Fareham&Gosport Primary SCITT

Subject Knowledge Tests – 2021-2022

Answer Booklet

SEPTEMBER 2021

English Test Answers

The nature and role of Standard English

1 (a) F (b) T (c) T (d) T (e) T (f) F (g) F (h) T (i) T (j) F

2 (a) (d) (e)

3 (b) (c)

4 (a) SE (b) NSE (c) SE (d) SE (e) NSE (f) SE

5 (a) dialect (b) accent

6 (a) dialect (**chimley**) (b) dialect (**never/nowt**) (c) dialect (**brung**) accent (**yer**)
(d) accent (**oi/'aven't/'im**) (e) dialect (**afeared**) (f) dialect (**went**) accent (**oot**)
(g) dialect (**blethering**)

Further support on the nature and role of standard English

You may have had some problems with these answers as there is some controversy over the definition of standard English. In the National Curriculum 2014 the definition is: 'Standard English is the variety of the English language that is generally used for formal purposes in speech and writing. It is not the English of any particular region and it can be spoken with any accent.'

However, you may want to look at this extract from a 2012 lecture by Professor David Crystal, which discusses some of the issues between standard and non-standard English: http://www.youtube.com/watch?v=hGg-2MQVReQ

The spoken and written language systems of English

1 (a) T (b) F (c) T (d) T (e) F (f) F

2 (a) spoken (b) written (c) spoken (d) spoken (e) spoken (f) written

Knowledge at word level

Phonology, graphology and how the writing system represents the sound system

1 In order: phonemes; graphemes; digraph; trigraph; cluster; syllables; onset; rime; segments; blends

2 (a) F (b) T (they can also refer to written letters) (c) T (d) T (e) F

(there are about 44 but lists can vary. The most commonly used list can be found in National Curriculum 2014)

3 Count any two of: **you**, **through**, **crew**, **queue**, **view**. In English there are alternative pronunciations and spellings for vowel phonemes and these are introduced in Year 1.

4 emu 2; hippopotamus 5

5 onset **s**, rime **eal**; onset **d**, rime **uck**; no onset, rime **owl** (Onset and rime are generally not taught in schools as it links to analytic phonics and the new statutory orders for 2014 state that systematic synthetic phonics should be taught.)

6 lion 4; bear 2 or 3 (depending on whether, in your accent, you pronounce the r or not); jackal 5; elephant 7; ape 2. When teaching systematic synthetic phonics it is essential that you can recognise the phonemes/sounds that are in a word. This is sometimes difficult to start with as you have to ignore the spelling and concentrate just on the sounds you can hear. It may take some practice!

7 zoo glasses field key rage just. Here again the difficulty lies in listening to the sounds in the words.

8 Count any two of the following marked clusters: When her friend left. Flora felt so sad that she began to cry. These clusters are sometimes referred to as consonant clusters.

9 Count any two of: elephant gorilla orang-utan. A digraph is two letters making one sound and in this case two consonants making one sound.

10 Count any two of: owl chimpanzee ape (a split digraph). A vowel digraph contains at least one vowel. A split digraph is when the two letters making the vowel sound in a word are split by a consonant. In this case the a and e in ape make the /a/ sound but are split by the /p/.

11 Consonant trigraph: catch or edge. tch is an alternative for the /ch/ phoneme and dge is an alternative for the /j/ phoneme. Vowel trigraph: sigh. Igh is one of the ways of representing the /i/ phoneme.

12 (a) height (b) caught or kit (c) toe (d) howl or frown (e) grown or frown (f) site or mate

13 grammar sentence misery (unstressed vowels often give rise to spelling confusion)

14 /a /

Further support for knowledge at word level

Jolliffe and Waugh (2012) give a good overview of the teaching of synthetic phonics in school today and explanations of the terminology. It is in line with the National Curriculum 2014.

Morphology – word structure and derivations

1 In order: morphology, morpheme, root, compound word, prefix, suffix, inflection

2

(a)	prefix: un	root: wrap(p)	suffix: ing
(b)	prefix: pre	root: cede	(no suffix)
(c)	(no prefix)	root: strange	suffix: ness
(d)	prefix: sub	root: tract	suffix: ion

Prefixes and suffixes are morphemes – the smallest unit of meaning in a word and change the meaning of the word.

3 (a) extra/outside (b) dis/not (c) intra/within (d) inter/between

4 results – plural noun; Jason's – possessive form of singular noun; highest – superlative adjective; scored – past tense verb; higher – comparative adjective. These again are morphemes which are the smallest unit of meaning in a word. The s at the end of 'results' changes the meaning from one to more than one. The apostrophe s in 'Jason's' conveys the meaning of possession. The inflectional -ed ending signals the past tense.

5 (a) noun (b) verb (c) adjective (d) adverb (e) adjective. Definitions of these terms are in the glossary of the new National Curriculum 2014 and further explanation can be found in the section on grammar below.

6 arrowhead, headlight, forehead, headteacher. Compound words are two words which combine to make one word.

7 Latin: submarine, innate, century, circumnavigate. Greek: psychology, phoneme, alphabet, grammar

8 sauna – Finnish; mutton – French; apartheid – Afrikaans; potato – Spanish; whisky – Gaelic; algebra – Arabic; kindergarten – German; shampoo – Hindi

Word meanings and how words relate to each other

1 Synonym (d), colloquialism (g), acronym (c), homonym (e), homograph (a), antonym (b), homophone (f). Note: homonyms are often interpreted more loosely, to incorporate homophones and homographs.

Sentence-level knowledge – grammar and punctuation

Word classes and cohesion within a sentence

1 (a) noun (b) determiner (c) nouns (d) verbs (e) verbs
(f) conjunctions (g) adjective (h) pronoun (i) adverb (j) preposition

2 (a) F (b) T (c) F (d) T (e) T

3 Note that sometimes a word is included in more than one word class.

(a)	proper noun	Charles/Jo/Bernard Benoit
(b)	abstract noun	surprise/delight
(c)	concrete noun	concert/meal/restaurant/diners/members/ band/ guitarist/table
(d)	collective noun	band
(e)	verb	was/went/found/included/was sitting
(f)	adverb	extremely
(g)	pronoun	their/they/theirs
(h)	preposition	following/for/to/of/at
(i)	conjunction	and/where
(j)	determiner	the/a/their/other/next
(k)	adjective	enjoyable/well-known/local/other/lead/next
(l)	relative pronoun	which

4 3rd person

5 (a) pronouns

6 past tense

7 (a) verb (b) noun (c) noun (d) adjective (e) adverb (f) preposition

8 (a) (i) (b) (iv) (c) (iii) (d) (ii) (e) (iv) (f) (iii) (g) (ii) (h) (i)

Sentence types and structure

1 Terminology: (a) subject (b) predicate (c) object
(d) simple sentence (e) compound sentence (f) complex sentence

2 (a) F (b) T (c) T (d) F (e) F

3 (a) question (b) statement (c) command (d) command (e) exclamation

4 (a) phrase (b) phrase (c) clause (d) phrase. Clause needs a subject–verb relationship.

5 Subject: The older children; verb: were studying; object: algebra

6 Subject: Ms Peters; verb: dismissed; object: the class; adverbial: as quickly as possible

7 (a) (c) (d)

8 The main clause is emboldened below; the subordinate clause is italicised.

(a) **Freddie,** *who had rather enjoyed the free wine,* **felt frivolous.**
(b) *After I finish writing up my assignment,* **I'm going to watch a horror film.**
(c) **Cordelia has not done her homework** *because she left her notebook in school.*

9 (a) complex (b) complex (c) simple (d) compound. Simple sentence has one main clause; compound sentence has two or more main clauses; complex sentence has main and subordinate clause(s). Embedded clause is in sentence (a).

10 and – C; when – S; although – S; if – S; or – C

11 if, while, because

12 whose, who, which

Punctuation

1 Terminology: apostrophe (d) semi-colon (e) full stop (c) exclamation mark (b) comma (a)

2 Remember: 2 marks if sentence is completely correct, 1 mark if one mistake only. Take care to check every single mark.

(a) He brought me a bar of chocolate, some crisps and a bottle of white wine. Sometimes a colon heads a list, and sometimes semi-colons are used to separate longer items in a list. However this is less appropriate in a short list of this sort.
(b) 'Go and apologise,' said Mrs Taylor, 'and offer to help tidy up.'
(c) Christopher, who had finished his lunch by ten o'clock, had nothing left to eat.
(d) Alternatives possible: 'Mum, help!' cried Sally. 'Mum – help!' cried Sally. 'Mum! Help!' cried Sally.
(e) Although the war ended in 1945, its repercussions were felt for a very long time afterwards.

