Unit 113: Plumbing, heating and ventilation

# Sample scheme of work

This sample scheme of work covers both classroom- and workshop-based learning for Unit 113. It is based on 3 hours per session for 46 sessions (with final recap being split over several). It is an example only of a possible scheme of work and is based on theory and practical within an FE centre, but can be amended to suit all learning facilities with the necessary adjustments to meet individual learners’ needs.

The delivery of this Unit has been split to accommodate as much practical training as possible, taking into account that this is a Foundation level Unit while still covering the requirements for theory, but may be adjusted in a suitable proportion to suit the centre. Generally, this scheme has been produced so that a theory session is delivered during the morning followed by a practical session in the afternoon, although in some cases practical sessions may be missed to accommodate the large quantity of theory that must be covered in this Unit.

**You can use the sample scheme of work as it is, adjust it or extract content to create a scheme of work to suit your delivery needs. It can also be adjusted by adding theory and practical workshops to support learners who have/need additional learning time.**

Centres should also incorporate the following themes, where appropriate, as strands running through each of the sections within the qualification. Although they are not specifically referred to in the section content section, City & Guilds regards these as essential in the teaching of the qualification:

* health and safety considerations, in particular the need to impress upon learners the fact that they must preserve the health and safety of others as well as themselves
* Essential Skills (Application of Number, Communication, Digital Literacy and Employability)
* extension tasks and differentiation, inclusion, entitlement and equality issues
* spiritual, moral, social and cultural issues
* environmental education and related European issues
* British values
* use of information learning technology (ILT).

Unit 113: Plumbing, heating and ventilation

# Sample scheme of work

**Course/qualification:** Foundation Qualification in Construction and Building Services Engineering **Tutor’s name:**

**Number of sessions**:46 **Delivery hours**: 140 **Venue**: **Group**:

|  |
| --- |
| **Learning outcomes**   1. Know the fundamental principles of plumbing and heating systems 2. Know the underlying principles that guide the work of a plumbing and domestic heating engineer 3. Know the requirements for carrying out common plumbing and heating tasks 4. Plan the completion of common plumbing and heating tasks 5. Carry out a pipework installation task 6. Understand performance criteria for the completion and evaluation of common plumbing and heating tasks |

| Session | Objectives/learning outcomes **The learner will:** | Activities and resources | Skills check |
| --- | --- | --- | --- |
| 1  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  . | Activities:  **Classroom session: Introduction to BSE and hand tools**   * Introduce the Unit and the trade area to learners. Start by listing the occupation areas related to the BSE sector. Learners may contribute as a group to produce scatter diagram on the board. * Introduce PowerPoint 1: Work within BSE occupations. * Learners are to list roles of each BSE trade operative in small groups before tutor reveals the answers. * Show images of typical site work from each trade. * Distribute Worksheet 1: Work within BSE occupations, learners are to complete Task 1 individually before discussing answers as a group. * Distribute a range of hand tools relevant to the domestic plumbing and heating fitter. Suggested tools: Screwdrivers, hammer, chisel, grip, wrench, spanner, spirit, level, manual pipe threader, pipe cutter, hack saw, pliers, cold chisel, bending tool, blow torch, pipework soundness test equipment. * Encourage learners to offer any information on what each tool does or is used for. Lead a discussion on these tools and identify the typical range within PowerPoint 1 from slide 11 onwards. Learners may use Worksheet 1 Task 2 to identify these tools in line with the PowerPoint images. * Break for lunch, explain the arrangements for the workshop session to follow.   Resources:   * **PowerPoint 1: Work within BSE occupations** * **Worksheet 1:** **Work within BSE occupations** * Range of hand tools for distribution and demonstration | **List the roles of the BSE operative as scatter diagram**  **Group task to list roles of the BSE operative**  **Worksheet 1 Tasks 1 & 2**  **Identify tools** |
| 2  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools | Activities:  Practical session: Introduction to BSE and hand tools   * Ensure all learners are aware of the workshop rules and start by discussing the requirements for PPE within this sector of work. * Gather learners around a suitable work area and demonstrate the use of a range of hand tools specific to the industry. Focus specifically on the tools that learners may not use in this manner in other units of the qualification such as hacksaw, pipeslice, pump pliers and blow lamp. Demonstrate the safe manner of operation. Focus in detail on how to assemble, light and safely dismantle blow lamp equipment. * Arrange class into small groups and explain the short training task. * Learners are to complete the task of producing a straight cut on a piece of 22mm copper pipe using a hacksaw and then a pipe cutter. * They are then to undo a 22mm compression fitting using an adjustable spanner and pump pliers and tighten onto the pipe. * Once complete learners should disassemble a blow lamp and then reconnect safely. * Learners to clean and tidy the work area before completion for the day.   Resources:   * Hand tools: adjustable spanner, pump pliers, pipe cutter, hacksaw and blow lamp * Short pieces of 22mm copper pipe * 22mm compression fittings | **Demonstrate the safe use of hand tools**  **Cut copper pipe**  **Assemble blow lamp** |
| 3  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.3 The pipework materials and sizes used in BSE  2.5 The fitting types used in BSE   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE | Activities:  Classroom session: Compression and push-fit copper pipework jointing   * Start session by introducing trade magazines, both online and paper versions. Encourage learners to look at trade magazines to keep up to date with industry trends. * Introduce PowerPoint 2: Copper pipework jointing part 1. * Deliver PowerPoint 2 and discuss the types of copper pipework used in both domestic and commercial applications. * Distribute a number of copper pipe pieces from R220, R250 and R290 and explain the differences. Discuss the application for each type using PowerPoint 2 to support main points. * Look at the Yorkshire Pegler Website for information on specific copper types: <http://yorkshirecopper.com/products/nordics/> * Now distribute a range of pipe fitting types including couplers, elbows and bends, equal tees, reducing tees, reducers, brazed capillary joints, press-fit, push-fit, crimped joints end feed, integral solder ring and compression. * Discuss the pipe sizes commonly used within the domestic and commercial sectors * Discuss the use and applications of each including advantages. Ask learners to make a short list of advantages and disadvantages of each jointing type. Learners may work in small groups to do this before feeding back into peer discussion. * Distribute Worksheet 2: Copper jointing compression and push fittings. * Explain the arrangements for practical session in the afternoon and finish for lunch.   Resources:   * **PowerPoint 2: Copper pipework and jointing part 1** * **Worksheet 2: Copper jointing – compression and push fittings** * R220, R250 and R290 grades copper pipe * Various copper pipe fittings * <http://yorkshirecopper.com/products/nordics/> | **Direct and indirect questions**  **Group task – list advantages and disadvantages for fittings**  **Worksheet 2** |
| 4  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.3 The pipework materials and sizes used in BSE  2.5 The fitting types used in BSE   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation | Activities:  Practical session: Compression copper pipe jointing   * Tutor to gather learners in workshop and introduce training task of jointing copper pipework using Type A compression and Type B as well as push-fit types. * As part of a ‘Toolbox talk’ nominate a learner or learners to identify the suitable safety precautions and PPE suitable for the task. * Demonstrate the methods of jointing Type A non-manipulative compression fittings to short piece of copper and discuss the use of olives. * Learners are to practice jointing short pieces with Type A fittings. * Demonstrate the process of producing a Type B compression fitting. Distribute equipment for learners to attempt a Type B joint individually. * Distribute a range of push-fit type copper fittings and allow learners to practice. * Introduce and demonstrate the principle of gaining length from fittings and discuss the process of measuring and marking a centre to centre measurement. * Allow learners to now practice this by shortening their previous piece of pipe to meet a given length. * Learners to clear the work area and tidy equipment as necessary.   Resources:   * Hand tools * Copper pipe * Type A and B compression fittings * Push-fit fittings for copper pipe | **List safety precautions for the task**  **Produce Type A joints on copper pipe**  **Produce Type B joints on copper pipe**  **Measure a centre to centre measurement** |
