High Speed Railway (HS2)
Functional Maths Entry 1 – Level 1

Name _____ Date _____

skills
w o r k s h o p

HS2 is the second phase of a new high-speed railway line for the United Kingdom. It will connect the city centres of London, Birmingham, Manchester and Leeds. Phase 1 completes in about 2030 and Phase 2 about ten years later. When completed, HS2 will carry more than 300,000 passengers a day.

Diagram A – HS2 proposed route

Image source (excluding compass): Metro, February 12 2020.
https://www.metro.news/all-aboard-high-spend-2-pm-approves-rail-scheme-despite-explosive-106bn-bill/1906952/

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Part A – position and direction (E1-E2)

Use Diagram A to answer the questions.

1. Tick (✓) the correct position word.

   a. **Where is Newcastle on the map?**

   at the bottom   at the top   in the middle

       ( )   ( )   ( )

   b. **Where are Cardiff, Bristol and London?**

   at the bottom   at the top   in the middle

       ( )   ( )   ( )

   c. **Where are Norwich and Colchester?**

   on the left   on the right   in the centre

       ( )   ( )   ( )

   (E1.10, E2.21 - 3 marks)

2. Fill in the gaps. Use each word once.

below	near	above

   a. Old Oak Common is _____ London.

   b. Cardiff is _____ Liverpool.

   c. Norwich is _____ Colchester.

   (E1.10, E2.21 - 3 marks)

3. Choose 4 places on the map. Write sentences about where they are on the map. Use each phrase once.

close to	a long way from	further down than	to the left of

   a. _____.

   b. _____.

   c. _____.

   d. _____.

   (E1.10, E2.21 - 4 marks)
   Total marks Part A = 10

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Part B – the four major compass points (E2-E3)

Use Diagram A to answer the questions.

1. Write the names and the abbreviations for the **4 main points of the compass**.

    • north – N _____

    • _____

    • _____

    • _____

    > **Vocabulary tip:** the four main compass points are called the **cardinal points** or **cardinal directions.**

    (E3.20 - 3 marks)

2. How do *you* remember the order of the 4 compass points? Explain or draw a picture.

    _____

    (E3.20 - 1 mark)

3. Label the 4 points of the compass in Diagram A.

    (E3.20 - 4 marks)

Now use the compass in Diagram A to help you answer these questions.

4. Fill in each gap with a correct compass direction. Write the full word.

    a. Liverpool is _____ of Cardiff.

    b. Cardiff is _____ of Liverpool.

    c. Norwich is _____ of Colchester.

    d. Bristol is _____ of Cardiff.

    e. Cardiff is _____ of Bristol.

    f. Newcastle is on the _____ coast of Britain.

    (E3.20 - 6 marks)
    Total marks Part B = 14

Name _____   Date _____

Part C – quarter, half and three-quarter turns (E3)

1. Objects can be turned in a **clockwise** or **anti-clockwise** direction.
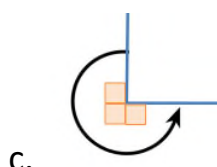   Label each diagram with the correct direction.

   a. _____   b. _____

   (E3.20 - 1 mark)

   > You describe a turn using **angles**. Angles are measured in **degrees** (°).
   > A quarter turn is a right angle ☐ (90°). A half turn is 180°.

2. Tick the correct boxes to describe each turn. One has been done for you.

   a.   b.   c.   d.

	Clockwise	Anti-clockwise	1/4	1/2	3/4
a.					
b.	✓		✓		
c.					
d.					

   (E3.19, E3.20 - 6 marks)

3. The information in the shaded box above will help you answer these questions.
   Show all your working out. Show a check for each answer.

   a. How many degrees in a 3/4 turn?   _____

   b. How many degrees in a full turn?   _____

   b. How many degrees on a straight line?   _____

   (E3.19, E3.20 - 9 marks)

   Part C – section 1 (16 marks)

Part C – quarter, half and three-quarter turns (E3)

4. Tick **two** correct descriptions for each HS2 map.

a. 3/4 turn clockwise ( )   1/4 turn anti-clockwise ( )   1/2 turn clockwise ( )

b. full turn clockwise ( )   1/2 turn anti-clockwise ( )   1/2 turn clockwise ( )

