



**Fireman**

**Mentor's  
Q&A**

***(Generic Version)***

**Version 1**

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## IMPORTANT NOTICE

This booklet is one of a series of generic training and assessment templates developed by the Association of Tourist & Heritage Rail Australia Inc (ATHRA) as guides for heritage railway operators seeking to develop or upgrade their local training and assessment resources.

This booklet and others in the series are not intended to be training resources in their own right but rather to be suitably customised, embellished and adapted by railway operators to match the specific context of their own railway, e.g. types of locomotives, rollingstock and associated equipment, the track layout and infrastructure, the local standard procedures and rules, the safety management and safeworking systems, the railway organisational structure, and the roles and functions of personnel in the railway, etc.

Railway operators seeking to use this booklet and others in the series should initially refer to the ***ATHRA Customisation Guidelines Booklet*** which provides important information on how the generic templates should be used.

### Disclaimer

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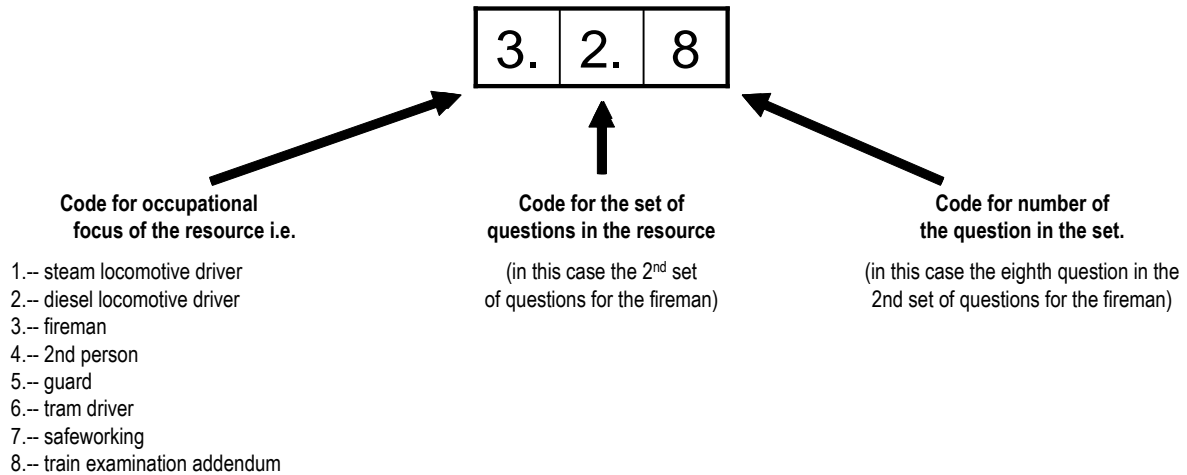
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# NOTES

## CODING SCHEME FOR THE ATHRA RESOURCES

The coding scheme for the ATHRA Resources is as follows:



## CUSTOMISATION OF QUESTIONS AND ANSWERS IN THE 'MENTOR'S Q&A'

As explained in the ATHRA Customisation Guidelines, this **Knowledge Checklist** and related **Mentors Q&A** are generic documents designed to be customized and adapted, if necessary, by local heritage railways to match their own railway configuration, equipment, procedures, safety management systems, etc. Questions in the booklet and related sample responses in the **Mentor's Q&A** may be modified by updating the content of the existing templates to incorporate appropriate information about the railway's own operating system, equipment, road, procedures, safety management system, etc. This may involve appropriate alteration to existing questions or the insertion of additional suitable questions.

To aid in the addition of questions, if needed, a blank row has been provided at the end of each set of questions in the generic checklist and Q&A. The following is a step-by-step process to incorporate any additional questions:

1. Using the mouse, select the blank row
2. In the 'TABLE' drop down menu at the top of the document select 'Insert'
3. Click on 'Insert rows below'
4. Repeat as many times as necessary until you have sufficient rows for the additional questions (including the original blank row in the generic document)
5. Insert the text for each of the additional questions
6. Insert the codes of the additional questions as per the coding scheme for the ATHRA training and assessment resources
7. Make sure there are matching questions and sample responses with the same code in both the **Knowledge Checklist** and the **Mentor's Q&A Booklet**

**Question Set 3.1 Role and responsibilities of a fireman on a steam locomotive**

QUESTION	SAMPLE RESPONSE
<p>Q3.1.1 What are the <b>key tasks</b> performed by a fireman?</p>	<ul style="list-style-type: none"> <li>• Signing on for locomotive duties,</li> <li>• Checking roster, notice boards, operational instructions, locomotive availability and other information needed to work as a fireman</li> <li>• Working under the direction of and collaboratively with the train driver, including....               <ul style="list-style-type: none"> <li>– responding to the driver’s instructions,</li> <li>– assisting the driver during a journey by checking the performance of the locomotive and taking any required action,</li> <li>– assisting the driver when approaching and traversing fixed signals, point stand indicators, check points, track side signs and level crossings,</li> <li>– calling all signs and signals to the driver and receiving acknowledgement from the driver (or vice versa)</li> <li>– assisting the driver during the arrival at and departure from stations</li> <li>– assisting the driver in the identification of faults and defects and associated trouble-shooting activities, and</li> <li>– assisting the driver in the response to abnormal situations that may arise during a train journey.</li> </ul> </li> <li>• Assisting in the performance of pre-operational checks,</li> <li>• Checking that the tool kit, fire extinguisher, first aid kit and other locomotive equipment is on the loco prior to service, is complete and is in good working order</li> <li>• Lighting up of the steam locomotive,</li> <li>• Filling of locomotive water tanks/tender ,</li> <li>• Firing of locomotive,</li> <li>• Manipulating fire irons to deal with clinkered fire,</li> <li>• Maintaining of adequate steam pressure,</li> <li>• Operating the train brake under the supervision of the driver from time to time,</li> <li>• Remaining vigilant throughout a journey, including looking back to train,</li> <li>• Stopping and securing a train in the event of an emergency, including the evacuation of the train,</li> <li>• Performance of tasks outside the cab including checking/filling of sand boxes, cleaning ash pans and smoke boxes, shovelling coal and coupling/uncoupling rolling stock</li> </ul>

<p>Q3.1.1 (cont.)</p> <p>What are the <b>key tasks</b> performed by a fireman? (continued)</p>	<ul style="list-style-type: none"> <li>• Conducting post-operational visual inspections and other checks of locomotive and associated equipment,</li> <li>• Completing all required lubrication and greasing tasks,</li> <li>• Checking and confirming that locomotive and associated equipment has been restored to required post-operational condition (including communication equipment), and</li> <li>• Completing required post-operational documents and reporting any faults or defects for appropriate action.</li> </ul>
<p>Q3.1.2</p> <p>What is the <b>relationship</b> between the fireman and the driver?</p>	<ul style="list-style-type: none"> <li>• The fireman and the driver are a team.</li> <li>• The fireman must at all times cooperate with the driver and carry out his instructions when doing working on the locomotive.</li> </ul>
<p>Q3.1.3</p> <p>Is the fireman responsible for <b>observing</b> fixed trackside signals, point stand indicators, check points, trackside signs and level crossings and <b>confirming</b> these sightings with the driver?</p>	<ul style="list-style-type: none"> <li>• Yes. He must always be on the alert to observe any fixed trackside signals, point stand indicators, check points, trackside signs and level crossings and inform the driver so that he may take the required action to ensure the safety of the train.</li> <li>• The fireman must also <u>confirm all such sightings with the driver</u>.</li> <li>• All signs and signals must be called by either the driver or fireman and be acknowledged by the other person concerned.</li> </ul>
<p>Q3.1.4</p> <p>Is the fireman responsible for the <b>water levels</b> and <b>steam pressure</b> in the boiler?</p>	<ul style="list-style-type: none"> <li>• Yes. He must maintain sufficient water at all times, but not too high a level.</li> <li>• The steam pressure must be kept near the blowing-off point.</li> </ul>
<p>Q3.1.5</p> <p>Who <b>directs</b> the fireman's work on the locomotive?</p>	<ul style="list-style-type: none"> <li>• The driver.</li> </ul>
<p>Q3.1.6</p> <p>Describe the processes involved in interpreting and applying '<b>authority</b>' to move a train?</p>	<ul style="list-style-type: none"> <li>• Candidate will describe the processes involved in interpreting and applying 'authority' to move a train as per the safety management system and standard operating procedures of the railway operator concerned.</li> </ul>
<p>Q3.1.7</p> <p>Describe the <b>key safeworking rules</b> that apply to you as a fireman?</p>	<ul style="list-style-type: none"> <li>• Candidate's response should paraphrase the rail operator's safeworking rules as they apply to fireman on the railway concerned.</li> </ul>
<p>Q3.1.8</p> <p>What are the <b>potential consequences</b> of not following safeworking rules and other regulations applicable to the fireman's role on your railway?</p>	<ul style="list-style-type: none"> <li>• A serious accident</li> <li>• Possible injury to self colleagues or the public.</li> <li>• Possible damage to locomotive, rollingstock or railway facilities.</li> </ul>

Q3.1.9

What are the fireman's **initial duties** after signing on?