| 5  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.3 The pipework materials and sizes used in BSE  2.5 The fitting types used in BSE   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE | Activities:  Classroom session: Copper pipework jointing – press-fit and capillary joints   * Start session with short video link: [www.youtube.com/watch?v=0RgMcaMnY1A](http://www.youtube.com/watch?v=0RgMcaMnY1A) * Discuss the advantages of this type of fitting and give classroom demonstration of the process. * Allow learners to try the process on a short piece of copper pipe. * Introduce and deliver PowerPoint 3: Copper pipework jointing part 2. In this session distribute a number of fitting types for discussion including: couplers, elbows and bends, equal tees, reducing tees, reducers. * Discuss the applications for each type of fitting and the method of ordering tees for size using main – main – branch. * Share a number of brazed fittings and highlight the advantage of hard soldering. * Use PowerPoint 3 to discuss the processes for soldering and include video clip, which demonstrates soft and hard soldering techniques: [www.youtube.com/watch?v=oBE7I0LT9eM](http://www.youtube.com/watch?v=oBE7I0LT9eM) * Discuss the advantage of the type of fitting used in this video and give a classroom demonstration of the process. * Distribute Worksheet 3: Copper jointing capillary and press fittings. Learners are to complete individually before discussing the answers as a tutor-led discussion. * Explain copper pipe jointing using capillary and press fittings before practical session.   Resources:   * **PowerPoint 3: Copper pipe jointing part 2** * **Worksheet 3: Copper pipe jointing capillary and press fittings** * [www.youtube.com/watch?v=oBE7I0LT9eM](http://www.youtube.com/watch?v=oBE7I0LT9eM) * Range of press fit and capillary fittings | **Connect pipe using push fitting**  **Worksheet 3**  **Open and direct questions** |
| 6  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.3 The pipework materials and sizes used in BSE  2.5 The fitting types used in BSE   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation | Activities:  Practical session: Capillary and press-fit copper pipe jointing   * Start session by discussing the H&S requirements for soldering and hot works. Use learners to develop an agreed process and look at the workshop risk assessments. * Following on from the previous theory session – demonstrate the use of the crimping /press-fit tools and marking depths. * Split the class into small groups and allow learners to each produce a small crimped section of pipework as directed by tutor. * On completion gather around for group peer discussion on the success of each crimped joint. * Demonstrate the process for producing a successful end-feed joint and integral solder ring joint. * Allow learners to move back into their small groups and try the process. Move between each small group and offer advice. * On completion again gather around to discuss any issues, faults or mistakes common to the joints produced. * Learners to tidy the work area before finishing the session.   Resources:   * Range of capillary fittings * Hand tools * Soldering equipment * Press-fit tools * Standard complete Risk Assessment for soldering activity in workshop scenario | **Suggest safe practices during soldering**  **Connect pipe using end feed fitting**  **Connect pipe using integral solder ring joint**  **Connect pipe using press-fit fitting** |
| 7  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.3 The pipework materials and sizes used in BSE  2.5 The fitting types used in BSE   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE | Activities:  Classroom session: LCS pipework and jointing   * Introduce PowerPoint 4: LCS pipework and jointing. * Deliver PowerPoint 4 and discuss the grades of LCS pipework used in both domestic and commercial applications. * Distribute a number of LCS pipe pieces including yellow, blue and red bands, black untreated, red oxide painted, stainless and galvanised. Discuss the differences. Discuss the application for each type using PowerPoint 4 to support main points. * Split the class into small groups and distribute a number of supplier catalogues. Ask learners to spend 5–10 minutes looking at the range of LCS pipe available and the range in sizes. Learners should be encouraged to find out what options pipe can be delivered in such as plain ends, threaded, painted and various lengths. For example: BSS Catalogue available here at [www.bssindustrial.co.uk/products/metal-pipe-systems](http://www.bssindustrial.co.uk/products/metal-pipe-systems) * Now distribute a range of pipe fitting types including sockets, elbows and bends, equal tees, reducing tees, reducers, unions, bushes, flanges, press-fit, weldable fittings in a number of sizes. * Discuss the pipe sizes commonly used within the domestic and commercial sectors and distribute PowerPoint 4. * Discuss the use and applications of each including advantages. Ask learners to make a short list of advantages and disadvantages of each jointing type. Learners may work in small groups to do this before feeding back into peer discussion.   Resources:   * **PowerPoint 4: LCS pipework and jointing** * Range of steel pipe pieces, grades and fittings * [www.bssindustrial.co.uk/products/metal-pipe-systems](http://www.bssindustrial.co.uk/products/metal-pipe-systems) * Industry catalogues |  |
| 8  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.3 The pipework materials and sizes used in BSE  2.5 The fitting types used in BSE   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE   1. **Carry out pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation | Activities:  Practical session: Cut and join LCS pipe   * Start by gathering all learners around a bench within the workshop to introduce learners to a range of power tools and hand tools required for the cutting and jointing of LCS pipe. This should include: hand stocks and dies, powered hand stocks and dies, power threading machines. * Demonstrate the process of making a centre to centre measurement on a piece of ½” or ¾” LCS pipe between two elbows or tees. * Examine the range of jointing compounds and materials for the BSP threads. * Split class into pairs and task the pairs with producing a thread using hand-stocks and a straight cut on a piece of LCS pipe. Learners must mark pipe to a set dimension to enable a centre to centre measurement and joint using a jointing material as offered by tutor. * Monitor and guide learners as they produce these pieces. On completion gather group to discuss progress and compare work. * Now demonstrate the use of the threading machine including all relevant PPE. Discuss the checks, visual inspection (including PAT) procedures and safety operations and set task for learners to cut and thread one short piece of LCS pipe each to a set length. * Learners to clean machinery on completion and tidy work area. * On completion ask learners to state one safety factor or pre-use check / visual inspection each, relevant to the operation of hand or power threading machines.   Resources:   * Range of pipe fittings for LCS BSP * Pipe – ½” and ¾” * Hand stocks * Power stocks * 110v threading machine | **Produce centre to centre measurements**  **Produce straight cuts**  **Safely operate machinery** |
| 9  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.4 The clip and bracket types used in BSE  2.6 Common fixing devicesfor pipework   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.1 How to measure and mark out for fixings to pipework and plumbing and heating components | Activities:  Classroom session: Common fixing devices, clips and brackets   * Start session by examining a range of different materials for structures such as walls, floors and ceilings. Encourage discussion regarding how fixings could be made to each type such as brick, block, concrete, lightweight block, plasterboard, wood and tiles. * Using PowerPoint 5: Common fixing devices clips and brackets, discuss the materials and the types of fixings used to fix to them. * Breakout to workshop to demonstrate to the class the procedures for fixing using rawl plugs, anchor bolts and plasterboard fixings etc. * Return to classroom and distribute a range of fixing devices to examine. * Distribute a range of common brackets such as brass and iron Munsen rings, plastic clips, stand-off clips, school board clips, hangers, rubber lined clip, cantilever brackets and the use of phenolic blocks in brackets. * Demonstrate how to assemble a standard rod and bracket using a short piece of Unistrut. * Watch videos on slide 12 - [www.youtube.com/watch?v=8NQ\_BXBOAt0&list=PL01YTbfJzSqxY4mkST3mEeenNI9ZRUKy1&index=6](http://www.youtube.com/watch?v=8NQ_BXBOAt0&list=PL01YTbfJzSqxY4mkST3mEeenNI9ZRUKy1&index=6) and <https://www.youtube.com/watch?v=2LxARk3BGTE>.   Resources:   * PowerPoint 5: Common fixing devices * Range of fixing devices for various materials * Range of brackets and clips * Power tools and drill bits for the demonstration * Power tools and drill bits for demonstration * <https://www.youtube.com/watch?v=8NQ_BXBOAt0&list=PL01YTbfJzSqxY4mkST3mEeenNI9ZRUKy1&index=6> * <https://www.youtube.com/watch?v=2LxARk3BGTE> | **Identify clip and fixing types in open and direct questions** |