3 (a) After lunch, we went to the park, **which** was deserted. After lunch, we went to the park. **It** was deserted. After lunch, we went to the park; it was deserted. (Replace comma in run-on sentence with grammatically more appropriate punctuation.)
(b) 'Mum, can we go out to play now?' asked Rosie. (Add comma.)
(c) We had **sausages** and roast potatoes. (Apostrophes not needed for plural.)
(d) No! That can't be true! (Extra full stop omitted.)
(e) Becky's cat was licking **its** kittens. (Apostrophe not needed in possessive pronoun.)

4 (c)

5 The following alterations change the meaning substantially:

(a) After he had eaten my dog, Sam was violently sick on the carpet.
(b) If you're unsure, don't ask me what to do.
(c) The teacher punished the boys for no good reason. They told their parents.
(d) Trolls usually smell. Nasty children are afraid of them.

Textual knowledge

Cohesion, layout and organisation

1 Cohesion: (a) Close relationship based on grammar or meaning between two parts of a sentence or paragraph. Coherence: (b) Reasonable connection or relation between ideas, arguments or statements.

Further support on coherence and cohesion

See Medwell *et al.* (2012a), Chapter 9: 'Cohesion: grammar at the level of the text'. The following website for English language teachers has some useful reference material on coherence and cohesion: http://www.onestopenglish.com/support/ask-the-experts/methodology-questions/methodology-coherence-and-cohesion/154867.article

2 (c) Petersfield is a small town in East Hampshire.
(a) Its position in an area of natural beauty, just north of Butser Hill, ensures that it maintains a completely separate identity from the Portsmouth conurbation to the south.
(d) This enables it to retain its traditional market-town character. Sadly, however, agricultural markets no longer take place in the historic town square around the central statue of William III.
(b) The square also provides access to the much-visited Norman church, and opens on to Sheep Street where some of the town's oldest houses can be found. These date from the 16th century.
(e) In contrast, on the opposite side of the square is the recently completed Rams Walk shopping centre. This has helped the town remain a popular destination.

3 Connectives: however, also, in contrast. Pronouns: its, it, this, these (any three).

Further support on connectives

See Medwell *et al.* (2012a), Chapter 7: 'The components of sentences'. See also http://www.bbc.co.uk/bitesize/ks2/english/spelling_grammar/sentences/read/1/ and http://www.bbc.co.uk/skillswise/topic/connectives

4 They are *all* recognisable by their layout so if all are ticked – one point.

Further support with layout and features of texts

See http://www.bbc.co.uk/bitesize/ks2/english/writing/

5 Why is textual layout important in relation to meaning?

(a) It can chop a text into coherent chunks that are easier to read.
(c) It can help you to locate information easily.
(d) It can draw your attention rapidly to the main idea of the text.
(f) It can often give an instant idea of the kind of text you are dealing with.

6 Paragraphs can be used in stories to:

- introduce new characters
- introduce a new speaker or new dialogue
- add suspense or change the mood
- introduce a new theme
- move between time/flashbacks

(a) 'You'd better go and get us something to eat,' said Charlie. 'I'll wait here until you get back, just in case Jenny arrives in the meantime.'

'O – what do you want? Pizza again?'

'Sounds good,' said Charlie. He licked his lips. 'Make mine a cheese and tomato, extra-large. I'm starving.'

(b) The National Curriculum was designed to raise standards and support progress towards national targets. It was implemented throughout England in1988.

The Revised National Curriculum is due to be introduced in 2013/2014 and represents a shift in what pupils and teachers are expected to achieve, particularly in the core subjects of English, mathematics and science at primary level.

The overarching aim for English in the National Curriculum is to promote high standards of literacy by equipping pupils with a strong command of the written and spoken word, and to develop their love of literature through widespread reading for enjoyment.

Fiction, non-fiction and poetry

1 Stories are essentially recounts of events. The *plot* is the chronological sequence which links events causally. A story may also have a deeper underlying meaning (such as the triumph of good over evil), which is its *theme*.

The way in which a story is written is important. The author may tell it through his or her *voice*, as an unspecified outsider who knows absolutely everything. Alternatively, it may be related from the particular *viewpoint* of a participant in the story. In this case, the *style* of writing may be more personal, reflecting the type of language used by that particular person.

2 (a) Cinderella lives miserably with her lazy, ugly sisters. (orientation)
(b) The two sisters go to the ball, leaving Cinderella at home, wishing she too could go. (problem)
(c) The Fairy Godmother arrives, and grants Cinderella's wish. Cinderella attends the ball; the prince falls madly in love with her. (development – also called complication)
(d) Midnight – as the magic runs out, Cinderella has to leave (but drops a slipper). (climax)
(e) The Prince finds the slipper fits Cinderella. (resolution)
(f) Wedding bells! (ending)

Further support on story structure

See http://johnwatsonsite.com/MyClassNotes/Topics/Short%20Story/Ch'csShortStory.html

3 (a) Usually includes animal characters who talk and act like humans; short, intended to teach a moral lesson: fable

(b) Setting located in the defined past; vocabulary may reflect this; may merge with other genres such as adventure or romance: historical fiction

(c) Ancient traditional story of heroes and gods; tackles a concern of human existence; may explain some natural phenomenon: myth

(d) Plot involves realistic characters engaging in and overcoming a series of exciting, often hazardous events: adventure story

(e) Traditional tale, often rooted in historical fact, which describes the actions of a hero figure: legend

(f) Includes stereotypical characters, whose lives are affected in some way by magic; often highly predictable: fairy tale

4 (a) Once upon a time, in a tumbledown cottage in a deep dark wood, there lived two poor sisters. Marguerite was fair and gentle, loved far and wide for her kind and thoughtful ways. Violet was dark and quick-tempered, with black eyes that flashed scornfully at all who displeased her. Genre: fairy tale

(b) I never knew my father, who was cut down at Culloden in '46, fighting for the royal cause. He died nobly, one amongst thousands of brave Scots who lost their lives striking a futile blow for freedom, leaving my mother alone to raise four hungry children. Genre: historical fiction

(c) Once there was a greedy fox who invited his neighbour Rabbit round for a slap-up dinner. More fool Rabbit for agreeing to go, I say – after all, everyone knows foxes are crafty critters who can't think further ahead than their next meal! Genre: fable

5 (a) describes arguments from different viewpoints, leading to a balanced conclusion: discussion text

(b) explains how or why something occurs: explanatory text

(c) retells series of events, to entertain or inform: recount

(d) tells reader what to do: instruction text

(e) provides a factual description of something: non-chronological report

(f) argues the case for a particular point of view: persuasive text

6 (a) In order to land, a bird first raises its tail to steer it downwards. It then brakes by bringing its body upright, thus tilting its wings to the vertical to create wind resistance. It then lowers its tail. The bird's strong leg muscles absorb the impact of landing. Text type: explanatory

(b) First, decide on the position, size and shape of your pond. Mark out the edges and dig. When the hole is deep enough, line it with sand. Next, carefully position the rubber liner and add a layer of soil. Fill up with water. Finally, cover the liner edges. Text type: instructional

(c) Later, went with Phil to the Apollo to see Macbeth – in my view, the most powerful play ever written. Afterwards we enjoyed a quick latte in Café Moon. Text type: recount

7 (a) impersonal style (a) is best

(b) connectives of time (a), (b) or (c)

(c) causal connectives (a)

(d) imperative present tense verb (b)

(e) past tense verbs (c)

8 (a) Alliteration refers to a phrase in which words begin with the same phoneme.
(b) Onomatopoeia refers to the effect created by words whose sound echoes their meaning.
(c) Metaphor refers to an author describing something as if it is something else.
(d) Personification refers to an author describing something non-human as if it has human qualities.

9 (a) A narrative poem is a poem which tells a story.
(b) Poetry which follows a metrical pattern, but does not rhyme, is known as blank verse.
(c) A limerick is a comic poem with five lines, following an aabba rhyme scheme and a set syllabic pattern.
(d) In a calligram, the way in which the poem is physically printed and laid out on the page relates to what it is about.
(e) A haiku has three lines, comprising 5, 7 and 5 syllables respectively.

10 Various options are possible. You might have answers such as: not written in conventional sentences; lots of imagery; lines are of varied length; not chronological

11 simile: like a lightning bolt, like a demon breathing out fire, like a madman; metaphor: a great green dragon, a metal monster

- alliteration: great green, metal monster, spitting out sparks, screeching and screaming, like a lightning bolt
- onomatopoeia: hissing, spitting, clanging, banging, crashing, flashing, screeching, screaming
- internal rhyme: clanging and banging, crashing and flashing
- assonance: like a lightning bolt, hissing and spitting, demon breathing, screeching and screaming

Critical evaluation of texts

An ability to analyse different types of fiction, poetry and non-fiction texts, evaluating their quality and making judgements about them

As already mentioned, subjectivity abounds in the area of textual evaluation. Literature cannot be judged simply on the basis of a list of criteria – there's far more to it than that. However, by starting to think about what criteria you might apply to different types of book, you're making a start.