- The candidate will describe the initial duties of a fireman after signing on and related standard operating procedures of the rail operator for the steam locomotive concerned.
- For example:
  - checking roster, notice boards, operational instructions, locomotive availability and other information needed to operate a locomotive
  - checking any notices posted which may concern the tracks on which the person is booked to work.
  - obtaining the stores and proceeding to the locomotive.
  - checking that the tool kit, fire extinguisher, first aid kit and other locomotive equipment is on the locomotive is complete, and is in good working order
  - lighting fire if not already lit.
  - testing both the water gauges;
  - examining the interior of the firebox and the condition of the fire and grates.
  - observing steam pressure.
  - if the fire needs no immediate attention, turning on the blower and examining it and if necessary, cleaning the spark arresters in the smoke-box, checking that there are not steam leaks, tightly closing smoke-box door and cleaning foot plate of ashes, if required.
  - adjusting destination discs or lights.
  - when passing to and from the smoke-box, the sand boxes should be examined. They must be full of dry sand.
  - after returning to the cab, give the fire attention, if required, by spreading with the dart and adding more wood or fresh coal to raise the steam pressure and building up the fire. (**Note:** Some railways introduce coal to the fire early in light up whilst others wait until full steam pressure is obtained. Check to ensure that the requirements of your railway are followed.)
  - the sight-feed lubricator must be filled with cylinder or valve oil.
  - the injectors should be operated to ensure they are in good working order.
  - after the fire has been spread, applying the ash-wetter and clean out the ashpan. Being extremely careful that the sliding doors are closed after the pan is cleared. Operating dampers from the cab.
  - ensuring that the correct fire-irons, re-railers, spare shovel and other tools are on the locomotive or tender.
  - blowing the boiler, take water and perform any other duties as directed by the driver.
  - checking the operational readiness of the tool kit, fire extinguisher, first aid kit and communication equipment.

<p>Q3.1.10 What <b>action</b> must you take if you find a defect during a shift as a fireman on a steam locomotive?</p>	<ul style="list-style-type: none"> <li>• Advise the driver immediately</li> <li>• The candidate should also outline the rail operator's standard procedures for the action, recording and reporting that needs to be taken by a locomotive crew in the event of an identified defect.</li> </ul>
<p>Q3.1.11 What <b>action</b> must you take if you are involved in a safety incident during a shift as a fireman on a steam locomotive?</p>	<ul style="list-style-type: none"> <li>• Candidate should also outline the rail operator's standard procedures for the action, recording and reporting that needs to be taken by a locomotive crew in the event of a safety incident.</li> <li>• Work under the direction of the driver to ensure that the train is secured.</li> <li>• If emergency services are in attendance observe the requirements of the senior combatant agency on site.</li> </ul>
<p>Q3.1.12 What <b>action</b> must you in the case of a limit of authority overrun during a shift as a fireman on a steam locomotive?</p>	<ul style="list-style-type: none"> <li>• Candidate should also outline the rail operator's standard procedures for the action, recording and reporting that needs to be undertaken in the event of a limit of authority overrun.</li> <li>• Immediately it is recognised that a limit of authority overrun has occurred draw this to the driver's attention and ensure that the movement is brought to an immediate stop.</li> <li>• Take action to provide protection against any approaching train</li> <li>• Work under the direction of train control to clear the section</li> <li>• In all instances a written report must be furnished.</li> </ul>
<p>Q3.1.13 What are the fireman's duties when <b>stabling</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the duties of a fireman and related standard operating procedures of the rail operator for stabling the steam locomotive concerned.</li> <li>• For example: <ul style="list-style-type: none"> <li>– Manage the fire so it is not dead as this may start the tubes leaking, nor should there be a heavy green fire, as this is wasteful.</li> <li>– Ensure there is a full glass of water, so as to avoid the use of the injector, when the fire-box temperature is low.</li> <li>– Have a good pressure of steam to enable the locomotive to be moved to the allotted position in the shed after the crew leave the locomotive.</li> <li>– After coal, sand and water have been taken, the locomotive is moved to the ash-pit.</li> <li>– Apply the ash-wetter, when ashpan slides are opened (where applicable).</li> </ul> </li> </ul>

<p>Q3.1.13 (cont.)</p> <p>What are the fireman's duties when <b>stabling</b>? (continued)</p>	<ul style="list-style-type: none"> <li>– Open the dead plate, then use the handle provided to shake the rocking grates to remove the fire. The pricker may in some instances have to be used to push the ashes through the dead plate opening, or to break up clinker which is too large to pass through the grates.</li> <li>– If the fire is to be banked, remove all dead ash from the fire-box, but save enough clean live coals to ignite fresh coal when added.</li> <li>– After the fire has been dealt with, examine the smoke-box and remove any cinders which may be there. See that the spark arresters are not broken or loose. Check to see that there are not steam blows.</li> <li>– After the ashpan has been emptied, shut off the ash-wetter and blower and close the dampers. When the locomotive is moved to the spot-pit, examine the ashpan and make sure it is clean. Close the dead plate and ash-pan and make sure it is clean. Close the dead plate and ash-pan slides.</li> <li>– Before leaving the locomotive, apply the hand brake and ensure that there is at least 3/4 of a glass of water. Assist the driver to return tools to the store.</li> </ul>
<p>Q3.1.14</p> <p>Where can you obtain a <b>copy</b> of the duties of a fireman, the safeworking rules applicable to firemen and other key reference documents a fireman needs on your railway?</p>	<ul style="list-style-type: none"> <li>• Candidate should outline where a copy of the rail operator's requirements, safeworking rules, standard procedures and other key reference documents for a fireman can be obtained.</li> </ul>
<p>Q3.1.15</p> <p>What is the location and purpose of instruction plates outlining headways and limits of authority?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe, for their railway, the location and purpose of instruction plates outlining headways and limits of authority.</li> </ul>
<p>Q3.1.16</p> <p>For your railway, describe the yard limits, commencement of yard limits and end of yard limits associated with train running.</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the yard limits, commencement of yard limits and end of yard limits associated with train running in their railway.</li> </ul>



<p>Q3.1.17 Give three examples of <b>hazards</b> that exist when working as a fireman on a steam locomotive.</p>	<ul style="list-style-type: none"> <li>• Dependent on the railway concerned, examples of possible responses include: <ul style="list-style-type: none"> <li>– Falling from heights</li> <li>– Working in confined spaces</li> <li>– Working under wires</li> <li>– Chemicals</li> <li>– Fire irons</li> <li>– Hot surfaces</li> <li>– Scalding/burns</li> <li>– Moving work platform</li> <li>– Oil spills on floors</li> <li>– Dehydration and fatigue</li> <li>– Noise</li> <li>– Flashbacks</li> <li>– Working with electric lights and power</li> <li>– Exposed steam pipes</li> <li>– Broken hand rails</li> <li>– Leaking fittings</li> </ul> </li> </ul>
<p>Q3.1.18 What personal protective equipment (PPE) must be used by firemen when carrying out their duties and functions?</p>	<ul style="list-style-type: none"> <li>• Candidate will describe the personal protective equipment (PPE) that must be used by firemen when carrying out their duties and functions as per the safety management plan and standard operating procedures of the rail operator concerned.</li> </ul>
<p>Q3.1.19 Give two examples of <b>risk management strategies</b> to control hazards when working as a fireman on a steam locomotive.</p>	<ul style="list-style-type: none"> <li>• Dependent on the railway concerned, examples of possible responses include: <ul style="list-style-type: none"> <li>– Taking required precautions when using oil as the locomotive fuel</li> <li>– Ensuring public safety (e.g. checking when the public is in the vicinity of loco before using injectors, blowing down, cleaning fires, etc.)</li> <li>– Using personal protective equipment (PPE)</li> <li>– Using fire extinguishers and water hoses to control fire emergencies</li> <li>– Following the railway's established risk management procedures</li> </ul> </li> </ul>
<p>Q3.1.20 What are the procedures for <b>handing over</b> a steam locomotive to a replacement crew?</p>	<ul style="list-style-type: none"> <li>• Candidate will describe the procedures for handing over a steam locomotive to a replacement crew as per the standard operating procedures of the rail operator concerned</li> </ul>
<p>Q3.1.21 <i>Blank for additional question</i></p>	<ul style="list-style-type: none"> <li>•</li> </ul>

