FURTHER EDUCATION & TRAINING PHASE (FET)

MECHANICAL TECHNOLOGY

SBA EXEMPLAR BOOKLET

GRADES 10-12

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

Read to Lead
A Reading Nation is a Leading Nation

2030 NDP

FOREWORD

The Department of Basic Education has pleasure in releasing a subject exemplar booklet for School Based Assessment (SBA) to assist and guide teachers with the setting and development of standardised SBA tasks and assessment tools. The SBA booklets have been written by teams of subject specialists to assist teachers to adapt teaching and learning methods to improve learner performance and the quality and management of SBA.

The primary purpose of this SBA exemplar booklet is to improve the quality of teaching and assessment (both formal and informal) as well as the learner's process of learning and understanding of the subject content. Assessment of and for learning is an ongoing process that develops from the interaction of teaching, learning and assessment. To improve learner performance, assessment needs to support and drive focused, effective teaching.

School Based Assessment forms an integral part of teaching and learning, its value as a yardstick of effective quality learning and teaching is firmly recognised. Through assessment, the needs of the learner are not only diagnosed for remediation, but it also assists to improve the quality of teaching and learning. The information provided through quality assessment is therefore valuable for teacher planning as part of improving learning outcomes.

Assessment tasks should be designed with care to cover the prescribed content and skills of the subject as well as include the correct range of cognitive demand and levels of difficulty. For fair assessment practice, the teacher must ensure that the learner understands the content and has been exposed to extensive informal assessment opportunities before doing a formal assessment activity.

The exemplar tasks contained in this booklet, developed to the best standard in the subject, is aimed to illustrate best practices in terms of setting formal and informal assessment. Teachers are encouraged to use the exemplar tasks as models to set their own formal and informal assessment activities.

MR HM MWELI

DIRECTOR-GENERAL

DATE: 13/09/2017

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1. INTRODUCTION

The School-Based Assessment Booklet

The booklet is intended as a guide for the development of Mechanical Technology Assessment tasks. This SBA booklet has exemplars tasks for Grades 10 and 11. It provides provinces, districts and schools with examples of quality assured School-Based Assessment tasks for Mechanical Technology. Whilst the purpose of the guideline is to focus on formal assessment tasks in SBA, it needs to be emphasised that informal assessments must be given the same degree of importance and attention. Assessment tasks in this booklet include term tests and examinations. These tests and examinations (theory and practical) are a collection of assessment methods and questions which samples a domain of knowledge and/or skills.

The CAPS refer to informal assessment as daily assessment, which can be done through observations, discussions, classroom activities, homework, investigation (research), etc. not be seen in isolation from formal assessment. Informal assessments are important as they lay the foundation for learners to do formal assessments. Informal assessments are integral to learners achieving the required standards of knowledge and skills needed to achieve successful results in their formal assessment tasks. Therefore, *informal daily assessment activities need to be well planned and developed to meet the required standards to support learners to achieve the desired good results*.

- It provides teachers with feedback that enables them to adapt their teaching strategies to effectively and efficiently meet the needs of their learners
- It stimulates continuous evaluation and adjustment of the teaching and learning programme.

It complements other forms of assessment, including external examinations. This booklet makes Subject advisors and teachers aware of the three compulsory components when developing assessment tasks:

- The assessment task
- The assessment tool
- The analysis grid

1.1.1 SCHOOL-BASED ASSESSMENT.

School-based assessment (SBA) is a form of assessment that is embedded in the teaching and learning process and is an integral part of learners' preparation for the final examinations. It has a number of important characteristics which distinguish it from other forms of assessment:

- It involves the teacher from the beginning to the end: from planning the assessment programme to identifying and/or developing appropriate assessment tasks right through to making the assessment judgments.
- It allows for the collection of a number of samples of learner performance over a period of time.

- It can be adapted and modified by the teacher to match the teaching and learning goals of the particular class and learners being assessed.
- It is carried out in the classroom and is conducted by the learners' own teacher.
- It takes place at different stages of the learning process, as required in Chapter 4 of the Curriculum and Assessment Policy Statement (CAPS).
- It involves learners more actively in the assessment process, especially if self and/or peer assessment is used in conjunction with teacher assessment.
- It allows the teacher to give learners immediate and constructive feedback on how they perform individually, as well as in relation to their peers (teamwork).
- It provides teachers with feedback that enables them to adapt their teaching strategies to effectively and efficiently meet the needs of their learner.
- It stimulates continuous evaluation and adjustment of the teaching and learning

1.1.2 AIMS AND OBJECTIVES

School-Based Assessment should:

- Provide a more balanced and trustworthy assessment system, increasing the range and diversity of assessment tasks.
- Improve the validity of practical assessment in particular by including aspects that cannot be assessed in formal examination settings.
- Improve the reliability of assessment because judgements will be based on many observations of the learners over an extended period of time.
- Have a beneficial effect on teaching and learning, particularly in relation to the development of teaching and assessment practices.
- Empower teachers to become part of the assessment process.
- Enhance collaboration and sharing of expertise within and across schools.
- Have a professional developmental function, building up knowledge and skills.

Unless assessment criteria are communicated clearly to learners, assessment will not improve learning (or teaching).It is only when learners understand the assessment criteria, and how they are applied to the responses they produce, that they can actually take responsibility for their own learning.

1.1.3 THE SEVEN ROLES OF A TEACHER [Emilia Potenza, M& G, Feb. 2002]

Emilia Potenza (Feb. 2002) identified the following **roles** of a teacher:

- **Learning Mediator**-the teacher is sensitive to diverse needs of his/her learners, he/she becomes an inspiration to his/her learners
- **Interpreter and designer of learning programme and materials**-The teacher should understand and interpret the already existing learning programmes and design/prepare appropriate textual and visual resources for learning.
- **Scholar, researcher and lifelong learner**- Teachers are expected to pursue their own ongoing personal, academic, occupational and professional growth.
- **Community, citizenship and pastoral role**- Teachers are to ensure that learners develop a sense of respect and responsibility toward others upholding the Constitution and promoting democracy
- **Assessor**-Continuous Assessment is an integral part of any meaningful teaching and learning

- **Subject Specialist**-The teacher should be well-grounded in his/her subject in terms of pedagogical content knowledge, skills and procedures of the subject and
- In addition to these roles, the teacher is also **a Leader** who continually **inspire, motivate** and **guide** his/her learner towards the accomplishment of the subject set target.

1.1.4 ACKNOWLEDGEMENTS

This booklet was made possible by the contributions of teachers, Subject Advisors and Provincial Subject coordinators from the nine provinces.

1.1.5 PRINCIPLES UNDERPINNING EFFECTIVE ASSESSMENT PRACTICE

- Assessment provides complete information about learner achievement
- Assessment is a complementary part of the teaching process (of learning and of teaching).
- Assessment is based on making use of multiple different methods
- Assessment is a continuous process.
- Assessment is fair, transparent, valid and reliable

1.1.6 THE PRINCIPLES OF ASSESSMENT

The SBA must always demonstrate equal opportunity to learning, consistency and realistic expectations by being validity, realible, fair, suffiecient, etc.

Valid assessment

The assessment task is valid when it is based on the content and standards as set out in the CAPS. The content, skills, values and attitudes included in the assessment task must be based on the work learners have completed as per the Annual Teaching Plan (ATP) in the CAPS.

Reliable assessment

Reliable assessment also means that when the assessment is developed, the input processes are well organised and based on sound theoretical and assessment principles. An assessment is deemed reliable when the results obtained from a formal assessment produce the same results every time it is used to assess learners.

Fair assessment

The method of assessment should not present any barriers to the learners' achievements. It must be free of bias and sensitive to contextual factors. The types of questions asked must be age appropriate. The questions must be based on the content, skills, values and attitudes that have been taught to the learner over a period of time. In addition, the distribution of the cognitive levels (low-, medium- and high-order questions) must be aligned to the requirements as stipulated in Section 4 of the CAPS for Electrical Technology.

Sufficient assessment

Sufficient assessment within the context of the Grades R – 12 means that the spread of content, skills and values assessed are based on the work done during the term or year/phase according to the Annual Teaching Plan. Learners should be able to complete the assessment task within the stipulated time.

1.1.7 THE FIVE STEPS OF QUALITY SCHOOL-BASED ASSESSMENT

Step 1: Generating and collecting evidence of learners' performance.
This is done through the various assessment tasks given to learners by the teacher.

Step 2: Assessing learners' performance
This is achieved when the teacher marks the learners' responses using an appropriate assessment tool in order to arrive at a mark that indicates the learners' understanding of the topic(s) covered by the assessment task.

Step 3: Recording learners' performance.
The teacher records the learners' marks to track their progress throughout the year and also records specific challenges experienced by the learners in order to plan intervention.

Step 4: Analysing learners' performance to improve the process of learning and teaching.
By analysing learner responses, the teacher may choose to repeat certain aspects of the content or use a variety of strategies to improve learning. This can be followed by extended opportunities for learners to improve their learning.

Step 5: Feedback to learners.
Feedback from the teacher is essential to improve the learners' confidence, self-awareness and enthusiasm for learning. It should be done in such a way that it maximises the learners' potential at different stages of the learning and teaching process.

1.1.8 THE THREE FUNCTIONS OF A QUALITY ASSESSMENT PROGRAMME

- ASSESSMENT ***FOR*** LEARNING - teachers monitor learners' progress to inform their teaching.
- ASSESSMENT ***AS*** LEARNING - learners reflect on their progress to inform their future learning.
- ASSESSMENT ***OF*** LEARNING - teachers use evidence of learners' performance to make judgments on learner achievement against clearly stated standards.

School-based Assessment needs to be continuous and integrated naturally into every stage of the teaching-learning cycle, not just at the end.

1.1.9 FORMATIVE AND SUMMATIVE ASSESSMENT

The difference between formative and summative assessment
School-based assessment tasks can be used for *formative* as well as *summative* purposes.

Summative assessment
Refers to more formal, planned assessments at the end of a unit or term/year, which are used primarily to assess learners' progress.

Formative assessment
Is usually more informal and more frequent, involving the gathering of information about learners and their learning needs while they are still learning.

ormative assessment has two key functions: informing and forming. In other words, formative assessment shapes the decisions about what to do next by helping the teacher to select what to teach in the next lesson, or even in the next moment in the lesson and the learners to understand what they have learnt and what they need to learn next.

1.1.10 Informal or daily assessment (assessment *for* learning)

Assessment for learning has the purpose of continuously collecting information on learners' achievements, which can be used to improve their learning. Informal assessment is a daily monitoring of learners' progress. This is done through observations, discussions, practical demonstrations, learner-teacher communication, informal classroom interactions, etc. Informal assessment may be as simple as stopping during the lesson to observe learners or to discuss with learners how learning is progressing. Informal assessment should be used to provide feedback to the learners and to inform planning for teaching, but need not be recorded. It should not be seen as separate from learning activities taking place in the classroom. Learners or teachers can mark these assessment tasks.

1.1.11 FORMAL ASSESSMENT (ASSESSMENT *OF* LEARNING)

All assessment tasks that make up a formal programme of assessment for the year are regarded as formal assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes. All formal-assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that proper standards are maintained.

Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments include projects, oral presentations, demonstrations, performances, tests, examinations, practical tasks, etc. This form of assessment should be marked by the teacher and not the learner.

All formal assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that proper standards are maintained.

The teacher must submit the annual formal programme of assessment to the School Management Team (SMT). This will be used to draw up a school assessment plan in each grade. The school assessment plan should be provided to learners and parents in the first week of the first term. Formal assessment tasks form part of a year-long formal Programme of assessment in each grade and subject.

1.1.12 QUALITY ASSURANCE PROCESS

Quality assurance of SBA is the planned and systematic process of ensuring that SBA tasks are valid, reliable, practicable, as well as equitable and fair, and thus increasing public confidence in SBA. This would include all the activities that take place before, during and after the actual assessment, that contribute to the improved quality of SBA. Quality assurance helps to support teachers and build expertise and capacity in the education system to deliver positive outcomes for learners. Through sharing, understanding and applying standards and expectations, quality assurance helps to raise standards and expectations, and levels of consistency across teachers

2. THE PROGRAMME OF ASSESSMENT FOR MECHANICAL TECHNOLOGY

All assessment tasks that make up a formal programme of assessment for the year are regarded as formal assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes.All formal assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that proper standards are maintained.

- Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments include projects, oral presentations, demonstrations, performances, tests, examinations, practical tasks, etc. Formal assessment tasks form part of a year-long formal Programme of Assessment in each grade and subject. The formal assessment requirements for Electrical Technology are as follows In Grades 10 and 11 all SBA is set and moderated internally.

- In Grade 12 the formal assessment (25%) is internally set and marked but externally moderated.

PROGRAMME OF ASSESSMENT		
School-Based Assessment (SBA)	Practical Assessment Task (PAT)	Final examination
25%	**25%**	**50%**

- **Practical Assessment Task (PAT):** PAT accounts for the skills the learner has mastered. It is assessed at intervals and requires the learner to engage in multiple practical sessions. During these weekly sessions, skills such as simulation, experimentation, hand skills, tool skills, machine skills and workshop practice are honed and perfected to the point where the learner may engage in the tasks set out for that particular term. The PAT accounts for 25% of the learner's promotion mark.

- In Grades 10 and 11, the Practical Assessment Task is set and marked internally but externally moderated.

- In Grade 12 the Practical Assessment Task is externally set, internally marked and externally moderated.

- **Final examination:** At the end of each academic year, every learner is required to write a final examination, which is compiled in such a way that it represents the entire theoretical content covered throughout the year. The final examination paper accounts for 50% of the learner's promotion mark and is externally set, marked and moderated.

Formal assessments should cater for the range of cognitive levels and abilities of learners as shown below:

Cognitive Levels	Percentage of Task
Lower-order: knowledge	30%
Middle-order: comprehension and application	50%
Higher-order: analysis, evaluation and synthesis	20%

3. COGNITIVE AND DIFFICULTY LEVELS

The cognitive demand of a question is the kind and level of thinking required of learners in order to successfully engage with and answer a question.