1 (a) R, O (b) R, P, H, F (c) P (d) H, F (e) R, P, H, O (f) P, H, F (g) P, H
(h) P, H, F (i) R (j) P (k) P, O (l) R (m) P, H, F (n) P, H
(o) H, F

Maths Test Answers

Number

1 (i) This can be solved mentally. Multiplying by 5 is the same as multiplying by 10 and dividing by 2.

120 is the product.

(ii) This can be solved mentally. Multiplying by 25 is the same as multiplying by 100 and dividing by 2 and dividing by 2 again.

1800 is the product.

(iii) $312 \times 235 = 73\,320$

This problem needs to be solved by using a long multiplication algorithm.

$$\begin{array}{r} 312 \\ \times\ 235 \\ \hline 1560 \\ 9360 \\ 62400 \\ \hline 73320 \\ {\scriptstyle 1\,1\,1} \end{array}$$

2 (i) This problem can be solved without using an algorithm.

The dividend, 1760, and the divisor, 40, have a common factor of 10.
1760 ÷ 40 is the same as 176 ÷ 4.
To divide by 4 we half and half again.
The quotient is 44.

(ii) This problem can be solved without using an algorithm.

The dividend,1638, and the divisor, 63, have a common factor of 9. (Note also that 1638 is divisible by 9 because its digits add up to 18 which is divisible by 9.)

$$9\overline{)16^{7}3^{1}8}\quad 1\,8\,2$$

1638 ÷ 63 is the same as 182 ÷ 7.

The quotient is 26.

(iii) 3325 and 23 have no factors in common. This problem needs to be solved by using a long division algorithm.

3335 ÷ 23 = 145

$$23\overline{)33^{10}3^{11}5}\quad 1\ \ 4\ \ 5$$

Many schools teach pupils the 'chunking method' to solve division problems. This approach is popular in Holland and some other European countries.

3335		
2300	100	(23 × 100 = 2300)
1035		(3325 – 2300 = 1035)
920	40	(23 × 40 = 920)
115		(1035 – 920 = 115)
115	5	(23 × 5 = 115)

So the answer is 100 + 40 + 5 = 145

3 (i) $p + q = \frac{2}{3} + \frac{1}{2} = \frac{4}{6} + \frac{3}{6} = \frac{7}{6} = 1\frac{1}{6}$

7/6 is a vulgar fraction. A fraction consisting of a whole number and a vulgar fraction is called a mixed fraction. The top line of a fraction is called the numerator. The bottom line is called the denominator. The line separating the numerator and the denominator is the vinculum or fraction bar.

(ii) $p + r = \frac{2}{3} + 2\frac{4}{7} = \frac{2}{3} + \frac{18}{7} = \frac{14}{21} + \frac{54}{21} = \frac{68}{21} = 3\frac{5}{21}$

(iii) $q + s = \frac{1}{2} + 1\frac{1}{5} = \frac{1}{2} + \frac{6}{5} = \frac{5}{10} + \frac{12}{10} = \frac{17}{10} = 1\frac{7}{10}$

(iv) $p - q = \frac{2}{3} - \frac{1}{2} = \frac{4}{6} - \frac{3}{6} = \frac{1}{6}$

(v) $r - q = 2\frac{4}{7} - \frac{1}{2} = \frac{18}{7} - \frac{1}{2} = \frac{36}{14} - \frac{7}{14} = \frac{29}{14} = 2\frac{1}{14}$

(vi) $r - s = 2\frac{4}{7} - 1\frac{1}{5} = \frac{18}{7} - \frac{6}{5} = \frac{90}{35} - \frac{42}{35} = \frac{48}{35} = 1\frac{13}{35}$

(vii) $p \times q = \frac{2}{3} \times \frac{1}{2} = \frac{2}{6} = \frac{1}{3}$

(viii) $q \times s = \frac{1}{2} \times 1\frac{1}{5} = \frac{1}{2} \times \frac{6}{5} = \frac{6}{10} = \frac{3}{5}$

(ix) $r \times s = 2\frac{4}{7} \times 1\frac{1}{5} = \frac{18}{7} \times \frac{6}{5} = \frac{108}{35} = 3\frac{3}{35}$

(x) $p \div q = \frac{2}{3} \div \frac{1}{2} = \frac{2}{3} \times \frac{2}{1} = \frac{4}{3} = 1\frac{1}{3}$

(xi) $q \div p = \frac{1}{2} \div \frac{2}{3} = \frac{1}{2} \times \frac{3}{2} = \frac{3}{4}$

(xii) $q \div r = \frac{1}{2} \div 2\frac{4}{7} = \frac{1}{2} \times \frac{7}{18} = \frac{7}{36}$

4 (i) $\frac{5}{8} = 0.625$

$$8\overline{)5.^{5}0^{2}0^{4}0}\quad 0.625$$

(ii) $\frac{7}{20} = 0.35$

$$20\overline{)7.^{7}0^{10}0}\quad 0.35$$

(ii) 65% = 0.65

(iv) 0.1% = 0.001

5 (i) $0.375 = \frac{375}{1000} = \frac{3}{8}$

(ii) $0.28 = \frac{28}{100} = \frac{14}{50} = \frac{7}{25}$

(iii) $76\% = \frac{76}{100} = \frac{38}{50} = \frac{19}{25}$

6 (i) $\frac{84}{96} = \frac{42}{48} = \frac{21}{24} = \frac{7}{8}$

(ii) $\frac{84}{91} = \frac{12}{13}$

7 (i) $\frac{5}{8} = 0.625 = 62.5\%$

(ii) $0.375 = 37.5\%$

(iii) $\frac{7}{20} = 0.35 = 35\%$

8 4% cheaper:

Let the original price be £100.
After a 20% increase the price is £120.
In the sales the price is reduced by 20% of £120 = £24.
The price in the sales is £96.
This is an overall reduction of 4%.

9 The two prices are the same:

Let the original price be £100.
An increase of 25% gives a new price of £125.
20% of £125 is £25.
The reduced price is £100.

10 In the first game the team scored 24 points; in the second game they scored 30 points. There was an increase of 6 points from the first game to the second game. As a percentage this increase can be represented as $\frac{6}{24} \times 100\% = 25\%$

11 For every £5 raised Edward contributed £2 (i.e. $\frac{2}{5}$) and Katherine contributed £3 (i.e. $\frac{3}{5}$). Applying this to the £160 total raised gives:

Edward: $\frac{2}{5} \times £160 = £64,$

Katherine: $\frac{3}{5} \times £160 = £96.$

Primary pupils should have the opportunity to use ratios in appropriate contexts. The following problem is suitable for primary pupils: 'Blue and yellow paint are mixed in the proportion 3:1 to produce dark green paint. If the ratio of blue to yellow paint is 1:3 what will the resulting paint look like?'

12 This is the same type of problem as question 11, only slightly larger.

The books are shared in the ratio 52 (i.e. $\frac{52}{200}$) to 68 (i.e. $\frac{68}{200}$) to 44 (i.e. $\frac{44}{200}$) to 36 (i.e. $\frac{36}{200}$). Applying this to

Year 3: $\frac{52}{200} \times 1000 \text{ books} = 260 \text{ books}$

Year 4: $\frac{68}{200} \times 1000 \text{ books} = 340 \text{ books}$

Year 5: $\frac{44}{200} \times 1000 \text{ books} = 220 \text{ books}$

Year 6: $\frac{36}{200} \times 1000 \text{ books} = 180 \text{ books}$

13 First express each number as a decimal fraction correct to three decimal places:

71% = 0.710 5/7 = 0.714 18/25 = 0.720 √ ½= 0.707 0.7 = 0.700

In order of size, smallest first, the numbers are: 0.7, √ ½, 71%, 5/7, 18/25

Give yourself 3 marks if the numbers are in the correct order. Subtract 1 mark for each number not in its correct position.

14 (i) $0.\dot{2}\dot{7}$ (ii) $0.2\dot{7}$ (iii) $0.\dot{9}0\dot{4}$ (iv) $18.\dot{1}\dot{8}$

Note that all rational numbers can be expressed as terminating decimals or recurring decimals.

Older primary school pupils should have the opportunity to investigate vulgar fractions and their decimal fraction equivalent. For example 1/7 expressed as a decimal fraction is $0.\dot{1}42857\dot{}$. An interesting investigation is to examine the decimal fractions of 2/7, 3/7, 4/7, 5/7, 6/7.

Similar investigations of fractions of the form 1/*a*, 2/*a*, 3/*a* .... where *a* is a prime number, reveal interesting patterns.

A difference between calculators used in the primary school and scientific calculators is that recurring decimals are truncated by a primary calculator but rounded by a scientific calculator. For example, 0.666666666... is truncated to 0.666666 on a primary calculator whereas a scientific calculator gives the answer as 0.666667.