### Question Set 3.2 Conducting pre-operational checks on a steam locomotive boiler

QUESTION	SAMPLE RESPONSE
<p>Q3.2.1 What are the <b>principal components</b> of steam locomotive(s) on which you will be working? What is the purpose of each?</p>	<ul style="list-style-type: none"> <li>• Candidate will describe the principal components of the steam locomotive(s) and their purpose as described in the relevant manual(s) or fact sheets provided by the rail operator.</li> </ul> <p>A sample indicative list for a steam loco is provided in 3.2.1 of the 'Fireman's Performance Checklist' This would need to be modified and customised to match the type(s) and class(es) of steam locomotive and the railway concerned</p>
<p>Q3.2.2 What are the <b>initial tasks</b> completed by the fireman when commencing a shift?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of rail operator concerned for the initial tasks to be undertaken by a fireman when commencing a shift. This will usually include: <ul style="list-style-type: none"> <li>– checking the roster,</li> <li>– checking the notices,</li> <li>– interpreting the day's train activities,</li> <li>– confirming the allocation of locomotives,</li> <li>– locating the locomotive to be checked, and prepared in the yard.</li> </ul> </li> </ul>
<p>Q3.2.3 What <b>type of boiler</b> is used in a locomotive?</p>	<ul style="list-style-type: none"> <li>• It is known as the multitubular type with an internal firebox.</li> </ul>
<p>Q3.2.4 How is the <b>efficiency</b> of a boiler measured?</p>	<ul style="list-style-type: none"> <li>• The efficiency of a boiler is measured by the amount of water that can be evaporated per Kg of coal. Whilst this will be affected to some degree by the quality of the coal, a great deal depends how well the driver and fireman carry out their duties. If the duties of both are carried out cooperatively with care and initiative, the efficiency will be high and easily obtained.</li> </ul>
<p>Q3.2.5 Describe the <b>firebox</b>?</p>	<ul style="list-style-type: none"> <li>• It consists of an inner and outer shell which forms a water space. These are connected and spaced from each other at the base by the foundation ring, and around the sides by stay bolts which are about four inches apart, and at the top, radial of roofing stays are used. The outer shell is connected to the barrel at the throat plate. The flood of the firebox consists of the grates on which the fire is laid.</li> </ul>
<p>Q3.2.6 What is the purpose of a <b>brick arch</b> in a firebox?</p>	<ul style="list-style-type: none"> <li>• It is situated inside the firebox. It protects the tubes from cold air when the fire door is opened. It lengthens the path for the gases from the fire to the tubes and so ensures more complete combustion. Maintains an even temperature is maintained in the firebox.</li> </ul>

Q3.2.7	What is <b>contained</b> in the firebox to protect the boiler from overheating due to lack of sufficient water?	<ul style="list-style-type: none"> <li>The fusible plugs.</li> </ul>
Q3.2.8	What are <b>fusible plugs</b> and what is their purpose?	<ul style="list-style-type: none"> <li>A safety device used to provide a warning of that the water level has already fallen to a dangerous level. The lead filled plugs are fitted in the top of the fire box crown (in some locos a suitable material other than lead is used in the plugs).</li> <li>Under normal circumstances, the water covering the firebox crown prevents the lead melting. If the water level falls below the top of the firebox crown, the plug overheats and melts. The resulting blast of water and steam acts as a warning (and may perhaps subdue the fire to some extent preventing further damage)</li> </ul>
Q3.2.9	What is the purpose of the <b>hole in the stay bolts</b> ?	<ul style="list-style-type: none"> <li>To detect when the stay is broken. This is shown by leakage of water (or watery vapour) blowing through the hole.</li> </ul>
Q3.2.10	What are the <b>grates</b> ?	<ul style="list-style-type: none"> <li>These consist of a number of iron plates having holes or slots through the plates to allow the air to pass through. By means of rods connected to the underside of the plates they may be rocked or partly rotated. This is done by a handle in the cab. The fire is shaken and the dead ashes fall into the ashpan.</li> <li>The section of the grate nearest the tube plate is designed to tip downwards so that a large opening allows clinker or other large pieces of ash to be pushed from the fire with the fire irons.</li> <li>The old type of grate consists of a number of flat iron bars on the edge and placed on the racks which are fitted with pegs to space the bars to allow air to pass to the fire.</li> </ul>
Q3.2.11	Describe the <b>barrel</b> ?	<ul style="list-style-type: none"> <li>This is the cylindrical portion of the boiler between the firebox and the smoke-box. At each end is the tube plate to hold securely in position the tubes which connect the firebox. Placed on top is the dome where dry steam is collected. The regulator valve is placed in it, which is secured to the internal steam pipe. Other steam pipes are placed there to supply dry steam for various appliances within the locomotive.</li> </ul>
Q3.2.12	What is the purpose of the <b>tubes</b> ?	<ul style="list-style-type: none"> <li>The tubes carry away the hot gases and smoke from the firebox to the smokebox. Due to the large heating surface and being surrounded by water in the barrel, they assist in quickly generating steam.</li> </ul>

Q3.2.13	What is the <b>smokebox</b> ?	<ul style="list-style-type: none"> <li>This is a large chamber which rests on and is rigidly secured to the locomotive framing and supports the front end of the barrel. It has an opening in the top over which the funnel is placed.</li> </ul>
Q3.2.14	What is <b>located</b> inside the smokebox?	<ul style="list-style-type: none"> <li>The smokebox contains the main steam pipes, the exhaust (or blast) pipe, the blower, various other steam pipes and spark arrestors or screens.</li> </ul>
Q3.2.15.	What is the <b>exhaust or blast pipe</b> and its use?	<ul style="list-style-type: none"> <li>This is a large pipe having a nozzle on the upper end, through which the exhaust steam passes from the cylinders. It is positioned directly under the centre of the chimney.</li> <li>As the steam escapes from the nozzle at a high velocity it creates a draft in the firebox. Air rushes through the dampers, firebox and tubes create the draft and so the fire is supplied with large quantities of air.</li> </ul>
Q3.2.16	What is the <b>blower</b> and its purpose?	<ul style="list-style-type: none"> <li>A blower is fitted on all locomotives to supply artificial draught for the fire when the engine is not working. A small pipe is fitted on top of the blast pipe in the smoke box and is perforated with small holes and bent in the form of a circle. By turning on the blower steam valve in the cab, a jet of steam is directed up the chimney. This creates a vacuum in the smoke box, causing the air to be drawn through the grate and ejected out through the stack).</li> </ul>
Q3.2.17	What is the purpose of <b>spark arresters</b> ?	<ul style="list-style-type: none"> <li>The mesh wire ensures that only the very small pieces of cinders escape from the locomotive. Thus, there is less likelihood of starting fires.</li> </ul>
Q3.2.18	What <b>checks</b> should be made on spark arrestors?	<ul style="list-style-type: none"> <li>The spark arresters must be examined when preparing and stabling a locomotive to ensure there are no holes in the mesh or openings between the plates.</li> </ul>
Q3.2.19	Is any <b>care</b> needed with the smoke-box door?	<ul style="list-style-type: none"> <li>Yes. The door must be correctly fitted and closed tightly to prevent air from getting into the smoke-box.</li> </ul>
Q3.2.20.	What is the <b>watergauge glass</b> ?	<ul style="list-style-type: none"> <li>It is a glass tube fitted between two (2) brass mountings attached to the face plate of the firebox. Its purpose is to show the water level in the boiler. The top mounting contains the steam cock and is connected to the steam space of the boiler.</li> </ul>

