

**KNOWLEDGE COMPONENT: FACILITATOR FORMATIVE AND SUMMATIVE ASSESSMENT TOOLS AND MODEL ANSWERS: KNOWLEDGE MODULE 13: MECHANICAL MAINTENANCE**

**Occupational Certificate: Sugar Processing Controller**

**KNOWLEDGE COMPONENT:**

**FACILITATOR FORMATIVE AND SUMMATIVE ASSESSMENT TOOLS AND MODEL ANSWERS**

**KNOWLEDGE MODULE 13: MECHANICAL MAINTENANCE**

**KNOWLEDGE COMPONENT: FACILITATOR FORMATIVE AND SUMMATIVE ASSESSMENT TOOLS AND MODEL ANSWERS: KNOWLEDGE MODULE 13: MECHANICAL MAINTENANCE**

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**OCCUPATIONAL CERTIFICATE: SUGAR PROCESSING CONTROLLER**

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1. INTRODUCTION TO THE FACILITATOR ASSESSMENT TOOLKIT OF THE OCCUPATIONAL CERTIFICATE: SUGAR PROCESSING CONTROLLER

Dear Facilitator

This Toolkit has been created to assist you to assess the Formative and Summative Learning Activities of learners undertaking the NQF 5 Occupational Certificate: Sugar Processing Controller Qualification.

During the programme, Learners must be directed to their Learning and Activities Guide to complete Learning Activities associated with each module of the Knowledge Component.

The time allocated to the Learning Activities is provided in the Facilitator’s Implementation Guide, this Facilitator Assessment Toolkit and Model Answers and the Learning and Activities Guide.

The marks allocated to each Learning Activity is provided in this Facilitator Assessment Toolkit and Model Answers and the Learning and Activities Guide.

**Instructions to be given to Learners**

* They must work individually to present the results of each Learning Activity in each of the Learning and Activities Guides (Workbooks).
* They must complete all the sections.
* They must use a black pen and ensure that they complete the questions in their own handwriting.
* The time provided to complete each activity is shown.
* The marks they will attain for each learning activity are shown in brackets.

1. KNOWLEDGE MODULE 13: MECHANICAL MAINTENANCE

**NQF LEVEL: 5**

**CREDITS: 4**

**PURPOSE OF THE KNOWLEDGE MODULE: The main focus of the learning in this knowledge module is to build an understanding of mechanical maintenance principles and concepts that relates to sugar mill.**

The learning will enable learners to demonstrate an understanding of:

* KM-13-KT01: Mechanical maintenance principles and concepts (70%)
* KM-13-KT02: Principles of preventative maintenance (30%)

2.1 Knowledge Topic 1: Mechanical maintenance principles and concepts (70%)

Topic elements to be covered include:

* KT0101 Methods for monitoring and controlling mechanical equipment based on operating parameters
* KT0102 Maintenance requirements for pumps
* KT0103 Maintenance requirements for motors
* KT0104 Maintenance requirements for heating equipment
* KT0105 Maintenance requirements for cooling equipment

Internal Assessment Criteria and Weight

* IAC0101 The maintenance requirements for mechanical components can be explained
* (Weight 70%)

**Learning activity 1.1: Individual Learning activity: 45 minutes (28 marks)**



**Learning Objective:** The maintenance requirements for mechanical components can be explained

**Task:** Read each question carefully and write your answer in the space provided.

1. List five most important benefits of a properly managed preventive maintenance program. (10)

|  |
| --- |
| * Equipment downtime is decreased and the numbers of major repairs are reduced. |
| * Better conservation of assets and increased life expectancy of assets, thereby eliminating premature replacement of machinery and equipment. |
| * Reduced overtime costs and more economical use of maintenance workers due to working on a scheduled basis instead of a crash basis to repair breakdowns. |
| * Timely, routine repairs lead to fewer large-scale repairs. |
| * Improved safety and quality conditions for everyone in the factory. |

1. During the pump routine inspections 9 tasks are performed name 5. (5)

|  |
| --- |
| * Check the level and condition of the oil through the sight glass on the bearing frame. |
| * Check for unusual noise, vibration, and bearing temperatures. |
| * Check the pump and piping for leaks. |
| * Analyze the vibration. |
| * Inspect the discharge pressure. |
| * Inspect the temperature. |
| * Check the seal chamber and stuffing box for leaks. |
| * Ensure that there are no leaks from the mechanical seal. |
| * Adjust or replace the packing in the stuffing box if you notice excessive leaking. |