| 10  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.4 The clip and bracket types used in BSE  2.6 Common fixing devicesfor pipework   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.1 How to measure and mark out for fixings to pipework and plumbing and heating components   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures | Activities:  Practical session: Common fixing devices, clips and brackets   * Start session by gathering all learners around the bench area to continue discussing any further clip, fixing and bracket type from the previous morning session. * Refresh knowledge by arranging the fixings, brackets and clips in a line and asking learners in pairs to identify each before comparing the answers and discussing as a group. * Gather learners around work area and explain today’s task. Learners should measure, mark and make fixings into wall / material as agreed with tutor. This may be concrete/brick/ timber as available in centre. * Gather learners and discuss the next part of the task – assemble stand-off clip with Unistrut, square plate washer and screwed rod. Learners in pairs are now to fix this using fixings previously made. * On completion, measure and check for accuracy. Learners are to clear the work area and leave tidy.   Resources:   * Range of fixings suitable for the available materials in centre * M10 Screwed Rod * M10 Nuts * Square plate washers * M10 ½” Munsen rings * Drills * Drill bits | **Identify fixing types in group exercise**  **Make measurements and mark dimensions on wall** |
| 11  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.6 Common fixing devicesfor pipework   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.1 How to measure and mark out for fixings to pipework and plumbing and heating components  3.2 The sources of information for carrying out preparatory work  3.4 The methods for the bending ofpipework used in BSE  3.5 The requirements for the installation of pipework | Activities:  Classroom session: Producing bends in metallic pipework   * Start session by introducing learners to some of the equipment used to form bends in copper and steel pipework. Use the link to show the learners specific manufacturers tools:  <https://rothenberger.com/gb-en/products/installation/bending.html> * Use PowerPoint 6: Bending metallic pipe (slide 1–12) to help demonstrate the processes involved while carrying out those processes in the classroom or workshop if ILT equipment is available. Demonstrate the process of setting up the hand benders and the methods of marking and measuring pipe once in the machine. * Demonstrate the process of bending a 90⁰ bend using learners for assistance. * Nominate learners to assist the demonstration process. * Discuss process for bending metallic pipe and explain the arrangements for the afternoon practical session in which learners will produce bends in copper and LCS pipe.   Resources:   * Copper and LCS bending equipment (<https://rothenberger.com/gb-en/products/installation/bending.html>) * Copper and LCS pipe * Set square * Tape measure * Level * Bench vice * PowerPoint 6: Bending metallic pipe | **Open and direct question techniques** |
| 12  3 hours | 1. **Know the requirements for carrying out common plumbing and heating tasks**   3.1 How to measure and mark out for fixings to pipework and plumbing and heating components  3.2 The sources of information for carrying out preparatory work  3.4 The methods for the bending ofpipework used in BSE  3.5 The requirements for the installation of pipework   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation | Activities:  Practical session: Bending copper pipe – 90⁰ and 45⁰ bends   * Following on from previous classroom session, start by asking one member of the group to state one thing they can remember regarding bending metallic pipe before nominating a peer to do the same. * Set training task for learners to produce a 90⁰ bend and 45⁰ bend in copper pipe to a set centre to end length. Learners should work individually and use the scissor bender. * On completion gather learners to compare end product and discuss where improvements may be made by encouraging peer discussion. * Set next task for learners to produce a bend in ½” or ¾” LCS pipe using the hydraulic bending machine. * On completion, compare results and again encourage peer discussion regarding the process. * Learners to clean and tidy the workspace before finishing.   Resources:   * Scissor benders * Copper pipe 15mm and 22mm * Microbore pipe * Spring benders | **State the processes for bending pipe**  **Produce various bends in metallic pipe**  **State flaws and improvements in peer learning session** |
| 13  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.2 – How to select and safely use hand tools and power tools   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.1 How to measure and mark out for fixings to pipework and plumbing and heating components  3.4 The methods for the bending ofpipework used in BSE  3.5 The requirements for the installation of pipework   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation | Activities:  Classroom / Practical session: Bending copper pipe - offsets   * Start session by asking learners to consider the advantages and disadvantages of bending and offsetting metallic pipe compared to the use of fittings. Distribute flipchart paper and pens for learners to make a list of advantages and disadvantages before discussing as a group. * Use PowerPoint 7: Producing offsets to assist in the explanation of the process for producing offsets in copper pipe. * Using a scissor bending machine in the classroom or workshop space, demonstrate the process for producing an offset in both copper and LCS pipe. * Set task for the class to produce offsets to a set dimension. Explain the task and allow learners to start the task producing offsets in both copper and LCS pipe. * This session will run through to the next / afternoon session for continuity.   Resources:   * PowerPoint 7: Producing offsets * Scissor benders * Hydraulic bending machine * LCS pipe * Copper pipe * Hand tools | **List advantages and disadvantages**  **Produce offsets and bends in copper pipework** |
| 14  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.4 The clip and bracket types used in BSE  2.6 Common fixing devicesfor pipework   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.1 How to measure and mark out for fixings to pipework and plumbing and heating components  3.2 The sources of information for carrying out preparatory work  3.4 The methods for the bending ofpipework used in BSE  3.5 The requirements for the installation of pipework   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation | Activities:  Practical session: Bending metallic pipe - offsets   * This session is a continuation of the morning / previous session and allows learners to produce offsets in copper and LCS pipe to a set dimension as specified by tutor. * Monitor progress of learners and stop for group discussion where required. * On completion of activity learners are to clear and tidy the work area before comparing the end products and discussing the activity as a group. Encourage tutor-led peer discussion to identify useful approaches to the task. It may be suitable to allow a learner who has excelled to offer their approach to the task.   Resources:   * Scissor benders * Hydraulic bending machine * LCS pipe * Copper pipe * Hand tools | **Produce bends and offsets in copper pipe**  **Peer marking feedback** |
| 15  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools  2.4 The clip and bracket types used in BSE  2.6 Common fixing devicesfor pipework   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE | Activities:  Classroom session: Plastic pipework systems   * Start session with short video link: [www.youtube.com/watch?v=v6kRm3KKCQo](http://www.youtube.com/watch?v=v6kRm3KKCQo) * Discuss the advantages of this type of fitting and give classroom demonstration of the process including cutting and de burring. * Allow learners to try the process on a short piece of polybutylene plastic pipe. * Distribute a number of fitting types for discussion including: couplers, elbows and bends, equal tees, reducing tees, reducers, inserts, cap ends and tap connectors. * Discuss the applications for each type of fitting and the method of ordering tees for size using main – main – branch. * Use the John Guest website to highlight a range of plastic jointing and pipework types: [www.johnguest.com/speedfit/products/plumbing-fittings-home/](http://www.johnguest.com/speedfit/products/plumbing-fittings-home/) * Distribute a range of MDPE push-fit and electrofusion fittings along with short pieces of pipe and discuss their application. * Use the following video to demonstrate the application of HDPE and MDPE pipe for MCW supplies: [www.youtube.com/watch?v=3GruX\_\_jVSc](http://www.youtube.com/watch?v=3GruX__jVSc) * Use the Geberit website to examine the ‘Mepla’ range of plastic barrier pipe systems and the press method of jointing. Use the video to demonstrate the process and distribute fittings for learners to examine: [www.geberit.co.uk/products/products/piping-systems-for-water-supply/geberit-mepla/](http://www.geberit.co.uk/products/products/piping-systems-for-water-supply/geberit-mepla/) * Use the manufacturers’ literature to identify recommended clipping distances and ask learners to consider the requirements for clips and make a scatter diagram taking into consideration: horizontal pipework, vertical pipework, temperature of the contents, expansion. * Watch the video on expansion of plastic pipe at: [www.youtube.com/watch?v=szp0DAsCdJQ](http://www.youtube.com/watch?v=szp0DAsCdJQ) * Distribute a range of ABS fittings and discuss its advantages. Use the following website to investigate temperature and pressure limits of ABS systems before demonstrating the jointing procedure in a well-ventilated space. <https://www.gfps.com/appgate/ecat/common_flow/10005L/UK/en/109068/109374/index.html> * Instruct learners to complete Worksheet 4: Plastic pipe jointing in pairs. * On completion, discuss the answers as a group.   Resources:   * [www.youtube.com/watch?v=v6kRm3KKCQo](http://www.youtube.com/watch?v=v6kRm3KKCQo) * [www.johnguest.com/speedfit/products/plumbing-fittings-home/](http://www.johnguest.com/speedfit/products/plumbing-fittings-home/) * [www.youtube.com/watch?v=3GruX\_\_jVSc](http://www.youtube.com/watch?v=3GruX__jVSc) * [www.geberit.co.uk/products/products/piping-systems-for-water-supply/geberit-mepla/](http://www.geberit.co.uk/products/products/piping-systems-for-water-supply/geberit-mepla/) * [www.gfps.com/appgate/ecat/common\_flow/10005L/UK/en/109068/109374/index.html](http://www.gfps.com/appgate/ecat/common_flow/10005L/UK/en/109068/109374/index.html) * Range of plastic pipe fittings and materials * Pipe cutters * **Worksheet 4: Plastic pipe jointing** | **Cut and de-burr pipe**  **Worksheet 4** |