(E3.20 - 4 marks)

5. Tick **one** correct map for each description.

a. 1/4 turn clockwise

( )   ( )   ( )   ( )

b. 3/4 turn anti-clockwise

( )   ( )   ( )   ( )

(E3.20 - 2 marks)

Part C – section 2 (6 marks). Total marks Part C = 22

Diagram B – HS2 route map, northern section (phases 2A, 2B)

▬	HS2 line (Phase One)
▬	HS2 line (Phase 2a)
▬	HS2 line (Phase 2b)
▬	HS2 services on existing network
◯	New station (Phase One)
◯	New station (Phase 2b)
◯	Destinations served by HS2 services on existing network

Stations shown: Lancaster, York, Leeds, Preston, Manchester Piccadilly, Wigan, Warrington, Liverpool, Manchester Airport, Sheffield Midland, Runcorn, Chesterfield, Crewe, East Midlands Hub, Stafford, Birmingham Curzon Street, Birmingham Interchange. MAIN LINE.
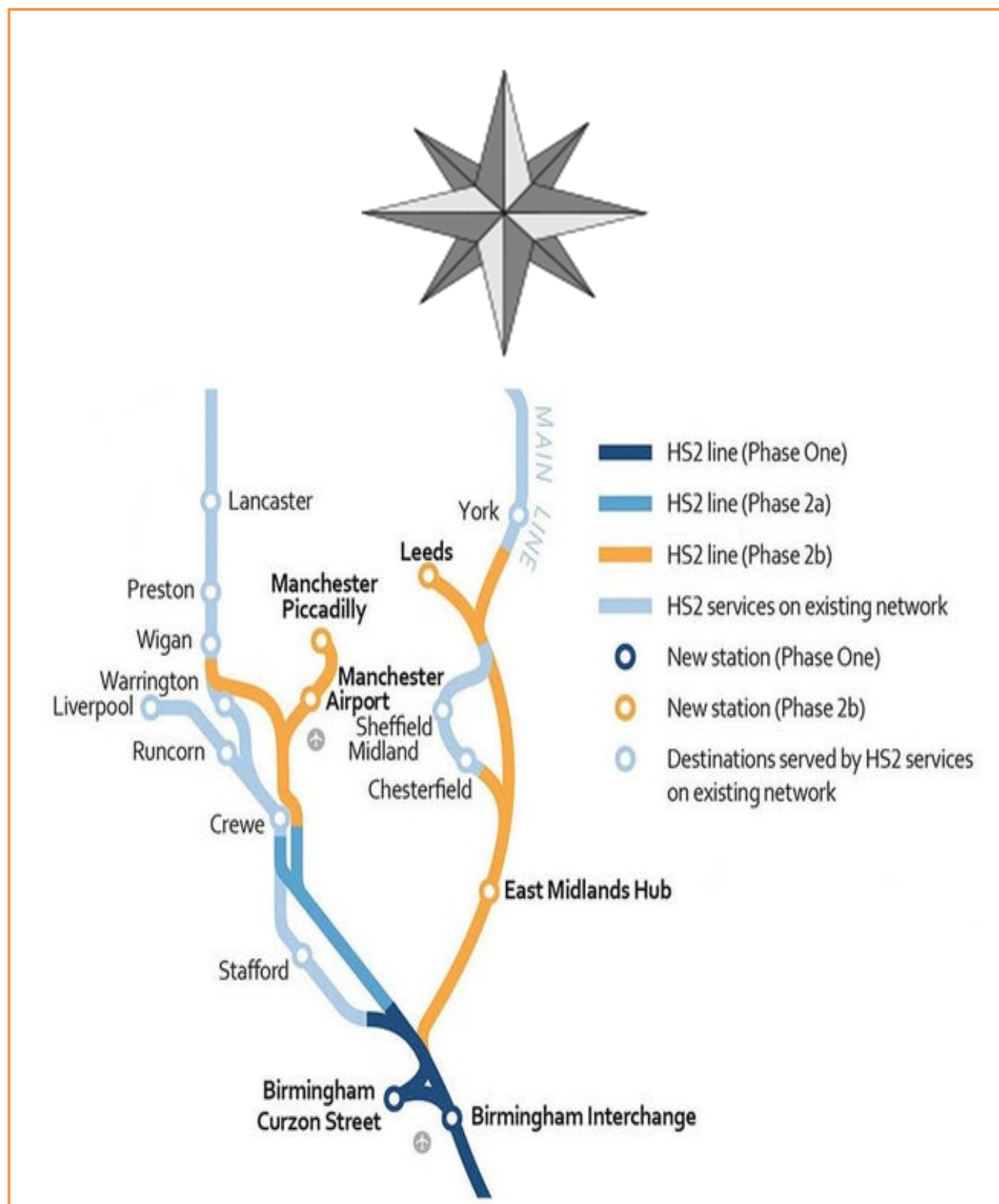
Image source (excluding compass): I Newspaper, February 12 2020
https://inews.co.uk/news/uk/hs2-route-map-rail-route-high-speed-new-stations-birmingham-london-speed-1438049