- High-order cognitive questions are those that demand that the learners manipulate bits of information previously learnt to create and support an answer with logically reasoned evidence. This sort of question is usually interpretive, evaluative, inquiry-based, inferential, synthesis-based and open-ended.

- Lower-order cognitive questions are more basic. They ask learners to recall material previously presented and learnt. No or very little thinking and reasoning is required. These questions are generally direct, closed, and recall-related and questions that measure knowledge only – factual and process orientated

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The following is the Programme of Assessment for Grades 10 and 11

GRADE 10 AND 11 ASSESSMENT REQUIREMENTS							
ASSESSMENT TASKS	**TERM 1**	**TERM 2**	**TERM 3**	**TERM 4**	**% OF FINAL PROMOTION MARK**		**MARK Weighting**
Tests	1		1		10	25	250 total converted to mark out of **100**
Mid-year		1			15		
Practical Assessment Task (PAT)	√	√	√	√	25		**100**
Final Examination				1	50		**200**
				TOTAL – PROMOTION MARK			**400**

The table below shows the compilation of the SBA mark:

Description	**Time Frame**	**Weighting of final mark**	**Mark Allocation**
Control test 1	**Term 1** January – April	5%	50
Mid-year examination	**Term 2** May – June	15%	150
Control test 2	**Term 3** July – October	5%	50
Total		**25%**	**250**

Question paper format for Mechanical Technology

Question	Content /Topic	Marks
Question 1	Multiple choice	20
Question 2	Safety	10
Question 3	Tools and Equipment	12
Question 4	Materials	13
Question 5	Terminology	30

Question 6	Jointing Methods	25
Question 7	Forces	30
Question 8	Maintenance	15
Question 9	Systems and control	25
Question 10	Engines ,Pumps & Turbines	20
	TOTAL	200

4. RECORDING AND REPORTING

Recording is a process in which the teacher documents the level of a learner's performance in a specific assessment task. It indicates learner progress towards the achievement of the knowledge as prescribed in the Curriculum and Assessment Policy Statements. Records of learner performance should provide evidence of the learner's conceptual progression within a grade and her / his readiness to progress or be promoted to the next grade. Records of learner performance should also be used to verify the progress made by teachers and learners in the teaching and learning process. Teachers will record actual marks against the tasks by using a record sheet and also report in percentages against the subject on the learner's report cards.

Reporting is a process of communicating learner performance to learners, parents, schools, and other stakeholders. Learner performance can be reported in a number of ways which include report cards, parents' meetings, school visitation days, parent-teacher conferences, phone calls, letters, class or school newsletters, etc. Teachers in all grades report in percentages against the subject. The following rating scale will apply for reports: • In order for the school to report back to the parents on the progression of the learner from term to term, regular feedback is given in the form of report cards. When compiling term marks it is proposed that teachers make use of the SBA and PAT marks to show how the learner is progressing. • The weighting of the term mark should be 50% for the SBA and 50% for the PAT mark. The term mark is however not used for the final promotion of the learner. At the end of the year the SBA, PAT and examination marks are used in the prescribed manner to calculate the promotion mark.

5. SETTING OF TASKS

The following are guidelines towards setting quality SBA tasks:

- Know the curriculum and its requirements to identify the knowledge, understanding and skills that are to be assessed.
- Ensure that the assessment allows learners to show that they have the acquired knowledge, understanding and skills to meet the national standards.
- Ensure that the scenarios or contexts are open and comprehensible to all learners.

- Ensure that the appropriate reading level is used. Tools to determine the reading level of a document are available in most word-processing software.
- Ensure that no part of the assessment has an adverse impact on specific groups of learners, e.g. learners with disabilities.
- Ensure that all illustrative material reflects an inclusive view of society and promotes equality.
- Consider time.
- Check that the diagrams, pictures or photographs used are necessary, helpful and of high quality.
- Place the text close to the relevant diagrams or pictures to enable the candidates relate the two effectively. Comprehension text and questions should be set on the same page or on adjacent page

6. CONSTRUCTION FEATURES TO CONSIDER WHEN SETTING TESTS AND EXAMINATIONS:

- The language used in the question paper should not be a barrier.
- The weighting given to a particular part of the question paper reflects its relative importance.
- Sampling is systematic but unpredictable to avoid question 'spotting'.
- The cognitive demand of the paper is appropriate, i.e. includes lower-order, middle-order and higher-order demands to the prescribed ratio.
- The level of difficulty of the individual questions is appropriate and the level of difficulty of the overall paper is appropriate to the level of the grade.
- The mark available for each question matches the demands of the task and the test specification.
- The memorandum allows for a range of valid answers, especially for open-ended questions

7. DEVELOPING A MARKING MEMORANDUM

- The marking guideline should be accurate
- It should corresponds with the questions in the paper
- The marking guideline must makes allowance for alternative responses
- The marking guideline should be laid out clearly and neatly typed
- The marking memo must be complete with mark allocation and distribution within the questions

8. TESTS and EXAMINATIONS

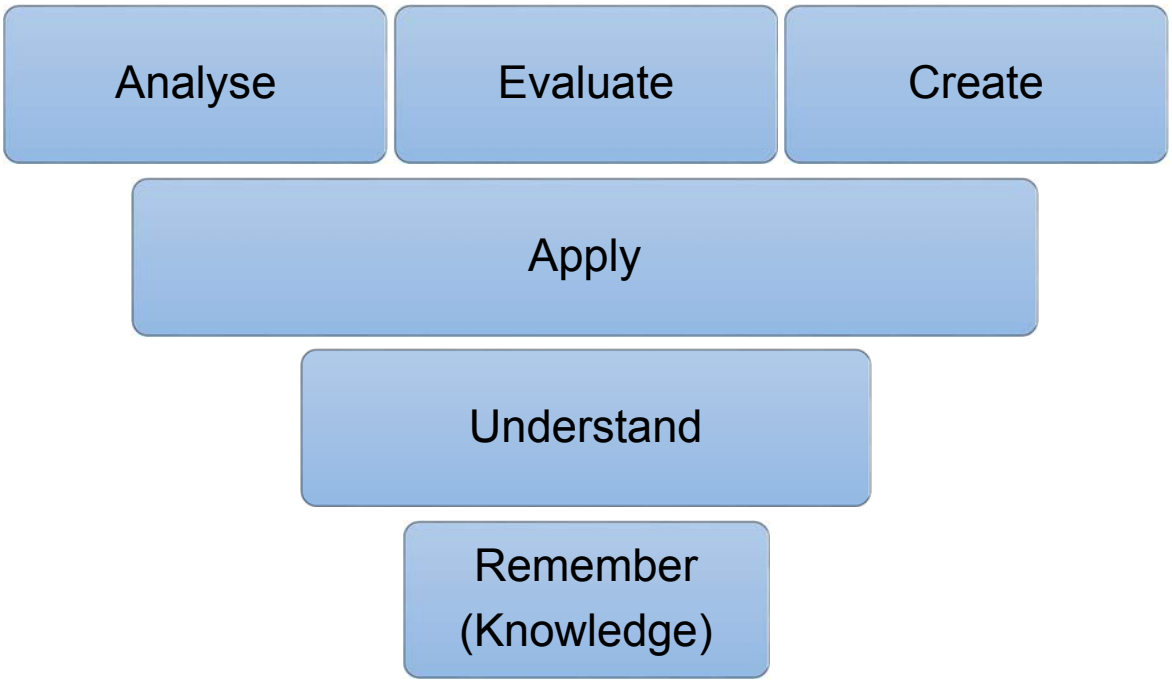
A test for formal assessment should not consist of a series of small tests, but should cover a substantial amount of content. The duration should be at least 60 minutes with a minimum of 50 marks (allocate one mark per fact).

- Each test must cater for a range of cognitive levels.
- The forms of assessment used should be appropriate to the grade and development level. The design of these tasks should cover the content of the subject and include a variety of tasks designed to achieve the objectives of the subject.

EXAMINATIONS

- Each examination must cater for a range of cognitive levels.
- For Grades 10, 11 and 12, the three-hour final examination in Mechanical Technology comprises 50% (150 marks) of a learner's total mark and for Grade 12 the three-hour final examination in Mechanical Technology comprises 50% (200 marks) of a learner's total mark. All quetion papers set by the teacher throughout the year, including the final examination paper, must be moderated by the head of department at the school and approved by the district curriculum advisor/facilitator. This is done to ensure that the prescribed weightings are adhered to by the teacher.
- In the Grade 12 examination, only Grade 12 content will be assessed. However, prior knowledge from Grades 10 and 11 may be necessary to interpret and answer some of the questions.

Bloom's revised taxonomy illustrates the different cognitive levels:



Bloom (1956) has provided us with his taxonomy to assist us to compose questions on different levels of thinking. This taxonomy ranges from lower to higher levels of cognitive thinking. These levels are :

(1) Knowledge
(2) Comprehension
(3) Application
(4) Analysis
(5) Synthesis
(6) Evaluation

Examples of questions in the taxonomy
Dalton and Smith[1] (1986) provide the following examples:

USEFUL VERBS
Tell List Describe Relate Locate Write Find State Name

USEFUL VERBS
Explain Interpret Outline Discuss Distinguish Predict Restate Translate Compare Describe

USEFUL VERBS
Solve Show Use Illustrate Construct Complete Examine Classify

USEFUL VERBS
Analyse Distinguish Examine Compare Contrast Investigate Categorise Identify Explain Separate Advertise

USEFUL VERBS
Create Invent Compose Predict Plan Construct Design Imagine Propose Devise Formulate

EVALUATION
Judge Select Choose Decide Justify Debate Verify Argue Recommend Assess Discuss Rate Prioritise Determine

Interpretation of cognitive levels

Cognitive level		**Comment**	**Context**
C1	Knowledge Recall of factual/process knowledge *in isolation*, i.e. one step/set of steps/ instruction/process at a time.	Requires recalling or recognising only Practised or learnt the isolatable bit, e.g. fact/skill/ process/steps before.	*Exactly* the *same context* as a textbook example of a classroom-based exercise. Explicitly part of the curriculum
C2	Understanding	Requires knowledge and understanding of steps/process/-isolatable bits	Familiar context Includes interpreting, exemplifying, classifying,

	Convert from one form of representation to another.	Translating 'words', pictures, symbols, diagrams into, e.g. programming code.	summarising, inferring, comparing, and explaining.
C3	Application Using *known routines/ steps/ processes* in order to complete a task. *All of the information required is immediately available to the learner*	Requires knowledge, understanding and use of steps/*routines/processes* Application of appropriate abstraction without having to be prompted, and without having to be shown how to use it in a familiar context.	*Familiar context* but with *new* elements/*new* circumstance Learners have seen the same or -very similar steps working with different data or other circumstances.
C4	Analysis Understand how parts relate to a whole (pinpoint the core/main aspects) or interact with each other and use appropriate methods to complete task/solve problem.	Requires reasoning/investigation/-developing a plan or algorithm; has some complexity Completing task could have more than one possible approach. Organising component parts to achieve an overall objective.	New context Unseen, unfamiliar problems/ tasks.
C5	Evaluation Judging or deciding according to some set of criteria, generally without real right or wrong answers.	Requires weighing possibilities, deciding on most appropriate Testing to locate errors.	
C6	Create Putting elements together to form a coherent or functional whole; or re-organising elements into a new pattern or structure	Requires familiarisation with the task by exploring different approaches, interpreting and analysing relevant approaches. Generalisation	Novel situation The learner has *no familiarity with completed functional whole*.

9. AN EXAMPLE OF AN ASSESSMENT GRID

The marking grid is used to analyse the tasks which has been set in order to check whether the task meets the question distribution requirements.

Question	Lower order	Middle order	Higher order	Total marks

10. EXAMPLES OF FORMAL ASSESSMENT TASKS

GRADE 10

TERM TEST 1

MARKS: 100

INSTRUCTIONS

1. Answer all questions.
2. Start each question on a new page
3. Number the questions as numbered in the question paper.
4. Show all calculations and units. Round off final answers to two decimal places.
5. Candidates may use non- programmable scientific calculators and drawing instruments
6. Write neatly and legibly

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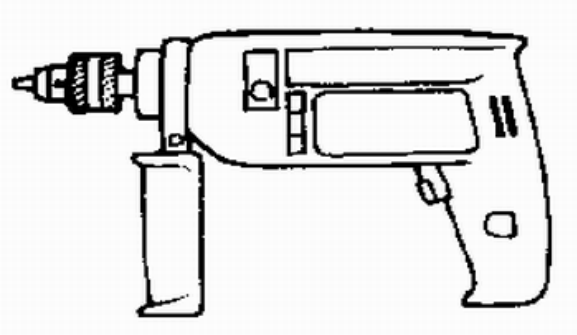
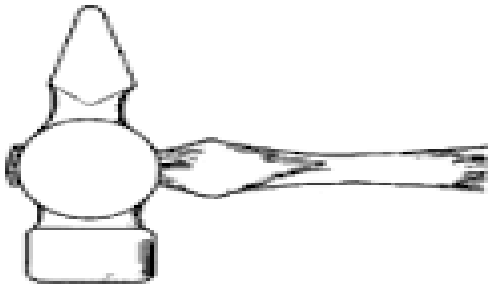
QUESTION 1: MULTIPLE CHOICE