1. After the all inspections are done and the pump’s performance is still not satisfactory. What is the procedure to follow? (7)

|  |
| --- |
| * Disassemble the pump. |
| * Clean all the parts thoroughly. |
| * Inspect for wear or damage and compile a condition report. |
| * Decide on the action - which could be to   a) replace worn parts or  b) To replace any damaged components, if necessary. |
| * Re-assemble the pump. |
| * Check its operation and measure its post-maintenance performance. |
| * Commission the maintenance action/job and hand back the equipment to the operator. |

1. Name 6 parameters that need to be monitored regularly in order to understand the performance of the pump? (6)

|  |
| --- |
| Suction pressure (Ps) |
| Discharge pressure (Pd) |
| Flow (Q) |
| Pump speed (N) |
| Pump efficiency (η) |
| Power. |

**Learning activity 1.2: Individual Learning activity: 45 minutes (28 marks)**



**Learning Objective:** The maintenance requirements for mechanical components can be explained

**Task:** Read each question carefully and write your answer in the space provided.

1. What are the two (2) schedules of lubrication system maintenance? (2)

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| Daily scheduled maintenance |
| Periodic scheduled maintenance |

1. Name five (5) basic guidelines to maintenance of motor controls (10)

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| * Cleanliness. In poor environments, blow out dirt weekly; in normal environments, a quarterly or semi-annual cleaning should be adequate. Make sure that dust or contamination is kept off high-voltage equipment. This is important because dust may contain conducting materials that could form unwanted circuit paths, resulting in current leakage or possible grounds or short circuits. |
| * Moving parts inspection. Moving parts should operate easily without excessive friction. Check operation of contactors and relays by hand, feeling for any binding or sticking. Look for loose pins, bolts, or bearings. If the control is dirty, it should be wiped or blown clean. |
| * Contact inspection. Check contacts for pitting and signs of overheating, such as discoloration of metal, charred insulation, or odor. Be sure contact pressure is adequate and the same on all poles; verify with manufacturer's specification. Watch for frayed flexible leads. |
| * Contact resistance testing. On essential controls, perform contact-resistance tests with a low-resistance ohmmeter on a regular basis. Proper contact resistance should be about 50 micro-ohms. Record readings for future comparison. This will indicate trends in the condition of contacts. |
| * Overloads relay inspection. Overload relays should receive a thorough inspection and cleaning. You also should check for proper setting. In general, maintenance requirements for these relays include checking that the rating or trip setting takes into account ambient temperature as well as the higher inrush currents of modern, energy-efficient motors. You also should verify that contacts are clean and free from oxidation and that the relay will operate dependably when needed. Relays should be tested and calibrated every one to three years. |

1. From the cooling towers maintenance checklist, list six tasks that need to be performed when maintaining towers. (6)

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| * Check the holding tank in the wet towers and remove all large debris. |
| * Remove all screens (some people refer to them as air scrubbers) and clean. |
| * Pressure wash the entire cooling tower. |
| * Check entire unit for rust. Remove any rust that is not removed from pressure washing. |
| * Check drains and clean. |
| * Lubricate all bearings both on motors and belt pulleys. |
| * Look for excessive belt ware, check belts for alignment and proper tension. |
| * Check all electrical wiring for loose or discolored connections. |
| * Check and clean all water nozzles that feed the return condenser water to the towers. |
| * Inspect the bottom of the towers for any water leaks. Make sure all leaks are repaired. |
| * Look for excessive corrosion, this could indicate improper chemical treatment program. |
| * Be sure and clean the area around the cooling towers. Remember they are like big vacuum cleaners that pull outside air into them to cool your condenser water. A dirty environment can impact the efficiency of the cooling system. |