15 (i) $100\,000 = 10^5$ (ii) $0.1 = 10^{-1}$ (iii) $100 = 10^2$

16 (i) $6.6 \times 10^3 = 6600$ (ii) $7.07 \times 10^{-2} = 0.0707$

17 (i) $523\,000 = 5.23 \times 10^5$ (ii) $0.0606 = 6.06 \times 10^{-2}$

18 (i) ✓ Division is right distributive over addition. In other words, if the division sign is on the right-hand side of the bracket, division is distributive over addition. For example, $(300 + 30 + 3) \div 3 = 100 + 10 + 1$.

Note also that division is right distributive over subtraction. For example, $(300 - 30 - 3) \div 3 = 100 - 10 - 1$.

(ii) × Division is not left distributive over addition. In other words, if the division sign is on the left-hand side of the bracket, division is not distributive over addition. For example, $300 \div (100 + 10) \neq 3 + 30$.

(iii) ✓ Multiplication is distributive over addition. Note that multiplication is left distributive and right distributive over addition. For example, $3 \times (100 + 10 + 1) = 300 + 30 + 3$ and $(100 + 10 + 1) \times 3 = 300 + 30 + 3$.

(iv) ✓ Multiplication is distributive over subtraction. Note that multiplication is left distributive and right distributive over subtraction. For example, $5 \times (1000 - 1) = 5000 - 5$ and $(1000 - 1) \times 5 = 5000 - 5$.

Primary pupils are not expected to be familiar with the term 'distributive'. They should, however, be able to use the distributive property of multiplication to solve problems of the kind 'find the cost of five T-shirts at £9.99 each'.

(v) × Division is not associative. For example, $(27 \div 9) \div 3 = 1$ whereas $27 \div (9 \div 3) = 9$. Note that it is possible to have numerous different answers to a division problem, depending on where the brackets are placed. For example, $128 \div 32 \div 8 \div 4 \div 2 \div 2$ has a number of answers, depending on where the brackets are placed. This is an interesting investigation for young children: to find out how many different answers are possible by placing brackets in different positions.

(vi) ✓ Addition is associative. Even at Key Stage 1 children should be introduced to this concept. For example, $6 + 12 + 8 + 9 + 11$ is made considerably easier if $12 + 8$ and $9 + 11$ are calculated first.

(vii) × Subtraction is not associative. For example, $(10 - 7) - 3 = 0$ whereas $10 - (7 - 3) = 6$. As with division, it is possible to have a large number of answers to a subtraction problem, depending on where the brackets are placed. For example, $150 - 60 - 30 - 20 - 10$ has a number of answers, depending on where the brackets are placed. This is an interesting investigation for young children: to find out how many different answers are possible by placing the brackets in different positions.

(viii) ✓ Multiplication is associative. Some calculations are made significantly easier if this property of multiplication is used. For example, $17 \times 4 \times 25 \times 50 \times 2$ is simplified if it is written as $17 \times (4 \times 25) \times (50 \times 2)$.

(ix) ✓ Multiplication is commutative. Primary school children need to understand this property of multiplication. Pupils need to know, for example, that 8×9 is the same as 9×8.

It is not immediately obvious to pupils (or adults) that 24% of £25 is the same as 25% of £24. It is far easier calculating 25% of £24.

(x) ✓ Multiplication is distributive over addition. Primary school children need to have experience of this kind of calculation. In primary school pupils are introduced to long multiplication by using grid multiplication.

	30	9
20	600	180
8	240	72

The diagram shows how primary school pupils are introduced to the multiplication of 28 by 39.

$28 \times 39 = 600 + 240 + 180 + 72 = 1092$.

19 (i) Factors of 24: 1, 2, 3, 4, 6, 8, 12, 24

24 has a large number of factors. (This is one of the reasons why the Babylonians decided there should be 24 hours in a day.)

(ii) Factors of 360: 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, 36, 40, 45, 60, 72, 90, 120, 180, 360

360 has a large number of factors. (This is one of the reasons why the Babylonians decided there should be 360 degrees in a full turn.)

20 (i) 49 has three factors: 1, 7, 49

(ii) In general, all square numbers have an odd number of factors.

This is a result that primary school children should know. The following problem is a suitable investigation for primary school children. It leads to the result that all square numbers have an odd number of factors.

A prison has 100 prisoners held in 100 cells numbered 1 to 100.

This is a high security prison with 100 warders. One night the first warder went to every cell and locked it. The second warder then visited every second cell and turned the key – every second cell was now unlocked. The third warder then went to every third cell and turned the key – the third cell was now unlocked, the sixth cell was now locked, the ninth cell was unlocked. The fourth warder then went to every fourth cell and turned the key. The fourth cell was now locked. In this way each warder visited a group of cells. Which cells are locked at the end of the night?

The locked cells are numbers 1 4 9 16 25 36 49 64 81 100

Each of these cells is visited an odd number of times by a warder because square numbers have an odd number of factors.

21 (i) $48 = 2 \times 2 \times 2 \times 2 \times 3$

(ii) $105 = 3 \times 5 \times 7$

(iii) $36 = 2 \times 2 \times 3 \times 3$

(iv) $56 = 2 \times 2 \times 2 \times 2 \times 7$

22 (i) The highest common factor of 36 and 48 is $2 \times 2 \times 3 = 12$.

(ii) The highest common factor of 105 and 56 is 7.

(iii) The highest common factor of a^2b^2 and a^3b is a^2b.

(v) The highest common factor of abc and cd^3 is c.

Year 6 pupils will be introduced to letters representing numbers. It is important that they view algebra as an extension of arithmetic. The highest common factor of 2^33^2 and 2^23^3 is 2^23^2. Similarly, the highest common factor of a^3b^2 and a^2b^3 is a^2b^2.

23 (i) 888

(ii) 1999

(iii) 2220

24 (i) CCCXXXIII

(ii) CDXLIV

(iii) MMXIII

25 (i) 37203

(ii) 203001050

(iii) 9000017. It is quite common for pupils to write 900000017. Teachers need to be aware of pupils' misconceptions in writing large numbers.

26 (i) Forty million four hundred and four thousand and forty

(ii) Seventy million seven thousand and seven (note that some children would interpret this number as seven thousand seven hundred and seven)

(iii) Three hundred million thirty thousand and three

Primary pupils are expected to be able to write numbers up to 10 million. The media make reference to numbers such as billion, trillion and quadrillion. A primary teacher should know what size these numbers are.

Algebra – Patterns and relationships

1 (i) $ab = 5 \times 15 = 75$

(ii) $ac = 5 \times 2 = 10$

(iii) $de = 15$ and $d = 3$, hence $e = 15 \div 3 = 5$

(iv) $df = 18$ and $d = 3$, hence $f = 18 \div 3 = 6$

(v) $a(b + c) = 5(15 + 2) = 85$

(vi) $d(e + f) = 3(5 + 6) = 33$

(vii) $a(b - c) = 5(15 - 2) = 65$

(viii) $d(e - f) = 3(5 - 6) = -3$

(ix) $2a^2b = 2 \times 5^2 \times 15 = 750$

(x) $2d^2e = 2 \times 3^2 \times 5 = 90$

(xi) $\frac{1}{a} = \frac{1}{5}$ or 0.2

(xii) $\frac{1}{d} = \frac{1}{3}$ or 0.333

2 (i) 36

(ii) 100

(iii) n^2

3 (i) 8, 12, 16, 20, 24

(ii) 44 slabs

(iii) $4n + 4$ or alternatively $4(n + 1)$

4 (i) 64

(ii) 512

(iii) $2(n - 1)$

5 (i) 1, 3, 6, 10, 15

(ii) 55 cubes

(iii) $\frac{n(n+1)}{2}$

Examples of triangle numbers in different contexts should be given to pupils. For example, pharmacists when counting circular tablets use a triangular scoop that is calibrated in triangular numbers. The numbers on the side of the scoop are 1, 3, 6, 10,..., showing how many tablets are in the triangular scoop.