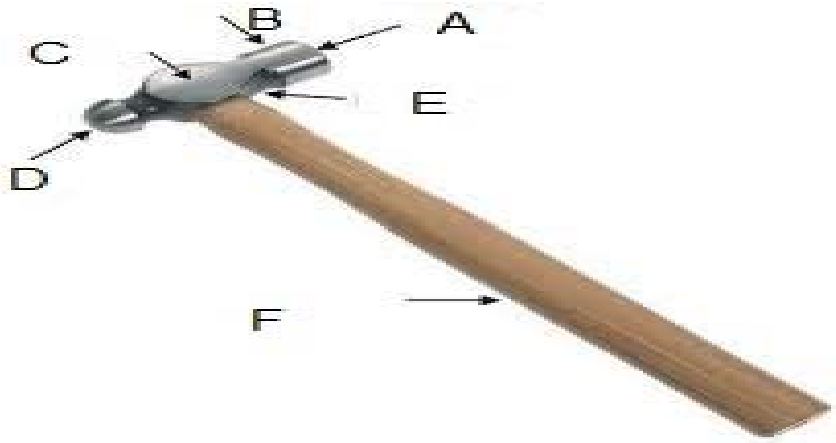
1.	Various options are provided as possible answers to the questions. Choose the answer and write only the letter (A-D) next to the question number (1.1.-1.5) in the ANSWER BOOK, for example 1.1 A	
1.1.	Which ONE of the following safety precautions is applicable when using hand tools?	(2)
	A. Work at a very slow speed B. Work with well-lubricated tools C. Use tools only for the purpose for which they were made D. Replace all tools after use	
1.2.	What is the maximum safe distance that a tool rest should be from a grinding wheel on a bench grinder	(2)
	A. 8 mm B. 10 mm C. 3mm D. 6m	
1.3.	Which ONE of the following tools is used for marking off?	(2)
	A. Combination pliers B. Circlip pliers C. Allen key D. scriber	
1.4.	What is the included angle of a centre punch	(2)
	A. 45 degrees B. 60 degrees C. 90 degrees D. 0 degrees	
1.5.	A smooth file is preferred to finish off...	(2)
	A. Soft material B. Hard material C. Wood D. plastic	
	TOTAL	**(10)**

QUESTION 2: SAFETY

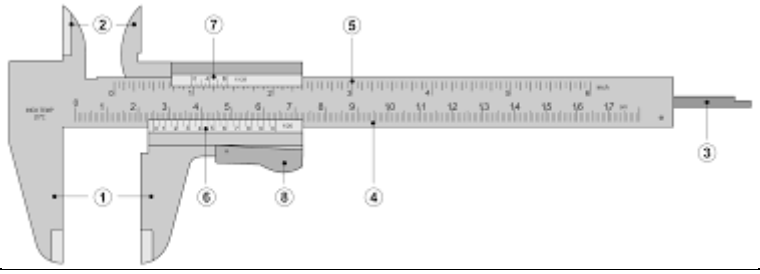
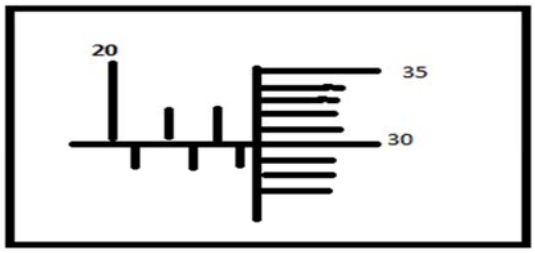
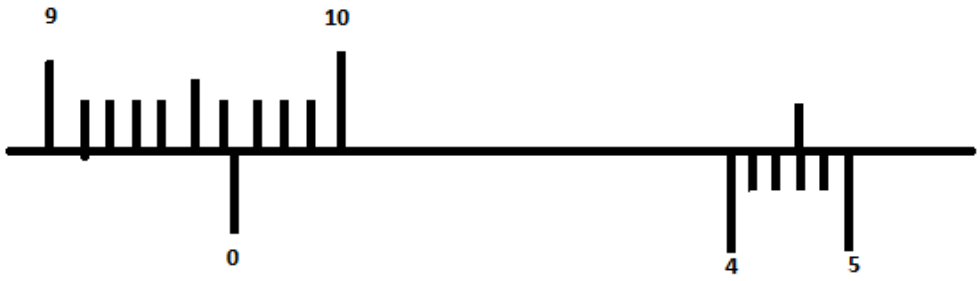
<table>
<tr><td>2.1.</td><td colspan="2">Define an ‘accident’</td><td>(4)</td></tr>
<tr><td>2.2.</td><td colspan="2">What is a good housekeeping</td><td>(2)</td></tr>
<tr><td>2.3.</td><td colspan="2">Name THREE unsafe acts in the workshop</td><td>(3)</td></tr>
<tr><td>2.4.</td><td colspan="2">Name THREE unsafe conditions in the workplace</td><td>(3)</td></tr>
<tr><td>2.5.</td><td colspan="2">Copy and complete the table below, give FIVE classification of fires and their example
<table>
<tr><td colspan="2">Table of colours</td></tr>
<tr><td>Classification of fire</td><td>example</td></tr>
<tr><td>2.5.1</td><td></td></tr>
<tr><td>2.5.2.</td><td></td></tr>
<tr><td>2.5.3.</td><td></td></tr>
<tr><td>2.5.4.</td><td></td></tr>
<tr><td>2.5.5.</td><td></td></tr>
</table></td><td>(10)</td></tr>
<tr><td>2.6</td><td colspan="2">Name FOUR safety precautions regarding the use of the following:</td><td></td></tr>
<tr><td></td><td>2.6.1.</td><td>A lathe machine</td><td>(4)</td></tr>
<tr><td></td><td>2.6.2.</td><td>A bench grinder</td><td>(4)</td></tr>
<tr><td></td><td>2.6.3.</td><td>A drill machine</td><td>(4)</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>[34]</td></tr>
</table>

QUESTION 3: TOOLS

3.1.	Identify the following tools		
	3.1.1.		(2)
	3.1.2.		(2)
	3.1.3.		(2)
	3.1.4.		(2)

	3.1.5.		(2)
3.2.	State the function of the following hand tools:		
	3.2.1	Open-ended spanner	(2)
	3.2.2.	Ring spanner	(2)
	3.2.3.	Centre punch	(2)
	3.2.4	Soft head hammer	(2)
3.3.	What is the difference between the long nose and combination pliers		(4)
3.4.	State TWO file profiles		(2)
3.5.	Study the diagram below and answer the following questions 		
	3.5.1.	What is the name of the above tool	(2)
	3.5.2	Label A-F	(6)
	TOTAL		**[32]**

QUESTION 4: TERMINOLOGY

4.1.	Provide the labels 1-8 below  		(8)
4.2.	What is the function of an inside micrometer		(2)
4.3.	FIGURE 3.2 below shows a reading on an outside micrometer. What is the value of the reading?  FIGURE 9.2		(5)
4.4.	FIGURE 3.2 below shows a reading on a vernier calliper. What is the value of the reading  		(5)
4.5.	Describe the function of the following centre lathe components		
	4.5.1.	chuck	(2)
	4.5.2.	tailstock	(2)
		TOTAL QUESTION 2	**(24)**
		TOTAL MARKS	**[100]**

MEMO

MECHANICAL TECHNOLOGY

QUESTION 1: MULTIPLE CHOICES

1.	***Various options are provided as possible answers to the questions. Choose the answer and write only the letter (A-D) next to the question number (1.1.-1.5) in the ANSWER BOOK, for example 1.1 A***	
1.1.	***Which ONE of the following safety precautions is applicable when using hand tools?***	(2)
	C	
1.2.	***What is the maximum safe distance that a tool rest should be from a grinding wheel on a bench grinder***	(2)
	C	
1.3.	***Which ONE of the following tools is used for marking off?***	(2)
	D	
1.4.	***What is the included angle of a centre punch***	(2)
	C	
1.5.	***A smooth file is preferred to finish off...***	(2)
	A	
	TOTAL QUESTIO 1	**(10)**

QUESTION 2: SAFETY

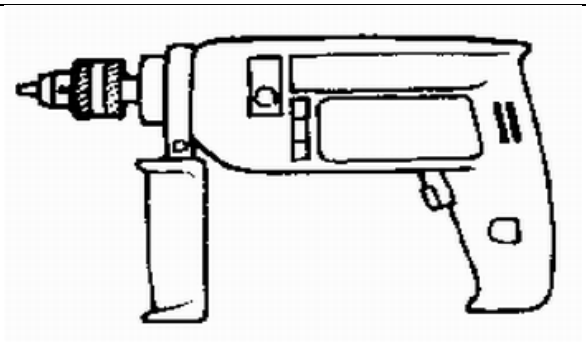
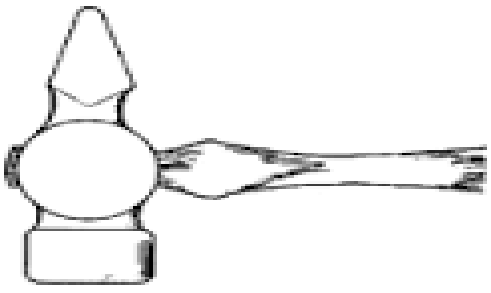
2.1.	***Define an 'accident'*** - is an unplanned and uncontrolled event caused by unsafe action and unsafe conditions	(4)
2.2.	***What is a good housekeeping*** - means working tidily and in an orderly way	(2)
2.3.	***Name THREE unsafe acts in the workshop*** - working at unsafe speed - failure to secure machinery and materials - fooling, teasing or abusing fellow employees	(3)
2.4.	***Name THREE unsafe conditions in the workplace*** - unsafe workshop lighting - unsafe constructions - lack of machine and other guards	(3)
2.5.	***Copy and complete the table below, give FIVE classification of fires and their example***	(10)
2.6	***Name FOUR safety precautions regarding the use of the following:***	

Table of colours

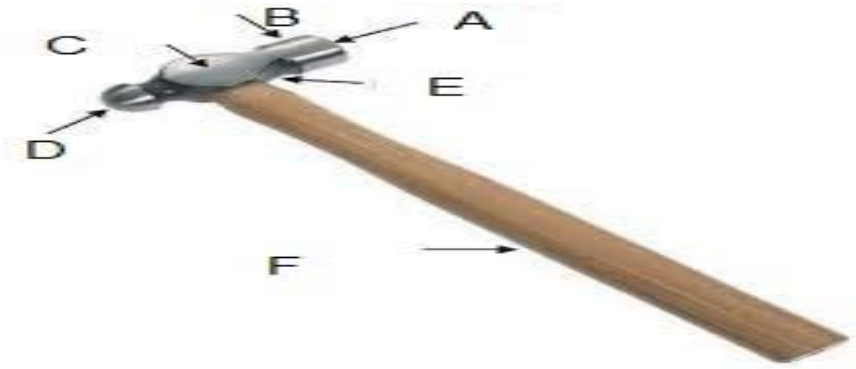
Classification of fire	example
2.5.1 class A	- paper or wood
2.5.2. class B	- petrol, grease or oil
2.5.3. class C	- gases
2.5.4. class D	- combustible metals
2.5.5. class E	- cooking fat and oil

	2.6.1.	***A lathe machine*** - never apply wrench on revolving work - do not leave the machine running unattended - remove tools or spanners on rotary parts - do not use your hands to remove cuttings	(4)
	2.6.2.	***A bench grinder*** - leave a gap of 3mm between tool rest and the wheel - do not force grind - stand aside and set the machine in motion - if the wheel running unevenly, dress it with an emery-wheel dresser	(4)
	2.6.3.	***A drill machine*** - do not force drill - use brush or wooden rod to remove chips from the drill - clamp the work piece securely to the table - a drill should run at the correct speed for the job	(4)
		TOTAL **QUESTION 2**	**[34]**

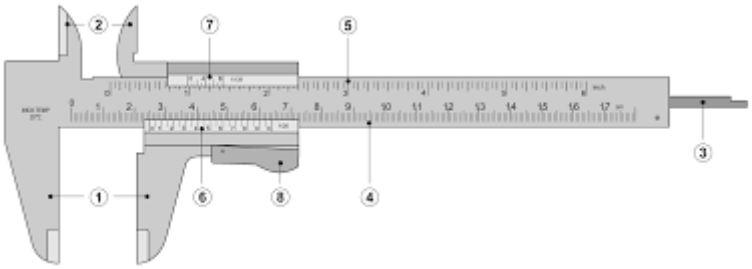
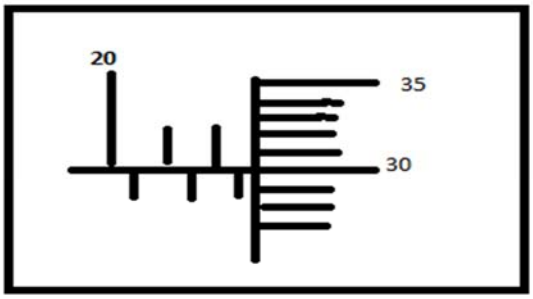
QUESTION 3: TOOLS

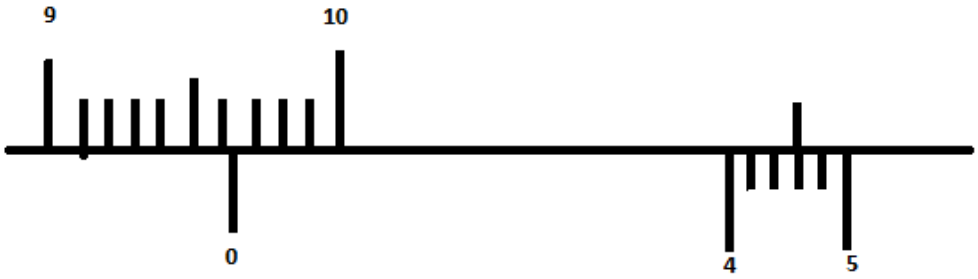
3.1.	Identify the following tools		
	3.1.1.	 - Portable drill	(2)
	3.1.2.	 - **Cross-peen hammer**	(2)

	3.1.3.	 - **Combination plier**	(2)
	3.1.4.	 - **hacksaw**	(2)
	3.1.5.	 - **scriber**	(2)
3.2.	***State the function of the following hand tools:***		
	3.2.1	***Open-ended spanner*** - loosen or fasten bolts and nuts where ring spanner can not fit	(2)
	3.2.2.	***Ring spanner*** - to loosen or fasten bolts and nut	(2)
	3.2.3.	***Centre punch*** - to enlarge a pop mark on a surface to guide a drill when a hole has to be drilled	(2)
	3.2.4	***Soft head hammer*** - for shaping finished surfaces that would be damaged by metal hammers	(2)

3.3.	***What is the difference between the long nose and combination pliers*** - long nose is used where your hands cannot fit To hold object in position or to tighten something		(4)
3.4.	***State TWO file profiles*** single cut files double cut files		(2)
3.5.	Study the diagram below and answer the following questions  		
	3.5.1.	***What is the name of the above tool*** - Ball-pein hammer	(2)
	3.5.2	***Label A-F*** A. face B. poll C. wedge D. ball pein E. neck F. handle	(6)
	TOTAL QUESTION 3		**[32]**

QUESTION 4: TERMINOLOGY

4.1.	***Provide the labels 1-8 below***  1. outside measurement 2. inside measurement 3. depth measurement 4. beam 5. guide bar 6. vernier scale 7. slide 8. vernier mover	(8)
4.2.	***What is the function of an inside micrometer*** - to measure an inside diameter or the inside of two parallel surfaces	(2)
4.3.	***FIGURE 3.2 below shows a reading on an outside micrometer. What is the value of the reading?***  FIGURE 9.2 ***Answer:*** 22.80mm	(5)
4.4.	***FIGURE 3.2 below shows a reading on a vernier calliper. What is the value of the reading***	(5)

	 ***Answer:*** 96.46mm		
4.5.	***Describe the function of the following centre lathe components***		
	4.5.1.	***Chuck*** - to hold the work piece	(2)
	4.5.2.	Tailstock To support the free end of the work and is also used in drilling, reaming and taper turning operations.	(2)
		TOTAL QUESTION 2	**(24)**
		TOTAL MARKS	**[100]**

GRADE 11

MID YEAR
EXAMINATIONS

MARKS: 150

TIME: 2 ½ HOUR

INSTRUCTIONS:

1. This question paper consists of FOUR sections:

SECTION A: COMPULSORY.