| 16  3 hours | 1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.1 The work in the BSE occupations trade area  2.2 How to select and safely use hand tools and power tools   1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for jointing of pipework used in BSE   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation | Activities:  Practical session: Plastic pipework systems   * In this session learners are to joint a range of plastic piping systems using different techniques. * Split the class into pairs and discuss the practical task. Learners should be given the opportunity to join a range of plastic pipe fittings to given centre to centre dimensions. * Learners are to produce a materials list as required for the task before gathering all equipment and materials as required. * Monitor learners throughout the task and assist where necessary. * On completion, gather all learners around the work area to compare end products. * Learners are to retain the pieces for later sessions where they may be used to test using water. * Learners to clear work area and tidy before finishing.   Resources:   * Range of plastics and fittings * Pipe cutters * Suitable hand tools | **Produce materials list**  **Joint plastic pipe**  **Measure accurately** |
| 17  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.1 The key stages of the rainwater cycle  1.2 The various sources of water and the typical properties of water from those sources  1.3 Underground sources: deep and shallow wells, Artesian wells, bore-holes, springs | Activities:  Classroom session: Rainwater cycle and sources of water   * Tutor to deliver PowerPoint 8: Sources of water. * Discuss the sources of water and the effects of the source on the quality and hardness of the water including: surface sources – lakes, reservoirs, rivers and streams; underground sources – deep and shallow wells, artesian wells, bore holes and springs. * Identify areas of Wales and England where water is particularly hard or soft and the effects of this on water fittings. Use link on slide 11 to help with this: <https://en.wikipedia.org/wiki/List_of_reservoirs_in_England_and_Wales_by_volume> * Demonstrate this by testing the water PH on site. * Distribute examples of pipework that has heavy deposits of limescale and ask learners in pairs to make a list of impacts that this may have on the system.   Resources:   * **PowerPoint 8: Sources of water** * <https://en.wikipedia.org/wiki/List_of_reservoirs_in_England_and_Wales_by_volume> * PH test kit | **Open and direct questions** |
| 18  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.4 The types and layout features of cold water systems   1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.3 The pipework materials and sizes used in BSE | Activities:  Classroom session: Types and layouts of domestic CW systems (direct and indirect)   * Start session with short video clip showing the potential pressure and volume within a mains cold water supply: [www.youtube.com/watch?v=nRD1XwfpbIU](http://www.youtube.com/watch?v=nRD1XwfpbIU) * Tutor to deliver PowerPoint 9: Direct and indirect CW systems and explain the types of direct and indirect systems. Discus the pressures dependent on system type and use of drinking water outlets. Discuss the position of valves and the importance of the kitchen sink outlet. * Set task: students are to produce a simple sketch of a direct cold water system using flip chart paper and include basic valve positions. * Learners are to split into pairs to produce a diagram of an indirect system including relevant valve positions etc. On completion learners may swap with other pairs for discussion led by tutor. * Distribute Worksheet 5: Direct and indirect cold water systems for learners to complete individually before swapping answer sheets and peer marking with another.   Resources:   * [www.youtube.com/watch?v=nRD1XwfpbIU](http://www.youtube.com/watch?v=nRD1XwfpbIU) * **PowerPoint 9: Direct and indirect CW systems** * **Worksheet 5: Direct and indirect cold water systems** * Flip chart paper and pens | **Open questions**  **Produce sketch of direct CW system**  **Produce sketch of indirect CW system**  **Worksheet 5** |
| 19  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.4 The types and layout features of cold water systems | Activities:  Classroom session: Types and layouts of industrial and commercial CW systems – direct, indirect and boosted   * Start session by introducing today’s aims using PowerPoint 10: Cold water systems in I and C premises and briefly discuss the need for Regulation – show link to Water Regulations and discuss their role.[www.legislation.gov.uk/cy/uksi/1999/1148/contents/made](http://www.legislation.gov.uk/cy/uksi/1999/1148/contents/made) * Ask learners to consider the differences between cold water supplies and distribution systems within a domestic property to that within an industrial or commercial property (use slide 3 as a brief). Allow learners 5 minutes to list differences / alternate requirements before discussing as a class. * Discuss the basic difference and need for increased pipe size, volume, potential pressure requirements, head, water treatment and storage in commercial buildings. * Use PowerPoint 10 to discuss the basic layout of commercial cold water systems including boosting water to high level. * Breakout to centre to examine the cold water systems within the building including storage where possible. * In classroom distribute flip chart paper and pens and ask learners to sketch a basic boosted system in pairs or small groups before comparing diagrams in tutor-led discussion. * Distribute Worksheet 6: Cold water systems for I and C properties, where learners will focus on basic system layout.   Resources:   * Flip chart paper and pens * **PowerPoint 10: Cold water systems in I and C premises** * **Worksheet 6: Cold water systems for I and C properties** | **Open and direct questions**  **List differences and requirements**  **Produce sketch of boosted cold water system**  **Worksheet 6** |
| 20  3 hours | 1. **Know the requirements for carrying out common plumbing and heating tasks**   3.4 The methods for the bending of pipework used in BSE   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification | Activities:  Practical session: Producing passover bends   * This session will allow learners to complete any bends and offsets that they were unable to complete in previous sessions before attempting a passover or pudding bend. * Gather learners to discuss the safety requirements and nominate one learner to discuss the requirements for using hand tools as part of a ‘Toolbox talk’. * Give demonstration of the process of producing a passover in copper and cranked passover in LCS. * Learners are to work in pairs to produce one of each to a set dimension as specified by tutor. * Allow time to complete before regrouping to compare work. Nominate a learner who has produced an accurate bend to demonstrate their technique to the rest of the group. * On completion, learners to clear and tidy site. Nominate one learner to state one fact they have learned today to share with the class before nominating another to do the same.   Resources:   * Scissor bender * Hydraulic bender * Copper pipe * LCS pipe * Hand tools | **Produce bends and passovers**  **State facts regarding bending and nominate a peer** |
| 21  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.4 The types and layout features of cold water systems | Activities:  Classroom session: Cold water systems – general components   * Start session by distributing a range of common components and materials suitable for use in a CW system. This may include: domestic CWSC, gate valves and stop taps, copper, brass and plastic fittings, float operated valves, single check valves and simple spindle taps. * Tutor to identify the components and discuss the materials focusing on the use of copper, plastic and brass in cold water systems to protect against corrosion from oxygenated water and other building materials. * Breakout session to identify a range of components and their use within the centre, discussing why they are used in their relative position. * Set short task – learners to use ILT equipment to find images and types of various components used with I&C and domestic applications. These may be put into a handout created by each small group or pair, which can then be shared with the rest of the group. Tutor to discuss each group’s work in peer discussion before these are handed out to the rest of the group as peer-produced handouts.   Resources:   * Various components as listed in activities * ILT equipment | **Open and direct questioning**  **Research types of components**  **Produce handout for peer sharing** |