1. Discuss five preventative maintenance tips to ensure that your boiler is safe and reliable. (10)

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| **Cleaning:** Scale, soot and other forms of residue can cover the inside surface of a boiler’s tubes, thereby reducing heat transfer efficiency and increasing the chance of a breakdown. A coating of residue as little as 0.0012 – 0.002 centimetres thick can reduce heat transfer by upwards of 10%. Cleaning of tubes, whether by mechanical (brush) or chemical means should be done at least annually and will help to prevent this issue. |
| **Blow down:** High concentrations of total dissolved solids (TDSs) in boiler units can cause matter to precipitate from the water and create scale. This build-up reduces efficiency and increases the likelihood of boiler failure. Regular and minor, boiler blowdowns involve draining water from the boiler and can prevent high TDS concentrations that allows solids to precipitate. |
| **Monitor and Manage Water Quality: Water** quality has a significant impact on boiler performance. In order to maintain water quality in a boiler, regular checks/testing of dissolved minerals, returned condensate, and the presence of a de-aerator are essential. Inspections should take place more frequently as the size and operating pressure of the boiler increases. |
| **Inspect Insulation:** Insulation is important for any surface with a temperature frequently in excess of 50°C. Un-insulated steam and condensate piping, valves, or fittings on boiler systems can result in critical heat loss and reduced boiler efficiency. It is therefore necessary to inspect and repair insulation regularly. |
| **Maintain Accurate Service/Maintenance Logs:** The best way to ensure a boiler is performing efficiently is to maintain accurate service and maintenance logs. Recording water and flue gas temperatures, as well as pressure, on a daily basis provides the information needed to maintain optimal performance and diagnose problems as they arise during the course of operation. |

2.2 Knowledge Topic 2: Principles of preventative maintenance (30%)

Topic elements to be covered include:

* KT0201 Scheduling and planning preventative maintenance
* KT0202 Principle of preventative maintenance
* KT0203 Reasons for preventative maintenance

Internal Assessment Criteria and Weight

* IAC0201 The roles and responsibilities of the sugar processing controller in preventative maintenance can be explained and motivated
* (Weight 30%)

**Learning activity 2.1: Individual Learning activity: 1.5 hours (40 marks)**



**Learning Objective:** The role and responsibilities of the sugar processing controller in preventative maintenance can be explained and motivated

**Task:** Read each question carefully and write your answer in the space provided.

1. What is the aim of preventative maintenance? (2)

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| The aim is to prevent equipment failures before they occur. Maintenance is regularly planned and performed on a piece of equipment while the equipment is still working, so that it does not break down unexpectedly. |

1. Discuss four principles of planning preventative maintenance (8)

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| **Planning Principle 1:** It is very important that the role of the planner/scheduler is identified to be independent of the other activities going on within a plant or facility. Responsibilities of the planner/scheduler should include:   * Planning emergency work * Acting as a relief supervisor * Becoming a material expeditor * Working on tools * Becoming a “go-for” for the maintenance / operations supervisor |
| **Planning Principle 2:** A planner must focus on arranging current and future maintenance work, as well as allocating the appropriate resources, parts, finances, costs, and reliability information for each project. The planner must also emphasize constant improvement, for planning, doing, checking, and acting on or adjusting schedules: |
| **Planning Principle 3:** When implementing different components of your preventative maintenance schedule take advantage of the ISO Standards of relevance to your equipment, factory and industry for best practice tips and ease of compliance. These standards may include guidance regarding work order histories, equipment registry, parts registry and more. |
| **Planning Principle 4:** Once tasks are identified, an important principle of maintenance planning is to ensure all instructions are documented and standardized. The best planners have experience estimating time and comparing actuals of work done in bite size chunks in order to bring efficiencies into the next iteration of carrying out preventive maintenance. |
| **Planning Principle 5:** Sometimes it’s not best to reinvent the wheel for all pieces of equipment. Planners should take advantage of standard plans and manufacturer’s guidelines and enhance them. Plans will also take into account and recognize the skills of technicians and help determine whether manufacturer’s technicians rather than internal technicians should be used. |
| **Planning Principle 6:** Take advantage of data from past work to properly estimate appropriate and accurate plans for the future. This will make maintenance time more available and the more maintenance time available, the more maintenance activity can be performed.   * Measuring how much time technicians actually spend on the job site versus other activities determines the effectiveness of the maintenance planning program: (Obtaining parts or tools, etc.). * Delays are not part of a technician’s job and should be avoided. * Sampling maintenance time periodically can be used to measure how effective planning can be. * Use this as a metric to determine how effective your maintenance team is and look for ways to improve performance when gaps emerge |