Name _____ Date _____

Part D – the eight compass points (E3). You need a ruler.

> **Punctuation tip:** compass points are common nouns. They <u>do not</u> start with a capital letter (unless they are at the beginning of a sentence).

Use Diagram B to answer the questions.

1. Write the full names and the abbreviations for the **8 points of the compass** One is done for you. You can write the compass points in any order.

- north-east NE_____

- _____

- _____

- _____

- _____

- _____

- _____

- _____

(E3.20 - 7 marks)

2. Label the 8 points of the compass **in Diagram B**.

(E3.20 - 4 marks)

Use the compass in Diagram B to help you answer these questions.

3. Choose the <u>most accurate</u> compass direction to complete each sentence.

> **Maths tip:** join each pair of places with a straight line. Compare the direction of this line to the lines running through the points of your labelled compass in Diagram B.

a. Leeds is _____ of York.

b. York is _____ of Leeds.

c. Lancaster is _____ of Manchester Piccadilly.

d. Manchester Piccadilly is _____ of Lancaster.

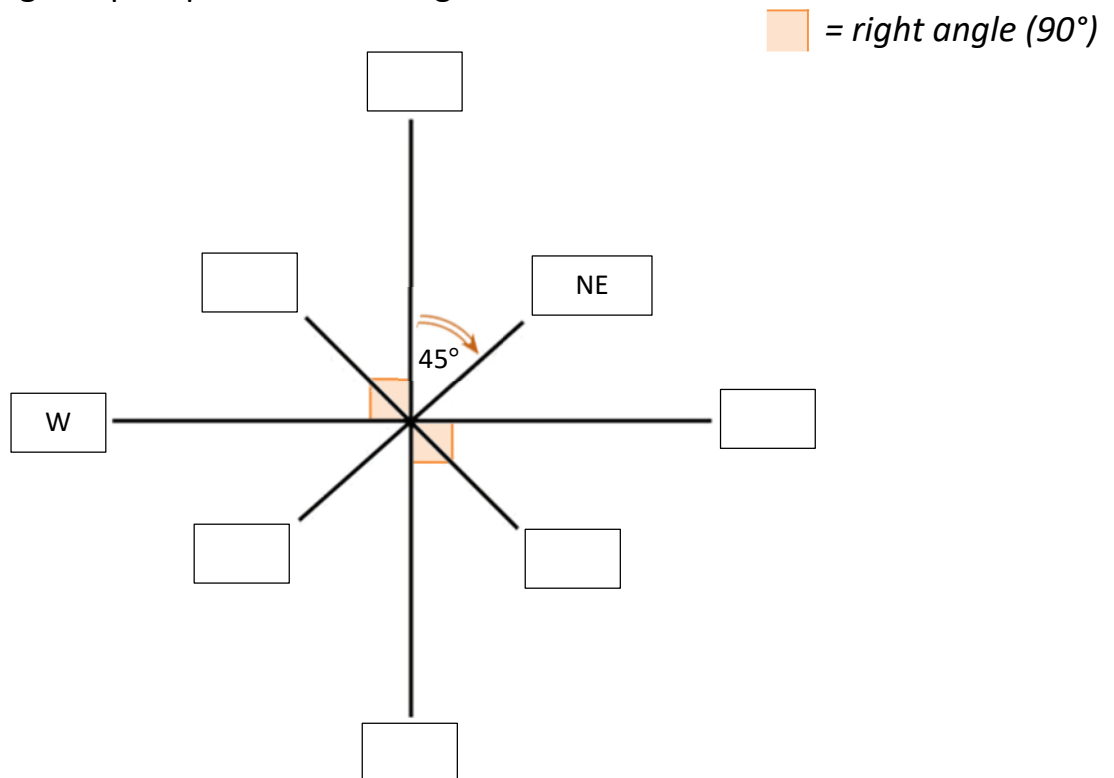e. Wigan is _____ of Preston.

