

GAUTENG DEPARTMENT OF EDUCATION
SENIOR CERTIFICATE EXAMINATION

FEB / MAR 2006

TECHNIKA (MECHANICAL) SG

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

- Pocket calculator
- Drawing instruments
- Information sheet (pages 9 to 12)

INSTRUCTIONS:

- ALL questions are COMPULSORY.
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QUESTION 1A
MULTIPLE-CHOICE QUESTIONS

Each of the following questions is supplied with various possible answers. Choose the correct answer or answers. Write down the question numbers below one another and **ONLY** the letter(s) of your choice next to them. The mark allocation on the right serves as an indicator of the number of correct questions.

- 1.1 Accidents in the workshop are caused by either personal or work-related factors. Which of the following are **work-related** factors?
- A. Careless attitudes
 - B. Faulty electrical wiring of machines
 - C. Lack of knowledge or skills
 - D. Inadequate tooling
 - E. Broken down machines
- (3)
- 1.2 Two spur-gears will only mesh properly if _____ .
- A. their circular pitches are equal
 - B. they have an equal number of teeth
 - C. the pitch circle diameters are the same
 - D. they have the same pitch and module
- (1)

- 1.3 Which of the following would influence the magnitude of the helix angle of a screw-thread?
- A. The pitch of the screw-thread
 - B. The outside diameter of the screw-thread
 - C. The lead of the screw-thread
 - D. The type of screw-thread
- (2)
- 1.4 Acme screw-threads are used _____ .
- A. where strong teeth are of the utmost importance
 - B. where backlash has to be eliminated
 - C. to prevent seizure of the thread as a result of sagging
 - D. where quick axial movement is required
- (1)
- 1.5 The concept power is best described as _____ .
- A. a push or a pull
 - B. energy in motion
 - C. the quantity inclined to change the form or state of motion of an object
 - D. action at a distance
 - E. work done
- (1)
- 1.6 A table-cloth can, if quickly pulled, be pulled from beneath a plate without the plate changing its position. This is a good illustration of _____ .
- A. inertia
 - B. Newton's second law
 - C. Newton's third law
 - D. an unbalanced force causing acceleration
 - E. momentum
- (1)
- 1.7 Which of the following is a vector quantity?
- A. Energy
 - B. Momentum
 - C. Mass
 - D. Time
 - E. Distance
- (1)
- 1.8 The minimum resultant of two velocities of 10 m.s^{-1} and 15 m.s^{-1} respectively is _____ .
- A. 0 m.s^{-1}
 - B. 5 m.s^{-1}
 - C. 10 m.s^{-1}
 - D. 25 m.s^{-1}
- (1)

- 1.9 Three blocks, equal in size, are dropped from the same height simultaneously. One block is composed of lead, the second of iron and the third of aluminium. The block(s) which strike(s) the ground first (air resistance not taken into account) is/are _____ .
- A. the lead block
 B. the iron block
 C. the aluminium block
 D. all three simultaneously
 E. the block with the greatest mass (1)
- 1.10 Two blocks, equal in size, of lead and aluminium respectively are dropped from the same height while a horizontal force equal in magnitude acts on each of the blocks. Which block will move the furthest horizontally?
- A. The lead block
 B. The aluminium block
 C. The blocks will move equal distances horizontally
 D. The one with the greatest mass
 E. The one with the greatest volume (1)
- 1.11 The kinetic energy of an object mostly changes by doubling its _____.
- A. mass
 B. temperature
 C. volume
 D. velocity
 E. weight (1)
- 1.12 A machine develops a power of $5 \times 10^4 \text{W}$. The work done in 2 hours, in kilowatt hours is _____ .
- A. 1,6 kW.h
 B. 50 kW.h
 C. 100 kW.h
 D. 150 kW.h
 E. 10^5kW.h (1)
- 1.13 A machine does work at a tempo of 1,2 kW. The work done in one minute is _____ .
- A. 1,2 J
 B. 1 200 J
 C. 2 J
 D. 72 J
 E. 72 000 J (1)

- 1.14 A man stands on the edge of a cliff and fires a bullet horizontally from a gun. At the same instant, he drops a similar bullet from the cliff. The time taken for the bullets to reach the ground (air resistance not taken into account) _____ .
- A. is the same for both
 B. is longer for the bullet that was dropped
 C. depends upon the velocity at which the bullet was fired
 D. depends on the height of the cliff (1)
- 1.15 An object has simultaneous velocities of 8 m/s south and 6 m/s west, respectively. The resultant velocity is _____ .
- A. 14 m/s in direction $53^{\circ}8'$
 B. 10 m/s in direction $53^{\circ}8'$
 C. 10 m/s in direction $36^{\circ}52'$
 D. 10 m/s in direction $233^{\circ}8'$
 E. 10 m/s in direction 216° (1)
- 1.16 According to Boyle's Law, for a mass of gas at constant temperature _____ .
- A. the pressure is constant
 B. the volume increases
 C. the pressure is directly proportional to the volume
 D. the pressure is inversely proportional to the volume
 E. the pressure is equal to the volume (1)
- 1.17 Diodes in an alternator charging system _____ .
- A. increase alternating current
 B. regulate current
 C. convert alternating current to direct current (1)

QUESTION 1B

- 1.18 Study the following statements and determine whether they are TRUE or FALSE. Write only the question numbers beneath each other and the word TRUE or FALSE next to it.
- 1.18.1 The included angle of an Acme screw-thread is 27° . (1)
- 1.18.2 Differential indexing is the simplest method of indexing. (1)
- 1.18.3 When a square screw-thread is cut, the compound slide is not set at an angle. (1)
- 1.18.4 A milling machine makes it possible to mill gears. (1)
- 1.18.5 The sector arms of a dividing head prevent an error from being made when the number of holes are counted with each movement of the index pin. (1)

