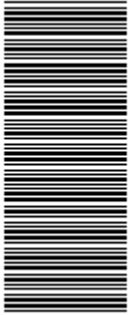


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higher education  
& training

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

**T600(E)(N21)T  
NOVEMBER EXAMINATION  
NATIONAL CERTIFICATE  
ENGINEERING SCIENCE N1**

(15070391)

**21 November 2013 (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

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**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. Write neatly and legibly.
-

**QUESTION 1**

1.1 Define the following terms:

1.1.1 Scalar

1.1.2 Velocity

1.1.3 Mass

1.1.4 Distance

(4 × 1) (4)

1.2 A taxi drives north and stops 15 km north at a taxi stop, then a further 6 km east to stop at another taxi stop. Here the taxi turns around and drives 10 km west before it stops at the last taxi stop.

Determine the resultant displacement in magnitude and direction. (2)

1.3 A racing car accelerates over a distance of 400 m from rest to 162 km/h in 12 seconds.

1.3.1 Draw a velocity/time graph of the motion.

**HINT:** Change km/h to m/s (3)

Answer the following questions with regard to the graph:

1.3.2 Calculate the acceleration of the racing car. (2)

1.3.3 Determine the velocity of the racing car after 7 seconds. (1)

1.3.4 Determine the time it would take to reach a velocity of 20 m/s. (1)

1.4 If a person has a weight of 637 N, what will this person's mass be in kilogram? (1)

**[14]**

**QUESTION 2**

2.1 Define the following terms:

2.1.1 A force

2.1.2 The law of moments

(2 × 1) (2)

- 2.2 The billboard hanging from a cable in front of a shop weighs 1 200 N, is supported by a beam as shown in FIGURE 1 below. Draw Bow's diagram and determine the forces (AB) and (BC).

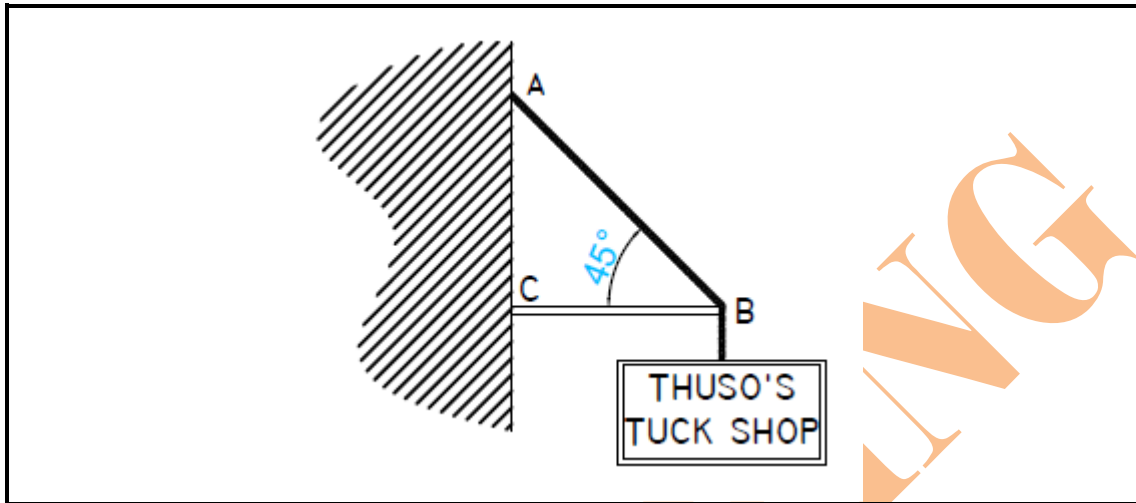


FIGURE 1

(4)

- 2.3 In a simple lever lifting machine an effort of 250 N is applied over a distance of 1,2 m to lift a rock of 160 kg over a distance of 180 mm.

Calculate the following:

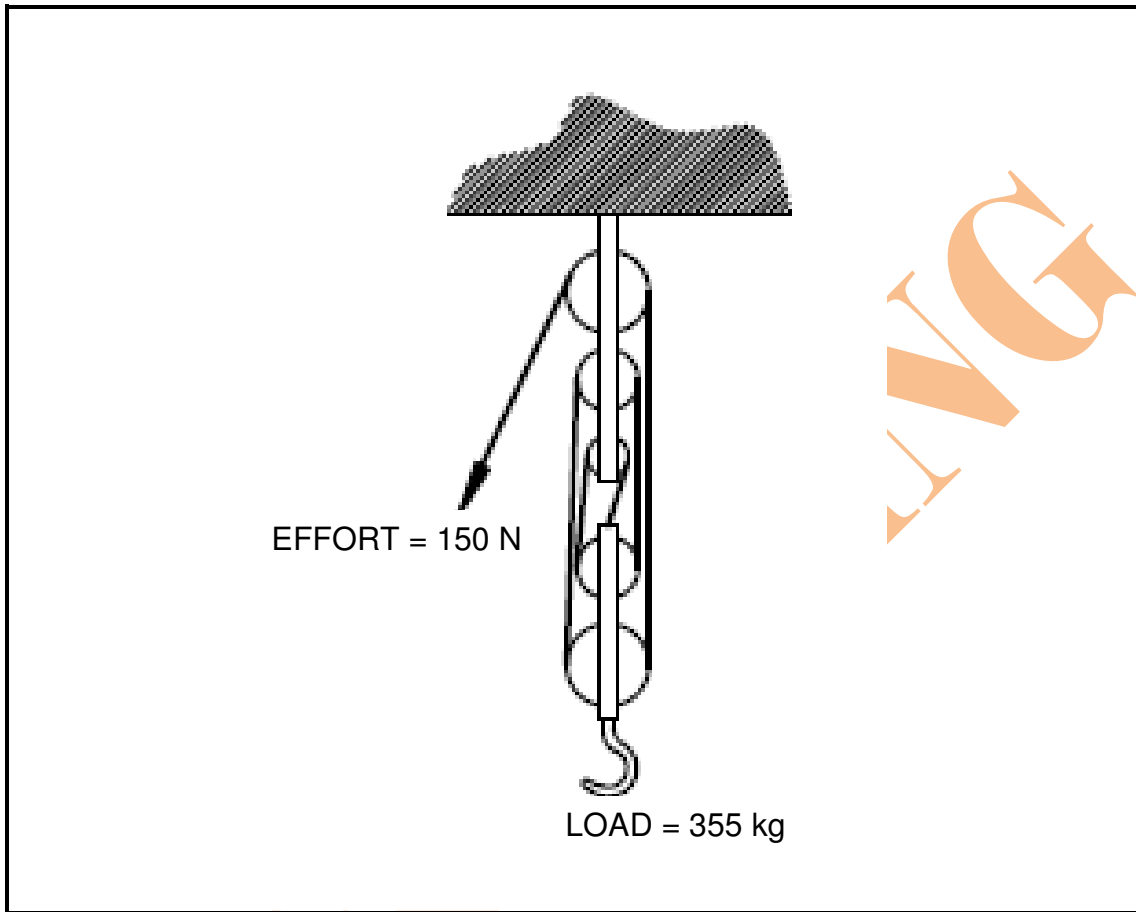
- 2.3.1 The displacement ratio (VR) (2)
- 2.3.2 The mechanical advantage (MA) (2)
- 2.3.3 The efficiency ( $\eta$ ) (1)
- 2.4 Complete the following sentences by using the word(s) given in the list below. Write only the word(s) next to the question number (2.4.1–2.4.4) in the ANSWER BOOK.

effort; standstill; anti-clockwise; equilibrant; resultant

- 2.4.1 A force causes an object that is moving to come to ... .
- 2.4.2 A ... is that force that will replace two or more forces.
- 2.4.3 Displacement ratio is the ratio between the ... it has moved and the load distance.
- 2.4.4 The law of moments states that if a system is in equilibrium, the sum of the clockwise moments is equal to the sum of the ... moments about the same point.

( $\frac{1}{2} \times 4$ ) (2)

2.5 A pulley system has three pulleys in the upper block and two pulleys in the lower block as shown in FIGURE 2 below.



**FIGURE 2**

Calculate the following:

2.5.1 The velocity ratio

2.5.2 The distance the load has moved if the effort moved 2,2 m

(2 × 2) (4)