<p>Q3.2.21      How are the watergauge glasses <b>tested</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for testing the watergauge glasses on the locomotive concerned.</li> <li>• For example: <ul style="list-style-type: none"> <li>– To test a gauge glass, firstly open the blow-through cock and allow steam and water to escape. Then close the cock and the water should return quickly to the original level in the glass.</li> <li>– If the water returns slowly to the glass, the water passage is partly choked. To clear it:- Close steam way cock and open the blow-through cock, this will allow the pressure in the boiler to force the obstruction clear. After some seconds open steam cock and close blow-through cock and the water should return quickly to the glass.</li> <li>– If the water returns quickly, rising high in the glass and settling back slowly, it will indicate the steam way is partly choked, to clear it:- Open blow-through cock and close water way cock. After some seconds open water way cock and close blow-through cock.</li> </ul> </li> </ul>
<p>Q3.2.22      What should you do if a watergauge glass <b>bursts</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator in the event that a watergauge glass bursts on the steam locomotive concerned.</li> <li>• For example: <ul style="list-style-type: none"> <li>– Close the water cock and steam cock at once. When the handles are connected with rods or chains, close both cocks simultaneously. If not connected, close water cock first.</li> <li>– When testing gauge glasses both of these must be checked. Whilst the blow-through cock is open, operate the steam and water cocks separately to make sure they are quite free. If these cocks have extensions on the handles see that the attached chain or rod is clear and can be pulled easily. When trying the cocks separately to clear them, note the sound of escaping steam or water. If there is increase in the volume of sound it would show the passage is becoming clear. Do not be satisfied with the reading of glasses unless both have been tested.</li> </ul> </li> </ul>
<p>Q3.2.23      What are the <b>principal fittings</b> of the boiler?</p>	<ul style="list-style-type: none"> <li>• Fittings in the cab include the water gauges; steam pressure gauge; injectors; firehole door; operating handle or wheel from the blower; damper handles; and in most cases blow-off cock handles. Fittings outside the cab include the safety valves; blow-off cock; dampers; blowers, and in some cases injectors.</li> </ul>

Q3.2.24	What is a <b>feedwater injector</b> ?	<ul style="list-style-type: none"> <li>An instrument operated by steam to force water into the boiler.</li> </ul>
Q3.2.25	How many types of <b>feedwater injector</b> are used on a steam locomotive?	<ul style="list-style-type: none"> <li>Only one type of feed water injector is used on any steam locomotive. However there are two of them on each loco. Injectors are either lifting or non-lifting. A lifting injector is placed above the high water line in the tank, therefore in forcing water into the boiler, it lifts the water through a height. A non-lifting injector is placed below the bottom of the water tank, hence the water flows to the injector, by reason of gravitation.</li> </ul>
Q3.2.26	Describe the <b>method of operating</b> a lifting injector?	<ul style="list-style-type: none"> <li>The candidate will describe the standard operating procedures of the rail operator for operating the type of lifting injector concerned.</li> </ul>
Q3.2.27.	Your <b>injector</b> fails to lift water, what could be the problem?	<ul style="list-style-type: none"> <li>The reason it fails to lift water due to: <ul style="list-style-type: none"> <li>– leaking non return valve (clack valve),</li> <li>– feed water check valve shut,</li> <li>– water too hot,</li> <li>– steam pressure too great, or</li> <li>– leaky suction or overflow.</li> </ul> </li> </ul>
Q3.2.28.	What is the <b>firehole door</b> ?	<ul style="list-style-type: none"> <li>It is a door which is fitted in or over the opening of the fire-box. They are of various designs, but all must be open to apply coal or clean the fire. The doors on most large type locomotives are operated by compressed air.</li> </ul>
Q3.2.29	What is the function of <b>safety valves</b> ?	<ul style="list-style-type: none"> <li>To allow the excess pressure of steam above the safe working pressure(Registered Boiler Pressure) of the boiler to escape to atmosphere</li> </ul>
Q3.2.30	Where are the <b>ashpans</b> and why are they fitted?	<ul style="list-style-type: none"> <li>They are fitted under the firebox. They collect the ashes that fall from the grates and thus prevent fires being started on the permanent way.</li> </ul>
Q3.2.31	What are the <b>dampers</b> ?	<ul style="list-style-type: none"> <li>Dampers are hinged plates fitted below the level of the grates. As they are operated from the cab they are used to regulate the flow air to the fire and so control steam pressure.</li> </ul>
Q3.2.32	What is the <b>blow-off cock</b> and what is its purpose?	<ul style="list-style-type: none"> <li>It is a valve fitted in the outside shell of the firebox at the lowest possible point. It is generally operated by a handle in the cab attached to a rod or level which is connected to the valve.</li> <li>With the correct and frequent use the water in the boiler can be kept clean. If this is carried out priming is prevented, also the amount of scale on the firebox plates and tubes is greatly reduced.</li> </ul>

<p>Q3.2.33      What causes the <b>scaling</b> inside a locomotive boiler?</p>	<ul style="list-style-type: none"> <li>• Almost all feed waters used on steam locomotives contain a percentage of solids and impurities. As the water is evaporated these solids remain in the boiler; if allowed to accumulate, scale is formed. In addition, the bubbles of steam rising to the surface of the water carry some of the solids upwards and this is the cause of a foaming boiler which results in priming.</li> </ul>
<p>Q3.2.34      What is <b>priming</b>?</p>	<ul style="list-style-type: none"> <li>• Priming is the carry-over of varying amounts of droplets of water in the steam (foam and mist), which lowers the energy efficiency of the steam and leads to the deposit of salt crystals. Priming may be caused by damaged steam separating equipment, operating above the boilers rating, sudden fluctuations in steam demand, or carrying too high water level in the steam release space.</li> </ul>
<p>Q3.2.35      What action should you take in the event of <b>priming</b>?</p>	<ul style="list-style-type: none"> <li>• Reduce the demand for steam by easing the Regulator.</li> <li>• Place locomotive in Full Gear in the direction of running.</li> <li>• Open drain cocks.</li> </ul>
<p>Q3.2.36      What action should you take in the event of <b>foaming</b>?</p>	<ul style="list-style-type: none"> <li>• Reduce the demand for steam by easing the regulator.</li> <li>• Place locomotive in full gear in the direction of running.</li> <li>• Open Drain Cocks.</li> <li>• If Foaming is persistent, water in the boiler may need replacing by blowing down then topping for as long as foaming persists.</li> </ul>
<p>Q3.2.37      What is the cause of <b>corrosion</b> in a steam locomotive boiler?</p>	<ul style="list-style-type: none"> <li>• Corrosion involves the combining of iron and oxygen reverting metal to its original form. Iron reverts to Iron oxide as the result of corrosion however the process is a complex electro-chemical reaction. Other factors such as stresses, pH conditions, and specific chemical corrodents may have an important influence and produce different forms of attack.</li> </ul>
<p>Q3.2.38      How can corrosion be prevented?</p>	<ul style="list-style-type: none"> <li>• Corrosion in a boiler can be prevented by a well managed boiler water treatment program. Corrosion for example may not be important to main line casual crews, but it is important to fireman on a tourist railway where the care of the boiler is something that they can play a part in and extend its life. They are part of the process and should know why and how to help to conserve it.</li> </ul>

Q3.2.39	Name the parts of the gauge glass?	<ul style="list-style-type: none"> <li>• Steamway cock and passage, waterway cock and passage, the blow through cock, the top cap plug, steam and waterway scavenger plugs, top and bottom gland nuts, top and bottom glands, top and bottom stuffing boxes and packing, gauge glass and protector</li> </ul>
Q3.2.40	There are two methods of blowing down a gauge glass, name them.	<ul style="list-style-type: none"> <li>• Independent test</li> <li>• Quick test</li> </ul>
Q3.2.41	What does blowing down a gauge glass prove?	<ul style="list-style-type: none"> <li>• That the steam and water way passages are clear giving a true water level above the crown or there is a blockage in one of the passages.</li> </ul>
Q3.2.42	Why are boilers fitted with two gauge glasses?	<ul style="list-style-type: none"> <li>• One checks against the other</li> </ul>
Q3.2.43	What is a <b>gauge glass isolation cock</b> and what is its purpose?	<ul style="list-style-type: none"> <li>• <u>Used</u> to isolate gauge glass from water in boiler system</li> </ul>
Q3.2.44	What are the principal parts of a <b>Westinghouse Brake System</b> and what is their purpose? (Where it is used on the locomotives and rollingstock of the railway concerned)	<ul style="list-style-type: none"> <li>• Where applicable, the candidate will describe the railways checklist of the principal parts of the <b>Westinghouse Brake System</b> and their purpose</li> </ul>
Q3.2.45	What are the principal parts of a <b>Vacuum Brake System</b> and what is their purpose? (Where it is used on the locomotives and rollingstock of the railway concerned)	<ul style="list-style-type: none"> <li>• Where applicable, the candidate will describe the railways checklist of the principal parts of the <b>Vacuum Brake System</b> and their purpose</li> </ul>
Q3.2.46	What is a <b>foundation ring</b> and what is its purpose?	<ul style="list-style-type: none"> <li>• Also known as the mud ring, it unites the lower edges of the inner and outer firebox plates (sheets). It can be forged, cast, welded or a pressed U-section. Because of the tight radius of corners in riveted foundation rings, the plates are held in place with boilermaker's (or patch) screws.</li> </ul>
Q3.2.47	What is a <b>dome</b> and what is its purpose?	<ul style="list-style-type: none"> <li>• It is on top of the barrel to provide a receptacle for collecting the steam.</li> </ul>
Q3.2.48	What is a <b>regulator or throttle</b> and what is its purpose?	<ul style="list-style-type: none"> <li>• Controls the amount of steam delivered to the cylinders</li> </ul>
Q3.2.49	What is a <b>feed water non-return valves</b> and what is its purpose?	<ul style="list-style-type: none"> <li>• Ensure feed water only flows in one direction – i.e. Into the boiler</li> </ul>
Q3.2.50	What is a <b>feed water stop valve</b> and what is its purpose?	<ul style="list-style-type: none"> <li>• Isolates the boiler from the feed system, to allow repairs to be carried out on the feed water non-return valve</li> </ul>