| 22  3 hours | 1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for the jointing of pipework used in BSE  3.5 The requirements for the installation of pipework   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification | Activities:  Practical session: First fix pipework   * Gather learners in work area/ workshop. Start session with refresher to discuss the terms ‘First fix, ‘Second fix’ and ‘Pre-fabricated’ pipework. Nominate learners to define the terms in group discussion. * Discuss today’s training task of fixing pipework into a range of positions including notching into joists, within holes in joists, through walls with a sleeve and at high level in hangers (this task will continue over a number of practical sessions). * Demonstrate notching and drilling for joists. * Issue training task for learners in pairs (or as suitable to centre) for learners to fix copper pipework into notches before finishing with boards. * Once complete demonstrate the process of drilling joists for the cabling of plastic pipework. Learners will again attempt this in pairs. * On completion gather learners to discuss the outcomes before tidying and clearing the work area.   Resources:   * Hand tools * Power tools * Copper pipe * Plastic PB pipe * Timber joists | **Open and direct questions**  **Produce notches and drill joists to dimension** |
| 23  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.5 The types and layout features of hot water systems | Activities:  Classroom session: Hot water systems for domestic dwellings – direct open vented centralised systems   * Introduce hot water outcome of the unit and start by looking at and sharing up-to-date magazine or online trade article publications regarding hot water system technology and discuss. Example:  [www.hvpmag.co.uk/news](http://www.hvpmag.co.uk/news) * Introduce PowerPoint 11: Hot water part 1 and discuss the heat transfer process. Follow link on slide 12 to discuss direct fired gas storage heaters:  www.rinnai-uk.co.uk/hotechnology/technology/tank-storage-units/ * Explain the process of heating water directly via a cylinder with immersion heater. Use PowerPoint 11 to identify the cold feed and open vent connections. * Breakout to workshop/centre to look at examples of cylinders used in domestic dwellings. Nominate learners to identify the pre-numbered connections on a cylinder in pairs or individually. * Return to the classroom and discus the term ‘centralised’ hot water. * Distribute Worksheet 7: Hot water part 1 for learners to complete individually before discussing answers in tutor-led discussion.   Resources:   * [www.hvpmag.co.uk/news](http://www.hvpmag.co.uk/news) * www.rinnai-uk.co.uk/hotechnology/technology/tank-storage-units/ * **PowerPoint 11: Hot water part 1** * **Worksheet 7: Hot water part 1** * Example of direct cylinder with labelled connections | **Identify cylinder connections**  **Open and direct questions**  **Worksheet 7** |
| 24  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.5 The types and layout features of hot water systems | Activities:  Classroom session: Hot water systems for domestic dwellings – indirect open vented centralised systems   * Start session by refreshing some of the terms from the previous hot water session. Nominate learners to state a fact before nominating a peer to do the same. * Introduce the term ‘Primary circuit’ and using PowerPoint 12: Hot water part 2 look at how the primary circuit is used to transfer heat from the boiler. * Breakout to workshop to identify an indirect cylinder that has been pre-labelled. Learners are to identify the numbered connections. * In classroom set task for learners to produce a clear drawing of a direct and an indirect system side by side. Distribute flip chart paper for this and board pens, learners may work in pairs or small groups. * Go to website to examine supplier products: [www.wolseley.co.uk/heating/cylinders/](http://www.wolseley.co.uk/heating/cylinders/) * On completion, pin up drawings and groups are to rotate between each making notes of any issues in a peer marking session before discussing as a tutor-led group discussion. * Distribute Worksheet 8: Hot water part 2 for learners to complete individually.   Resources:   * **PowerPoint 12: Hot water part 2** * Example of indirect cylinder * www.wolseley.co.uk/heating/cylinders/ * Flip chart paper and pens * **Worksheet 8: Hot water part 2** | **Open questions**  **Identify numbered connections**  **Produce diagram of direct and indirect cylinder**  **Peer marking and feedback**  **Worksheet 8** |
| 25  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.5 The types and layout features of hot water systems | Activities:  Classroom session: Instantaneous hot water heaters and secondary circulation   * Start session with recap on hot water systems so far. Learners are to write two facts from previous sessions on flip chart paper in pairs to read out in turn. * Deliver information regarding instantaneous hot water heaters using PowerPoint 13: Hot water part 3. * Discuss the layout for cold connections and both electrical and gas fired heaters. Recommended video for installation process:[www.youtube.com/watch?v=e8fJH1BTVA4](http://www.youtube.com/watch?v=e8fJH1BTVA4) * Breakout to centre to examine a range of instantaneous heaters. * Return to classroom to discuss the importance of secondary returns on hot water systems. Highlight the importance of maintaining a suitable temperature throughout the distribution pipework. * Learners are to sketch an indirect hot water system that includes a secondary return as directed by tutor. Distribute flip chart paper and pens. This can be done in pairs. * Tutor to examine each diagram in turn and offer feedback.   Resources:   * [www.youtube.com/watch?v=e8fJH1BTVA4](http://www.youtube.com/watch?v=e8fJH1BTVA4) * **PowerPoint 13: Hot water part 3** * Examples of hot water heaters * Flip chart paper and pens | **Write two facts from previous session and discuss**  **Sketch indirect hot water system** |
| 26  3 hours | 1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for the jointing of pipework used in BSE  3.5 The requirements for the installation of pipework   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification | Activities:  Practical session: First fix pipework continued   * Continuing from previous practical session learners will gather all materials required to install pipework into a range of positions including notching into joists, within holes in joists, through walls with a sleeve and at high level in hangers. * Learners may pre-fabricate LCS pipework (suggest approximately 2m of ¾” pipe) with phenolic brackets into suspended drop hangers at high level. * Other learners may prefabricate 1” LCS pipe before installing through pre-drilled and sleeved holes. * Monitor progress throughout, gathering learners to discuss important points as required. * It may be a suggestion to retain pipework in place where possible and practicable to allow for testing later in the unit. * On completion learners are to clean work area and equipment.   Resources:   * Hand tools * LCS pipe * Suitable mild steel fittings * Power tools * Fixings and brackets | **Install pipework in joists**  **Install pipework in brackets and clips**  **Fabricate brackets** |
| 27  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.5 The types and layout features of hot water systems | Activities:  Classroom session: Unvented hot water   * Start this session by watching the short video of a cylinder explosion: [www.youtube.com/watch?v=rGWmONHipVo&t=9s](http://www.youtube.com/watch?v=rGWmONHipVo&t=9s) * Use the video to introduce the potential dangers of removing the open vent pipe. * Use PowerPoint 14: Hot water part 4 to show the principle differences between vented and open vented systems. Compare the component differences. * Show learners examples of unvented undersink and storage type heaters and the range of components involved including expansion vessel. * Set task for learners in small groups. Learners are to list the advantages and disadvantages of the systems considered so far including centralised direct hot water, centralised indirect hot water, instantaneous hot water and unvented hot water systems. * Allow learners time to make the lists using flip chart paper and pens before regrouping as a class and producing full list on the board in tutor-led discussion. * Distribute Worksheet 9: Hot water part 4 for learners to complete individually. On completion learners may mark their own work during discussion.   Resources:   * [ww.youtube.com/watch?v=rGWmONHipVo&t=9s](https://www.youtube.com/watch?v=rGWmONHipVo&t=9s) * **PowerPoint 14: Hot water part 4** * **Worksheet 9: Hot water part 4** * Flip chart paper and pens * Unvented heaters and systems to examine | **Open and direct questions**  **List advantages and disadvantages**  **Worksheet 9** |