- 1.19 Describe the concept **tools**. (6)
- 1.20 Classify tools into FOUR main groups. (4)
- 1.21 What is the main aim of the Factory Act? (2)
- 1.22 Name the causes of burns. (3)
- [40]**

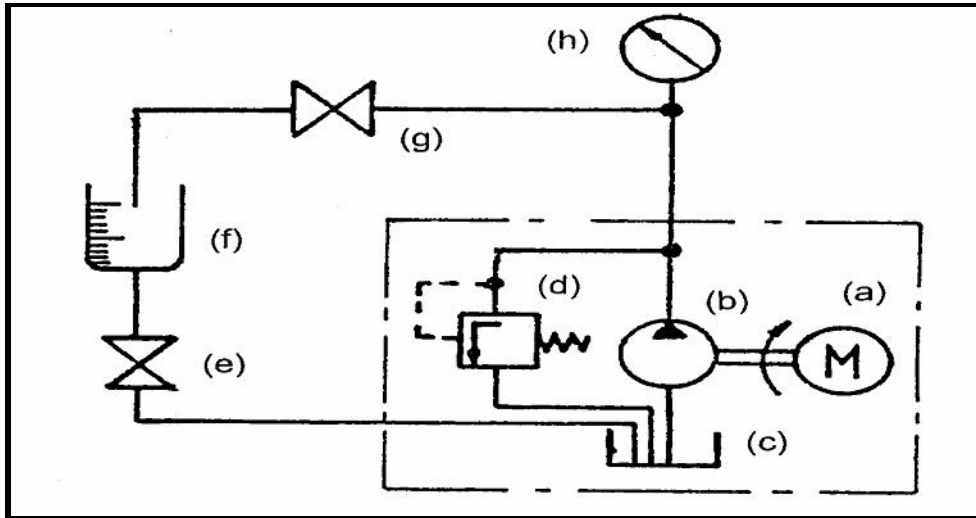
QUESTION 2

- 2.1 A steel rod is subjected to a compressive load of 55 kN. The stress developed in the rod is 175 MPa. Calculate the diameter of the rod in mm. (7)
- 2.2 Name THREE types of stress and illustrate each by means of a sketch. (9)
- 2.3 Briefly describe the following tests and illustrate your answers with the aid of simple sketches:
- 2.3.1 The Brinell hardness test (8)
- 2.3.2 The Rockwell hardness test (8)
- 2.4 What is an employee's responsibility with regard to industrial disease? (4)
- 2.5 State FOUR aspects with regard to safe working conditions for employees which are considered important when designing a factory building. (4)
- [40]**

QUESTION 3

- 3.1 A fluid pressure of 350 MPa is required in the cylinder of a hydraulic press. Calculate the magnitude of the force that must be exerted on the 120 mm diameter piston to obtain the required pressure. (9)
- 3.2 Name any FOUR applications of hydraulic systems. (4)

- 3.3 The following flow diagram illustrates the layout of the hydraulic system. Name the components of the hydraulic system marked (a) to (h) on the diagram. (8)



- 3.4 What is the aim of the measuring vessel and a non-return valve? (4)
- 3.5 Define **kinetic** and **potential energy**. (6)
- 3.6 Define the **Law of Moments**. (4)
- 3.7 Name the qualities of an ideal gas. (5)

[40]

QUESTION 4

- 4.1 State the THREE main types of fits and illustrate, by means of simple sketches, the differences between them. (9)
- 4.2 Using the Table of primary fits on page 12, calculate the following for a 45H9-d10 hole-shaft combination:
- 4.2.1 The low limit and high limit of the hole (4)
- 4.2.2 The low limit and high limit of the shaft (4)
- 4.2.3 The tolerance of the shaft (2)
- 4.2.4 The tolerance of the hole (2)
- 4.2.5 The maximum allowance for the fit (2)
- 4.2.6 The minimum allowance for the fit (2)
- 4.2.7 State the type of fit. (1)

- 4.3 Calculate the width, length and thickness of an ordinary parallel key that is used to secure a component to a 20 mm diameter shaft. (6)
- 4.4 Name FOUR facets that are important for good work stream planning. (4)
- 4.5 Define **mean effective pressure** (MEP). (4)
- [40]**

QUESTION 5

- 5.1 Name SIX basic functions of an engineer. (6)
- 5.2 What is the meaning of the Latin word *ingenium* and what connotation does it have? (4)
- 5.3 To rotate a car engine at 50 revolutions per minute, a force of 135 Newton is perpendicularly applied to the crank-arm of the cylinder. The distance from the centre of the crank to the point of the applied force is 168 mm.
- Calculate:
- 5.3.1 The torque (5)
- 5.3.2 The power (5)
- 5.4 The following data refers to a two-cylinder, two-stroke engine which was tested with a Pröny brake:
- | | |
|-------------------------|-----------|
| Mean effective pressure | 875 kPa |
| Length of stroke | 86 mm |
| Cylinder bore | 84 mm |
| Revolutions per minute | 1 850 rpm |
| Brake arm length | 410 mm |
| Spring balance reading | 25 kg |
- Assume that 1 kg = 9,8 N
- Calculate the
- 5.4.1 indicated power. (9)
- 5.4.2 brake power. (7)
- 5.4.3 mechanical efficiency. (4)
- [40]**

TOTAL: 200