1. Provide a description for “planning and scheduling preventative maintenance” (2)

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| Maintenance planning and scheduling is a systematic approach to optimize efficiencies while maximizing work performance, and the most critical element to ensuring proactive maintenance. |

1. Discuss five (5) maintenance scheduling principles (10)

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| **Scheduling Principle 1:** To set realistic goals and schedules, the planner/scheduler must look at the appropriate resources for the work to be performed and then estimate the hours and effort it will require. To manage this process and avoid roadblocks, try to plan to the lowest required skill level available and work upwards.  If you work the opposite way, organizations may end up in a situation where skills are available, but the sort of work available is not appropriate for the priority level skill element. As a best practice, at the beginning of a project, identify skills for:   * Persons * Work hours * Duration of work |
| **Scheduling Principle 2:** For the most effective scheduling, identifying job priorities in order of importance. Determine what this measure of importance is – it could be most downtime first (then lesser cost next), highest loss of profit first (then less profit loss next), lowest cost first (then higher cost next), highest safety impact first (then least impact on safety next), highest danger first (then less dangerous next), etc. as relevant. Better yet, a weighting and scoring matrix could be used to prioritise using **ALL** these indices working with parties from management, sales and production. Such prioritization is useful in terms of getting everyone to understand the importance of maintenance and its impact on the mill. |
| **Scheduling Principle 3:** Scheduling from forecasts of the maintenance required helps to increase productivity. If the work orders are generated 10 days in advance, then more details can be put into the scheduling. These details include the resources required, the availability of parts, and the work to be done. Consider what jobs can be put together, what jobs can be grouped, what condition monitoring work is outstanding and can it be bundled, and any proactive work that can be done in advance. |
| **Scheduling Principle 4:** To help set up an organization’s maintenance team for success, scheduling work for every hour available is a good rule of thumb, and allows for organizations to achieve practical goals. |
| **Scheduling Principle 5:** When it comes down to daily activities, the planner/scheduler should leave the detail of the planning and scheduling to a crew leader or technician supervisor. With proper training, these crew members can use the plan and take advantage of their own functionality to realign the resources based on their priorities for the day. This should be easy enough if the planning and scheduling is proactive, but knowing that potential emergencies and urgent activities might interrupt the day, there is still a chance that it can be done if 80-90% of the day is planned out. |
| **Scheduling Principle 6:** In order to keep employees engaged, begin measuring performance by analysis of scheduled success. This measure avoids supervisors feeling the calculation gives an unfair poorer-than-actual view of their performance, and offers the crew any benefit of any doubt. |

1. Explain the principles of preventative maintenance. (8)

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| --- |
| **Planning:** Planning is one of the pillars of preventive maintenance. When tasks are efficiently scheduled, delays between maintenance jobs are minimized and maintenance resources are maximized. Scheduling maintenance tasks and creating a preventative maintenance management plan will list maintenance labour hours, materials, technicians and reasons for each work order. This information can be used later on for reports for the establishment of overall improvement strategies. |
| **Discipline:** The second pillar of an effective preventative maintenance programme is discipline. Discipline means that the organization should stick to planned maintenance and reinforce the quality of maintenance work. Collecting valid fault data is one of the preconditions for the establishment of an effective preventive maintenance system. Therefore, to successfully implement preventive maintenance, it is important to have sufficient data on the failures to be evaluated.  When production deadlines are approaching, equipment utilization rates are high and interventions on machines may be difficult. Furthermore, the objective of a preventative maintenance program is the regular inspections where access to equipment is scheduled in a timely manner. Therefore, a good preventive maintenance program requires discipline and support of all involved teams to coordinate availability and create time for equipment inspection. |
| **Consider Equipment Maintenance History:** As mentioned before, all data related to previous failures is of crucial importance for the creation of a preventative maintenance program. Previous incidents, the type and operation of the machine, and the manufacturer’s recommendations should be considered when defining the type and frequency of the maintenance. |
| **Preventive Maintenance Training:** Preventative maintenance training encourages autonomous maintenance and ensures that all machine operators and maintenance technicians are familiar with basic maintenance practices such as lubrication of various crucial components, oil changes, cleaning, functional checks and repairing of some issues. |