| 28  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.4 The types and layout features of hot water systems | Activities:  Classroom session: Industrial and commercial hot water applications   * Start session by visiting the college or centre’s boiler/plant room where applicable to examine the differences between a domestic and a commercial hot water system. Use the following link to assist:  [www.hamworthy-heating.com/Knowledge/Articles/Comparing-direct-and-indirect-fired-water-heaters](http://www.hamworthy-heating.com/Knowledge/Articles/Comparing-direct-and-indirect-fired-water-heaters) * Ask learners to list examples of industrial and commercial properties and make a list on the board. In pairs learners will then write a quick list of requirements that each example may have for hot water. For example, a commercial gym may need large quantities of water consistently, offices may need small quantities at intervals etc. * Discuss these ideas as a group before showing learners examples of large indirect storage calorifiers, plate heat exchangers and direct gas fired storage heaters using PowerPoint 15: Hot water part 5. * Use links to manufacturers’ websites to show examples if none are available in centre such as:  [www.hamworthy-heating.com/Products/Hot-water-heaters](http://www.hamworthy-heating.com/Products/Hot-water-heaters)   <https://stokvisboilers.com/hot-water-systems/heat-exchangers/>   * Use video to help explain the operation of a plate heat exchanger:[www.youtube.com/watch?v=br3gkrXTmdY](http://www.youtube.com/watch?v=br3gkrXTmdY) * Distribute Worksheet 10: Hot water system knowledge check for learners to complete individually before marking as a group led by tutor.   Resources:   * [www.hamworthy-heating.com/Knowledge/Articles/Comparing-direct-and-indirect-fired-water-heaters](http://www.hamworthy-heating.com/Knowledge/Articles/Comparing-direct-and-indirect-fired-water-heaters) * [www.hamworthy-heating.com/Products/Hot-water-heaters](http://www.hamworthy-heating.com/Products/Hot-water-heaters) * <https://stokvisboilers.com/hot-water-systems/heat-exchangers/> * [www.youtube.com/watch?v=br3gkrXTmdY](http://www.youtube.com/watch?v=br3gkrXTmdY) * **PowerPoint 15: Hot water part 5** * **Worksheet 10: Hot water system knowledge check** | **List I&C property types and hot water requirements**  **Worksheet 10** |
| 29  3 hours | 1. **Planning the completion of common plumbing and heating tasks**   4.1 Planning the sequence of work  4.3 Recording work | Activities:  Classroom session: Planning plumbing and heating tasks – drawings and site documents   * Start session by distributing a number of site drawings across the desks. Gather learners to inspect the first example. Focus initially on scale of the drawing. * Distribute scale rulers and nominate a learner to offer an example of how this may be used. * Explain the use of scale and calculate some simple examples using board. * In small groups, set task for learners to find the length of a number of pre-highlighted lengths on the distributed site drawings. Allow time for learners to complete. * Focus next on the symbols used for pipework height and the indications of datum points. * Returning to the drawings, learners may now identify a number of pre-highlighted sections of pipework to determine the position as directed by tutor. * Discuss the other information relevant to the drawings found in the information bar and key. * Distribute the symbols involved for basic pipework systems. * Ask learners to suggest other documents that may be used throughout a project. Create scatter diagram on board before discussing each one including: site diary, timesheets, invoices, delivery notes, job sheets, Risk Assessments and Method Statements (RAMS), test certificates. * Offer examples of each to look at and discuss. * Distribute Worksheet 11: Site documents and drawings and site documents for learners to complete individually or in pairs as directed by tutor. Discuss answers on completion.   Resources:   * Site drawings * Site diary * Timesheets * Invoices * Delivery notes * Job sheets * Risk Assessments and Method Statements (RAMS) * Test certificates * Scale rulers * **Worksheet 11: Site documents and drawings** | **Open and direct questions**  **Find lengths of scaled items**  **Identify components on drawing**  **Worksheet 11** |
| 30  3 hours | 1. **Know the requirements for carrying out common plumbing and heating tasks**   3.3 The methods for the jointing of pipework used in BSE  3.5 The requirements for the installation of pipework   1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification | Activities:  Practical session: Second fix and making connections   * Start by gathering group together in workshop and examining a range of final connections such as outlets, cisterns and appliances. Discuss the fittings used to do this. * Distribute a range of fittings such as flexes, tap connectors, tank connectors flanges and unions and explain how these are used. * Set training task for learners to make short connections to fixed points such as flanges, unions and outlets. If possible, learners could carry on from existing pipework that they have installed in previous practical sessions. * Learners may work in pairs to do this and an example may be making a short piece of LCS pipe to fit into a bracket with flange to make connection representing a pump or boiler. Others may make short flexes onto copper pipe and fix to a wash hand basin. * These training tasks could be rotated in the next session allowing learners to attempt various examples of making connections. * On completion of session learners are to clear and tidy work area.   Resources:   * Flanges * Flexes * Various connectors * Gaskets * Clips and brackets * Hand tools * Power tools | **Open and direct questions**  **Make connections to fixed points** |
| 31  3 hours | 1. **Planning the completion of common plumbing and heating tasks**   4.2 Calculating quantities | Activities:  Classroom session: Planning plumbing and heating tasks – calculating quantities   * Start session by asking learners to suggest a method of calculating the area of a wall in the classroom. Nominate a learner who made a suggestion to measure the wall using a tape measure before calculating the area. * Ask learners how volume is now measured. Again, nominate a learner to measure before working out the volume as a group. * Distribute drawings across desks (reuse from previous session if suitable) and ask learners to focus on a suitable room that you have pre-determined. Learners are to use scale rules to measure the dimensions of that room and the volume. * Discuss the basic processes onsite for planning labour and materials for a simple task – perhaps the installation of a sink within a new office canteen area. Encourage learner suggestions regarding what considerations must be taken before the job starts including materials, protection of building fabric, labour and time.   Resources:   * Tape measures * Examples of site drawings | **Calculate volumes**  **Calculate areas**  **Calculate using scale drawings** |
| 32  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems   1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.3 The pipework materials and sizes used in BSE | Activities:  Classroom session: Introduction to hydronic heating systems – one-pipe systems   * Introduce heating systems using PowerPoint 16: Hydronic heating part 1. * Discuss the principles of using water to transfer heat from a boiler to heat spaces and explain the basic principle of the boiler. * Use PowerPoint 16 to explain the concept of gravity circulation and the layout of the one-pipe system. Use examples such as lava lamps to show this. * Use a small commercial pump to show learners how pumped circulation works. Suggested video:   [www.youtube.com/watch?v=onIMNox24NI](http://www.youtube.com/watch?v=onIMNox24NI)   * Discuss the role of the open vent pipe, cold feed and expansion pipe and the F&E cistern. * Breakout to workshop or centre to examine connections at the heat emitters. * Ask learners in small groups to list any advantages or disadvantages of this system and discuss as a class. * Highlight the difference in pipe sizes for a one pipe system – look at a typical old school, public house or church where one-pipe systems may still be present and the need for larger pipework. * Distribute Worksheet 12: Hydronic heating part 1 for learners to complete individually before tutor-led classroom discussion regarding the answers.   Resources:   * **PowerPoint 16: Hydronic heating part 1** * Examples of pumps/circulators * www.youtube.com/watch?v=onIMNox24NI * **Worksheet 12: Hydronic heating part 1** | **Open and direct questions**  **List advantages and disadvantages**  **Worksheet 12** |
| 33  3 hours | 1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification | Activities:  Practical session: Second fix pipework and making connections   * This session continues on from previous practical session allowing learners to make final connections as suited to the centre. * Learners will continue with training task and rotate as directed by tutor. * Distribute a range of fittings such as flexes, tap connectors, tank connectors, flanges and unions and explain how these are used. * Set training task for learners to make short connections to fixed points such as flanges, unions and outlets. If possible, learners could carry on from existing pipework that they have installed in previous practical sessions. * Learners may work in pairs to do this and an example may be making a short piece of LCS pipe to fit into a bracket with flange to make connection representing a pump or boiler. Others may make short flexes onto copper pipe and fix to a wash hand basin. * On completion of session learners are to clear and tidy work area.   Resources:   * Flanges * Flexes * Various connectors * Gaskets * Clips and brackets * Hand tools * Power tools | **Make connections to fixed points**  **Open and direct questions** |