6 (i) $\frac{1}{x+2} = 3$

$1 = 3(x+2)$

$1 = 3x+6$

$-5 = 3x$

$x = -\frac{5}{3}$

(ii) $\frac{1}{5x-4} = \frac{1}{x}$

$x = 5x - 4$

$4 = 4x$

$x = 1$

(iii) $\frac{3}{1+b} = \frac{5}{b+3}$

$3(b + 3) = 5(1 + b)$

$3b + 9 = 5 + 5b$

$4 = 2b$

$2 = b$

7 (i) $\begin{cases} y - 2x = 4 & (1) \\ y + x = 7 & (2) \end{cases}$

(2) – (1):

$$\begin{array}{r} y + x = 7 \\ \underline{y - 2x = 4} \\ 3x = 3 \\ x = 1 \end{array}$$

Substitute in (2):

$y + x = 7$

$y + 1 = 7$

$y = 6$

(ii) $\begin{cases} 2x - 3y = 2 & (1) \\ 4x + 6y = 4 & (2) \end{cases}$

Rearranging (1) gives:

$$x = \frac{2+3y}{2}$$

Substituting for x in (2) gives:

$4x + 6y = 4$

$4\left(\frac{2+3y}{2}\right) + 6y = 4$

$4 + 6y + 6y = 4$

$12y = 0$

$y = 0$

Substituting for y in (1) gives:

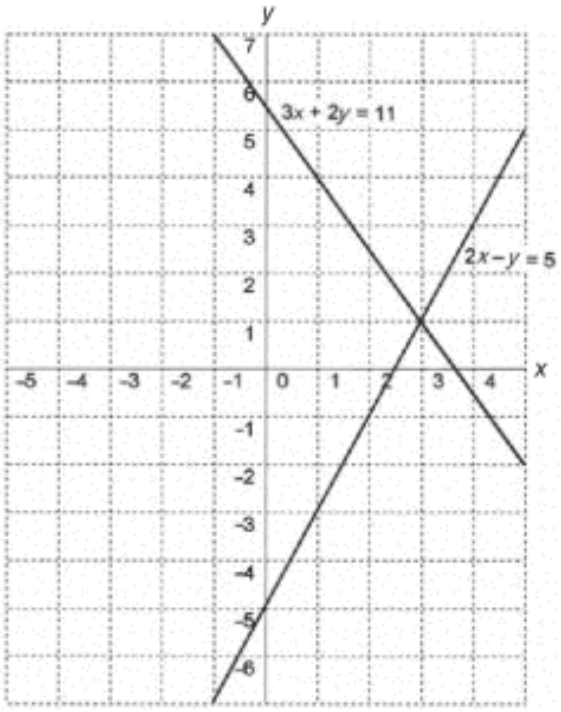
$2x - 3y = 2$

$2x - 0 = 2$

$x = 1$

(iii) $\begin{cases} 2x - y = 5 \\ 3x + 2y = 11 \end{cases}$

By drawing the graphs represented by the two equations it is possible to find the common solution. The common solution is found where the two lines cross. At this point the values for x and y in both of the equations are the same.



In this case the lines cross at the point (3,1), giving the common solution $x = 3$ and $y = 1$.

8 (i) True

(ii) False. If $x < -4$ then $x^2 > 16$.

(iii) True

(iv) True

(v) True

(vi) True

(vii) False. If $6 - x > 10$ then $x < -4$.

Shape and space

1 $b = 80°$, $c = 100°$, $d = 80°$, $e = 100°$, $f = 100°$.

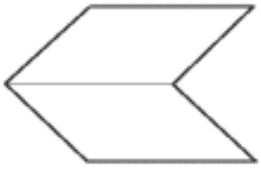
Opposite angles are equal. Complementary angles sum to 90°. Supplementary angles sum to 180°.

2 Angle $d = 80°$.

3

6 lines of reflective symmetry
rotational symmetry of order 6

no lines of reflective symmetry
rotational symmetry of order 2



1 line of reflective symmetry
rotational symmetry of order 1

4 lines of reflective symmetry
rotational symmetry of order 4

2 lines of reflective symmetry
rotational symmetry of order 2

Primary pupils are encouraged to examine the properties of shapes by considering their order of rotational symmetry and the number of lines of symmetry. For example, quadrilaterals can be categorised by their symmetry properties.

	Number of lines of symmetry passing through corners	Number of lines of symmetry passing through the mid-points of sides	Order of rotational symmetry
Square	**2**	**2**	**4**
Rectangle		**2**	**2 (at least)**
Rhombus	**2**		**2 (at least)**

	Number of lines of symmetry passing through corners	Number of lines of symmetry passing through the mid-points of sides	Order of rotational symmetry
Parallelogram			**2 (at least)**
Kite	**1 (at least)**		
Isosceles trapezium		**1 (at least)**	

See Mooney et al., *Primary Mathematics: Knowledge and Understanding*, for further explanation.

4 angle *a*: right angle *b*: reflex angle *c*: acute angle *d*: reflex
angle *e*: acute angle *f*: right angle *g*: obtuse

An acute angle is one that is less than 90 degrees.

An obtuse angle is between 90 and 180 degrees.

A reflex angle is between 180 and 360 degrees.

5 (i) Shapes A and B are congruent. Two shapes are congruent if the angles are the same and the lengths are the same.

(ii) All of the other shapes, A, B and D are similar to shape C. Shapes are similar if their angles are the same and the ratio of the lengths of sides is the same.

6 Area of the triangle is equal to half × base × height = 2 cm × 3 cm = 6cm^2.

7 Area of the parallelogram is equal to base × height = 8 cm × 5 cm = 40 cm^2.

8 The area of the trapezium is found by dissecting it into a parallelogram and a triangle, then adding the area of the parallelogram and the area of the triangle:

$$\text{Area of parallelogram} + \text{Area of triangle} = (5\text{ cm} \times 4\text{ cm}) + (1.5\text{ cm} \times 4\text{ cm})$$
$$= 20\text{ cm}^2 + 6\text{ cm}^2$$
$$= 26\text{ cm}^2$$

9 $\text{Perimeter} = 7\text{ cm} + 3\text{ cm} + 3\text{ cm} + 6\text{ cm} + (7 - 3)\text{ cm} + (6 - 3)\text{ cm}$
$$= 7\text{ cm} + 3\text{ cm} + 3\text{ cm} + 6\text{ cm} + 4\text{ cm} + 3\text{ cm}$$
$$= 26\text{ cm}$$
$$\text{Area} = (7 \times 6)\text{ cm}^2 - (4 \times 3)\text{ cm}^2$$
$$= 42\text{ cm}^2 - 12\text{ cm}^2$$
$$= 30\text{ cm}^2$$

10 Using Pythagoras' theorem to calculate L:

$$4^2 + 5^2 = L^2$$
$$16 + 25 = L^2$$
$$41 = L^2$$
$$\sqrt{41} = L$$
$$L \approx 6.4\text{ cm}$$

$$\text{Perimeter} \approx 2\text{ cm} + 13\text{ cm} + 8\text{ cm} + 5\text{ cm} + 6\text{ cm} + 3\text{ cm} + 4\text{ cm} + 6.4\text{ cm}$$
$$\approx 47.4\text{ cm}$$
$$\text{Area} = (2 \times 13)\text{ cm}^2 + (6 \times 5)\text{ cm}^2 + \left(\frac{1}{2} \times 4 \times 5\right)\text{ cm}^2$$
$$= 26\text{ cm}^2 + 30\text{ cm}^2 + 10\text{ cm}^2$$
$$= 66\text{ cm}^2$$

Pupils should investigate rectangles that have the same perimeter but different areas. It is a common misconception to think that if two shapes have the same perimeter they have the same area.

11 Circumference $= \pi d$

$= 10\pi$ cm

≈ 31.4 cm (taking π to be 3.14)

Area $= \pi r^2$

$= 25\pi$ cm^2

≈ 78.5 cm^2 (taking π to be 3.14)

Pupils should be encouraged to investigate the circumference of everyday objects. For example, to investigate how far a bicycle moves when the wheels rotate once.

12 (i) Reflection in the *y*-axis has the effect of multiplying the *x*-coordinate (or abscissa) by –1, giving:

$a' = (-1, 1)$
$b' = (-1, 3)$
$c' = (-5, 3)$
$d' = (-5, 1)$

(ii) The new coordinates are

$a'' = (1, -1)$
$b'' = (3, -1)$
$c'' = (3, -5)$
$d'' = (1, -5)$

Do you notice a pattern in the new coordinates?

Older primary pupils are expected to be able to plot points in each of the four quadrants. They should be encouraged to investigate problems such as 'Rotate the rectangle with coordinates (0,0) (2,0) (2,3) (0,3) 180 degrees about the point (0,0). What do you notice about the new coordinates?'

13

Solid	Faces	Edges	Vertices
Cube	**6**	**12**	**8**
Tetrahedron	**4**	**6**	**4**
Triangular prism	**5**	**9**	**6**

Euler's law states that the number of faces of a polyhedron plus the number of vertices minus two equals the number of edges. Older primary school pupils should be familiar with this law. Older pupils should have the opportunity to discover relations between the number of faces, vertices and edges of a polyhedron. For example, pupils should have the opportunity to discover that if a polyhedron is a pyramid the number of vertices is the same as the number of faces.

14 (i) The cuboid has:

2 faces with an area of 3 cm × 4 cm = 12 cm^2
2 faces with an area of 4 cm × 6 cm = 24 cm^2
2 faces with an area of 3 cm × 6 cm = 18 cm^2

(ii) The total surface area = (2 × 12 cm^2) + (2 × 24 cm^2) + (2 × 18 cm^2)
= 24 cm^2 + 48 cm^2 + 36 cm^2
= 108 cm^2

(iii) The volume of the cuboid = 3cm × 4 cm × 6 cm
= 72 cm^3

15 Surface area:

Area of each circular face = πr^2
= 25π cm^2
≈ 78.5 cm^2

Area of curved surface = 10 × 2πr cm^2
= 10 × 10π cm^2
≈ 314 cm^2

Total surface area = (2 × 25π cm^2) + 100π cm^2
≈ 157 cm^2 + 314 cm^2
= 471 cm^2

Volume:

Area of circular face × length = 78.5 cm^2 × 10 cm
= 785 cm^3

Pupils should be encouraged to investigate the dimensions of labels on cans and discover the relation between the width of the label and the diameter of the can.