1. Name and discuss five (5) good reasons why it is important to have preventative maintenance. (10)

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| --- |
| **Save Money:** Unplanned downtime caused by equipment failure can cost a fortune in lost production revenue, not to mention emergency repair costs.  From paying technicians overtime to the cost of overnight parts delivery, everything is more expensive in an emergency especially when a production line goes down. A preventive maintenance program is simply good business. |
| **Maximize Efficiency:** Regular equipment maintenance optimizes operations so you can run at maximum efficiency.  Keeping your equipment running at optimal potential increases uptime, enhancing production while reducing costs. Poorly maintained equipment uses a lot more power, resulting in increased energy costs that add up over time. Well-maintained equipment also reduces scrap (waste, redo, recall) produced by machinery that’s operating at a sub-par performance level. |
| **Prolong Equipment Life:** Predictive maintenance programs result in longer lasting, better-performing equipment.  According to Plant Engineering’s survey, aging equipment is the leading cause of unscheduled downtime. Regular maintenance protects your investment and improves both your equipment’s lifespan and performance. More efficient, effective equipment translates to higher profits. |
| **Reduce Maintenance Costs:** Reactive maintenance is widely thought to be anywhere from 2 to 5 times more expensive than preventive maintenance. Over a period of time, regularly scheduled maintenance minimizes breakdowns and makes for much quicker, easier repairs when issues do arise.  It’s simply smarter to replace components that wear down before they fail. Preventing problems before they occur is always going to be less expensive than equipment failures. |
| **Improve Safety and Reliability:** Poorly operating machinery can create hazards and unsafe working conditions. Dulled and warped edges on equipment with grinding gears can be dangerous. Regular maintenance inspections ensure that faulty equipment doesn’t cause injury. And when your equipment is in safe working order, your employees stay safe as well. |

1. CONCLUSION OF KNOWLEDGE MODULE 13: MECHANICAL MAINTENANCE

Throughout this knowledge module you have been provided opportunities to complete formative learning activities. You have captured your results in this Learner Workbook.

The total marks for this Knowledge Module are as follows:

|  |  |  |
| --- | --- | --- |
| **Knowledge Module** | **Total Marks** | **Marks attained** |
| KM-13-KT01: Mechanical maintenance principles and concepts (70%) | 56 |  |
| KM-13-KT02: Principles of preventative maintenance (30%) | 40 |  |
| **Total Marks** | **96 marks** |  |

1. WRITTEN ASSESSMENT

**Candidate instruction:** Complete the following multiple-choice questionnaire by marking the most appropriate response with an x in the space provided.