SECTION B: FITTING AND MACHINING

SECTION C: AUTOMOTIVE

SECTION D: WELDING AND METALWORK

3. Answer SECTION A (COMPULSORY) and then answer SECTION B or C or D, according to your choice of specialisation.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Start EACH question on a NEW page.

6. Show ALL calculations and units. Round off final answers to TWO decimal places.

7. You may use a non-programmable scientific calculator and drawing instruments.

8. The value of gravitational force should be taken as 10 $m.s^{-2}$.

9. All dimensions are in millimetres, unless stated otherwise in the question.

10. Write neatly and legibly.

11. A formula sheet is attached to the question paper.

12. Use the criteria at the beginning of each section to assist you to manage your time.

SECTION A (COMPULSURY)

QUESTION	CONTENT		MARKS
1	Multiple-choice Questions		**20**
2	Safety		**31**
3	Tools and equipment		**24**
	TOTAL FOR SECTION A	**75**	**75**

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (1.1–1.20) in your ANSWER BOOK, for example 1.21 A

1.1 In terms of the Occupational Health and Safety Act, what safety measure is applicable when the bench grinder is used?

A The tool rest must not be more than 3 mm away from the grinding wheel
B surface. (1)
C Remove all guards before grinding.
D Grind on the side of the grinding wheel.
The grinder can be forced to grind thick metal.

1.2 Which ONE of the following safety procedures is applicable when using the drill press? (1)

A Leave the chuck key in the chuck. (1)
B Do not hold small work pieces by hand, use a machine vice.
C The drill bit can be adjusted while the machine is in motion.
D Always use goggles with dark lenses to protect your eyes.

1.3 What safety measure is applicable when using the angle grinder? (1)

A Do not force grinding. (1)
B Guards can be removed while cutting materials.
C The machine can be used in wet conditions.
D Always wear goggles with dark lenses to protect your eyes.

1.4 What colour is the acetylene gas cylinder?

A Red
B Black (1)
C Green
D Maroon

1.5 What substance is used for the operation of a pneumatic system?

A Oil
B Fuel (1)
C Air
D Electricity

1.6 What will be the tap drill size for a M10 x 1,5 screw thread?

A 10 mm
B 11,5 mm (1)
C 8,5 mm
D 10,5 mm

1.7 What is the function of an angle grinder?

A To do precision grinding of a surface
B To sharpen drill bits (1)
C To grind off sharp edges
D To grind a perfect flat surface

1.8 Which drilling machine is used for heavy drilling processes?

A Portable drilling machine
B Sensitive drill press (1)
C Upright drill press
D Radial drilling machine

1.9 What is a guillotine used for in the mechanical workshop?

A To roll sheet metal
B To bend sheet metal (1)
C To cut sheet metal
D To join sheet metal

1.10 A hydraulic press employs the principle of the multiplication of a force within a closed system by using …

A air under pressure
B fluid under pressure (1)
C electric current
D lever advantage

1.11 Which ONE of the following methods is used to reduce friction between two moving parts?

A Use two different types of metal
B Increase the temperature between the two metals (1)
C Add abrasives to the contact area
D Increase the speed

1.12 Which ONE of the following is a cause of excessive wear of the belt on the belt drive of a pedestal drilling machine?

A Lack of lubrication
B Misalignment of the pulleys (1)
C Frequent change of speed
D Continuous drilling procedures

1.13 Lack of lubrication in any type of machinery is caused by…

A overloading.
B low operating speed. (1)
C undercutting.
D high volatility.

1.14 Which ONE of the following fluids can be used to reduce friction in mechanical machinery?

A Water
B Grease (1)
C Thinners
D Anti-freeze fluid

1.15 A lack of maintenance on the bench grinder will result in …

A inaccurate grinding results. (1)
B sharp edges on the work piece.
C insufficient lubrication of the grinding wheel.
D high speed grinding.

1.16 What is the maximum gab for the work rest of a Bench grinder?

A Between 3mm and 6mm
B 2 mm (1)
C 3mm
D 1mm

1.17 A Tap set consist of three taps. Choose the correct arrangement?

A first, second and third tap
B first, middle and last tap (1)
C first, second and last tap
D first, second and bottoming tap

1.18 Which ONE of the following is an unsafe action in the workshop?

A Set the machine when it is off
B Oil machine while it is turning (1)
C Only use machine when you are trained to do so
D Wear safety clothes

1.19 Flashback arrestors are used ..……

A in an arc welder.
B to prevent flashbackin Oxy-acetylene cylinders. (1)
C to prevent flashback in CO_2 welders.
D to prevent flashback in a fire extinguisher.

1.20 A Hydraulic press is using …….. as a medium to transfer power.

A electricity
B water (1)
C air
D oil

[20]

QUESTION 2: SAFETY (GENERIC)

2.1 After welding a joint it needs to be grinded with an angle grinder to obtain a smooth surface. State THREE safety measures to observe before switching on the angle grinder. (3)

2.2 Give THREE reasons why it is important to wear a welding helmet during arc welding. (3)

2.3 State THREE safety rules to apply when using a portable hand drill machine. (3)

2.4 What safety rule must be adhered to after working procedures on any machine have been completed? (1)

2.5 State THREE safety rules one must adhere to before switching on the horizontal band saw. (3)

2.6 What safety precaution should be adhered to when drilling a small work piece on a drill press? (1)

2.7 State THREE safety rules to be observed when using a hydraulic press. (3)

2.8 Name THREE types of personal protective equipment (PPE) needed when using gas welding equipment. (3)

2.9 Why are you only allowed to light the acetylene with a flint lighter, not with a match or cigarette lighter? (2)

2.10 Give TWO reasons why is it important to wear surgical gloves when treating a co-worker with open wounds. (2)

2.11 Name TWO types of guards to use on a machine? (2)

2.12 Give FIVE safety rules when using a Bench grinder. (5)

[31]

QUESTION 3: TOOLS AND EQUIPMENT (GENERIC)

3.1 FIGURE 3.1 below shows a type of cutting machine. Answer the questions that follow.

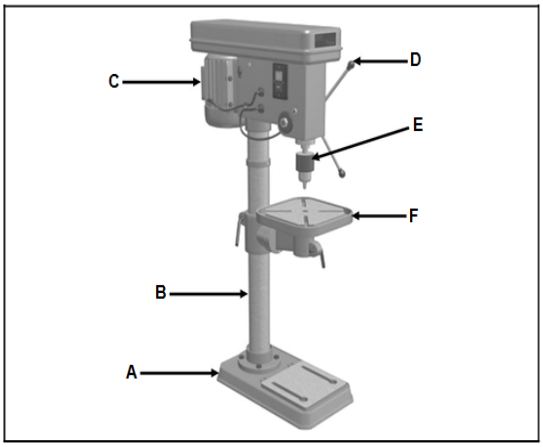


FIGURE 3.1

3.1.1 Identify the machine in FIGURE 3.1 above. (1)

3.1.2 Label A–F. (6)

3.1.3 What is the purpose of part E? (1)

3.2 What is the function of a tap and die set? (2)

3.3 What is the difference between a power saw and a horizontal band saw? (2)

3.4 What is the function of the following equipment?

3.4.1 Roller machine (2)
3.4.2 Hydraulic press (2)
3.4.3 Guillotine (2)
3.4.4 Angle grinder (2)
3.4.5 Bench grinder (2)
3.4.6 Fly press (2)

[24]

TOTAL SECTION A: 75

SECTION B: FITTING AND MACHINING (SPECIFIC)

QUESTION	CONTENT	MARKS
4	Terminology (Specific)	25
5	Tools and Equipment (Specific)	8
6	Forces(Specific)	19
7	Maintenance (Specific) Generic	11
8	Joining Methods (Specific)	12
	TOTAL FOR SECTION B	**75**
	TOTAL FOR SECTION A + B	**150**

QUESTION 4: TERMINOLOGY (SPECIFIC)

4.1 Describe the function of EACH of the following types of equipment on a centre lathe:

4.1.1 Four-jaw chuck (2)

4.1.2 Lathe steadies (2)

4.1.3 Lathe mandrels (2)

4.2 You are required to cut a taper on a lathe using the compound slide. The length of the taper is 105 mm, the large diameter is 78 mm and the small diameter is 62 mm. Calculate the angle at which the compound slide must be set to cut the taper. (3)

4.3 A 7 mm pitch, three-start thread is to be cut on a lathe with a 5 mm pitch lead screw. If the pitch diameter of the thread is 90 mm and a clearance angle of 3° is used, calculate the following:

4.3.1 The helix angle of the thread (4)

4.3.2 The leading tool angle (2)
4.3.3 The following tool angle (2)

4.4 A parallel key needs to be manufactured to secure a pulley onto a 60 mm diameter shaft. Calculate the following dimensions of the key:

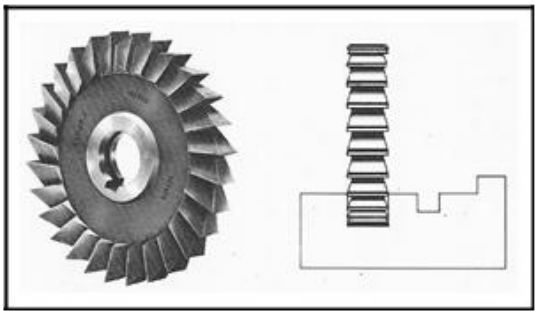
4.4.1 The width (2)

4.4.2 The thickness (2)

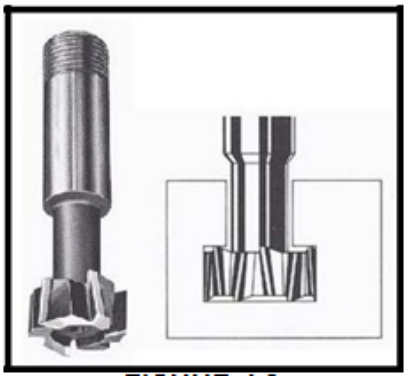
4.4.3 The length (2)

4.5 Identify the milling cutters in FIGURES 4.5.1 and 4.5.2 below. (2)

4.5.1



4.5.2



[25]

QUESTION 5: TOOLS AND EQUIPMENT (SPECIFIC)

5.1 State ONE purpose of the following tools:

5.1.1 Dial indicator (1)

5.1.2 Telescopic gauge (1)

5.2 Give THREE reasons for using a torque wrench. (3)

5.3 Determine the reading displayed on the inside micrometer shown in FIGURE 5.1 below.

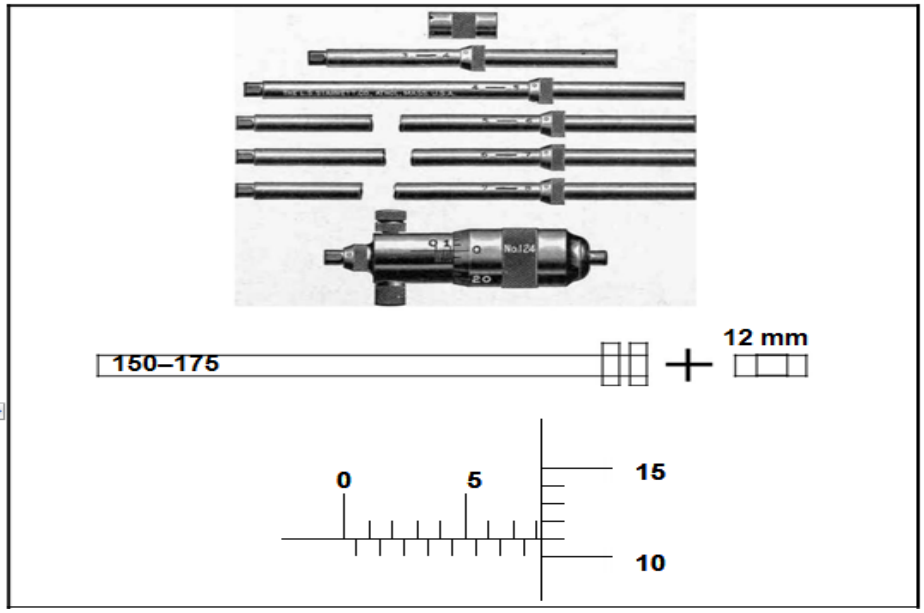


FIGURE 5.1 (3)

[8]

QUESTION 6: FORCES (SPECIFIC)

6.1 The diagram in FIGURE 6.1 below shows a beam supported by two vertical supports, A and B. Two vertical point loads of 800 N and 300 N are exerted onto the beam. Calculate the magnitude of the reactions in supports A and B.