16 Surface area:

Area of each triangular face = 6 cm × 8 cm
= 48 cm^2

Area of 2 rectangular faces = 10 cm × 20 cm
= 200 cm^2

Area of remaining rectangular face = 12 cm × 20 cm
= 240 cm^2

Total surface area = (2 × 48 cm^2) + (2 × 200 cm^2) + 240 cm^2
= 96 cm^2 + 400 cm^2 + 240 cm^2
= 736 cm^2

Volume:

Area of triangular face × length = 48 cm^2 × 20 cm
= 960 cm^3

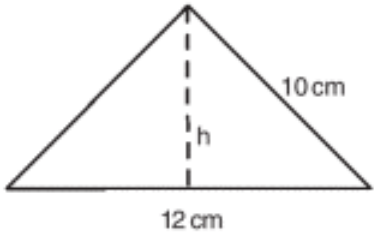
Using Pythagoras $10^2 = 6^2 + h^2$

$10^2 - 6^2 = h^2$

$100 - 36 = h^2$

$64 = h^2$

$h = 8$ cm



Pupils should be encouraged to construct cuboids from card of a fixed size – say, card of area 500 cm^2 – and try to find the largest volume they can enclose.

Statistics

1 Mode = 3 Median = 3 Mean = 4

2 Size 8 is the mode. The mode is sometimes called the shopkeeper's average. Shopkeepers use an average that represents the most popular product.

£21500 is the median. The median is not affected by very large values, whereas the mean is. For this reason the government uses the median to represent the country's average wage.

80 kg is the mean. The total weight in the lift is crucial. The mean allows the total weight to be calculated.

Pupils are expected to know how to find the different averages but also, equally important, to understand the contexts in which they are used.

3 Lower quartile = 3
Median = 6
Upper quartile = 9
Range = 9
Inter-quartile range = 6

4 (i) 21

(ii) 6

(iii) One pupil has a reading age of 7 years 7 months and a chronological age of 6 years 1 month.

A scatter diagram is used for bivariate data. For example, pupils' height and shoe size could be plotted on a scatter diagram. The relationship between height and shoe size is immediately apparent when displayed in this way. Older primary pupils should be able to use and interpret scatter diagrams.

5 (i) 30

(ii) 20

(iii) 24

(iv) Test 2

6 (i) False. There are 182 pupils. 3/7 of 182 is 78.

(ii) True

(iii) False. 2/7 of 182 is 52.

7 (i) 50

(ii) 40 degrees Celsius

(iii) 100

Pupils should be able to use conversion graphs to convert, for example, pounds (sterling) to euros, pounds (mass) to kilograms, gallons to litres.

8 (i) Categoric. Eye colour is not a quantitative variable. A variable that is not quantitative is called categoric or qualitative.

(ii) Discrete. Shoe size is a quantitative variable. However, it only takes particular values. Other examples of discrete variables are: number of siblings, dress size.

Probability

1 (i) $\frac{1}{36}$ (ii) $\frac{6}{36}=\frac{1}{6}$ (iii) $\frac{5}{36}$ (iv) 0

2 (i) $\frac{1}{6}$ (ii) $\frac{1}{2}$ (iii) $\frac{1}{6}\times\frac{1}{2}=\frac{1}{12}$

3 (i) $\frac{13}{52}=\frac{1}{4}$ (ii) $\frac{26}{52}=\frac{1}{2}$ (iii) $\frac{32}{52}=\frac{16}{26}=\frac{8}{13}$ (iv) $\frac{12}{52}=\frac{6}{26}=\frac{3}{13}$

(iii) and (iv) can be answered by thinking in terms of each suit rather than the whole pack of cards. In each suit of 13 there are 8 cards less than a 10, and 3 higher than a Jack.

4 (i) He is not correct. There is an equal number of even and odd cards, therefore it is equally likely that he will have an even number or an odd number.

(ii) (a) unlikely

(b) certain

Measures

1

(i)	yard	metre
(ii)	pound	kilogram
(iii)	mile	kilometre
(iv)	square inch	square centimetre
(v)	acre	hectare
(vi)	ounce	gram
(vii)	pint	litre
(viii)	ton	tonne

There is very little difference between a ton and a tonne. A ton is 2240 pounds and a tonne is 1000 kg.

(ix)	miles per hour	kilometres per hour
(x)	inches per minute	centimetres per minute
(xi)	inches per year	centimetres per year
(xii)	cubic inches	cubic centimetres

2 (i) Hectare. A hectare is 10000 square metres. An acre is 4840 square yards. A hectare is more than twice the size of an acre. Historically an acre was defined as a rectangular field that was a furlong (= 220 yards) long and a chain (= 22 yards) wide.

(ii) 2 pints. A litre is approximately $1\frac{3}{4}$ pints.

(iii) Kilogram. A kilogram is approximately 2.2 pounds.

(iv) Metre. A metre is approximately 10% more than a yard.

(v) 2 kilometres. A kilometre is approximately 5/8 mile. A kilometre is defined as 1/10000 the distance from the North Pole to the Equator.

(vi) Gallon. A gallon is 8 pints.

(vii) Inch. An inch is approximately 2.5 centimetres.

(viii) 1 kilometre. There are 8 furlongs in a mile. A furlong was considered to be the longest distance a horse could plough a straight furrow. Furrow long was abbreviated to furlong.

Although metric measures have been used in the United Kingdom for some time, Imperial measures continue to be used. Primary pupils are expected to be familiar with the common Imperial measures.

3 (i) 10 centimetres

(ii) 1 millimetre

4 (i) 1:10000

(ii) 1:10000

(iii) 1:100000

5 (i) 36 km/hr

(ii) 6 km/hr

(iii) 1.8 km/hr

A compound measure is one with more than one unit. For example, pressure is measured in composite units, pounds per square inch. Primary pupils should have experience of using compound measures. They should be familiar, for example, with compound measures such as miles per gallon. They should be encouraged to investigate the relation between miles per gallon and gallons per 1000 miles. In the UK miles per gallon is the compound measure used, whereas in the United States gallons per 1000 miles is used and in Continental Europe litres per 100 km. It is a useful exercise to discuss the advantages and disadvantages of the different compound measures.

6 (i) 148 days

(ii) 181 days

7 (i) 31 leap years. Note that 1900 was not a leap year. In general, a year is a leap year if it is divisible by 4. If the year ends in 00, however, it is only a leap year if it is divisible by 400. For example, 2100 will not be a leap year. There are a little less than 365¼ days in a year. For this reason leap years occur less frequently than once every 4 years.

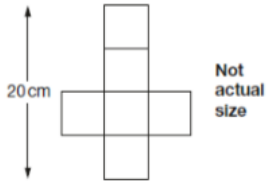
8 (i) 5 hours 46 minutes

(ii) 11 hours 13 minutes

4Additional Section - Mathematics

Additional Section - Mathematics

This is the net of a cube.



What is the **volume** of the cube?

125 cm^3

1 mark

The length of a day on Earth is 24 hours.

The length of a day on Mercury is $58\frac{2}{3}$ times the length of a day on Earth.

What is the length of a day on Mercury, in **hours**?

1408 hours

2 marks

The length of an alligator can be estimated by:

- measuring the distance from its eyes to its nose
- then multiplying that distance by 12

What is the **difference** in the estimated lengths of these two alligators?

Not to scale

30 cm

2 marks

33,630 = 354 × 95

Use this multiplication to complete the calculations below.

354 × 9.5 = 3363

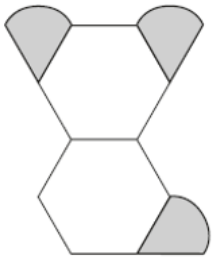
3,540 × 95 = 336300

3,363 ÷ 95 = 35.4

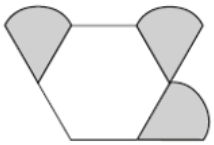
2 marks

Amina is making designs with two different shapes.

She gives each shape a value.



Total value is 147



Total value is 111

Calculate the value of each shape.

 = 36

1 mark

 = 25

1 mark

There are 28 pupils in a class.

The teacher has 8 litres of orange juice.

She pours 225 millilitres of orange juice for every pupil.

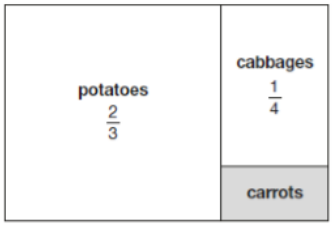
How much orange juice is left over?