Q3.2.51	What is a <b>blow down valve or cock</b> and what is its purpose?	<ul style="list-style-type: none"> <li>Valve to blow out sediment contained in the boiler water and to drain the boiler empty for inspection and cleaning.</li> </ul>
Q3.2.52	What is a <b>blower valve</b> and what is its purpose?	<ul style="list-style-type: none"> <li>Controls the flow of steam to the blower ring that creates a draft to draw the heat through the boiler tubes</li> </ul>
Q3.2.53	What is <b>the vital part</b> of a locomotive boiler?	<ul style="list-style-type: none"> <li>The firebox crown – the part of the boiler that first becomes exposed if there is a water shortage.</li> </ul>
Q3.2.54	What is <b>Primary Air</b> ?	<ul style="list-style-type: none"> <li>Air supplied to provide initial combustion.</li> </ul>
Q3.2.55	What is <b>Secondary Air</b>	<ul style="list-style-type: none"> <li>Air supplied to complete combustion.</li> </ul>
Q3.2.56	What is the <b>registered boiler pressure</b> ?	<ul style="list-style-type: none"> <li>The pressure at which the boiler is authorised to operate.</li> </ul>
Q3.2.57	<p><i>Explain the following terms:</i></p> <p>a) <i>Saturated steam</i></p> <p>b) <i>Superheated steam</i></p>	<ul style="list-style-type: none"> <li><b>Saturated Steam:</b> is steam taken directly from a boiler steam space and is characterised by having a constant temperature, volume and density for any given pressure. Because saturated steam is always generated in the presence of water it contains water droplets in suspension (This is the vapour seen issuing from cocks)..</li> <li><b>Superheated Steam:</b> is steam that has passed through elements where its temperature is raised above the corresponding <a href="#">saturation temperature for the pressure</a>.</li> </ul>
Q3.2.58	What are the advantages and disadvantages of using <b>saturated steam</b> for driving reciprocating steam engines?	<ul style="list-style-type: none"> <li><b>Advantages:</b> <ul style="list-style-type: none"> <li>The wetness of saturated steam acts as a lubricant for all the components it comes in contact with, including: the governor, slide valves and the piston and its rings.</li> <li>The gland packing relies on a small steam leak and the resultant condensate to keep it lubricated and to prevent it from drying out.</li> <li>Assists in distributing the steam oil fed from the lubricator.</li> <li>Most reciprocating engines are designed to operate on saturated steam.</li> <li>For a given pressure the temperature is constant.</li> </ul> </li> <li><b>Disadvantages:</b> <ul style="list-style-type: none"> <li>When using saturated steam an amount of heat is given up in heating steam lines and the engine, as a result much of the steam is converted back to water.</li> <li>This is an economic loss as no mechanical work has been performed.</li> <li>The condensate formed can cause damage such as broken pistons or forcing the cylinder covers off the engine due to its incompressibility.</li> </ul> </li> </ul>

<p>Q3.2.59      What are the advantages and disadvantages of using <b>superheated steam</b> for driving reciprocating steam engines?</p>	<ul style="list-style-type: none"> <li>• <b>Advantages:</b> <ul style="list-style-type: none"> <li>– The hotter the steam is, the less work it has to do.</li> <li>– Uses less coal.</li> <li>– Uses less water</li> <li>– Gives greater efficiency</li> <li>– Super heated steam has a less volume than saturated steam at the same pressure and therefore provides greater power and efficiency.</li> <li>– With sufficient super heat, expansion can take place in the engine forming less condensation, which can damage the engine.</li> </ul> </li> <li>• <b>Disadvantages:</b> <ul style="list-style-type: none"> <li>– Lubrication must be provided, as super heated steam is an invisible odourless gas that does not have any lubricating properties.</li> <li>– Engines using high temperature super heat must be supplied with the correct grade of lubricant designed to resist vaporization and oxidization.</li> <li>– The temperature of the steam supplied to the engine can only be accurately determined with a temperature gauge.</li> <li>– <b>Safety Note:</b> Because superheated steam is invisible and odourless, it presents a danger to operational personnel. Care should be taken if a leak is suspected as this steam has the potential to cause life threatening injuries</li> </ul> </li> </ul>
<p>Q3.2.60      <i>Blank for additional question</i></p>	<ul style="list-style-type: none"> <li>•</li> </ul>

### Question Set 3.3 Lighting fire and raising steam

QUESTION	SAMPLE RESPONSE
<p>Q3.3.1 What are the <b>pre-light up procedures</b> when preparing a steam locomotive for service?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard pre-light up procedures of the rail operator for the steam locomotive concerned.</li> <li>• For example:               <ul style="list-style-type: none"> <li>– Making sure there is sufficient water in the boiler.</li> <li>– Checking reports from previous use (locomotive operation and repair book) and details of any action taken.</li> <li>– Checking for leaks</li> <li>– Checking that the handbrake is on.</li> <li>– Checking that the regulator is closed.</li> <li>– Confirming that the cylinder cocks are open.</li> <li>– Making sure that the locomotive is in mid gear.</li> <li>– Ensuring that the wheels are chocked where required.</li> <li>– Making sure that the tool kit, fire irons, fire extinguisher, first aid kit and other locomotive equipment is ready for use</li> </ul> </li> </ul>
<p>Q3.3.2 What are the <b>steps</b> when lighting fire on a steam locomotive?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for lighting fire on the steam locomotive concerned.</li> <li>• <b>Note:</b> Some railways introduce coal to the fire early in light up whilst others wait until full steam pressure is obtained. The candidate should recognise the importance of checking to ensure that the requirements of the specific railway concerned are followed</li> </ul>
<p>Q3.3.3 How do you <b>raise steam</b> once the fire is lit?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for raising steam on the steam locomotive concerned.</li> <li>• For example:               <ul style="list-style-type: none"> <li>– Once lit, the size of the banked fire should be managed so that there is sufficient live coal available to spread over the whole of the fire grate.</li> <li>– The boiler pressure and water levels should be gradually adjusted so they will be 100 lb per square inch and half a glass respectively by the time the driver needs to take charge of the locomotive.</li> <li>– If required the blower can be used to ensure there is sufficient draft of the firebed when raising steam (as discussed in the next section).</li> </ul> </li> </ul>

<p>Q3.3.4      When do you use the <b>blower</b>?</p>	<ul style="list-style-type: none"> <li>• The blower on a steam locomotive is used to blow steam up the chimney to assist in creating an up draft across the firebed and through the smokebox.</li> <li>• The blower effectively creates a vacuum in the smokebox so that air is drawn through the flues, and thus thru the firebox, to draft the fire when the cylinders are not working.</li> </ul>
<p>Q3.3.5      Why should <b>smoke generation be minimised</b> when raising steam?</p>	<ul style="list-style-type: none"> <li>• It is wasteful and inefficient as the much of the energy producing gases emitted from the coal are being discharged through the chimney without contributing to power producing steam of the locomotive,</li> <li>• It is environmentally bad practice, as it is contributing to pollution of the air, and</li> <li>• It can be discomforting to passengers, as the acrid smoke may blow into carriages or onto platforms at stations.</li> </ul>
<p>Q3.3.6      How do you <b>test</b> the water gauge glass?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for testing the water gauge glass on the steam locomotive concerned.</li> </ul>
<p>Q3.3.7      How can you <b>minimise black smoke</b> when raising steam?</p>	<ul style="list-style-type: none"> <li>• Black smoke can often be minimised or rectified by spreading the firebed and increasing the draft of air over the firebed in the firebox.</li> <li>• Increased draft can also be temporarily increased by opening the firehole door and/or briefly using the blower.</li> </ul>
<p>Q3.3.8      Why is it important to have <b>adequate ventilation</b> in the locomotive shed while lighting fire? How can you achieve this?</p>	<ul style="list-style-type: none"> <li>• During firing up and preparation the locomotive is giving off large volumes of potentially poisonous gases, fumes and smoke.</li> <li>• There must be adequate means of through ventilation to allow these noxious gases and fumes to escape.</li> <li>• Check that doors, windows and other forms of ventilation available are functioning correctly before lighting fire and raising steam on a steam locomotive.</li> </ul>
<p>Q3.3.9      What are the steps in testing the <b>feedwater injectors</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures for testing the operation of the injector for the locomotive and rail operator concerned.</li> </ul>
<p>Q3.3.10    <i>Blank for additional question</i></p>	<ul style="list-style-type: none"> <li>•</li> </ul>