(E3.20 - 5 marks)
Total marks Part D = 16

Part E – Introduction to bearings (L1).

> **Three figure bearings:**
> Another way to describe directions is to use bearings. Bearings are:
> - measured **clockwise** from **north**. North has a bearing of 000°.
> - always have **3 figures**. E.g. a 62° bearing is written as 062°.

1. Add the missing compass points to the diagram.

☐ = *right angle (90°)*

NE

45°

W

(E3.20, L1.20 - 3 marks)

2. Use the diagram in Q1 to help you complete the table.

Direction (intercardinal points)	3 Figure bearing
north-east	045°
	135°
south-west	
	315°

Direction (cardinal points)	3 Figure bearing
north	
	090°
south	
west	

(E3.20, L1.20 - 7 marks)

Total marks Part E = 10

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Diagram C – HS2 lines and stations

Image adapted from: https://assets.hs2.org.uk/wp-content/uploads/2019/08/14094931/our-story-and-key-facts.pdf *(p2)*

Part F – calculating bearings (L1). You need a ruler and a protractor.

The word '**from**' is important when calculating bearings.

Examples:

Find the bearing of B **from A:**

1. Draw a north-south line at point A.

2. Draw a line from A to B.

3. Measure the angle between the two lines (in a clockwise direction). **Answer: 115°**

Find the bearing of A **from B**

1. Draw a north-south line at point B.

2. Draw a line to join B to A.

3. The bearing will be a large reflex angle (i.e. greater than 180°). An easy way to work this out is to measure the smaller acute angle (65°) and subtract it from 360°.
   Answer: 295°

N

N

115°

A

65°

B

360 - 65
= 295°
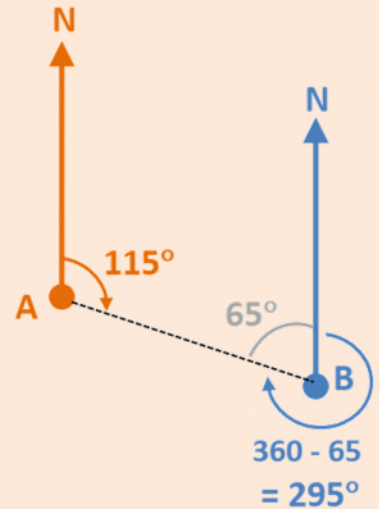
Use Diagram C to calculate 3 figure bearings. Draw lines on Diagram C.
You **must show** all your working out and a check of your answers.

1. Leeds **from** Manchester Piccadilly.

   _____
   (L1.20 - 4 marks)

2. Old Oak Common **from** Birmingham Interchange.

   _____
   (L1.20 - 4 marks)

3. Manchester Piccadilly **from** Leeds.

   _____
   (L1.20 - 4 marks)

4. Manchester Airport **from** East Midlands Hub.

   _____
   (L1.20 - 4 marks)
   Total marks Part F = 16

HS2 Functional Maths - notes and curriculum mapping

Subject content – Reformed FUNCTIONAL SKILLS MATHEMATICS (effective from September 2019)

✓✓ indicates **main content** and **problem-solving skill(s)** covered in this resource, although these may vary with the student group and how the resource is used by the teacher. ✓ = minor content. *Content at each level subsumes and builds upon the content at lower levels.* Only **measure, shape & space** content is shown below. Full content (which also includes *Numbers & the Number System*, and *Handling Information & Data*) can be found at:
DfE (Feb 2018) https://www.gov.uk/government/publications/functional-skills-subject-content-mathematics

1. Fundamental mathematical knowledge and skills:
These must be demonstrated in their own right, **both with and without a calculator**, in addition to being used to solve problems or complete tasks.

