

**DEPARTMENT OF HIGHER EDUCATION AND TRAINING**  
**REPUBLIC OF SOUTH AFRICA**  
NATIONAL CERTIFICATE  
ENGINEERING SCIENCE N1  
TIME: 3 HOURS      NOV 2011  
MARKS: 100

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**INSTRUCTIONS AND INFORMATION**

1. Answer ALL the questions.
  2. Read ALL the questions carefully.
  3. Questions can be answered in any order.
  4. Keep subsections of questions together.
  5. Rule off across the page on completion of each question.
  6. ALL sketches should be drawn using suitable drawing instruments.
  7. Sketches must be neat and in good proportion.
  8. ALL the calculations should consist of at least THREE steps:
    - 8.1 The correct, appropriate formula or manipulation thereof
    - 8.2 The correct substitution of values
    - 8.3 The answer with the correct SI unit
- NOTE:  $g = 9,8 \text{ m/s}^2$   
 $1 \text{ m/s} = 3,6 \text{ km/h}$
9. Number the answers correctly according to the numbering system used in this question paper.
  10. Write neatly and legibly.
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### QUESTION 1: DYNAMICS

- 1.1 Define the following terms:
- 1.1.1 Scalar (1)
  - 1.1.2 Velocity (1)
- 1.2 An athlete takes 12 seconds to run 100 m at a constant velocity.
- 1.2.1 Draw a displacement-time graph of the athlete's movement. (Use scale 1 cm = 10 m and 1 cm = 1 s) (4)
  - 1.2.2 Read from the graph the distance the athlete has travelled in four seconds. (1)
  - 1.2.3 Calculate the end velocity of the athlete. (3)
- 1.3 A person travelled from A to B according to the route in FIGURE 1 below. The trip took 1 hour to complete.

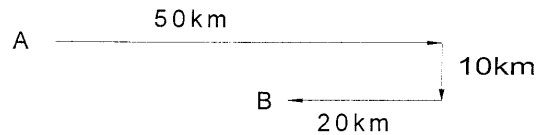


FIGURE 1

Calculate the following:

- 1.3.1 The distance travelled from A to B (1)
  - 1.3.2 The displacement between A and B by means of vector adding. Use scale 1,5 cm = 10 km (3)
- [14]

### QUESTION 2: STATICS

- 2.1 When a force is represented, there are three properties you must keep in mind. Name the THREE properties. (3)
- 2.2 Define the following:
- 2.2.1 Mechanical advantage (1)
  - 2.2.2 Law of moments (1)

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- 2.3 FIGURE 2 below shows a system of forces.  
Identify the following:  
Write only the symbol or magnitude of the force next to the question number  
(2.3.1 – 2.3.2) in the ANSWER BOOK.

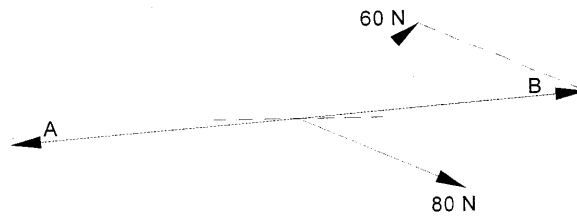


FIGURE 2

- 2.3.1 Equilibrant (1)  
2.3.2 Resultant (1)
- 2.4 2.4.1 Draw a neat, labelled sketch of a pulley system with TWO pulleys in the upper block and THREE pulleys in the lower block. (3)  
2.4.2 Calculate the displacement ratio of the system. (1)
- 2.5 A force of 900 N is applied on the one end of a spanner 400 mm long. Calculate the torque applied on the nut. (3)
- 2.6 A lifting machine is used to lift a load up to a height of 800 mm when an effort moves through a distance of 4 m.  
Calculate the following:
- 2.6.1 The displacement ratio (2)  
2.6.2 The effort needed to lift a load of 200 kg if the mechanical advantage is 4 (2)

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### QUESTION 3: ENERGY, WORK AND POWER