### Question Set 3.4 Operating the boiler during a train journey

QUESTION	SAMPLE RESPONSE
Q3.4.1 What is <b>combustion</b> ?	<ul style="list-style-type: none"> <li>• Combustion is the chemical union of carbon and oxygen in the proper proportions at a high firebox temperature to produce heat.</li> <li>• Perfect combustion consists of 2 parts of oxygen and 1 part of carbon brought together at the right temperature of 2,500° Fahrenheit.</li> <li>• Imperfect combustion consists of 1 part of oxygen and 1 part of carbon at a much lower firebox temperature of 1,300° Fahrenheit producing Carbon Monoxide.</li> <li>• Perfect combustion produces Carbon Dioxide.</li> </ul>
Q3.4.2 Why is a <b>high pressure</b> steam required in a steam locomotive boiler?	<ul style="list-style-type: none"> <li>• This enables the train to be handled easier, as well as being economical. Less water and coal are used, thus reducing the fireman's work.</li> </ul>
Q3.4.3 Describe the <b>passage of steam</b> from the time it leaves the boiler of a steam locomotive until it reaches the atmosphere.	<ul style="list-style-type: none"> <li>• When the regulator valve is open, steam flows into the internal steam pipe in the boiler through the main steam pipes in the smoke-box into the steam-chest, and is admitted to the cylinders by the slide valve opening a port.</li> <li>• Having completed its work in the cylinders, it returns through the same port, into the cavity in the slide valve, through the exhaust pipe via the smoke-box and up the funnel to the atmosphere.</li> <li>• If super-heated steam is being used when the regulator valve is open, steam flows into the internal steam pipe and passes into the saturated passages of the heater and then enters one end of each element flowing backwards and forwards through the elements, acquiring additional heat and is then delivered to the super-heated passages of the header as super-heated steam. It then passes through the main steam pipes to the steam-chest and proceeds as per saturated engines.</li> </ul>
Q3.4.4 How is <b>coal burned</b> in a locomotive firebox?	<ul style="list-style-type: none"> <li>• When coal is applied to the fire the gaseous matter is expelled. If properly mixed with air and heated to a sufficient temperature in the firebox, the mixture will ignite and be consumed, then passed through the tubes and out of the funnel. If, however, the gases are only partly consumed, the unburnt carbon gases will be lost as they pass out the funnel as black smoke. The solid matter is left on the grates in the form of coke which burns at a lower rate.</li> </ul>

<p>Q3.4.5      What conditions must prevail to obtain the <b>best results</b> from coal?</p>	<ul style="list-style-type: none"> <li>• A very high temperature when the gases are expelled from the coal and mixed with the oxygen.</li> <li>• The air must be heated and in large quantities.</li> <li>• The right proportion of coal gases in relation to the oxygen which is present.</li> </ul>
<p>Q3.4.6      How are optimum fire conditions <b>maintained</b>?</p>	<ul style="list-style-type: none"> <li>• Keep the fire clean and bright and as thin as conditions will permit.</li> <li>• Be sure the dampers are fully open and the grates clean to allow air to pass through the fire bed and be heated.</li> <li>• Apply the coal lightly or in small quantities and distribute it over the grate evenly.</li> </ul>
<p>Q3.4.7      How is the <b>air</b> supplied to the fire?</p>	<ul style="list-style-type: none"> <li>• When the dampers are opened, air passes into the ashpan through the grates and the fire bed to enter the firebox. Some will also pass through and around the firehole door. Insufficient air causes smoke which shows a waste of gases.</li> </ul>
<p>Q3.4.8      Do the <b>gases continue to burn</b> after they enter the tubes?</p>	<ul style="list-style-type: none"> <li>• No. The water surrounding the tubes absorbed the heat so quickly that the gases will be cooled below the igniting temperature after they have passed a short distance into the tubes.</li> </ul>
<p>Q3.4.9      How should the fire be <b>managed</b> when <u>preparing</u> for a trip?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for managing the fire when <u>preparing</u> for a trip for the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– See that the grates are free of ash and clinker.</li> <li>– After the fire has been spread over the whole grate area with the fire-iron, commence to build the fire, by applying the fuel so that the fire is slightly heavier under the fire door and back corners and along the sides of the firebox, and tapering towards the tube plate. It should be a little thinner in the centre of the box.</li> <li>– It is essential to have a good body of clean white hot coals when starting with the train.</li> </ul> </li> </ul>

<p>Q3.4.10 How should the fire be <b>managed on the road</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for managing the fire when '<u>on-the-road</u>' for the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– The coal should be applied lightly and often, spread evenly all over the grates.</li> <li>– Do not fire with large lumps of coal as the cool air will pass around the lumps, which may cause a hole in the fire. Coal broken to about the size of the fist lies closer together and burns better.</li> </ul> </li> </ul>
<p>Q3.4.11 What should be the <b>depth</b> of the fire?</p>	<ul style="list-style-type: none"> <li>• This can only be determined by experience as the grades, loads and different types of trains will need various amounts of fire.</li> <li>• The depth of the fire should always be kept as thin as possible for the efficient production of steam.</li> </ul>
<p>Q3.4.12. What should you manage your fire when <b>approaching a station</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for managing the fire when approaching a station for the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– Do not put on a fire, as this would cause black smoke.</li> <li>– Do not perform duties which will distract attention from signals</li> </ul> </li> </ul>
<p>Q3.4.13 How do you <b>read a fire</b> on a steam locomotive?</p>	<ul style="list-style-type: none"> <li>• If a section of the firebed is giving off <b><u>long, orange coloured flame</u></b>, this indicates that the combustion of the coal in this area has not yet reached an advanced state. Coal should not be added to this area until a higher temperature is achieved</li> <li>• If a section of the firebed is emitting a flame that is a <b><u>bright lemon colour</u></b>, this indicates that the coal in that area is burning fiercely with combustion and temperature approaching peak level. Additional coal can be placed in this area.</li> <li>• If a section of the firebed is showing a <b><u>very bright white hot appearance</u></b>, this indicates that the fire will shortly become 'thin' in this area. This shows that combustion and temperature will have already peaked. Additional coal must be placed in this area immediately.</li> </ul>

<p>Q3.4.14 How do you <b>read smoke</b> from a steam locomotive?</p>	<ul style="list-style-type: none"> <li>• A <b><u>dense black smoke</u></b> indicates that at that time too heavy a fire has been put on and a large quantity of volatile hydrocarbons are being wasted due to temporary insufficiency of air for the combustion of the large volume of gases being emitted (<i>This can often be rectified by opening the firehole door</i>).</li> <li>• A <b><u>light brown smoke</u></b> will usually indicate that the air-to fuel mixture is just right and that the highest firebox temperatures are being generated and the maximum combustion efficiency over the grate are generally being achieved.</li> <li>• A <b><u>completely clear chimney</u></b> will indicate either that the fire has burned through (and additional fuel is required) or else an excessive amount of air is entering the firebox at some point where there is either a 'hole' in the fire or the firebed is locally too thin.</li> </ul>
<p>Q3.4.15 How is <b>black smoke</b> prevented when the locomotive is running with steam shut off?</p>	<ul style="list-style-type: none"> <li>• By firing the locomotive some distance from the shutting off point, which enables most of the gases to be burnt before the regulator is shut, if there is still black smoke, close the dampers and open the fire door slightly, and turn on the blower a little more.</li> </ul>
<p>Q3.4.16 What should be the condition of the fire when <b>stopping at a station</b> with a passenger train?</p>	<ul style="list-style-type: none"> <li>• It should be bright and clean with no smoke from the funnel, but always have a body of fire, sufficient to maintain the steam pressure when the train is leaving the station.</li> </ul>
<p>Q3.4.17 What should be the condition of the fire when the <b>top of a heavy upgrade</b> is reached?</p>	<ul style="list-style-type: none"> <li>• Always have the fire well burned through, so that the black smoke will not flow from the funnel when running down-grade. Also it will be much easier to prevent the safety valves from blowing.</li> </ul>