Entry Level 1	Entry Level 2	Entry Level 3	Level 1
Using common measures, shape and space (MS)			
5. Recognise coins and notes and write them in numbers with the correct symbols (£ & p), where these involve numbers up to 20 6. Read 12 hour digital and analogue clocks in hours 7. Know the number of days in a week, months, and seasons in a year. Be able to name and sequence 8. Describe and make comparisons in words between measures of items including size, length, width, height, weight and capacity 9. Identify & recognise common 2-D and 3-D shapes inc. circle, cube, rectangle (inc. square) and triangle 10. Use everyday positional vocabulary to describe position and direction including left, right, in front, behind, under and above ✓✓ **A1,2,3.**	12. Calculate money with pence up to one pound and in whole pounds of multiple items and write with the correct symbols (£ or p) 13. Read and record time in common date formats, and read time displayed on analogue clocks in hours, half hours and quarter hours, and understand hours from a 24-hour digital clock 14. Use metric measures of length including millimetres, centimetres, metres and kilometres 15. Use measures of weight including grams and kilograms 16. Use measures of capacity including millilitres and litres 17. Read and compare positive temperatures 18. Read and use simple scales to the nearest labelled division 19. Recognise and name 2-D and 3-D shapes inc. pentagons, hexagons, cylinders, cuboids, pyramids, spheres 20. Describe properties of common 2-D & 3-D shapes inc. nos. of sides, corners, edges, faces, angles & base 21. Use appropriate positional vocabulary to describe position and direction including between, inside, outside, middle, below, on top, forwards and backwards ✓ ✓**A1,2,3.**	10. Calculate with money using decimal notation & express money correctly in writing in pounds & pence 11. Round amounts of money to the nearest £1 or 10p 12. Read, measure and record time using am and pm 13. Read time from analogue and 24-hour digital clocks in hours and minutes 14. Use and compare measures of length, capacity, weight and temperature using metric or imperial units to the nearest labelled or unlabelled division 15. Compare metric measures of length including millimetres, centimetres, metres and kilometres16. Compare measures of weight including grams and kilograms 17. Compare measures of capacity including millilitres and litres 18. Use a suitable instrument to measure mass and length 19. Sort 2-D and 3-D shapes using properties including lines of symmetry, length, right angles ✓, angles including in rectangles and triangles 20 Use appropriate positional vocabulary to describe position and direction inc. eight compass points and including full/half/quarter turns ✓✓ **B1-4, C1-5, D1-3, E1.**	18. Calculate simple interest in multiples of 5% on amounts of money 19. Calculate discounts in multiples of 5% on amounts of money 20. Convert between units of length, weight, capacity, money and time, in the same system 21. Recognise and make use of simple scales on maps and drawings 22. Calculate area and perimeter of simple shapes including those that are made up of a combination of rectangles 23. Calculate the volumes of cubes and cuboids 24. Draw 2-D shapes and demonstrate an understanding of line symmetry & knowledge of the relative size of angles ✓ 25. Interpret plans, elevations and nets of simple 3-D shapes 26 Use angles when describing position and direction, and measure angles in degrees ✓✓ **E1-2. F1-4**

2. Mathematical problem solving (at all levels of Functional Mathematics)

Although underpinning knowledge is tested in its own right, problem solving is a core element of Functional Skills mathematics yet should not obscure or add additional mathematical complexity beyond the level of the qualification. Defining problem solving is a challenge but the attributes below may help. Not all (often just one) of the listed attributes must be present in a single task for it to be considered to be problem solving. ✓ indicates why all or parts of this resource can be considered to be problem solving. **Source:** DfE (Feb 2018) https://www.gov.uk/government/publications/functional-skills-subject-content-mathematics.

