.1 When heat is added to a liquid it changes to a solid.

5.1.2 An electron has a negative charge.

5.1.3 When a gas changes to a liquid the process is called condensation.

5.1.4 Mercury is a solid at room temperature.

5.1.5 The molecules of a liquid are very tightly packed.

(5 × 1) (5)

5.2 Draw a neat, labelled sketch of a simple atom with two electrons, two protons and two neutrons. (3)

5.3 Matter has different characteristics in the different phases.

5.3.1 Why is it that you can see through a gas? (1)

5.3.2 Name TWO main characteristics of solids. (2)

5.4 How is an ion formed? (1)

[12]

QUESTION 6

6.1 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 (6.1.1–6.1.5) in the ANSWER BOOK.

6.1.1 Which ONE of the following can conduct electricity?

A Bakelite
B PVC
C Iron
D Plastic

6.1.2 An alarm system has a power source of 12 V and has a resistance of 5 Ω. The current drawn by the alarm system when switched on is:

A 4,2 A
B 2,4 A
C 1 A
D 5 A

6.1.3 Temperature changes have different effects on different materials. If the temperature decreases, which of the following materials' resistance will stay the same?

A Insulators
B Conductors
C Alloys
D All of the above

6.1.4 The formula that represents Ohm's law:

A $P = V.I$
B $I = \frac{V}{R}$
C $R = V.I$
D $P = I^2R$

6.1.5 Joule's law can be defined as:

A The current is proportional to the voltage and the current is inversely proportional to the resistance.
B The heat generated in a conductor is directly proportional to the square of the current, the resistance of the conductor and the time the current flows.
C The rate at which work is done.
D The electrical pressure that is required to overcome the resistance so that the current can flow.

(5 × 1) (5)

6.2 Draw neat electrical circuit symbols for each of the following components:

6.2.1 Galvanometer

6.2.2 Cell

6.2.3 Switch (open)

6.2.4 Variable resistor

(4 × ½) (2)

6.3 Three resistors with resistance values of 8 Ω, 9 Ω and 14 Ω are connected in parallel and a battery with a voltage of 24 V is connected across them.

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

6.3.2 Calculate the total current flowing in the circuit. (2)

6.4 Name FOUR factors that will influence the resistance of a conductor. (4 × ½) (2)

6.5 Define *Fleming's right-hand rule* for a current-carrying conductor. (1)

6.6 A current of 15 A flows through a heater's element. The element has a resistance of 8 Ω.

6.6.1 If the heater is switched on for 1 hour, calculate the energy generated during this time. (2)

6.6.2 Calculate the power of the heater. (2)

6.6.3 Calculate the applied voltage. (2)

6.7 Draw a neat, labelled sketch of a current-carrying solenoid. Also show the magnetic field around the solenoid. (3)

6.8 Draw a neat, labelled sketch of a single-stroke electrical bell. (3)

[26]

TOTAL: 100

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. $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} \ldots$