- 3.1 What is the difference between work done and power? (Do NOT use formulae and SI units.) (1)
- 3.2 A lifting machine is used to hoist a bucket of water with a mass of 20 kg out of a well, 30 m deep.
- 3.2.1 Calculate the weight of the water. (1)
- 3.2.2 Draw the force/distance graph of this work done.  
(Use scale 3 m = 1 cm and 20 N = 1 cm) (2)
- 3.2.3 Use the graph to determine the work done. (2)
- 3.3 A motorcar travels at a speed of 120 km/h on a horizontal road. The resistance force is 1 200 N.
- Calculate the following:
- 3.3.1 The speed in m/s (1)
- 3.3.2 The power developed through the engine of the motor in KW (1)
- 3.4 Indicate whether the following statement is TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (3.4) in the ANSWER BOOK.
- If 1 Joule of work is done onto a body and it moves 1 meter in 1 second, it is said that the rate at which work is done is 1 Watt. (1)
- 3.5 Calculate the time (in hours) it will take to travel 120 km with a force of 1 200 N and with the help of a 25 KW engine. (2)
- 3.6 A body has a mass of 80 kg on earth. Determine its mass on the moon. (1)
- [12]**

### QUESTION 4: TEMPERATURE AND HEAT

- 4.1 Define *temperature* and also write the SI unit. (2)
- 4.2 Make a neat, labelled sketch of a thermo-couple. (2)
- 4.3 State TWO advantages of an alcohol thermometer. (1)
- 4.4 How is heat transferred in the following mediums?
- 4.4.1 Vacuums
- 4.4.2 Liquid
- 4.4.3 Solid (3)

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- 4.5 A body with a mass of 2,2 kg has a specific heat capacity of 3,2 kJ/kg °C. It emits 897 kJ of heat when cooled in water which has a specific heat capacity of 4 187 J/kg °C. The original temperature of the body was 165 °C.
- Calculate the following:
- 4.5.1 Final temperature of the mixture (2)
- 4.5.2 Mass of water required if the initial temperature of the water was 5°C (2)
- 4.6 Define *linear coefficient of expansion*. (2)
- 4.7 When a steel pipe with a length of 122,3 m is heated, its length increases by 102 mm.
- Calculate the final length of the pipe in millimetres. (1)
- 4.8 Calculate the final temperature of 2 kg of mercury with specific heat capacity of 138 J/kg °C if 579 J of heat is added to it when it is at a temperature of 4 °C. (2)
- 4.9 Define *specific heat capacity*. (1)

[18]

#### QUESTION 5: PARTICLE STRUCTURE OF MATTER

- 5.1 Name the THREE phases of matter and give ONE example of each. (3)
- 5.2 Define *an atom*. (2)
- 5.3 Name ALL the possible components of an atom and state also the electric charge of each component. (3)
- 5.4 Name the process that takes places when matter changes from:
- 5.4.1 A solid to a liquid
- 5.4.2 A liquid to a solid
- 5.4.3 A liquid to a gas (3)
- 5.5 Choose from the following list TWO solids that can be in a crystal structure:

mercury, carbon, sugar, salt, glass, oxygen

(1)  
[12]

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**QUESTION 6: ELECTRICITY**

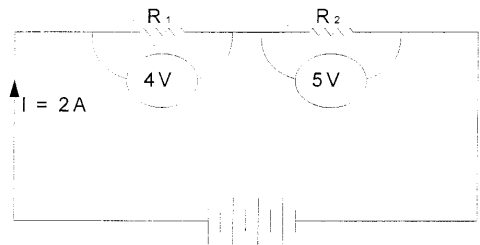
6.1 Complete the following sentence by filling in only the missing word from the following list:

positive, negative, neutral

When a resistor and a battery are connected in series, the current flows from (6.1.1) ... pole of the battery to the (6.1.2) ... pole of the battery. (2)

6.2 What happens to the resistance of the conductor if the conductors become longer, but the diameter stays the same? (1)

6.3 The FIGURE 3 below shows a circuit diagram with two resistors connected in series.



**FIGURE 3**

Calculate the following:

6.3.1 The voltage of the battery (1)

6.3.2 The total resistance of the circuit (2)

6.3.3 The value of  $R_1$  (2)

6.3.4 The power developed in  $R_2$  (2)

6.4 A heater is marked, 2 200 W; 240 V.

Calculate the following:

6.4.1 Energy used in 10 minutes (2)

6.4.2 Value of the current (2)

6.5 Describe the following:

6.5.1 Potential difference (1)

6.5.2 Direct current (1)

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- 6.6 If the temperature of the following materials increases, what will happen to their resistance?
- 6.6.1 Bakelite (1)
  - 6.6.2 Brass (1)
- 6.7 Define the property of *resistivity*. (2)
- 6.8 Formulate Fleming's right-hand rule. (2)
- 6.9 Draw a neat, labelled single stroke bell. (4)

**[26]**

**TOTAL: 100**