2.6 Calculate the torque of the spanner shown in FIGURE 3 below.

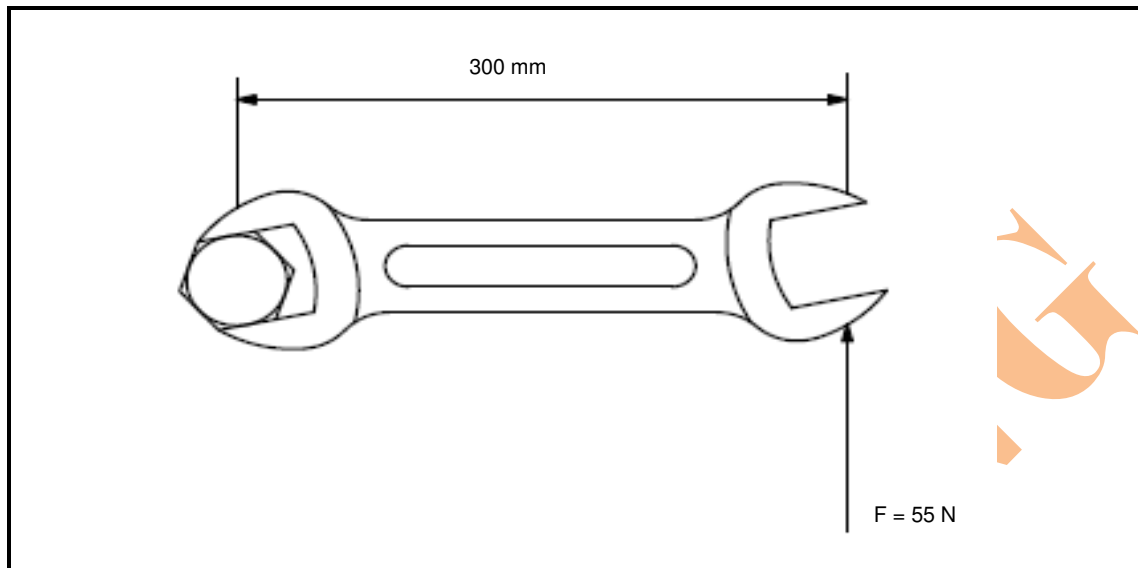


FIGURE 3

(1)  
[18]

### QUESTION 3

3.1 Explain in your own words the following types of energies:

3.1.1 Potential energy

3.1.2 Kinetic energy

3.1.3 Chemical energy

(3 × 1) (3)

3.2 A lift in a mineshaft has a weight of 21 kN and the mineshaft is 220 m deep.

3.2.1 Draw a force/displacement graph of the movement. (3)

Determine the following from the graph:

3.2.2 The work done when the lift moved 220 m (2)

3.2.3 The power if the movement took three minutes (2)

3.3 How far can a sledge be pulled with 5,6 kJ energy if a pulling force of 86 N is needed? (2)

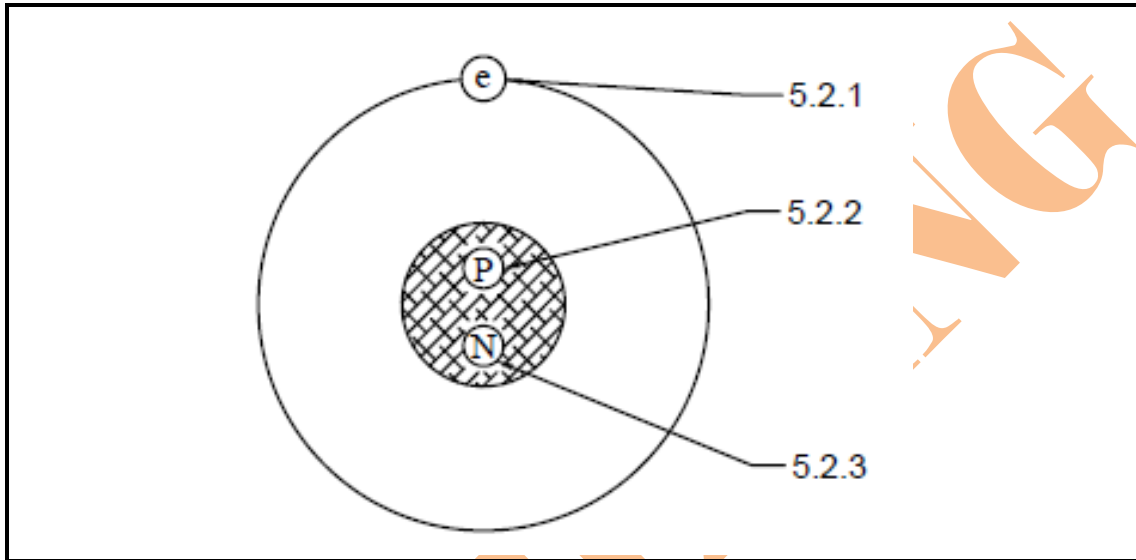
[12]

**QUESTION 4**

- 4.1 Name THREE factors that will influence linear expansion. (3)
- 4.2 Explain in your own words the difference between *heat* and *temperature*. (2)
- 4.3 The change in length of a steam-turbine pipe was found to be 0,21 mm after it has been running for some time and the temperature had risen to 110 °C. At an initial temperature of 25 °C the length of the pipe was found to be 4,154 m.
- 4.3.1 Calculate the change in temperature.
- 4.3.2 What is the final length of the pipe? (2 × 2) (4)
- 4.4 If you apply heat to an object it will undergo certain changes.  
Name THREE effects heat can have on an object. (3 × 1) (3)
- 4.5 A steel casting is at a temperature of 465 °C. It is dumped in 15 ℓ of water at 21 °C to cool down. The final temperature of the water and steel settles at 38 °C. The specific heat capacity of water is 4 187 J/kg °C and that of steel 490 J/kg °C.  
Calculate the following:
- 4.5.1 The energy taken up by the water. (2)
- 4.5.2 What will the energy be that the steel has given off? (1)
- 4.6 Give ONE example where you will use a bimetallic strip. (1)
- 4.7 State TWO advantages of a mercury thermometer. (2)
- [18]**