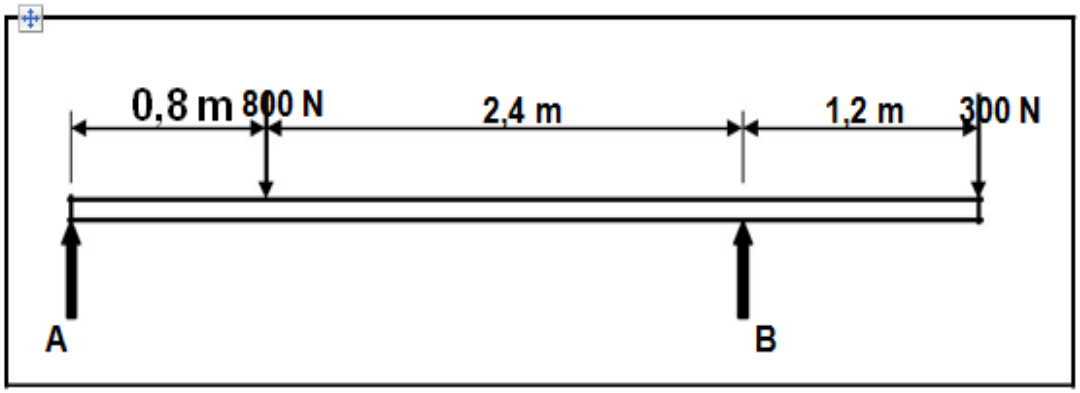


FIGURE 6.1 (4)

6.2 Calculate the compressive stress in a brass bush caused by a load of 60 kN. The bush has an outside diameter of 60 mm and an inside diameter of 54 mm. Give your answer in MEGA magnitude. (5)

6.3 FIGURE 6.2 below shows a system of forces with three coplanar forces acting on the same point. Use calculations and determine the magnitude and direction of the resultant force of this system of forces.
(Draw and complete the diagram in FIGURE 6.2. Show ALL the horizontal and vertical components before you do the calculations.)

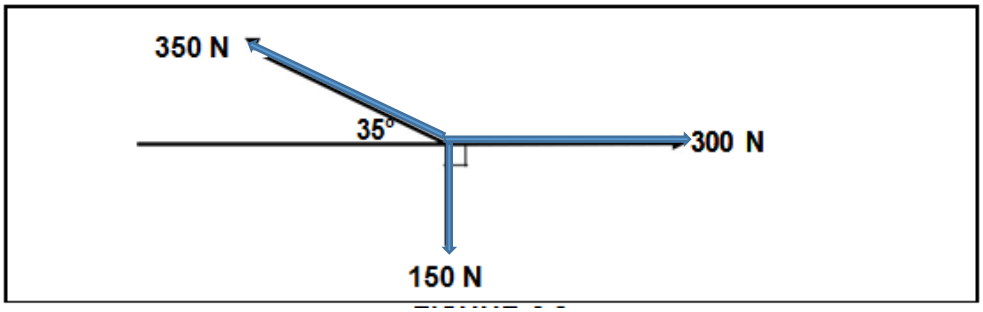


FIGURE 6.2 (10)

[19]

QUESTION 7: MAINTENANCE (SPECIFIC)

7.1 State THREE causes of the malfunctioning of lathes and milling machines. (3)

7.2 Explain overheating that causes friction on a machine when lubrication is inadequate: (2)

7.3 State ONE procedure that may be followed to reduce physical wear on the milling cutter of a milling machine. (1)

7.4 State TWO results of an unbalanced work piece in a lathe. (2)

7.5 State TWO results of a lack of lubrication in a gear system. (2)

7.6 What do you understand by the term overloading? (1)

[11]

QUESTION 8: JOINING METHODS (SPECIFIC)

8.1 Draw a neat sketch of an isometric V-screw thread and indicate the following on the sketch:

8.1.1 Pitch (1)

8.1.2 Screw-thread angle (1)

8.1.3 Effective diameter (Dm) (1)

8.1.4 Crest (1)

8.2 The pitch of a M20 V-screw thread is 2,5 mm.
Calculate the following:

8.2.1 The depth of the screw thread (2)

8.2.2 The effective diameter of the screw thread (2)

8.3 Explain, with the aid of simple sketches, the difference between single- and multiple-start screw threads. (4)

[12]

TOTAL SECTION B: **75**

TOTAL OF SECTION A+B: **150**

SECTION C: AUTOMOTIVE (SPECIFIC)

QUESTION	CONTENT		MARKS
9	Tools and Equipment (Specific)		9
10	Engines (Specific)		15
11	Systems and Control(Specific)		25
12	Materials		26
TOTAL FOR SECTION C			**75**
TOTAL FORSECTION A + C			**150**

QUESTION 9: TOOLS AND EQUIPMENT (SPECIFIC)

9.1 FIGURE 9.1 below shows an outside micrometer. Label A–D in the figure.

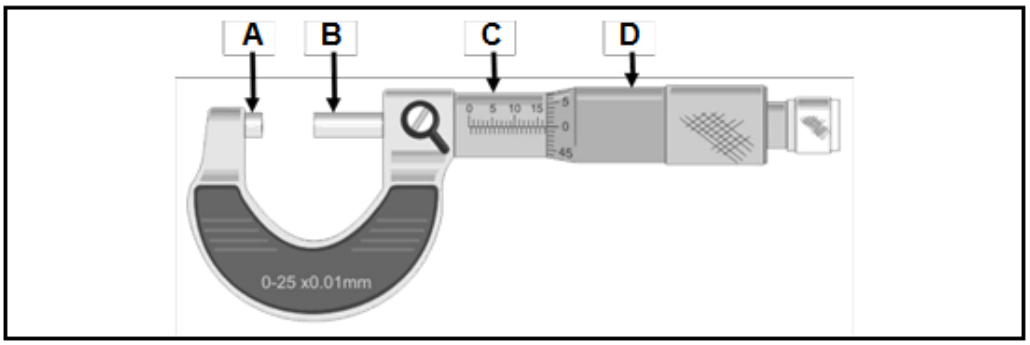


FIGURE 9.1 (4)

9.2 Give TWO reasons for using a torque wrench on an engine. (2)

9.3 Explain TWO instances where you would use a dial gauge indicator. (2)

9.4 Explain the function of a telescopic gauge. (1)
[9]

QUESTION 10: ENGINES (SPECIFIC)

10.1 What do you understand by the term direct ignition for a compression ignition engine? (1)

10.2 State the function of the injector in a compression ignition engine. (1)

10.3 Name TWO types of injector nozzles. (2)

10.4 Give TWO advantages of hydraulic valve lifters. (2)

10.5 Give TWO advantages of a direct injection. (2)

10.6 Name TWO camshaft arrangements. (2)

10.7 Explain what a electronic control CVVT – system is. (3)

10.8 Describe the purpose of the tensioner in the timing belt assembly. (2)
[15]

QUESTION 11 SYSTEMS AND CONTROL (Specific)

11.1.1 Identify the final drive systems shown in FIGURE 15.2 and FIGURE 15.3 below and give ONE advantage and ONE disadvantage of each.

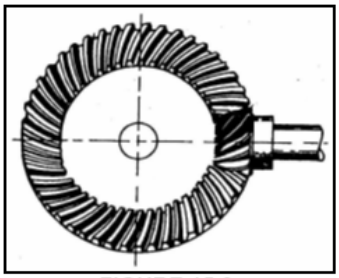


FIGURE 15.2

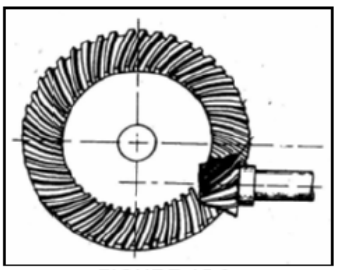


FIGURE 15.3

(8)

11.2 FIGURE 11.2 below shows the hydraulic brake master cylinder unit of a motor vehicle. Label A–E in the diagram.

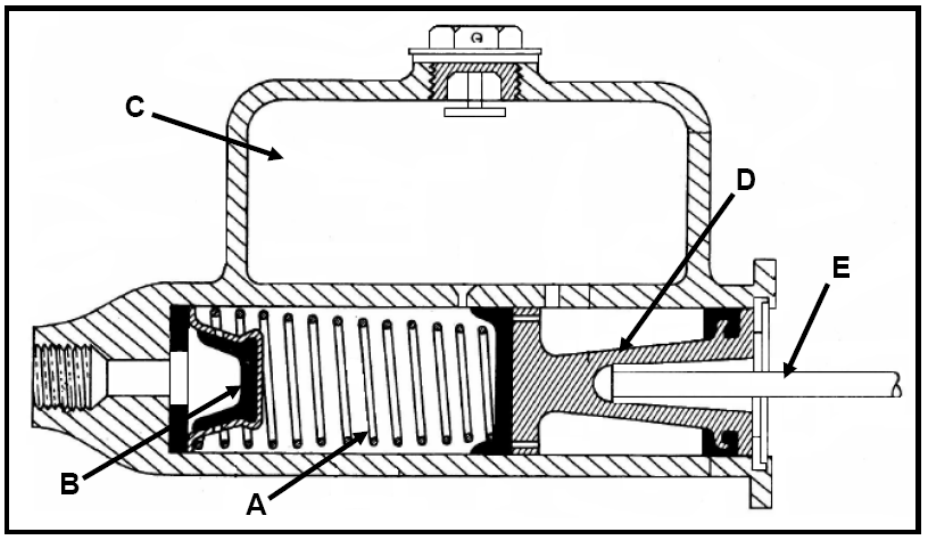


FIGURE 11.2 (5)

11.3 Describe the purpose of the servo-brake unit. (2)

11.4 What does the abbreviation ABS stand for in respect of brake systems in a motor vehicle? (1)

11.5 FIGURE 11.5 below shows an ABS system in a motor vehicle. Label A–D.

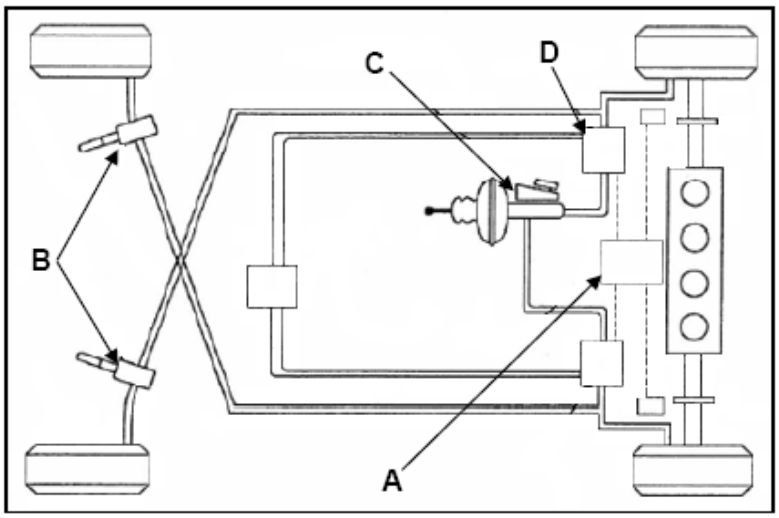


FIGURE 11.5 (4)

11.6 FIGURE 11.6 below shows the drive system of a motor vehicle. Answer the questions that follow.

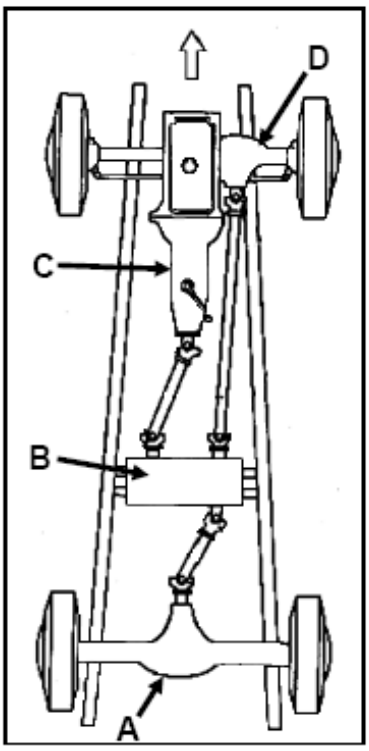


FIGURE 11.6

11.6.1 Identify the type of drive system shown in FIGURE 11.6. (1)

11.6.2 Label A-D (4)

[25]

QUESTION 12: MATERIALS (GENERIC)

12.1 Distinguish between the following properties of engineering materials:

12.1.1 Hardness (3)

12.1.2 Elasticity (3)

12.1.3 Malleability (3)

12.2 Name the product produced by a blast furnace. (1)

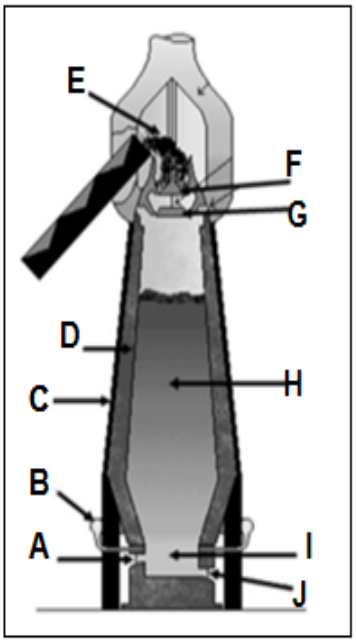
12.3 State ONE function of EACH of the following elements used in a blast furnace:

12.3.1 Iron ore (2)

12.3.2 Coke (2)

12.3.3 Limestone or dolomite (2)

12.4 FIGURE 5.1 below shows a cross-sectional view of a blast furnace. Label A–J.



FIGUUR 5.1 (10)

[26]

TOTAL SECTION C: 75

TOTAL SECTION A+C 150

SECTION D: WELDING AND METALWORK (SPECIFIC)

QUESTION	CONTENT	MARKS
13	Welding Terminology(templates, trusses, cost calculations ,terms, welding symbols)(Specific)	**20**
14	Tools and Equipment (Specific)	**7**
15	Forces (Specific)	**26**
16	Maintenance (Specific)	**7**
17	Joining Methods (Specific)	**15**
	TOTAL FOR SECTION D	**75**
	TOTAL FOR SECTION A + D	**150**

QUESTION 13: WELDING TERMINOLOGY (SPECIFIC)

13.1 State TWO uses of templates. (2)

13.2 Identify the following supplementary welding symbols:

13.2.1 ⌒ (Weld face) (2)

13.2.2 M (Finish) (2)

13.3 FIGURE 13.1 below shows a simple roof truss. Label A–E.

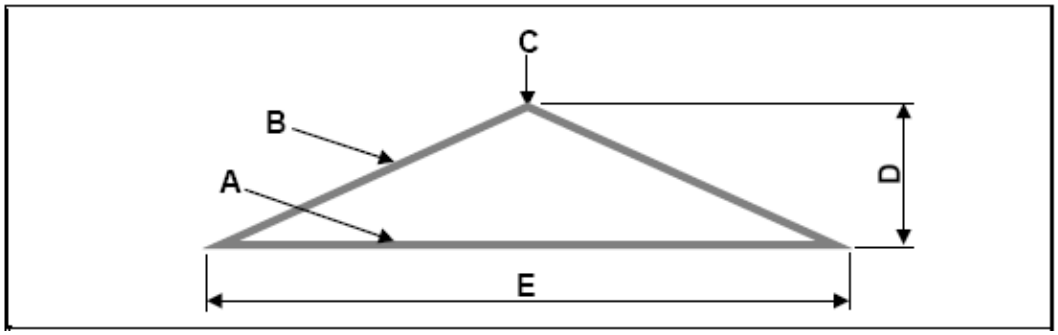
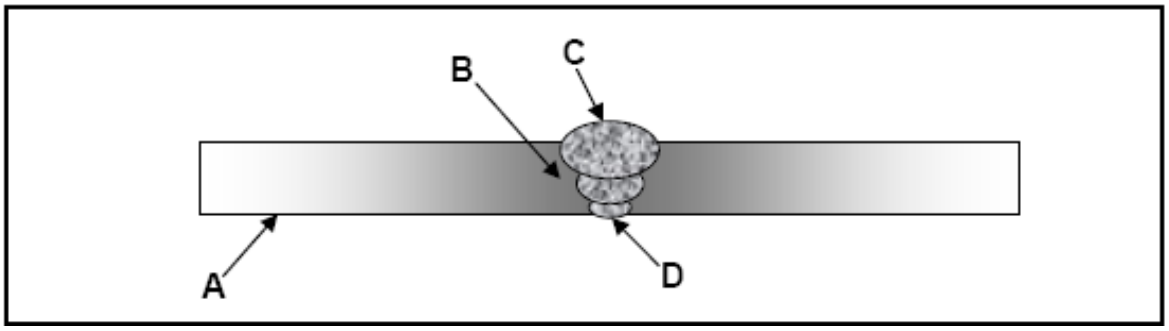


FIGURE 13.1 (5)

13.4 The span of a simple roof truss is 10 m and the rise is 2 m. Calculate the truss rafter. (5)

13.5 FIGURE 13.2 below shows a multiple welded run in a butt joint. Label A–D.



(4)

FIGURE 13.1

[20]

QUESTION 14: TOOLS AND EQUIPMENT (SPECIFIC)

14.1 Briefly describe the working principle of the cropper on a punch and shearing machine. (3)

14.2 Describe the use of the punching machine. (2)

14.3 Describe the function of EACH of the following machines:

14.3.1 Guillotine (1)

14.3.2 Rolling machine/Bending roll (1)

QUESTION 15: FORCES (SPECIFIC)

15.1 A round mild steel tube, 80 mm long, with an inner diameter of 34 mm and an outer diameter of 38 mm, is used in a steel framework. A compressive force of 50 kN is exerted on the tube.

Calculate the following:

15.1.1 The stress in the material and state your answer in mega magnitude (4)

15.1.2 The change in length caused by the force ($E = 90 \times 10^3$ MPa) (4)

15.2 FIGURE 15.1 shows a system of forces acting on the same point. Determine graphically the magnitude and direction of the equilibrant for this system. Use the following scale with Bow's notation: 1 mm = 3 N.

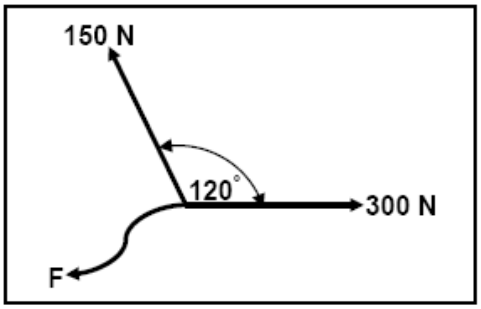
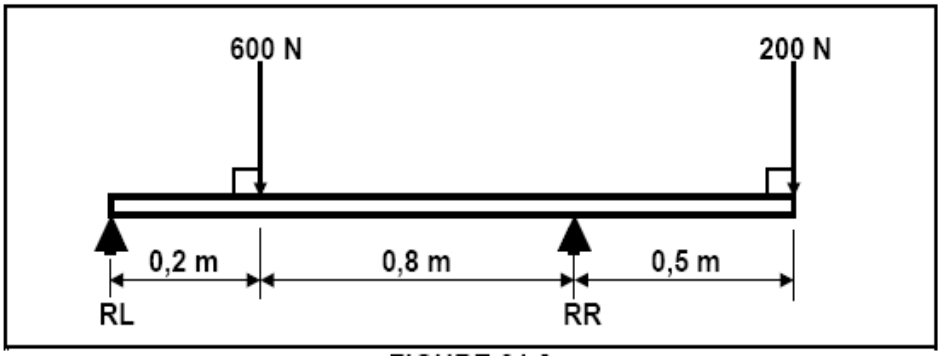


FIGURE 15.1 (8)

15.3 Determine the shear forces and bending moments of the beam indicated in FIGURE 15.2. Use scale: 1 mm = 10 N.



RL = 354.5N **RR = 445.5N**

FIGURE 15.2 (10)

[26]

QUESTION 16: MAINTENANCE (SPECIFIC)

16.1 State a cause for the malfunctioning of cutting machines in the workshop. (1)

16.2 State TWO results of inadequate lubrication of the bearings of a roller machine. (2)

16.3 State TWO precautions to take to prevent excessive wear on a guillotine. (2)

16.4 A well-maintained shearing machine has a longer lifespan, enhances production and reduces cost. State TWO factors that extend the service life of a machine effectively. (2)

[7]

QUESTION 17: JOINING METHODS (SPECIFIC)

17.1 FIGURE 17.1 shows the iron-carbon equilibrium diagram used for carbon steels. Answer the questions that follow.

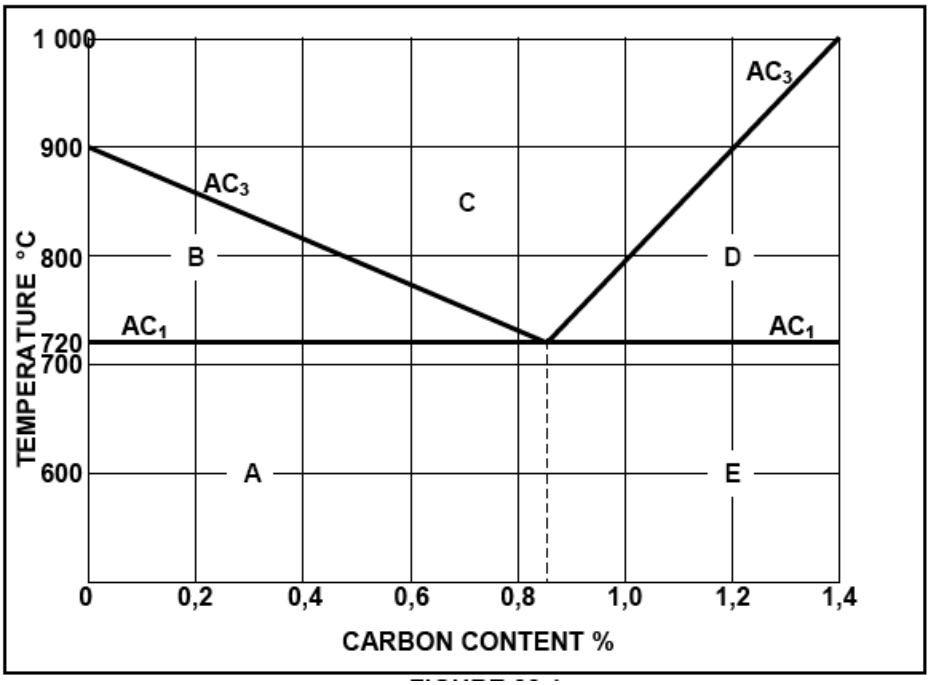


FIGURE 17.1

17.1.1 Label A–E. (5)

17.1.2 State TWO properties of structure E on the diagram. (2)

17.2 What is the purpose of case hardening steel? (2)

17.3 State TWO causes of slag inclusion as a welding defect found in arc welding. (2)

17.4 Describe the TWO functions of the flux on a welding electrode used for arc welding. (2)

17.5 Name TWO types of inert gases used for MIG/MAGS welding. (2)

[15]

TOTAL FOR SECTION D: 75

TOTAL FOR SECTION A+D: 150

FORMULA SHEET

1. BELT DRIVES

1.1 $N_1 D_1 = N_2 D_2$ where N = rotational frequency, D = diameter of pulley

1.2 $$Belt\ speed = \frac{\pi DN}{60}$$

1.3 $$Speed\ ratio = \frac{Diameter\ of\ driven\ pulley}{Diameter\ of\ driver\ pulley}$$

1.4 $$Power(P) = \frac{(T_1 - T_2)\pi\, DN}{60} \quad OR \quad Power(P) = (T_1 - T_2)v$$

2. STRESS AND STRAIN

2.1 $$Stress = \frac{Force}{Area} \quad or \quad (\sigma = \frac{F}{A})$$

2.2 $$A_{shaft} = \frac{\pi d^2}{4}$$

2.3 $$A_{pipe} = \frac{\pi(D^2 - d^2)}{4}$$

2.4 $A_{square\ bar} = length\ x\ length$

3. KEYS

3.1 $$Width\ of\ key = \frac{Diameter\ of\ shaft}{4}$$

3.2 $$Thickness\ of\ key = \frac{Diameter\ of\ shaft}{6}$$

3.3 Length of key = 1,5 × Diameter of shaft

3.4 Standard taper for taper key: 1 in 100 or 1 : 100

4. GEAR DRIVES

4.1 $N_1T_1 = N_2T_2$ where N = rotational frequency, T = number of teeth on the gear

4.2 $Power(P) = \frac{2\pi NT}{60}$

4.3 $Gear\ ratio = \frac{Product\ of\ the\ number\ of\ teeth\ on\ driver\ gears}{Product\ of\ number\ of\ teeth\ on\ driven\ gears}$

4.4 $\frac{N_{input}}{N_{output}} = \frac{Product\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{Product\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$

5. POWER

$IP = pLANn$

6. SCREW THREAD

6.1 $Lead = number\ of\ starts \times pitch$

6.2 $Helix\ angle: \tan\theta = \frac{lead}{\pi\ diameter}$

6.3 $Leading\ tool\ angle = 90° - (clearance\ angle + helix\ angle)$

6.4 $Following\ tool\ angle = 90° + (helix\ angle - clearance\ angle)$

6.5 $Depth\ of\ thread: H = 0{,}866\,P$

6.6 $Pitch\ diameter\ of\ thread: = OD - 2 \times \left[\frac{3 \times H}{8}\right]$

7. TAPER TURNING

$Compound\ slide\ angle\ \frac{\theta}{2} = \frac{D-d}{2l}$

8. HYDRAULICS

8.1 $A_{piston} = \frac{\pi d^2}{4}$

8.2 $Pressure = \frac{Force}{Area}$ or $p = \frac{F}{A}$

GRADE 11

Mechanical Technology - Memorandum MARKS: 150

QUESTION 1: MULTIPLE-CHOICE QUESTIONS (GENERIC)

1.1	A	(1)
1.2	B	(1)
1.3	A	(1)
1.4	D	(1)
1.5	C	(1)
1.6	C	(1)
1.7	C	(1)
1.8	D	(1)
1.9	C	(1)
1.10	B	(1)
1.11	A	(1)
1.12	B	(1)
1.13	A	(1)
1.14	B	(1)
1.15	A	(1)
1.16	C	(1)
1.17	D	(1)
1.18	B	(1)
1.19	B	(1)
1.20	D	(1)
		[20]

QUESTION 2: SAFETY (GENERIC)

2.1 **Angle grinder:**

The safety guard must be in place before starting.

Protective shields must be placed around the object being grinded to protect the people around.

Use the correct grinding disc for the job.

Make sure that there are no cracks on the disc before you start.

Protective clothing and eye protection are essential. ANY3x1 (3)

2.2 **Welding helmet:**

To protect your face against sparks

To protect your face against UV-rays

To protect your eyes against UV-rays

To protect your face against heat ANY3x1 (3)

2.3 **Portable drill machine:**

Do not leave the chuck key in the chuck.