| 34  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems | Activities:  Classroom session: Hydronic heating two-pipe systems   * Start session by nominating a learner to draw a one-pipe heating system on the board and refresh on the system layout. * Use PowerPoint 17: Hydronic heating part 2 to help explain the layout of a two-pipe system and the principle of more regular temperatures throughout the system. * Look at the radiators in centre and briefly identify the types of connection to radiators and the types of valves. * Split class into small groups and ask learners to list as many advantages and disadvantages of a two-pipe system relative to the one pipe system before discussing ideas as a class. * Complete the delivery of PowerPoint 17 and identify the need for temperature control and develop this by identifying the different control methods used by Honeywell plans including C, S and Y arrangements. * In same groups ask learners to produce a simple sketch of the two-pipe system including heat source, F&E cistern, open vent pipe, pump and a number of radiators. * Inspect each group’s drawing and offer feedback. * Introduce learners to the useful ‘Engineering Toolbox’ website, suggested link here shows a number of links to basic terms: [www.engineeringtoolbox.com/si-units-engineering-t\_19.html](http://www.engineeringtoolbox.com/si-units-engineering-t_19.html) * Set homework task for learners to use this site before next session to feedback one fact learned from the information available.   Resources:   * **PowerPoint 17: Hydronic heating part 2** * Examples of radiators in centre * Flip chart paper and pens * [www.engineeringtoolbox.com/si-units-engineering-t\_19.html](http://www.engineeringtoolbox.com/si-units-engineering-t_19.html) | **Draw one-pipe heating system**  **List advantages and disadvantages**  **Produce sketch of two-pipe system**  **Homework task** |
| 35  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems   1. **Know the underlying principles that guide the work of a plumbing and domestic heating engineer**   2.3 The pipework materials and sizes used in BSE | Activities:  Classroom session: Microbore systems and underfloor heating systems   * Start session by nominating a learner to offer a fact learned from the website:  [www.engineeringtoolbox.com/si-units-engineering-t\_19.html](http://www.engineeringtoolbox.com/si-units-engineering-t_19.html)  This was set as a homework task in last session. Learner to state a quick fact learned before nominating a peer to do the same. * Introduce guest speaker from manufacturer to discuss the underfloor systems and components available in the market. Learners are encouraged to ask questions to guest speaker and develop professional communication skills. * Distribute examples of microbore pipework and components to examine and discuss including manifolds. * Use PowerPoint 18: Hydronic heating part 3 to help explain the basic system layouts of underfloor systems and discuss the specific advantages and suitable application for the system. * Breakout to workshop or centre to examine an installed system. * Distribute Worksheet 13: Hydronic heating part 3 for learners to complete individually or in pairs as suitable before discussing the answers as a class.   Resources:   * **PowerPoint 18: Hydronic heating part 3** * [www.engineeringtoolbox.com/si-units-engineering-t\_19.html](http://www.engineeringtoolbox.com/si-units-engineering-t_19.html) * Example microbore components and pipework * Example underfloor heating system components and pipework * Examples of installed systems * **Worksheet 13: Hydronic heating part 3** | **Offer fact from previous session**  **Open and direct questions**  **Worksheet 13** |
| 36  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems | Activities:  Classroom session: Sealed heating systems   * Start session by watching the suggested video: [www.youtube.com/watch?v=8lyqFkFsH28](http://www.youtube.com/watch?v=8lyqFkFsH28) * Use the video as an introduction to the effect of pressurising water within a sealed loop and the amount of energy that can be added before it boils. * Use PowerPoint 19: Hydronic heating part 4 to explain the differences between the sealed and the open vented systems. * Discuss the need for extra components such as expansion vessel, filling loop, pressure relief valve and pressurisation units for Commercial and Industrial systems and the temperature ranges of LTHW, MTHW and HTHW. * Breakout to centre to examine examples of components involved and the arrangement for the cold fill pipe and filling loop. * Examine the pressurisation unit and make learners aware of the backflow protection provided by the cistern in the unit. Compare with the need to disconnect at the filling loop and the use of valves and backflow protection. * Split class into small groups and set task for learners to use the resource centre and internet to find two manufacturers of pressurisation units and an example and price of a filling loop before printing and returning to the classroom to discuss as a class.   Resources:   * [www.youtube.com/watch?v=8lyqFkFsH28](http://www.youtube.com/watch?v=8lyqFkFsH28) * **PowerPoint 19: Hydronic heating part 4** * ILT equipment | **Open and direct questions**  **Research task using internet resources** |
| 37  3 hours | 1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification   1. **Planning the completion of common plumbing and heating tasks**   4.1 Planning the sequence of work  4.2 Calculating quantities  4.3 Recording work | Activities:  Practical session: Planning and preparing for an installation   * This session may be started in the classroom if required or gather learners in workshop to have group discussion to start session. * In this session learners should be spilt into small groups or pairs. Learners will be set a small installation task from start to finish. This activity should be selected by the tutor based on resources and centre arrangements but as a suggestion could be a mixture of pipe materials from a fixed point to a fixed point using both domestic and commercial components. * Distribute Worksheet 14: Planning and preparing for an installation. Discuss the task, which includes learners producing a simple clear sketch, a list of potential hazards (a basic Risk Assessment), a bullet point process plan (basic Method Statement), materials list and equipment list. * Learners are to start this task by producing a simple list of hazards (at this level it is not expected that they will be able to produce a formal Risk Assessment) in the workshop or classroom as required and a Method Statement. * Learners will then make a list of all materials and equipment required for the task. * Allow learners time to complete this. Work between groups to check progress and offer advice. * Nominate a learner to carry out a ‘Toolbox talk’ relevant to the task and agree the plans for the next practical session where learners will start the installation task.   Resources:   * **Worksheet 14: Planning and preparing for an installation** * Scale rulers | **Open and direct questions**  **Worksheet 14**  **Produce list of hazards**  **Produce material list**  **Produce simple Method Statement** |
| 38  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems | Activities:  Classroom session: Boiler room / plantroom layouts and components   * Start session by distributing examples of schematic drawings of boiler room layouts. Make a point of highlighting the complexity of the system and that to understand this it must be broken down into component parts. Please note that at this level it is not important that learners understand all of these complex components but, more importantly, that they are aware of the differences between Domestic and Commercial systems. * Use PowerPoint 20: Hydronic heating part 7 to help identify the main parts of the boiler room layout including boilers, modular boilers, low loss headers, pump sets and pressurisation units. * Breakout to the centre boiler room or workshop to compare the layout and set task for learners to identify the pre-labelled components within the room. Learners may do this individually or in pairs. * Discuss the answers to the task as a group.   Resources:   * **PowerPoint 20: Hydronic heating part 7** | **Open and direct questions** |
| 39  3 hours | 1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification | Activities:  Practical session: Prepare and carry out installation   * In this session learners will prepare and carry out the installation that they started to plan and prepare for in session 37. * Learners in pairs or small groups will collect all materials and equipment as per Worksheet 14: Planning and preparing for an installation from session 37 and begin to install the pipework components, ensuring a safe and tidy work area. * Monitor learners’ progress and offer advise where necessary. It is expected that learners will take two sessions to complete this task. * At end of session learners are to leave the work area safe and tidy, clean equipment and store materials to continue in the next session. * Explain that in the next session these installations will be tested and that the pipework must remain in place to allow this.   Resources:   * **Worksheet 14: Planning and preparing for an installation (from session 37)** * Hand tools * Power tools * Relevant pipework and materials | **Install pipework**  **Collect all correct materials and equipment** |
| 40  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems | Activities:  Classroom session: District heating systems and warm air heating systems   * Tutor to introduce session and deliver PowerPoint 21: Hydronic heating part 6 District heating. Introduce district heating with suggested video: [www.youtube.com/watch?v=40nC\_OB5s3E](http://www.youtube.com/watch?v=40nC_OB5s3E) * Discuss the advantages and applications of district heating and offer examples of such within Wales. Suggested links: [www.dhcnews.net/cardiff-announce-plans-for-new-district-heating-network/](http://www.dhcnews.net/cardiff-announce-plans-for-new-district-heating-network/)   [www.youtube.com/watch?v=TkfzqlYfB\_M](http://www.youtube.com/watch?v=TkfzqlYfB_M)   * Set short research task for learners in pars to research any applications in the UK where district heating has been used before feeding back any information in group discussion. * Learners may produce a flip chart sized poster of the basic layout of DHS and a list of advantages. This may be done in small groups or pairs before comparing and discussing as a class.   Resources:   * **PowerPoint 21: Hydronic heating part 6** * [www.dhcnews.net/cardiff-announce-plans-for-new-district-heating-network/](http://www.dhcnews.net/cardiff-announce-plans-for-new-district-heating-network/) * [www.youtube.com/watch?v=TkfzqlYfB\_M](http://www.youtube.com/watch?v=TkfzqlYfB_M) * [www.youtube.com/watch?v=40nC\_OB5s3E](http://www.youtube.com/watch?v=40nC_OB5s3E) | **Open and direct questions**  **Research task using internet resources**  **Produce sketch, poster and advantage list** |