1700ml

3 marks

This is a diagram of a vegetable garden.

It shows the fractions of the garden planted with potatoes and cabbages.



Not to scale

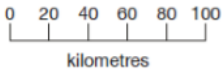
The remaining area is planted with carrots.

What **fraction** of the garden is planted with carrots?

$\frac{1}{12}$

2 marks

On a map, 1cm represents 20 km.



The distance between two cities is **250 km**.

On the map, what is the distance between the two cities?

12.5 cm

2 marks

Here is a pattern of number pairs.

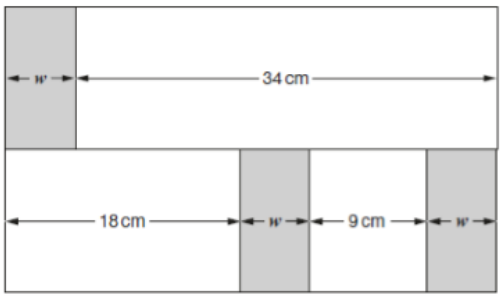
a	b
1	9
2	19
3	29
4	39

Complete the **rule** for the number pattern.

$b = 10 \times a - 1$

1 mark

In this diagram, the shaded rectangles are all of equal width (w).



Not to scale

Calculate the width (w) of one shaded rectangle.

7 cm

2 marks

Dev thinks of a **whole** number.

He multiplies it by 4

He rounds his answer to the nearest 10

The result is 50

Write **all** the possible numbers that Dev could have started with.

12, 13

2 marks

Miss Mills is making jam to sell at the school fair.

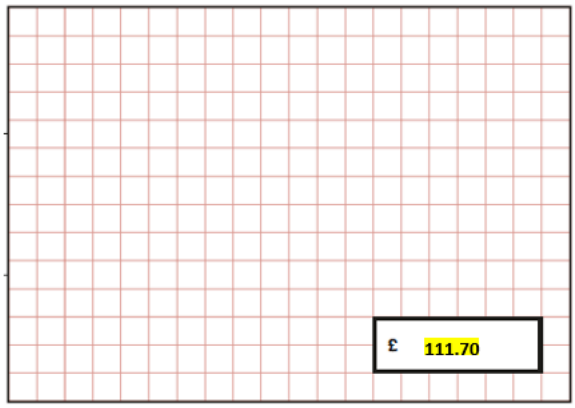
Strawberries cost £7.50 per kg.

Sugar costs 79p per kg.

10 glass jars cost £6.90

She uses 12 kg of strawberries and 10 kg of sugar to make 20 jars full of jam.

Calculate the total cost to make 20 jars full of jam.



3 marks

Lara had some money.

She spent £1.25 on a drink.

She spent £1.60 on a sandwich.

She has **three-quarters** of her money left.

How much money did Lara have to **start with**?

2 marks

Science Test Answers

Biology

Structure and function of living organisms: plants

1 **A** flower; **B** leaf; **C** stem; **D** tap root; **E** lateral root; **F** root hair; **G** shoot system; **H** root system

Roots **anchor** plants firmly in the ground. They are also responsible for the uptake of **water** and **minerals** from the soil. Stems hold plants upright, spread out leaves for **photosynthesis** and elevate flowers for **pollination**. Most leaves are green due to the presence of **chlorophyll**. Flowers are the structures of most plants that are responsible for **reproduction.**

2 **A** petal; **B** stigma; **C** style; **D** ovary with ovules; **E** anther; **F** filament; **G** sepal; **H** receptacle

Flowers usually consist of five main elements (though these are not always present or immediately obvious): often brightly coloured and scented petals which attract **pollinators**, papery sepals which **protect** the flower in bud, male and female reproductive organs which work together to ensure the **continuity** of each species, and a receptacle which **supports** the weight of everything.

3 (c) the anther and filament

4 (a) the stigma, style and ovary

5 carbon dioxide + water $\xrightarrow[\text{(chlorophyll)}]{\text{(energy in sunlight)}}$ glucose + oxygen

(*Note*: 1 mark for each side of the equation and 1 mark for sunlight and chlorophyll)

6

root hair cells	to	take up water and dissolved minerals from soil
guard cells	to	allow various gases to move into and out of leaves
phloem cells	to	form vessels which conduct simple sugars in sap
xylem cells	to	form vessels which conduct water and dissolved minerals
palisade cells	to	carry out photosynthesis in leaves

7 (c) all of the above

8

pollination	to	the transfer of pollen from anther to stigma
fertilisation	to	nuclei of male and female sex cells meet and fuse
seed formation	to	development of embryo plant
seed dispersal	to	scattering mechanism which helps avoid competition
germination	to	appearance of new root and shoot systems

9 (c) all of the above

10 The energy which drives photosynthesis comes from the Sun.

Common misconceptions including simple explanations in brackets

Children may think that:

- plants are not living things (plants are alive even though some of the characteristics of living things, e.g. movement and sensitivity, are less obvious in plants than in animals);
- living things are those that move (children often over-emphasise movement as a criterion for classification of objects as 'living' and do not take into account all seven conditions required – Mrs Gren);
- trees, grass, vegetables and weeds are not plants (children do not classify systematically and their criteria for classification lack discrimination; there are many types of plants and not all plants have the same structures);
- seeds require light and soil as well as warmth and water to germinate (most seeds only require oxygen, warmth and water to germinate; seedlings, once germinated, require light, as well as minerals from soil);
- plants take all the things they need from the soil through their roots in order to grow (water and mineral salts are taken in through the roots from the soil; air is taken in through the leaves, and the chloroplasts in the leaves absorb the Sun's energy and use the carbon dioxide in the air together with water to produce glucose in the process of photosynthesis);
- flowers are for human enjoyment and to look pretty (children may have anthropocentric ideas about plants; flowers are the sexual reproductive structure of a flowering plan; most non-flowering plants reproduce sexually via spores).

Structure and function of living organisms: humans and other animals

1 **A** cranium; **B** maxilla; **C** mandible; **D** clavicle; **E** scapula; **F** sternum; **G** rib; **H** humerus; **I** vertebra; **J** ulna; **K** radius; **L** sacrum, ilium and coccyx (bones of the pelvis); **M** femur; **N** patella; **O** fibula; **P** tibia; **Q** carpals, metacarpals and phalanges (bones of the hand); **R** tarsals, metatarsals and phalanges (bones of the foot)

The human skeleton **protects** vital organs. It provides a framework which supports the **weight** of individuals and, with the help of muscles, allows humans to **stand** upright. The human skeleton also provides attachment for **muscles** and **tendons** allowing free movements to take place across joints.

2 (b) 206

3 True

4 (a) **A** biceps; **B** triceps

(b) the arm bends or flexes at the elbow

(c) the arm straightens or extends at the elbow

(d) antagonistic pairs – they work together so when one relaxes the other contracts

(e) the leg

Muscles have the ability to **contract** when stimulated by nerves. Almost all movements within the human body, voluntary and involuntary, are caused by muscles, and muscles allow humans to **locomote** or to get around from one place to another. Muscles are grouped on the basis of structure and function into three types: **skeletal** muscle, **smooth** muscle and **cardiac** muscle.

5 **A** superior vena cava; **B** pulmonary artery; **C** aorta; **D** pulmonary vein; **E** right atrium; **F** right ventricle; **G** left atrium; **H** left ventricle; **I** inferior vena cava; **J** pulmonary circuit

Blood is circulated around the body by the **heart**, a four-chambered organ that works like two pumps side by side. The human circulatory system transports **blood**, food substances and **heat** all around the body. It gets white blood cells and platelets to where they are needed for the fight against **disease** and for **healing** wounds.

6 **A** teeth; **B** salivary glands; **C** tongue; **D** epiglottis; **E** oesophagus; **F** stomach; **G** liver; **H** gall bladder; **I** pancreas; **J** small intestine; **K** large intestine; **L** rectum; **M** anus

The human digestive system essentially receives and, where necessary, processes food into substances that will **dissolve**. These are eventually transported around the body in the **blood** to wherever they are needed. The processing of food takes place in three stages: **ingestion**, digestion and **egestion**. During digestion, which takes place in the digestive tract or **alimentary** canal, the useful constituents or nutrients within food are released. A **balanced** diet of **carbohydrates**, fats, **proteins**, vitamins, **minerals**, fibre and water provides all the nutrients humans need.

7

incisors	to	cutting food
canines	to	tearing food
premolars	to	crushing and grinding soft food
molars	to	crushing and grinding hard food

8 **A** enamel; **B** dentine; **C** pulp; **D** root; **E** crown

The hardest substance in your body is **enamel** but this can be eroded by **bacteria**, which live on your teeth. They feed on **sugars** and produce **acid**, which dissolves your teeth causing tooth **decay**. **Fluoride** in toothpaste helps strengthen the **enamel** to resist acid attack.