Clamp the work piece securely to the table, do not hold by hand.

Clamp the drill bit securely in the chuck.

Never try to stop the work piece by hand if it slips from the clamp.

Never try to stop the chuck by hand.

Do not force drilling.

Use the correct speed and bit for the job.

Do not use loose clothing.

Always wear goggles to protect your eyes ANY3x1 (3)

2.4 Ensure that you switch it off. (1)

2.5 **Horizontal band saw:**

See that all safety guards are in place

See that there is no grease, oil and obstacles around the machine

See that the correct blade for the job is installed

Make sure that work piece is properly clamped

See that the blade speed is set correctly ANY3x1 (3)

2.6 Clamp the small work piece securely and firmly so it does not slip while drilling. (1)

2.7 **Hydraulic press:**

The predetermined pressure of the hydraulic press must not be exceeded.

Ensure the pressure gauge is in a good working order.

Platform in which the work piece rest must be rigid and square with the cylinder of the press.

Prescribed equipment must be used.

Check that securing pins for the platform are fitted properly.

Check hydraulic pipes for leaks

Check for oil on the floor. ANY 3x1 (3)

2.8 **Gas welding equipment:**
Safety goggles with dark lenses
Leather apron
Safety boots
Use leather gloves
Overall ANY3x1 (3)

Cigarette lighter is explosive and

Match burns continuously without stopping (2)

2.10 **Surgical gloves:**

To prevent infection

To prevent the transmission of blood related diseases, like HIV/Aids (2)

2.11 Belt guard, Automatic guard, Fix guard (2)

2.12 Oil and grease on floor

All the guards must be on

No grinding on the side of wheel

Don't force the work piece

Look for cracks in disc

Motor and disc speed must be the same

Safety clothes

Safety goggles (5)

[31]

QUESTION 3: TOOLSAND EQUIPMENT (GENERIC)

3.1 **Cutting Machine:**

3.1.1 Drillpress(1)

3.1.2 A. Base
B. Column
C. Motor
D. Feedlever
E. Chuck
F. Machinetable (6)

3.1.3 To hold the drill bit (1)

3.2 **Tap and die set:**

Tap to cut internal screw threads

Die to cut external screw threads

Power saw–blade move forward and backward
Horizontal band saw–blade moves in a circular motion (2)

3.4 **Function of equipment:**

3.4.1 Rolling machine–used to roll sheet metal (2)

3.4.2 Press machine–press, fit or remove parts from each other (2)

3.4.3 Guillotine – To cut sheet metal in sizes (2)

3.4.4 Angle Grinder – To cut and grind material (2)

3.4.5 Bench Grinder – Sharpen cutting tools, general grinding (2)

3.4.6 Fly Press – General press work by means of a handle or a wheel,
And it uses a coarse screw to converts rotation
(2)
[24]

TOTAL: 75

SECTION B: FITTING AND MACHINING (SPECIFIC)
QUESTION 4: TERMINOLOGY (SPECIFIC)

4.1 **Centre lathe functions:**

.1.1 **Four-jaw chuck:** To clamp an awkwardly-shaped object in a Centre lathe. (2)

4.1.2 **Lathe steadies:** To support long or slender shafts in one or more places, in a centre lathe. (2)

4.1.3 **Lathe mandrels:** It is used for the further machining of a work piece between centers after it has been bored or reamed while held in the chuck. (2)

4.2 Compound slide angle tan Θ/2 = D – d / 2 X *l*

tan Θ/2 = 78- 62 / (2 x105)

Θ/2 = 4, 36° (3)

4.3 **Screw threads:**

4.3.1 **The helix angle of the thread:**

Lead= number of starts×pitch

Lead=3×7

Lead=21mm

Helix angle: tan Θ= Lead / π x Diameter

Helix angle: tan Θ = 21 / π x 90
= 4,25° (4)

Leading tool angle= 90°–(clearance angle+ helix angle)

Leading tool angle= 90°–(3°+4,25°)
Leading tool angle= 82,75°

4.3.3 **The following tool angle:**

Following tool angle=90°+ (helix angle–clearance angle)

Following tool angle=90°+ (4,25°–3°)
Following tool angle=91,25°

4.4 **Parallel key:**

4.4.1 **The width:**

$$\text{With of key} = \frac{\text{Diameter of shaft}}{4}$$

$$\frac{60}{4}$$

$$= 15 \text{ mm} \quad (2)$$

4.4.2 **The thickness:**

$$\text{Thickness of key} = \frac{\text{Diameter of shaft}}{6}$$

$$\frac{60}{6}$$

$$= 10 \text{ mm} \quad (2)$$

4.4.3 **The length:**

$$\text{Length of key} = 1{,}5 \times \text{Diameter of shaft}$$

$$= 1{,}5 \times 60$$

$$= 90 \text{mm} \quad (2)$$

4.5 **Milling cutters:**

4.5.1 Side- and facemill (1)

4.5.2 T-slotmill

(1)

[25]

QUESTION 5: TOOLSAND EQUIPMENT (SPECIFIC)

5.1 **Purpose of tools:**

5.1.1 **Dial indicator:** It is used as precision-measuring tool in setting up of work on machinery, such as centre lathes or milling machines. (1)

5.1.2 **Telescopic gauge:** To provide a quick and accurate method of checking inside measurements. (1)

5.2 **Reasons for using a torque wrench:** (3)

It prevents bolts or studs from breaking.

It prevents bolts and nuts from loosening.

It prevents castings from warping.

5.3 170,11mm (3)

[8]

QUESTION 6: FORCES(SPECIFIC)

6.1

Moments:

Calculate A. Take moments about B.

$$\sum LHM = \sum RHM$$

$$(A \times 3{,}2) + (300 \times 1{,}2) = (800 \times 2{,}4) \quad \checkmark$$

$$\frac{3{,}2A}{3{,}2} = \frac{1\,920 - 360}{3{,}2}$$

$$A = 487{,}5\ N \quad \checkmark$$

Calculate B. Take moments about A.

$$\sum RHM = \sum LHM$$

$$(B \times 3{,}2) + (800 \times 0{,}8) = (300 \times 4{,}4) \quad \checkmark$$

$$\frac{3{,}2B}{3{,}2} = \frac{640 - 1320}{3{,}2}$$

$$B = 612{,}5\ N \quad \checkmark$$

6.2

Stress:

$$A = \frac{\pi(D^2 - d^2)}{4} \quad \checkmark$$

$$= \frac{\pi(0{,}06^2 - 0{,}054)}{4}$$

$$= 0{,}54 \times 10^{-3} m^2 \quad \checkmark$$

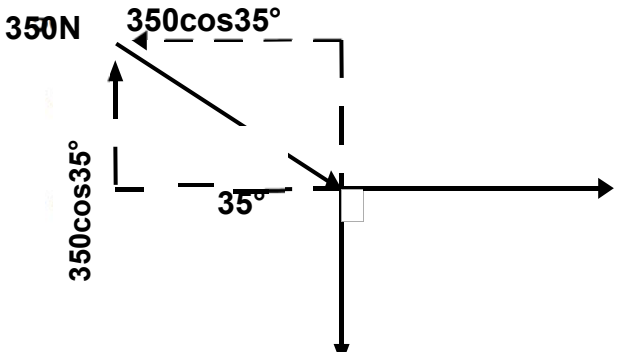
$$\sigma = \frac{F}{A} \quad \checkmark$$

$$= \frac{60 \times 10^3}{0{,}54 \times 10^{-3}} \quad \checkmark$$

$$= 111{,}11 \times 10^6\ Pa$$

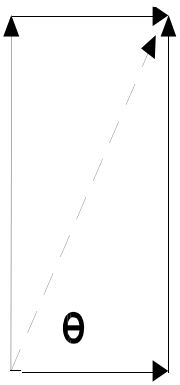
$$= 111{,}11\ MPa \quad \checkmark$$

6.3 **Forces:**



$$HC = 300 - 350\cos 35°$$
$$= 300 - 286{,}70$$
$$= 13{,}3\,N$$

150N



HC

$$VC = 350\sin 35° - 150$$
$$= 200{,}75 - 150$$
$$= 50{,}75\,N$$

$$R^2 = HC^2 + VC^2$$

$$\sqrt{\quad} \quad \sqrt{\quad}$$

$$Tan\theta = \frac{VC}{HC}$$
$$= \frac{50{,}75}{13{,}3}$$

R

VC

$$R^2 = 13{,}3^2 + 50{,}75^2$$

$R = 52{,}46N$

$\theta = 75{,}31$

Resultant=52,46N 75,31°North from East (10)

[19]

QUESTION 7: MAINTENANCE (SPECIFIC)

7.1 **Lathes and milling machines:**
Lack of lubrication
Overloading
Balancing (3)

If a machine runs over extended periods within adequate lubrication the

Machine will exceed the normal operating temperature which will cause excessive friction and wear

7.3 **Physical wear on the milling cutter of a milling machine:**

Cutting fluid should be applied.

Do not exceed the appropriate cutting depth.

Do not exceed the appropriate feed. ANY1x1 (1)

7.4 **Unbalanced workpiece in a lathe:**

Vibration

Inaccurate results

Risk of work piece coming loose ANY2x1 (2)

7.5 **Lack of lubrication in gear systems**

More friction

More heat ANY 2 x 1 (2)

Oil become contaminated by fine particles that may be give gear wear

7.6 **Overloading**

Strain on motor

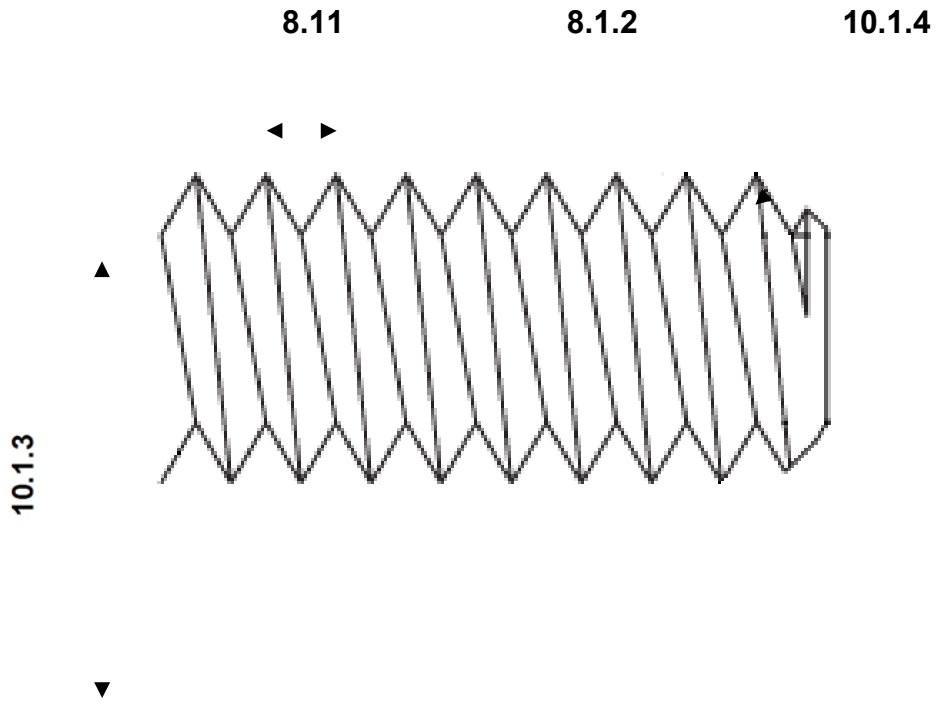
Strain on components moving onto each other

More friction ANY 2 x 1 (2)

[8]

QUESTION 18: JOININGMETHODS(SPECIFIC)

18.1 Isometric V-screwthread:



18.1.1 Pitch (1)

18.1.2 Screw-thread angle (1)

18.1.3 Effective diameter (1)

18.1.4 Crest (1)

(2)

18.2.1 **The depth of the screw thread:**

$H = 0{,}86603\ P$

$= 0{,}86603 \times 2{,}5$ ✓

$= 2{,}165075\ mm$ ✓

(2)

18.2.2 **The effective diameter of the screw thread:**

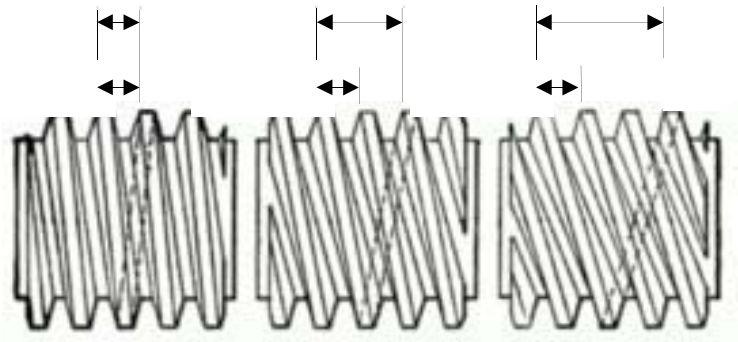
$$Pitch\ diameter\ of\ thread = OD - 2\left(\frac{3H}{8}\right)$$

$$= 20 - 2\left(\frac{3 \times 2{,}17}{8}\right) \checkmark$$

$$= 18{,}38\ \text{mm} \checkmark$$

LEAD **LEAD** **LEAD**

PITCH **PITCH** **PITCH**



SINGLE **TWO-START** **TRIPLE** (4)

[12]

TOTAL: 75

SECTION C: AUTOMOTIVE (SPECIFIC)

QUESTION 9: TOOLSAND EQUIPMENT (SPECIFIC)

9.1 **Outside micrometer:**

A.Anvil
B.Spindle
C.Barrel
D.Thimble

It prevents bolts or studs from breaking.
It prevents bolts or studs from loosening.
It prevents castings from warping. ANY2x1 (2)

To determine the run-out of a flywheel.
To determine if a crankshaft is bent.
To determine if a work-piece in a lathe is running true.
To determine if two work pieces are the same size. ANY2x1 (2)

It provides a quick and accurate means of checking inside measurements. (1)

[9]

QUESTION 10: ENGINES (SPECIFIC)

10.1 **Direct ignition:**

The injector injects the fuel directly into the combustion chamber which has a cavity in the crown of the piston.