**QUESTION 5**

- 5.1 Name THREE phases in which matter can exist and give an example of each. (3)
- 5.2 FIGURE 4 below shows the construction of an atom. Label the parts numbered (5.2.1–5.2.3) and indicate the charge of each particle.



**FIGURE 4**

- 5.3 Explain the following terms:
  - 5.3.1 Evaporation
  - 5.3.2 Solidification(2 × 1) (2)
- 5.4 What causes a substance to change phase? (1)
- 5.5 Define the following terms:
  - 5.5.1 Matter
  - 5.5.2 Ion
  - 5.5.3 Element(3 × 1) (3)

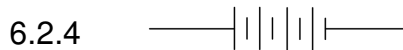
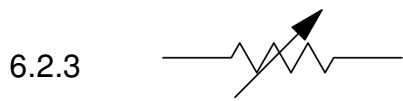
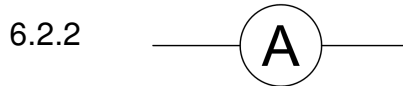
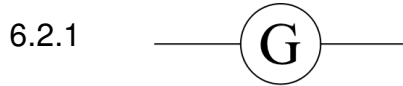
**[12]**



**QUESTION 6**

6.1 Define the term *conductor* and give ONE example thereof. (2)

6.2 Name the following symbols of electrical components.



( $\frac{1}{2} \times 4$ ) (2)

6.3 Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (6.3.1–6.3.4) in the ANSWER BOOK. Correct the statement if it is FALSE.

6.3.1 An electrical bell is an example of electromagnetism.

6.3.2 The temperature of a conductor doesn't affect the resistance of a conductor.

6.3.3 The magnetic field around a conductor induce a current in the conductor.

6.3.4 Ohm's law states that current in a circuit directly proportional is to the resistance of the circuit.

(4 × 1) (4)

6.4 Three resistors of 36  $\Omega$ , 56  $\Omega$  and 23  $\Omega$  are connected in parallel over a power source of 12 V.

6.4.1 Draw a neat, labelled sketch of the circuit. (2)

Calculate the following:

6.4.2 The total resistance of the circuit. (2)

6.4.3 The total current of the circuit. (1)

6.4.4 The total power of the circuit. (1)

- 6.5 In what way will the following factors influence the resistance of a conductor?
- 6.5.1 Type of metal.
- 6.5.2 Length of conductor. (2 × 1) (2)
- 6.6 When the temperature of a conductor like silver rises, the resistance of the conductor also rises. What happens in the following materials if the temperature rises?
- 6.6.1 Insulators like bakelite.
- 6.6.2 Alloys like brass. (2 × 1) (2)
- 6.7 The heating effect of an electric current depends on THREE factors.  
Name these factors. (3)
- 6.8 Define *Fleming's right-hand rule* for a straight current carrying conductor. (1)
- 6.9 With the aid of a neat labelled sketch, explain the working of a relay. (4)
- [26]**
- TOTAL: 100**

**ENGINEERING SCIENCE N1****FORMULA SHEET**

Any applicable formula may also be used.

$$1. \quad v = \frac{s}{t}$$

$$2. \quad F = m.g$$

$$3. \quad DR = \frac{E_{dist.}}{L_{dist.}}$$

$$VV = \frac{M_{afst.}}{L_{afst.}}$$

$$4. \quad MA = \frac{L}{E}$$

$$HV = \frac{L}{M}$$

$$5. \quad VR = \frac{D}{d}$$

$$SV = \frac{D}{d}$$

$$6. \quad \text{MOMENT} = F.s$$

$$7. \quad T = F.R$$

$$8. \quad W = F.S$$

$$9. \quad P = \frac{W}{t}$$

$$10. \quad P = F.v$$

$$11. \quad Q = m.c. \Delta t$$

$$12. \quad L_f = L_o + \Delta L$$

$$13. \quad L_f = L_o - \Delta L$$

$$14. \quad P = V.I$$

$$15. \quad P = I^2.R$$

$$16. \quad P = \frac{V^2}{R}$$

$$17. \quad Q = P.t$$

$$18. \quad I = \frac{V}{R}$$

$$19. \quad R_t = R_1 + R_2 \dots$$

$$20. \quad \frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} \dots$$