

**DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA**

NATIONAL CERTIFICATE
ENGINEERING SCIENCE N1

TIME: 3 HOURS

MARKS: 100

AUG 2011

INSTRUCTIONS AND INFORMATION

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

1.1 A man has a mass of 80 kg on the moon.

Calculate the following:

1.1.1 The mass of the man on earth (1)

1.1.2 The weight of the man on earth (2)

1.2 Two forces act on a point. The one force (A) is 100 N South, the other force (B) is 180N North.

Calculate the magnitude and direction of the force that will keep the system of forces in equilibrium. (3)

1.3 A rock has been dropped from a space shuttle. It takes five seconds to fall a distance of 100 m to reach a velocity of 40 m/s, just before it reaches the ground of the planet.

Calculate the following:

1.3.1 The gravitational acceleration of the planet (4)

1.3.2 The average velocity of the rock (4)

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QUESTION 2: STATICS

2.1 Define the *equilibrant* of TWO or more forces. (2)

2.2 FIGURE 1 below shows THREE forces in equilibrium acting on a point. By using Bow's notation, draw a vector diagram needed to represent the forces.

(NOTE: Do NOT calculate the forces.)

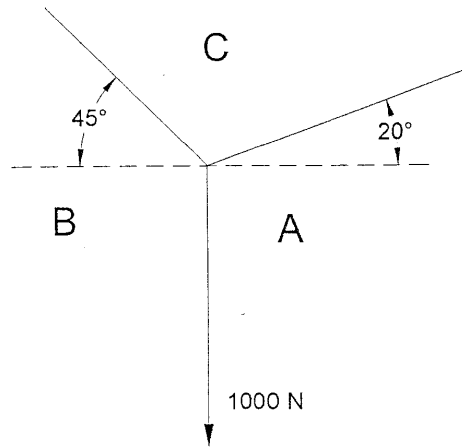


FIGURE 1

(4)

2.3 FIGURE 2 below shows a force acting on a pulley. Calculate the moment of the force around the axle.

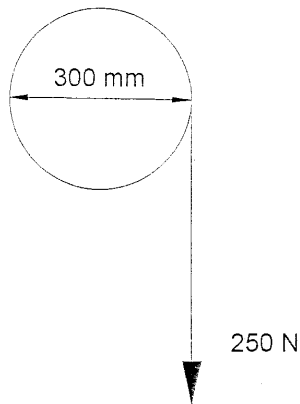


FIGURE 2

(3)

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- 2.4 FIGURE 3 below shows two forces applied on a body. Use the parallelogram method to determine the magnitude and direction of the resultant and equilibrant forces of the TWO forces.

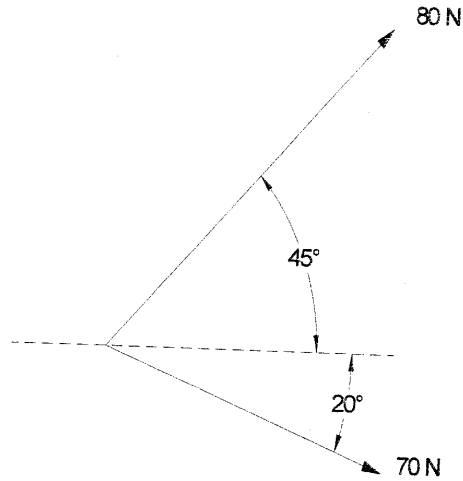


FIGURE 3

(4)

- 2.5 An effort of 125 N is applied over a distance of 1.5 m to lift a rock of 120 kg over a distance of 120 mm.

Calculate the following:

- 2.5.1 Mechanical advantage (2)
- 2.5.2 Displacement ratio (2)
- 2.6 Define *torque*. (1)

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QUESTION 3: ENERGY, WORK AND POWER

3.1 Define *energy* and also give its symbol and SI-unit. (2)

3.2 Define the *law of conservation of energy* and give an example to illustrate this term. (2)

3.3 FIGURE 4 below is that of a force/distance graph representing the force exerted by a tractor on a trailer.

Study the graph and answer the questions that follow:

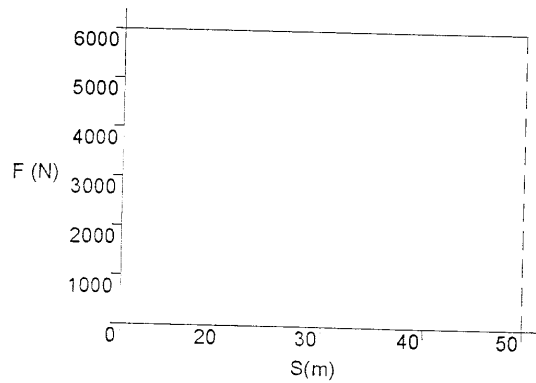


FIGURE 4

3.3.1 Calculate the mass of the tractor. (1)

3.3.2 What does the area of this graph represent? (1)

3.3.3 Determine the area of the graph. (2)

3.3.4 If the force is exerted over a period of TWO minutes. Calculate the power of the engine of the tractor. (2)

3.4 A small diesel locomotive develops a power of 70 kW and exerts a force of 1,4 kN onto the railway lines.

Calculate the speed that the locomotive will reach. (2)
[12]

QUESTION 4: TEMPERATURE AND HEAT

- 4.1 Define heat and also write down the symbol and SI-unit. (2)
- 4.2 Make a neat, labelled sketch of a thermometer that can be used in the house. (3)
- 4.3 State TWO advantages of a mercury thermometer. (2)
- 4.4 Name the method of heat transfer in each of the following examples:
- 4.4.1 Water heated inside a kettle
 - 4.4.2 Heat transfer in a metal rod
 - 4.4.3 Heater inside a room
 - 4.4.4 Air in a hot-air balloon (2) ✓
- 4.5 An electric kettle contains 3 kg of water at 20 °C.
Calculate the amount of heat energy required to boil the water at sea level.
Take specific heat capacity as 4 187 J/kg °C. (2)
- 4.6 Explain the difference between *specific heat capacity* and *heat capacity*. (2)
- 4.7 A crane has a beam with a length of 47 m at 21 °C. When the temperatures in the winter drop to -7 °C, it is found that the length of the beam is only 46,983 m.
Calculate the following:
- 4.7.1 Change in length in mm (1)
 - 4.7.2 Change in the temperature (2) ✓
- 4.8 What type of thermometer will you use in the following cases?
- 4.8.1 Inside a freezer (1)
 - 4.8.2 Boiling water (1)

[18]

QUESTION 5: ATOMIC STRUCTURE OF MATTER

- 5.1 Define *matter*. (1)
- 5.2 Define the THREE properties in the motion of the particles in the gaseous phase. (3)
- 5.3 Explain what the following terms mean:
- 5.3.1 Evaporation (1)
- 5.3.2 Solidification (1)
- 5.4 Classify which of the following substances are SOLIDS, GASES and LIQUIDS at room temperature:
Carbon; Oxygen; Copper; Mercury (2)
- 5.5 State the electrical charge in each of the following:
- 5.5.1 The proton
- 5.5.2 The neutron
- 5.5.3 The electron
- 5.5.4 The atom (2)
- 5.6 Name the smallest part of an element. (1)
- 5.7 What causes a substance to change phase? (1)

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QUESTION 6: ELECTRICITY

- 6.1 State ONE example of a conductor and ONE example of an insulator. (1)
- 6.2 Does a conductor have a high or low resistance against the flow of electricity? (1)
- 6.3 Give the symbols of each of the following circuit components:
- 6.3.1 Variable resistor
- 6.3.2 Battery
- 6.3.3 Galvanometer
- 6.3.4 Ammeter (4)

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- 6.4 Define *alternating current*. (2)
- 6.5 Three resistors of $5\ \Omega$, $10\ \Omega$ and $13\ \Omega$, respectively, are connected in parallel in a circuit with a $24\ \text{V}$ DC voltage source.
- 6.5.1 Draw a circuit diagram with all the symbols in the diagram. (3)
- Calculate the following:
- 6.5.2 The total resistance (2)
- 6.5.3 The total current (1)
- 6.5.4 The current in the $13\ \Omega$ resistor (1)
- 6.5.5 The heat generated in the $13\ \Omega$ resistor in TWO minutes (2)
- 6.6 Describe Joule's law. (2)
- 6.7 An electrical lamp is marked as follows: $240\ \text{V}$, $100\ \text{W}$.
- Calculate the following:
- 6.7.1 The current in the lamp (1)
- 6.7.2 The resistance of the filament (1)
- 6.8 Make a neat, labelled drawing of an electromagnet. Show also the north pole. (3)
- 6.9 Name TWO practical uses of a relay switch. (2)
- [26]**
- TOTAL: 100**