|  |  |  |
| --- | --- | --- |
| **Scope of Assessment** | **Exit Level Outcome/s** | **Module/s** |
|  | 1. : Mechanical maintenance | **13** |
| **Alignment – Learning Outcome 1:** **Mechanical maintenance principles and concepts**  **Award four marks for selection of valid “x”. Four marks = Competent** | | |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.1** | **What is the main purpose of regular maintenance?** | | **Mark Allocation** |
| **a.** | 🞎 | Reduce overtime costs |  |
| **b.** | 🞎 | Avoid workplace accidents |  |
| **c.** | 🗷 | To ensure that all equipment required for production is operating at 100% efficiency at all times |  |
| **d.** | 🞎 | Keeping equipment clean at all times |  |
| **e.** | 🞎 | Improve safety and quality condition in the factory | **(4)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **13.2** | **The maintenance program plan cycle has the following components** | | | **Mark Allocation** | |
| **a.** | 🞎 | Plan |  | |
| **b.** | 🞎 | Do |  | |
| **c.** | 🞎 | Check |  | |
| **d.** | 🞎 | Act |  | |
| **e.** | 🗷 | All of the above | **(4)** | |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.3** | **In general preventative maintenance includes?** | | **Mark Allocation** |
| **a.** | 🞎 | Sharpening of blades as required (or replacement of dull blades) |  |
| **b.** | 🞎 | Thorough cleaning of valves, screens and pipes |  |
| **c.** | 🞎 | Replacement of old, worn or defective seals. |  |
| **d.** | 🗷 | All of the above |  |
| **e.** | 🞎 | None of the above | **(4)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.4** | **The advantages of regular monitoring of pumps are?** | | **Mark Allocation** |
| **a.** | 🞎 | The time to maintain the pump set may be predicted and planned more accurately and in a qualified manner in line with predictive and planned maintenance strategies. |  |
| **b.** | 🞎 | No dismantling of the pump is necessary |  |
| **c.** | 🞎 | If a flow meter is installed to measure process liquid flow, then the pump monitor is able to verify the accuracy of the meter readings. |  |
| **d.** | 🞎 | Offers cost savings and energy savings by increasing the pump availability and reliability coefficients for pumps. |  |
| **e.** | 🗷 | All of the above | **(4)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.5** | **The responsibilities of the preventative maintenance planner/scheduler include?** | | **Mark Allocation** |
| **a.** | 🞎 | Observe the cooling system’s operation, listen for any unusual noise |  |
| **b.** | 🞎 | Check and make sure all gauges are in proper working order. |  |
| **c.** | 🗷 | Planning emergency work |  |
| **d.** | 🞎 | Clean all condenser tubes. |  |
| **e.** | 🞎 | None of the above | **(4)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.6** | **A planner must focus on arranging the current and future maintenance work as well as allocating the appropriate resources, which planning principle is that?** | | **Mark Allocation** |
| **a.** | 🞎 | Planning principle 3 |  |
| **b.** | 🗷 | Planning principle 2 |  |
| **c.** | 🞎 | Planning principle 5 |  |
| **d.** | 🞎 | Planning principle 4 |  |
| **e.** | 🞎 | Planning principle 6 | **(4)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.7** | **What does planning involve?** | | **Mark Allocation** |
| **a.** | 🞎 | Acting as a relief supervisor |  |
| **b.** | 🗷 | What you see, expect, know, able to do and taking action |  |
| **c.** | 🞎 | Implementing a successful preventative maintenance program |  |
| **d.** | 🞎 | Setting realistic goals and schedules |  |
| **e.** | 🞎 | Assigning duties to employees | **(4)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.8** | **The following guidelines will help maintain motor controls** | | **Mark Allocation** |
| **a.** | 🞎 | Cleanliness |  |
| **b.** | 🞎 | Moving parts inspection |  |
| **c.** | 🞎 | Contact inspection |  |
| **d.** | 🗷 | All of the above |  |
| **e.** | 🞎 | None of the above | **(4)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.9** | **Some important features of cranes that need care in inspection and testing are:** | | **Mark Allocation** |
| **a.** | 🞎 | The hook - check for spreading |  |
| **b.** | 🞎 | The brake - does it support the load |  |
| **c.** | 🞎 | Top and bottom limit switches |  |
| **d.** | 🗷 | All of the above |  |
| **e.** | 🞎 | None of the above | **(4)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.10** | **The role of preventative maintenance training is to?** | | **Mark Allocation** |
| **a.** | 🞎 | Save money |  |
| **b.** | 🗷 | To encourage autonomous maintenance and ensures that all machine operators and maintenance technicians are familiar with basic maintenance practices such as lubrication of various crucial components. |  |
| **c.** | 🞎 | Reduce maintenance costs |  |
| **d.** | 🞎 | Prolong equipment life |  |
| **e.** | 🞎 | Improve safety and reliability | **(4)** |