<p>Q3.4.18      How should you <b>manage the boiler</b> throughout a train journey?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for managing the boiler throughout a train journey for the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– The coal should be applied lightly and often, spread evenly all over the grates.</li> <li>– The firebed should not be fired with large lumps of coal as the cool air will pass around the lumps, which may cause a hole in the fire.</li> <li>– Draft should be adjusted to optimise the burning of the coal and the flammable gases given off.</li> <li>– Water should be fed to the boiler as required to ensure sufficient to ensure the right balance for economical boiler operation.</li> <li>– The control of water feed and the firing of the boiler will vary according to the character of the road ahead. When approaching a rising grade in the road, it will be necessary to prepare the locomotive for steaming by building up the firebed to increase the levels of combustion and temperature. When approaching a falling grade, it will be necessary to prepare the locomotive for drifting by reducing the depth of fire and lowering the level of combustion and temperature.</li> <li>– When approaching a station it is important not to put on a fire, as this would cause black smoke.</li> <li>– When stopping at a station with a passenger train the fire should be bright and clean with no smoke from the funnel. However, it is always important to have a body of fire, sufficient to maintain the steam pressure when the train is leaving the station.</li> </ul> </li> </ul>
<p>Q3.4.19      Describe <b>Total Dissolved Solids</b> or TDS.</p>	<ul style="list-style-type: none"> <li>• Is a measure of the combined content of all <u>inorganic</u> and <u>organic</u> substances contained in a liquid (Boiler water) in molecular, ionized or micro-granular (<u>colloidal sol</u>) suspended form. (Too higher levee of TDS may cause foaming)</li> </ul>
<p>Q3.4.20.      What are <b>Suspended Solids</b>?</p>	<ul style="list-style-type: none"> <li>• Suspended Solids are small solid particles which remain in <u>suspension</u> in water as a <u>colloid</u> or due to the motion of the water. (Too higher level of Suspended Solids may cause foaming)</li> </ul>

<p>Q3.4.21 How should the fire be managed when <b>running down a grade</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for managing the fire when running down a grade for the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– Add the coal in a manner that will keep the fire bright, with enough to build on to enable the steam pressure to be maintained when the locomotive starts working.</li> </ul> </li> </ul>
<p>Q3.4.22 What <b>level of water</b> must be carried in the boiler?</p>	<ul style="list-style-type: none"> <li>• Always have enough water to cover the crown of the fire-box and the front ends of the tubes at all times. On level tracks about 1/2 a glass, down-grade 1/2 of a glass, up-grade 3/4 or some times a full glass. The water must never be out of sight in the bottom of the glass.</li> </ul>
<p>Q3.4.23 What is the <b>result if too much water</b> is carried in the boiler?</p>	<ul style="list-style-type: none"> <li>• The steam to the cylinders is wet. This will wash off the oil from cylinders and valves, at times may damage the covers or side rods. The locomotive will work very stiffly and will require more steam to do a certain amount of work.</li> </ul>
<p>Q3.4.24 Why is it important to regularly check the <b>water level</b> in the boiler during a journey?</p>	<ul style="list-style-type: none"> <li>• It is important that to regularly check the level of water in the boiler to confirm that there is water continues to cover the boiler tubes and crown sheet at all times. Otherwise the boiler components could overheat and serious damage caused.</li> </ul>
<p>Q3.4.25 How must you check the water level when the locomotive is <b>traversing steep rising or falling grades</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for checking the water level when the locomotive is traversing steep rising or falling grades for the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– Using the markings for the various rising or falling grades shown on the water gauge glass, make sure that the level of water is appropriate for the grade concerned by adding sufficient water to the boiler using the feedwater injector.</li> </ul> </li> </ul>
<p>Q3.4.26 What would happen if the water level is <b>too low</b> in the boiler?</p>	<ul style="list-style-type: none"> <li>• Damage will occur to the crown of the fire-box, or the fusible plugs, or the front of the tubes may be burnt</li> </ul>
<p>Q3.4.27 What are the symptoms of <b>fusible plug failure</b>?</p>	<ul style="list-style-type: none"> <li>• Steaming difficulty</li> </ul>
<p>Q3.4.28 Does the failure of a plug provide a <b>warning</b> that the water level is low?</p>	<ul style="list-style-type: none"> <li>• No, it demonstrates that the water level has already fallen to a dangerous level.</li> </ul>

<p>Q3.4.29 Will the escaping steam from a failed fusible plug <b>put the fire out</b>?</p>	<ul style="list-style-type: none"> <li>• Not necessarily. It may do in a small boiler, but in a large boiler with multiple fusible plugs, a single failure may not have enough quenching effect to extinguish the fire.</li> </ul>
<p>Q1.4.30 What <b>should be done</b> in the event that a fusible plug melts?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the emergency procedures of the rail operator in the event that a fusible plug melts on the boiler of the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– Extinguish the fire, but keep the blower going strongly to keep steam from entering the cab. . In the case of oil, turn it off. In the case of a solid fuel, if there is a drop grate arrangement, drop the fuel into the ash pan, with the ash wetter turned on.</li> <li>– In some arrangements, where the fire cannot be easily dropped it may be necessary to smother the fire with earth or sand. However, any practice that requires the fire door to be open has risk of burning for the crew, so this must be done with due care, and with the blower operating. Do not inject feed water, as this may flash to steam on the overheated plates of the boiler, causing greater volumes of steam and/or water to pass through the fusible plug.</li> <li>– In all cases, steam is to be vented from the boiler by whatever auxiliary devices that are available. An example could be a non-lifting injector, with the water turned off.</li> </ul> </li> <li>• The failure of a fusible plug indicates a very serious situation. It is extremely important to know the emergency procedures of <u>the railway</u> concerned in the event of the failure of a fusible plug.</li> </ul>
<p>Q3.4.31 Why is it important for the fireman to remain <b>vigilant</b> at all times during a train journey?</p>	<ul style="list-style-type: none"> <li>• During a train journey it is vital that the fireman remains vigilant at all times to identify any situation that may potentially be unsafe or cause a problem in the safe and efficient running of the train.</li> <li>• This may include problems on the road ahead, on the locomotive itself or on the train being drawn. In this regard it is the fireman's special duty to regularly look back at the train being drawn to check that there are no problems occurring.</li> </ul>

<p>Q3.4.32</p> <p>What is the role of a fireman concerning <b>speed limits</b> along a train's route?</p>	<ul style="list-style-type: none"> <li>• Trains must comply with the prescribed speed limits both within the yard and during a train journey.</li> <li>• It is important that the fireman is aware of all of the prescribed speed limits along a train route and in the yard and draws the driver's attention to any need to vary the train's speed to comply with the limits in the current or approaching section.</li> <li>• Maximum speed is the maximum of the line speed or class of rollingstock -- not just track speed. In this regard, the driver needs to know the limits on any rollingstock attached to the train</li> </ul>
<p>Q3.4.33</p> <p>Describe the precautions and procedures a fireman should follow when <b>approaching and stopping</b> at stations along a train's route?</p>	<ul style="list-style-type: none"> <li>• Anticipating a scheduled stop at a station and assisting the train driver in action that enables a steady deceleration in sufficient time for a gradual stop,</li> <li>• Approaching the stop smoothly and steadily with appropriate deceleration and braking that allows the train to come to a gentle stop on the required stopping position, and</li> <li>• The stop should be achieved without sudden deceleration or jerks arising from sudden braking.</li> </ul>
<p>Q3.4.34</p> <p>What are five examples of <b>abnormal situations</b> that may occur during a train journey and what is the role of the fireman in responding to these abnormal situations?</p>	<ul style="list-style-type: none"> <li>• Candidate will describe the action to be taken by a fireman in the event of five different types of abnormal situation as per the rail operator's emergency and standard operating procedures.</li> <li>• This may include assisting the driver in stopping and securing the train, undertaking required emergency procedures including communication, and assisting passengers and train crew in an orderly evacuation of the train as per the rail operator's emergency procedures.</li> <li>• Examples of the types of abnormal situations that could be included are: <ul style="list-style-type: none"> <li>– a track obstruction</li> <li>– trespassers crossing the track</li> <li>– equipment failure</li> <li>– signals in stop mode</li> <li>– incorrect information or failure in communications</li> <li>– a passenger emergency (e.g. illness or injury)</li> <li>– an ill crew member</li> <li>– a passenger initiated alarm</li> <li>– a false alarm</li> <li>– a derailment</li> <li>– a collision</li> <li>– a chemical spill</li> <li>– a fire and explosion on the locomotive or train</li> <li>– a bomb threat</li> <li>– head or marker light failure</li> </ul> </li> </ul>