10.2 **Injector:**

To deliver fuel in a fine spray into the charge. (1)

10.3 **Injector nozzles:**

Multihole
Single hole
Pintle type ANY2x1 (2)

10.4 **Hydraulic valve lifters:**

Operates silently.
No clearance between rocker and valve stem.
Precise timing for the opening and closing of the valves. (2)

10.5 **Advantages**

Easier starting because less heat loss during compression

Glow plugs are not required

Lower fuel consumption ANY 2 x 1 (2)

10.6 **Camshaft arrangements**

Single overhead cam in centre of rockers

Single overhead cam on the side

Double overhead cam above valves

A lower cam on the side of cylinder block ANY 2 x 1 (2)

10.7 **CVVT SYSTEM**

Control oil system

Control oil temp

Control valves (3)

10.8 **Tentioner:**

To ensure the correct tension in the timing belt

To prevent belt slip

To prevent it from knocking noisily against the timing cover

ANY1x1 (1)

[15]

QUESTION 11: SYSTEMS AND CONTROL (SPECIFIC)

11.1

11.1.1 **Spiral final drive** (1)

Advantages: Strong drive, quiet drive (1)

Disadvantages: Floor must have relative high tunnel, Friction is increased (1)

11.1.2 **Hypoid final drive** (1)

Advantages: Quiet drive, Stronger drive, Lubrication is more efficient (1)

Disadvantages: More friction, High degree of side and end thrush, High pressure and temp, efficient seals must be used for oils not to mix (1)

11.2 **Hydraulic brake master cylinder:**

A. Rebound spring
B. Control valve
C. Reservoir
D. Plunger
E. Pushrod (5)

11.3 Brake servo unit enhances the braking action. (2)

11.4 Anti-lock braking system (1)

11.5 **Anti-lock braking system:**

A. Electric controller
B. Apportioning valve (pressure valve)
C. Brake cylinder
D. Modulator (4)

11.6 **Drive system:**

11.11.2 A. Rear wheel final drive
B. Transfer gearbox
C. Gearbox
D. Front wheel final drive (4)

[25]

QUESTION 12: MATERIALS(GENERIC)

12.1 **Properties of engineering materials:**

12.1.1 **Hardness:** Ability to withstand surface indentation and scratching

Stress and to return to its original size and shape when the stress is removed. (3)

12.1.3 **Malleability:** Ability to deform permanently under compressive forces or hammering without developing defects. (3)

12.2 Pig iron (1)

12.3 **Function of the following elements used in a blast furnace:**

12.3.1 **Iron ore:** Raw material for producing iron (2)

12.3.2 **Coke:** Acts as a fuel to provide heat for smelting (2)

12.3.3 **Limestone or dolomite:** Serves as a fluxing agent and binds with

12.4 **Blast furnace labels:**

A. Iron tap hole

B. Hot air supply from stoves

C. Steel casing

D. Refractory brick lining

E. Hopper or Load

F. Small bell

G. Larger bell

H. Stack

I. Melting zone

J. Slag tap hole (10)

[26]

TOTAL SECTION C : 75

SECTION D: WELDING AND METALWORK (SPECIFIC)

QUESTION 13: WELDINGTERMINOLOGY (SPECIFIC)

13.1 **Uses of templates:**

Templates are used to avoid repetitive marking

(2)

To avoid unnecessary wastage of material
dimensions

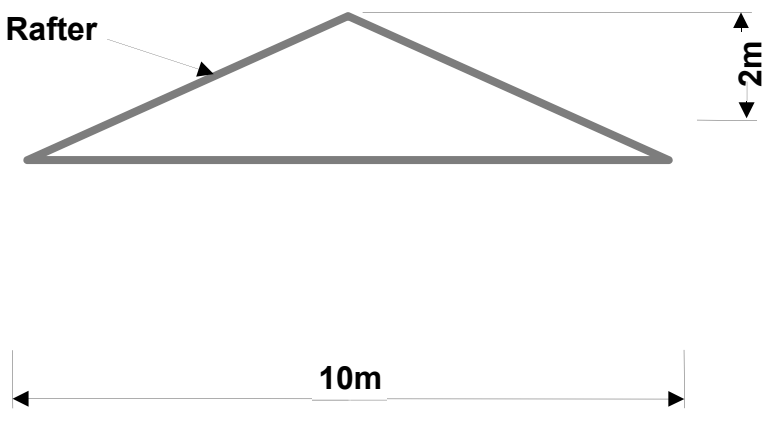
13.2 **Welding symbols:**

13.2.1 Convex finish (2)

13.2.2 Machining (2)

A. Tie beam
B. Rafter
C. Ridge
D. Rise
E. Span (5)

13.4 **Rafter calculations:** (5)



$$Rafter^2 = (Span \div 2)^2 + Rise^2 \quad \checkmark$$
$$= (10 \div 2)^2 + 2^2 \quad \checkmark$$
$$= 25 + 4 \quad \checkmark$$
$$Rafter^2 = 29 \quad \checkmark$$
$$Rafter = \sqrt{29}$$
$$= 5{,}39\ m \quad \checkmark$$

13.5 **Multiple-run butt joint:**

A. Parent metal
B. Heat affected zone
C. Weld face
D. Weld run (4)

[20]

QUESTION 14: TOOLSAND EQUIPMENT (SPECIFIC)

14.1 **Working principle of the cropper on a punch and shearing machine:**

Shearing off bars and sections by means of a sliding blade behind a Fixed blade with the shape of the profile in it. (3)

To rapidly remove metal to a form of round, square or other shaped holes By using a top punch and a bottom die. (2)

14.3 **Functions of machines:**

The guillotine is generally used to cut sheetmetal (1)

A rolling machine is used to roll(form)flatbar, plate, angle iron, and various other steel profiles. (1)

[7]

QUESTION 15: FORCES(SPECIFIC)

.1 **Stress:**

$$A = \frac{\pi(D^2 - d^2)}{4}$$

$$= \frac{\pi(0{,}038^2 - 0{,}034^2)}{4}$$

$$= 0{,}23 \times 10^{-3} 10\, m^2 \checkmark$$

$$\sigma = \frac{F}{A} \checkmark$$

$$= \frac{50 \times 10^3}{0{,}23 \times 10^{-3}}$$

$$= 217{,}39 \times 10^6 Pa$$

$$= 217{,}39\, MPa \checkmark$$

.2 **Strain – E = 90 x 10^3 MPa):**

$$\varepsilon = \frac{\sigma}{E} \checkmark$$

$$= \frac{217{,}39 \times 10^6}{90 \times 10^9} \checkmark$$

$$= 2{,}42 \times 10^{-3} \checkmark$$

1. Stress: (4)

$A = \pi \frac{(D^2 - d^2)}{4}$

$= \pi \frac{(0{,}038^2 - 0{,}034^2)}{4}$ ✓

= 0,226 × 10^{-3} m^2✓ **(or 2,26 x 10^{-3}m^2)**

$\sigma = F/A$

$= \frac{50 \times 10^3}{0{,}226 \times 10^{-3}}$ ✓ (4)

= 221, 23 x10^6 Pa

= 221,23 M Pa ✓

2. Strain

$\varepsilon = \sigma/E$

$= \frac{221{,}23 \times 10^6}{90 \times 10^9}$ ✓

= 2.45 x 10^{-3}✓

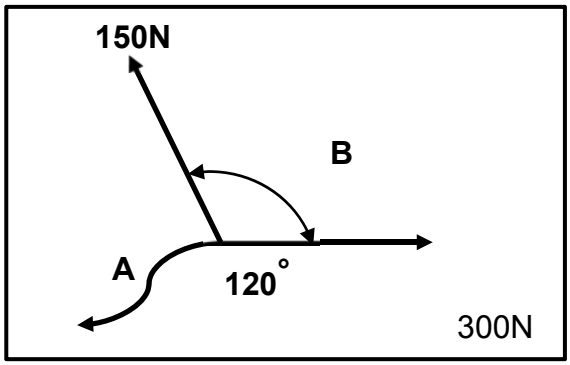
$\Delta l = \varepsilon \times ol$

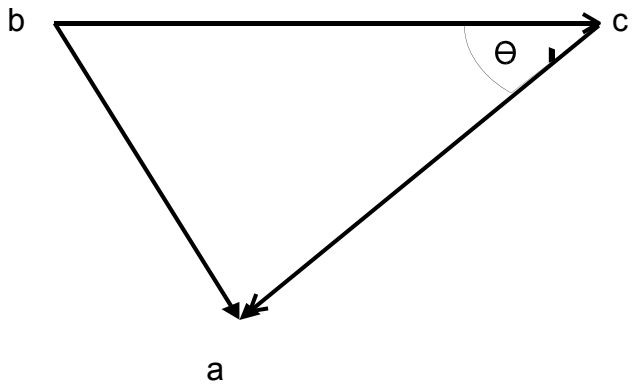
$= (2.45 \times 10^{-3}) \times 0{,}08$

$= 0{,}196 \times 10^{-3} m$ ✓✓

$= 0{,}196 mm$

15.2 **Forces:**

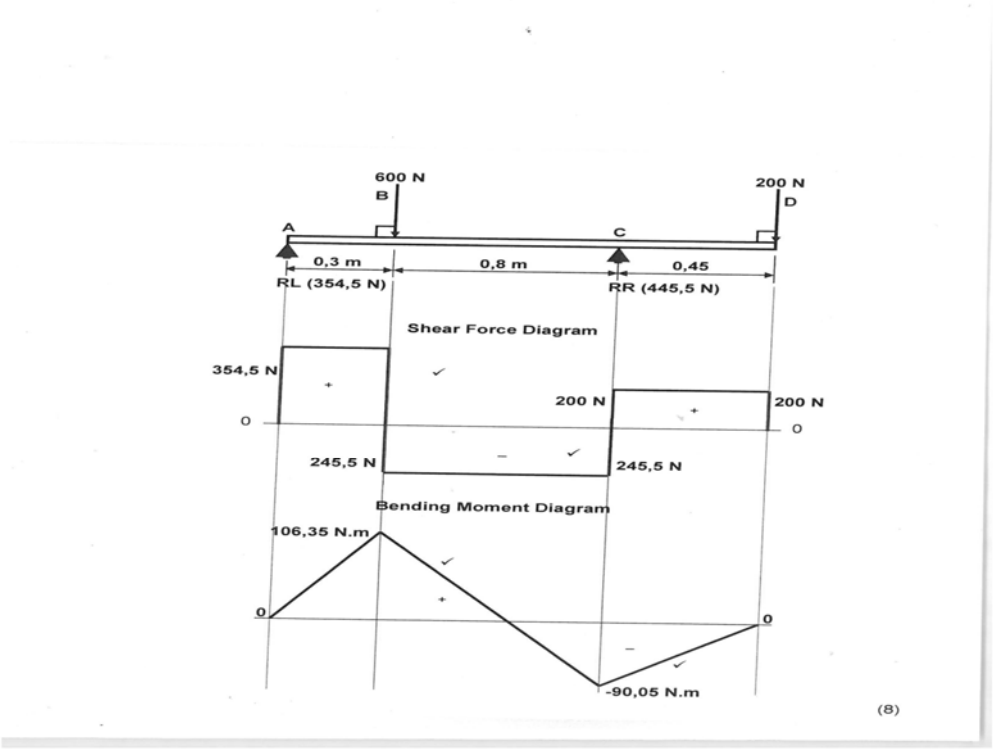




Scale1 mm=5N

ac= F = 265N Θ = 30° South from West (8)

15.3 **Shear force and bending moment diagrams:**



(10)

[26]

QUESTION 16: MAINTENANCE(SPECIFIC)

16.1 **Malfunctioning of cutting machines:**

Lack of lubrication or incorrect lubrication

Overloading

Friction causing excessive wear
Overheating causing bearings to seize (2)

16.3 **Prevent excessive wear:**

The specified amount of the specified lubricant is to be applied to the relevant lubricating **poi**nt in a specified quantity and at a (1)

16.4 **Factors that effectively extends the machine's service life:**
Proper operation in accordance with manufacture's instruction.
Machine should be kept clean at all times.
Before starting machine, ensure that it is properly lubricated.
All electrical parts should work in a safe and reliable way.

A well trained person should operate the machine to prevent breaking or causing accidents. ANY2x1

(2)

[6]

QUESTION 17: JOINING METHODS (SPECIFIC)

17.1 **Iron carbon equilibrium diagram:**

17.1.1 **Labels:**

A–Ferrite–Pearlite

B–Ferrite–Austenite

C –Austenite

D –Cementite–Austenite

E–Pearlite–Cementite (5)

17.1.2 **Properties of perlite–cementite:**

Hard

Brittle (2)

17.2 **Purpose of casehardening:**

To give steel a hard surface with a tough core (2)

17.3 **Causes of slag inclusion:**

Slag not removed from previous weld

Current is to low

Arc is too long

Welding tempo is too fast. ANY 2x1 (2)

17.4 **Functions of the flux on a welding electrode:**

Protecting the steel core

Cause gas shield to protect the weld from atmospheric contamination

Form slag on top of weld to protect while cooling ANY 2 x 1
(2)

17.5 **Inert gases for MIG/MAGS welding:**

CO_2

Argon

Helium

Teral (Argon+CO_2) ANY 2 x 1
(2)

[15]

TOTAL SECTION D: 75
GRAND TOTAL: 150

CONCLUSION
Improving learner performance

"If our aim is to improve learner performance, not just measure it, we must ensure that learners know the performance expected of them, the standards against which they will be judged, and have opportunities to learn from the assessment in future assessments."

(Grant Wiggens, 2002)

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