| 41  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems | Activities:  Classroom session: Heat emitters   * Introduce guest speaker from radiator/heat emitter manufacturer to discuss their range of products. * Introduce PowerPoint 22: Hydronic heating part 7 and use to identify the differences between panel types and the connections such as TBOE etc. Use suggested weblinks to examine manufacturers’ types such as: [www.stelrad.com/?gclid=CjwKCAjwt-L2BRA\_EiwAacX32VKl5MJzf9USN6ucfjMRS4Is3yGf-NpWL9hrI2I5mUWp9HMCogEHlhoCa3oQAvD\_BwE](http://www.stelrad.com/?gclid=CjwKCAjwt-L2BRA_EiwAacX32VKl5MJzf9USN6ucfjMRS4Is3yGf-NpWL9hrI2I5mUWp9HMCogEHlhoCa3oQAvD_BwE)   [www.screwfix.com/c/heating-plumbing/radiators/cat830960](http://www.screwfix.com/c/heating-plumbing/radiators/cat830960)   * Breakout to examine radiators installed in centre and look at the suitability of each. * Return to classroom to continue the delivery of the PowerPoint. Discuss the applications of FCUs, trench heating, radiant panels etc. Suggested video for FCUs (may need to find specific sections):[www.youtube.com/watch?v=MqM-U8bftCI](http://www.youtube.com/watch?v=MqM-U8bftCI) * Suggestedvideo showing radiant panel being installed using suspended gripple wire:<https://www.youtube.com/watch?v=MqM-U8bftCI> * Distribute a range of radiator valves and tail connections along with air vents and blanks and explain how these are made into the radiators. * Distribute Worksheet 15: Hydronic heating part 7 for learners to complete individually before discussing answers in tutor-led discussion.   Resources:   * [www.stelrad.com/?gclid=CjwKCAjwt-L2BRA\_EiwAacX32VKl5MJzf9USN6ucfjMRS4Is3yGf-NpWL9hrI2I5mUWp9HMCogEHlhoCa3oQAvD\_BwE](http://www.stelrad.com/?gclid=CjwKCAjwt-L2BRA_EiwAacX32VKl5MJzf9USN6ucfjMRS4Is3yGf-NpWL9hrI2I5mUWp9HMCogEHlhoCa3oQAvD_BwE) * [www.screwfix.com/c/heating-plumbing/radiators/cat830960](http://www.screwfix.com/c/heating-plumbing/radiators/cat830960) * **PowerPoint 22: Hydronic heating part 7** * [www.youtube.com/watch?v=MqM-U8bftCI](http://www.youtube.com/watch?v=MqM-U8bftCI) * [www.youtube.com/watch?v=MqM-U8bftCI](http://www.youtube.com/watch?v=MqM-U8bftCI) * Examples of radiator valves * **Worksheet 15: Hydronic heating part 7** | **Open and direct questions**  **Worksheet 15** |
| 42  3 hours | 1. **Know the fundamental principles of plumbing and heating systems**   1.6 The types and layout features of heating systems | Activities:  Classroom session: Warm air heating   * Start session by asking learners to consider the scenario of heating a large space such as a warehouse or school hall. Split class into small groups to produce ideas on flip chart paper before regrouping to discuss. * Discuss the methods of heat transfer and ask learners to refresh and identify the heat transfer methods for the following heat emitters and appliances: radiators,radiant panels, trench heating and warm air heaters. Allow time for discussion before feeding back. * Use PowerPoint 23: Warm air heating and space heating to describe the types and differences within warm air heating appliances. * Breakout to centre workshop to examine types of heaters. Focus on the use of a dry to dry heat exchanger and fan to distribute the heat. * Look at a range of manufacturer’s literature and model types including domestic ranges and commercial suspended and floor standing cabinets at suggested sites such as: <https://combat.co.uk/commercial-heating-solutions/warm-air-heating/> <https://reznor.eu/products/unit-heaters/> [www.johnsonandstarley.co.uk/products/warm-air-heating/downflow-dhw](http://www.johnsonandstarley.co.uk/products/warm-air-heating/downflow-dhw) * Finish by nominating a learner to offer one fact from the session before nominating a peer to do the same.   Resources:   * **PowerPoint 23: Warm air heating and space heating** * <https://combat.co.uk/commercial-heating-solutions/warm-air-heating/> * [www.winterwarm.co.uk/projects/nissin\_showa.aspx](http://www.winterwarm.co.uk/projects/nissin_showa.aspx) * <https://reznor.eu/products/unit-heaters/> * [www.johnsonandstarley.co.uk/products/warm-air-heating/downflow-dhw](http://www.johnsonandstarley.co.uk/products/warm-air-heating/downflow-dhw) * Examples of warm air heaters to examine | **Make scatter diagram regarding heating a large space**  **Open and direct questions** |
| 43  3 hours | 1. **Carry out a pipework installation task**   5.1 Follow safe working procedures  5.2 Measure, mark and cut pipework materials for installation  5.3 Install pipework accurately to the specification | Activities:  Practical session: Prepare and carry out installation continued   * In this session learners will continue the installation that they started in session 39. * Learners in pairs or small groups will collect all materials and equipment and begin to install the pipework components ensuring a safe and tidy work area. * Monitor learners’ progress and offer advise where necessary. It is expected that learners will take two sessions to complete this task. * At end of session learners are to leave the work area safe and tidy, clean equipment and store materials to continue in the next session. * Explain that in the next session these installations will be tested and that the pipework must remain in place to allow this.   Resources:   * **Worksheet 14: Planning and preparing for an installation (from session 37)** * Hand tools * Power tools * Relevant pipework and materials | **Collect correct materials and equipment**  **Install pipework and components** |
| 44  3 hours | 1. **Carry out a pipework installation task**   5.4 Inspect work in accordance with the specification  5.5 Select the appropriate test instrument and accessories and prepare them for use  5.6 Carry out the appropriate tests  5.7 Record the test result accurately | Activities:  Classroom session: Testing pipework   * Introduce session with video that helps show the principles of pressurising water within a sealed vessel (hydro forming) and link to hydraulic testing. Use this to compare to the use of gas for pneumatic testing and the hazards that it possesses.[www.youtube.com/watch?v=llhcATrmsBg](http://www.youtube.com/watch?v=llhcATrmsBg) * Show learners hydraulic test pumps and demonstrate how they are operated. * Discuss the pressure testing process and make learners aware of the BESA TR6 guide to site pressure testing document and the guidance available in BSEN 806 and The Water Regulations. * Move to workshop area to demonstrate the process on plastic or metallic pipe as suitable. Nominate learners to carry out the practice under tutor instruction. * On completion discuss the information required within the test certificate and the importance of client or clients’ representative being present at the test sign off. * Distribute Worksheet 16: Testing and inspecting pipework for learners to complete individually before group discussion of the answers.   Resources:   * [www.youtube.com/watch?v=llhcATrmsBg](http://www.youtube.com/watch?v=llhcATrmsBg) * Hydraulic test pumps * BESA TR6 * **Worksheet 16: Testing and inspecting pipework** | **Open and direct questions**  **Worksheet 16** |
| 45  3 hours | 1. **Carry out a pipework installation task**   5.4 Inspect work in accordance with the specification  5.5 Select the appropriate test instrument and accessories and prepare them for use  5.6 Carry out the appropriate tests  5.7 Record the test result accurately | Activities:  Practical session: Testing pipework installations   * Gather learners in work area and explain the task of testing and decommissioning the small completed installation. * Nominate one learner to give ‘Toolbox talk’ on testing including the required safety measures and the PPE. * Distribute Worksheet 17: Inspect and test pipework systems. Learners should complete the test certificate within the activity sheet. * Learners are to complete the installation if they have not already and then put the pipework under test. Witness the test pressures and periods before signing the learner’s activity sheet once completed correctly. * Learners are to remove the water and decommission the pipework before removing all materials and equipment and storing correctly. Learners are to clear and tidy work area.   Resources:   * **Worksheet 17: Inspect and test pipework systems** * Hand tools * Test equipment | **‘Toolbox talk’ from learner(s)**  **Worksheet 17**  **Install and test pipework** |
| 46  5 hours | **All learning outcomes** | Activities:  Classroom session: Knowledge round up – unit knowledge test   * In this session learners will be given time to revise and complete any outstanding work before completing the practice MCQ test individually. * Learners to produce peer learning questions in small teams or create an ask the teacher quiz etc. * Distribute multiple choice questions for learners to complete individually. * Allow time for learners to complete before collecting question papers for individual marking and later individual feedback.   Resources:   * **Multiple choice questions** | **Open and direct questions**  **Peer learning**  **Multiple choice questions** |