<p>Q3.4.35</p> <p>Why is it important that a fireman can give and interpret <b>hand signals</b>?</p>	<ul style="list-style-type: none"> <li>• Firemen work closely with other members of the train crew and other qualified railway personnel in the safe and effective operation of locomotives and trains. A key skill required of all the railway personnel concerned is being able to give and interpret the standard railway hand signals.</li> <li>• In various circumstances, these hand signals may be complemented by the use of flags and lights or radio equipment (e.g. where night work is involved).</li> <li>• Firemen must be proficient in giving these signals and using the equipment as per the railway's standard procedures. They must also be able to recognise and correctly interpret signals given by others.</li> <li>• Candidate will describe the signals used on the railway concerned.</li> </ul>
<p>Q3.4.36</p> <p>What is the fireman's role during a <b>locomotive run around</b> at a terminus or siding?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the fireman's role during a locomotive run around at a terminus or siding for the rail operator concerned.</li> <li>• The role and procedures will vary from railway to railway. In some cases the guard detaches and runs around when the fireman is responsible to keep a sharp look out for hand signs etc.</li> <li>• It is critically important for the fireman to keep a sharp look out for hand signals from guard/station staff re stopping position for stop</li> </ul>
<p>Q3.4.37</p> <p><u>Describe the method of safe working on your railway and what actions you as fireman need to take in relation to the authority to enter a section</u></p>	<ul style="list-style-type: none"> <li>• The candidate will describe the method of safe working on the railway concerned and will specifically describe the action a fireman must take <u>in relation to the authority to enter a section</u>.(for that railway).</li> </ul>
<p>Q3.4.38</p>	<p><i>Blank for additional question</i></p> <ul style="list-style-type: none"> <li>•</li> </ul>

### Question Set 3.5    **Cleaning and checking the boiler after operations**

QUESTION	SAMPLE RESPONSE
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<p>Q3.5.1</p> <p>How do you secure the locomotive prior to <b>post-operational cleaning and checking</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for securing the loco prior to post-operational cleaning and checking</li> <li>• For example: <ul style="list-style-type: none"> <li>– Move the locomotive to the ash pit.</li> <li>– Manage the fire so it is not dead as this may start the tubes leaking, nor should there be a heavy green fire, as this is wasteful.</li> <li>– Make sure there is a full glass of water, so as to avoid the use of the injector, when the fire-box temperature is low.</li> <li>– Make sure you have a good pressure of steam to enable the locomotive to be moved to the allotted position in the shed.</li> <li>– After coal, sand and water are taken, the loco is moved to the ash-pit and the brakes applied</li> </ul> </li> </ul>
<p>Q3.5.2</p> <p>Why is it important to remove all <b>grime and grease</b> and to <b>clean</b> the locomotive's paintwork and brassware?</p>	<ul style="list-style-type: none"> <li>• Maintains the life and serviceability of the locomotive.</li> <li>• Keeps the locomotive attractive and presentable which important to maintain the interest and ongoing patronage of tourists and other passengers.</li> </ul>
<p>Q3.5.3</p> <p>What steps are involved in <b>cleaning the smokebox</b>?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for cleaning the smokebox of the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>– Close firehole door.</li> <li>– Open smokebox door slowly allowing combustible gases to escape.</li> <li>– Checking for indications of water or steam leaks from boiler tubes and steam pipe joints,</li> <li>– Checking that the spark arrester mesh is clean and undamaged,</li> <li>– Checking that the spark arresters and baffle plates are not broken or loose, do not have excess gaps and that there are no steam blows,</li> <li>– Removing any cinders/ flyash which may be in the smokebox,</li> <li>– Making sure that the smokebox door ring is clean of any ashes, and</li> <li>– Closing and tightening the smokebox door and testing for leaks with the blower turned on (a lighted flare lamp can be used by running it around the door joint)</li> </ul> </li> </ul>
<p>Q3.5.4</p> <p>What should you do if you find a <b>defect or other problem</b> during a post-operational check of a locomotive after service?</p>	<ul style="list-style-type: none"> <li>• Record the defect of problem in the log or service record.</li> <li>• Report the defect immediately to the driver or other authorised person as per the rail operator's standard procedures</li> </ul>

<p>Q3.5.5 How do you <b>clean</b> the firebox and ashpan?</p>	<ul style="list-style-type: none"> <li>• The candidate will describe the standard operating procedures of the rail operator for cleaning the firebox and ashpan of the locomotive concerned</li> <li>• For example: <ul style="list-style-type: none"> <li>• Move the locomotive to the ash-pit.</li> <li>• Open the ashpan slides and apply the ash-wetter.</li> <li>• Open the dead plate, then use the handle provided to shake the rocking grates to remove the fire. The pricker may in some instances have to be used to push the ashes through the dead plate opening, or to break up clinker which is too large to pass through the grates.</li> <li>• After the ash pan has been emptied, shut off the ash-wetter and blower and close the dampers.</li> <li>• When the locomotive is moved to the spot-pit, examine the ash pan and make sure it is clean.</li> <li>• Close the dead plate and ash-pan and make sure it is clean.</li> <li>• Close the dead plate and ash-pan slides.</li> </ul> </li> </ul>
<p>Q3.5.6 What is <b>clinker</b>?</p>	<ul style="list-style-type: none"> <li>• When coal burns, it forms ash. Some coals have ash that has a high melt point, whilst others have a low melt point. Ash melts when subjected to sufficient temperature fusing it together to form clinker. When the ashbed on the grates becomes too thick, it starves the burning coal of cooling air. This quickly heats up the surface of the ashbed, melting and fusing ash particles together.</li> </ul>
<p>Q3.5.7 What post operational <b>lubrication and greasing tasks</b> need to be completed as part of stabling activities?</p>	<ul style="list-style-type: none"> <li>• Candidate should outline the rail operator's requirements and checklist for the lubrication and greasing of locomotives after service.</li> </ul>
<p>Q3.5.8 What action should you take concerning the <b>water level</b> of the boiler when stabling a locomotive?</p>	<ul style="list-style-type: none"> <li>• Before securing a steam locomotive after service, you should apply the hand brake and check the level of water in the boiler. If necessary, add water to make sure that there is at least 3/4 of a glass of water in the boiler</li> </ul>

<p>Q3.5.9      What <b>other tasks</b> might a fireman undertake as part of securing a steam locomotive after service?</p>	<ul style="list-style-type: none"> <li>• Check the tool kit, fire irons, fire extinguisher, first aid kit and other locomotive equipment to make such they are complete and are in good operational condition.</li> <li>• If there are any defective or broken components or if some parts of the kits or equipment are missing, take appropriate action to report and rectify the problem</li> <li>• Make sure that the tool kit, fire irons, fire extinguisher, first aid kit and other locomotive equipment is properly stowed and/or returned to store and is ready for use when the locomotive is next prepared for service</li> </ul>
<p>Q3.5.10      How should the boiler and associated equipment be left <b>after service</b>?</p>	<ul style="list-style-type: none"> <li>• Candidate should outline the rail operator's requirements and standard procedures for a fireman to ensure that a locomotive is in its required post-operational condition and is properly secured.</li> </ul>
<p>Q3.5.11      What <b>paperwork</b> must be completed after cleaning and shutting down a boiler on a steam locomotive after service?</p>	<ul style="list-style-type: none"> <li>• Candidate should outline the rail operator's requirements and standard procedures for the paperwork that needs to be completed by a fireman after cleaning and shutting down the boiler on a steam locomotive after service. This may include... <ul style="list-style-type: none"> <li>– time sheet,</li> <li>– log or record of boiler operations,</li> <li>– reports of operational problems with boiler operation and/or any defective equipment identified and details of any action taken or required,</li> <li>– reports of any safety incidents as per rail operator's procedures and regulatory requirements, and</li> <li>– paper work related to the return of kit to store.</li> </ul> </li> </ul>
<p>Q3.5.12      <i>Blank for additional question</i></p>	<ul style="list-style-type: none"> <li>•</li> </ul>