One or more of the following attributes may be present in a single task for it to be considered problem solving:

A Tasks that have little or no scaffolding: there is little guidance given to the student beyond a start point and a finish point. Questions do not explicitly state the mathematical process(es) required for the solution.	
B Tasks that provide for multiple representations, such as use of a sketch or a diagram as well as calculations.	✓
C The information is not given in mathematical form or in mathematical language; or there is a need for the results to be interpreted or methods evaluated, for example, in a real-world context.	✓
D Tasks have a variety of techniques that could be used	✓
E The solution requires understanding of the processes involved rather than just application of the techniques.	✓

2. Mathematical problem solving, carrying out tasks and decision-making:

Entry Level 1 (E1)	Entry Level 2 (E2)	Entry Level 3 (E3)	Level 1 (L1)
Students are expected to be able to use the content knowledge and skills to recognise and obtain a solution to a:			
[1]simple problem			[2]straightforward problem ✓
E1a. Use given mathematical information and recognise and use simple mathematical terms appropriate to E1. ✓	E2a. E3a. Use given mathematical information including numbers, symbols, simple diagrams and charts. ✓		L1a. Read, understand and use mathematical information and mathematical terms used at this level. ✓
	E2b. Recognise, understand and use simple mathematical terms appropriate to Entry Level 2. ✓	E3b. Recognise, understand and use simple mathematical terms appropriate to Entry Level 3. ✓	L1b. Address individual problems as described above. ✓
			L1c. Use knowledge and understanding to a required level of accuracy. ✓
E1b. E2c. E3c. Use the methods given above to produce, check and present results that make sense [E3 only: to an appropriate level of accuracy]. ✓			L1d. Analyse and interpret answers in the context of the original problem.
E1c. Provide a simple explanation for those results. ✓	E2d. Present appropriate explanations using numbers, measures, simple diagrams, simple charts and symbols appropriate to Entry Level 2. ✓	E3d. Present results with appropriate explanation using numbers, measures, simple diagrams, charts and symbols appropriate to Entry Level 3. ✓	L1e. Check the sense, and reasonableness, of answers. ✓
			L1f. Present results with appropriate explanation and interpretation demonstrating simple reasoning to support the process and show consistency with the evidence presented.

Problem type:	[1]Simple problem	[2]Straightforward	Complex
Level:	All levels	L1 and L2	Level 2 only
Draws upon knowledge or skills from:	One MCA only	One MCA or a combination of any two MCA	Up to a combination of any three MCA
Number of steps or processes	1	More than 1	At least 2
Context	Familiar to all and easily described	Less familiar – requires some comprehension	Less familiar – requires interpretation and analysis

Abbreviations: MCA = mathematical content area(s). NS = Using numbers and the number system. MS = Using common measures, shape and space. HD = Handling information and data.

HS2 Functional Maths - notes and curriculum mapping

Background

This resource covers reformed Functional Skills (FS) content descriptors relating to position and direction. It was written with mixed-level classes in mind. Compass points, angles and bearings are introduced with graduated HS2 themed problems, interspersed with context-free underpinning questions, examples and tips. I've also included a few vocabulary and punctuation snippets.

At Entry Level, contexts should always be familiar so introduce the resource with a discussion about HS2. It's also worth checking that learners can point to the approximate position of their own region on Diagram A.

The steady build-up of skills from Part A through to Part F means that Entry learners do not necessarily have to halt at Section D. Part A is for E1-E2 learners and can be omitted for those at E3 or above. I suggest L1-L2 learners start at Parts C or D, despite these sections being mapped to E3. Before progressing to Parts E and F, I recommend a separate session on using a protractor, and recognising and measuring acute, obtuse, reflex and right angles. If learners do complete the entire resource (not obligatory!), the maximum number of marks is 88.

I had hoped to continue up to L2, covering new descriptor L2.22 (*calculate values of angles and/ or coordinates with 2-D & 3-D shapes*) but ran out of HS2-related ideas! Nonetheless, as each FS level subsumes lower levels, do check that your L2 learners are familiar with compass points and bearings – they will not have studied this topic in Legacy FS.

Maggie Harnew, Feb 18th 2020.

Answer sheet & marking guidance available to resource contributors.

If you are a skillsworkshop.org contributor please email Maggie or use the site contact link to request your free copy (available from late February).

If you wish to become a contributor please use the contact link to request a free log-in and membership. You can only request the answer sheet if you have uploaded one or more suitable resources to the queue or have already had a resource published on www.skillsworkshop.org.

Thank you for your support 😊 .