**Award one mark for selection of valid “T/F”. One mark = Competent**

|  |  |  |  |
| --- | --- | --- | --- |
| **13.11** | **True or False: The following are the most important benefits of a properly managed preventive maintenance program?** | | **Mark Allocation** |
| **a.** | **ⓣ** | Equipment downtime is decreased and the number of major repairs are reduced |  |
| **b.** | **ⓣ** | Better conservation of assets and increased life expectancy of assets, thereby eliminating premature replacement of machinery and equipment. |  |
| **c.** | **ⓣ** | To reduce accidents due to wear and tear and faulty equipment to zero |  |
| **d.** | **ⓣ** | Timely, routine repairs lead to fewer large-scale repairs. |  |
| **e.** | **ⓣ** | Improved safety and quality conditions for everyone in the factory | **(5)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.12** | **True or False: Discipline is?** | | **Mark Allocation** |
| **a.** | **ⓕ** | One of the pillars of preventive maintenance |  |
| **b.** | **ⓣ** | The second pillar of an effective preventative maintenance |  |
| **c.** | **ⓕ** | Preventing equipment failure before they occur |  |
| **d.** | **ⓕ** | Thinking in terms of what you see, expect, know and do |  |
| **e.** | **ⓕ** | Identifying job priorities in order of importance | **(5)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.13** | **True or False: The following should be done when the cooling system is shut down?** | | **Mark Allocation** |
| **a.** | **ⓣ** | Clean all condenser tubes |  |
| **b.** | **ⓕ** | Check and make sure all gauges are in proper working order |  |
| **c.** | **ⓕ** | Amp-probe drive motors for proper readings |  |
| **d.** | **ⓣ** | Consider running a fiber optic camera into the condenser tubes to make sure nothing was missed. |  |
| **e.** | **ⓕ** | Check all valves and piping, observe and list any leaks that will require repair or replacement. | **(5)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.14** | **True or False: The following should be done when the cooling system is running?** | | **Mark Allocation** |
| **a.** | **ⓕ** | Clean all condenser tubes |  |
| **b.** | **ⓕ** | Check fans for proper balance |  |
| **c.** | **ⓣ** | Attach A/C gauges and check for proper coolant readings |  |
| **d.** | **ⓣ** | Clean the outside of the entire chiller and the area around it. |  |
| **e.** | **ⓣ** | Check all valves and piping, observe and list any leaks that will require repair or replacement. | **(5)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.15** | **True or False: Maintenance checklist for cooling towers includes?** | | **Mark Allocation** |
| **a.** | **ⓕ** | Monitoring and managing water quality |  |
| **b.** | **ⓣ** | Look for excessive belt ware, check belts for alignment and proper tension. |  |
| **c.** | **ⓣ** | Check all electrical wiring for loose or discolored connections. |  |
| **d.** | **ⓣ** | Check and clean all water nozzles that feed the return condenser water to the towers. |  |
| **e.** | **ⓕ** | Inspecting Insulation | **(5)** |

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| --- | --- | --- | --- |
| **13.16** | **True or False; there are -----planning preventative maintenance principles?** | | **Mark Allocation** |
| **a.** | **ⓕ** | 1 |  |
| **b.** | **ⓕ** | 3 |  |
| **c.** | **ⓣ** | 6 |  |
| **d.** | **ⓕ** | 8 |  |
| **e.** | **ⓕ** | 5 | **(5)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **13.17** | **True or False: boiler maintenance involves?** | | **Mark Allocation** |
| **a.** | **ⓣ** | Cleaning |  |
| **b.** | **ⓣ** | Blowdown |  |
| **c.** | **ⓣ** | Monitor and Manage Water Quality |  |
| **d.** | **ⓣ** | Inspect Insulation |  |
| **e.** | **ⓣ** | Maintain Accurate Service/Maintenance Logs | **(5)** |

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| **13.18** | **True or False: The reasons for preventative maintenance are?** | | **Mark Allocation** |
| **a.** | **ⓕ** | To consider equipment maintenance history |  |
| **b.** | **ⓣ** | To save money |  |
| **c.** | **ⓕ** | To measure performance |  |
| **d.** | **ⓣ** | To maximize efficiency |  |
| **e.** | **ⓣ** | To reduce maintenance costs | **(5)** |

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| **13.19** | **True or False: the following performance parameters are tested during specialized tests?** | | **Mark Allocation** |
| **a.** | **ⓣ** | Vibration analysis and diagnostics |  |
| **b.** | **ⓣ** | Lubricant analysis. |  |
| **c.** | **ⓕ** | Removal of scale and rust |  |
| **d.** | **ⓣ** | Ultrasound testing (material thickness/flaw testing) |  |
| **e.** | **ⓕ** | Re-welding of joins that have weakened | **(5)** |

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| **13.20** | **True or False: Principles of preventative maintenance include?** | | **Mark Allocation** |
| **a.** | **ⓣ** | Planning |  |
| **b.** | **ⓕ** | Maximising efficiency |  |
| **c.** | **ⓣ** | Discipline |  |
| **d.** | **ⓣ** | Preventive Maintenance Training |  |
| **e.** | **ⓕ** | Maintenance of boilers | **(5)** |

1. FINAL MARKS

**TOTAL MARKS: 90**

**PASS MARK: 72**

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| **LEARNER MARKS** |  |
| **PERCENTAGE** |  |
| **ASSESSOR SIGNATURE:** | |