9 Humans reproduce sexually. The **internal** fertilisation of a female **gamete** or sex cell (an egg or ovum) by a male **gamete** or sex cell (a sperm), usually following sexual intercourse, results in the fusion of cell nuclei and the formation of a **zygote** containing all of the genetic information or **DNA** needed in order to produce a fully formed adult. Eventually, and in the uterus, a human **foetus** grows within its own environment in a fluid-filled sac or amnion, which protects it. Here, it gets its oxygen and other useful substances from its mother via the **placenta** and **umbilical** cord. After a gestation period of about **40** weeks, female humans give birth to babies who grow and mature in order to complete their own life cycles.

10 **M** movement; **R** reproduction; **S** sensitivity; **G** growth; **R** respiration; **E** excretion; **N** nutrition

11

bacteria	to	sore throats, tuberculosis, typhoid, cholera
viruses	to	colds, flu, measles, mumps, polio
fungi	to	athlete's foot, ringworm, thrush
protoctista	to	amoebic dysentery, sleeping sickness, malaria

12 Kingdom, Phylum, Class, Order, Family, Genus, Species

13 True

1. suckle their young
2. have hairy bodies
3. give birth to living young
4. are vertebrates
5. are warm blooded

14

woodlice	to	crustaceans
worms	to	annelids
spiders	to	arachnids
snails	to	molluscs
butterflies	to	insects

Common misconceptions including simple explanations in brackets

Children may think that:

- anything that moves is alive, e.g. the Moon, clocks, fires, cars, bicycles (animism is the ascription of animal characteristics to items that are not animals);
- animals have happy faces (anthropomorphism is the ascription of human characteristics and feelings to other objects and living things);
- humans are not animals (children often classify human beings as a separate category to other animals);
- food and drink are taken into the human body and travel through it separately, blood is not contained in blood vessels, and the bones of the skeleton are not connected together (children's knowledge of the structure and function of the systems within the human body is generally not well developed).

Interactions and interdependencies

1 (a) From the diagram, the leaves, seeds and berries are the 'producers'. Strictly speaking, however, the green plants (e.g. the trees and shrubs) they come from are actually the producers, for it is the green plants that produce their own food by photosynthesis and make the leaves, seeds and berries available.

(b) The rabbit is a herbivore; it eats leaves.

(c) The small bird is an omnivore; it eats insects and berries.

(d) The fox is a carnivore; it eats almost all of the other animals present.

(e) berries ⟶ insect ⟶ small bird ⟶ fox

(f) An increase in the number of rabbits potentially provides the foxes with more food. If this situation were to persist, such favourable conditions would support a larger fox population. Fox numbers would therefore be expected to increase too.

2

grass	to	producer
rabbit	to	primary consumer (herbivore)
fox	to	secondary consumer (carnivore)

The place where a community of organisms lives is called a **habitat**. A community, together with the living and non-living environmental factors which affect how organisms interact and live their lives, is called an **ecosystem**. All living organisms need food for **energy** and the raw materials necessary for healthy growth. **Green** plants are **autotrophs (producers)** and make their own food by photosynthesis. Animals are **heterotrophs (consumers)** and get their food by eating plants and other animals. A food **chain** shows how living organisms feed on other living organisms. Complex feeding relationships are better shown using a food **web**. Micro-organisms which feed on the remains of dead plants and animals and return useful chemicals into the soil are known as **decomposers**.

3 pollution; increase of human population; introduction of alien species; intensive farming; global warming

Common misconceptions including simple explanations in brackets

Children may think that:

- food chains only involve predators and prey (the roles of the Sun as the ultimate source of energy and plants as primary producers are frequently ignored);
- organisms that are higher in a food web eat everything that is below them (there are different feeding relationships in a food web; a simple version is that herbivores eat plants, primary predators eat the herbivores and secondary predators eat the primary predators);
- food chains constitute the relationship in an ecosystem (a community of organisms in a habitat form a complex food web that more accurately depicts the energy flow in an ecosystem).

Genetics and evolution

1	polar bear	to	big feet
	camel	to	long eyelashes
	seal	to	large amount of subcutaneous fat

Common misconceptions including simple explanations in brackets

Children may think that:

- genes are the sole determinant of the traits in an individual (environmental factors and life style choices – for humans – can affect the traits of an individual);
- living things choose to have particular characteristics in response to their needs, e.g. the thick white coat of a polar bear (plants and animals adapt in response to their environment for survival).

Chemistry

Materials and their properties including the particulate nature of matter

1

Elastic	– deforms when a force is applied but returns to its original shape when force is removed	– rubber band
Plastic	– is permanently deformed as a result of a force acting on it	– play dough
Hard	– very difficult to scratch	– diamond
Tough	– does not break or tear easily	– polythene wrapping
Brittle	– breaks easily	– glass

2 **Physical changes:** true – usually reversible, cause changes in the arrangement of the particles in a substance; false – usually irreversible, produce new substances

Chemical changes: true – usually irreversible, produce new substances; false – usually reversible, cause changes in the arrangement of the particles in a substance

3

solid	to	definite shape, fixed volume, moderate to high density, not compressible
liquid	to	takes the shape of the container it is in, fixed volume, moderate density, very slightly compressible
gas	to	no definite shape, no fixed volume, low density, easily compressible

4 **A** melting; **B** solidifying/freezing; **C** evaporating/boiling; **D** condensing; **E** subliming; **F** reverse subliming

5 **True –** the particles move faster, the particles move further apart, the particles have more energy

False – the particles change shape, the particles lose mass, the particles gain mass, the particles are more tightly bonded

6 (a) energy is transferred to the molecules of the substance

7 **Chemical change:** paper burning, an egg being boiled, grass cuttings decomposing in a compost heap, concrete hardening, an iron nail rusting

Physical change: solid carbon dioxide changing into gaseous carbon dioxide, ice changing to water, a lump of play dough rolled into a 'wiggly worm', sugar dissolving in a cup of coffee, salt added to an icy path

8 **Exothermic:** plaster of Paris and water becomes hotter, nuclear fission

Endothermic: bicarbonate of soda and vinegar becomes cooler, obtaining iron from iron ore

9 (c) the same mass as the reactants

10

solid in a solid	to	sand and pebbles
gas in a liquid	to	Coca Cola
gas in a gas	to	air
liquid in a gas	to	clouds
solid in a gas	to	smoke
liquid in a liquid	to	milk
solid in a liquid	to	flour in water

11

paper clips and sawdust	to	using a magnet
pebbles and sand	to	sieving
salt and sand	to	dissolving, filtering, evaporating
different coloured inks	to	chromatography
water and alcohol	to	distillation

12 (c) break up and become so small that they are no longer visible

13 water – solvent; salt – solute; brine – solution

sugar – solute; water – solvent; syrup – solution

alcohol – solvent; plant oils – solute; perfume – solution

pigment – solute; ink – solution; water – solvent

14 (a) A

(b) A polystyrene; B china

(c) Polystyrene is a better heat insulator than china. The tea cools more slowly. Alternatively, you could say that china is a better heat conductor than polystyrene and the tea cools more quickly.

(d) The tea would cool rapidly. Both curves would show a marked drop in temperature.

(e) The tea would cool down but less rapidly than with milk. Both curves would show a marked but gentle drop in temperature.

(f) Heat energy is transferred through the material of both cups by conduction and radiated into the atmosphere around them. The air around both cups is heated and this energy is transferred further into the atmosphere by convection. Some heat energy is transferred to the atmosphere by evaporation.

Common misconceptions including simple explanations in brackets

Children may think that:

- the uses of objects rather than the materials they are made from are used to identify and characterise them (children focus on the object properties rather than the properties of the materials);
- solids are generally large, heavy and inflexible (this makes it difficult for children to understand that sand, salt or flour are solids);
- the terms solid, liquid or gas refer only to ice, water and vapour/steam (the majority of materials can exist in these different physical states);
- melting and dissolving are the same (melting is a change of state from solid to liquid; dissolving occurs when one substance is mixed into a liquid substance to form a solution);
- when a physical change occurs, a new substance forms (physical changes alter the physical properties not the chemical properties of a material);
- substances disappear when they evaporate or dissolve, and can also 'magically' reappear (the notion of conservation of mass is difficult for children to understand).

Earth and atmosphere

1 **igneous** – formed from the intrusion or extrusion and cooling of molten rock – granite, basalt

metamorphic – formed when heat and pressure completely change existing rocks over long periods of time – slate, schist, gneiss, marble

sedimentary – formed when layers of sediment get buried and crushed under the weight of other layers – limestone, mudstone, sandstone

2 **A** heat energy from the Sun; **B** evaporation; **C** transpiration; **D** condensation; **E** precipitation; **F** run-off

3 Non-renewable means that the energy resources will one day become depleted and cannot ever be used again or replaced.

4 Renewable means that the energy resources will never run out, can be used over and over, and are replaced continually.

5 (d) the petrified remains of different organisms from a previous geological age

Common misconceptions including simple explanations in brackets

Children may think that:

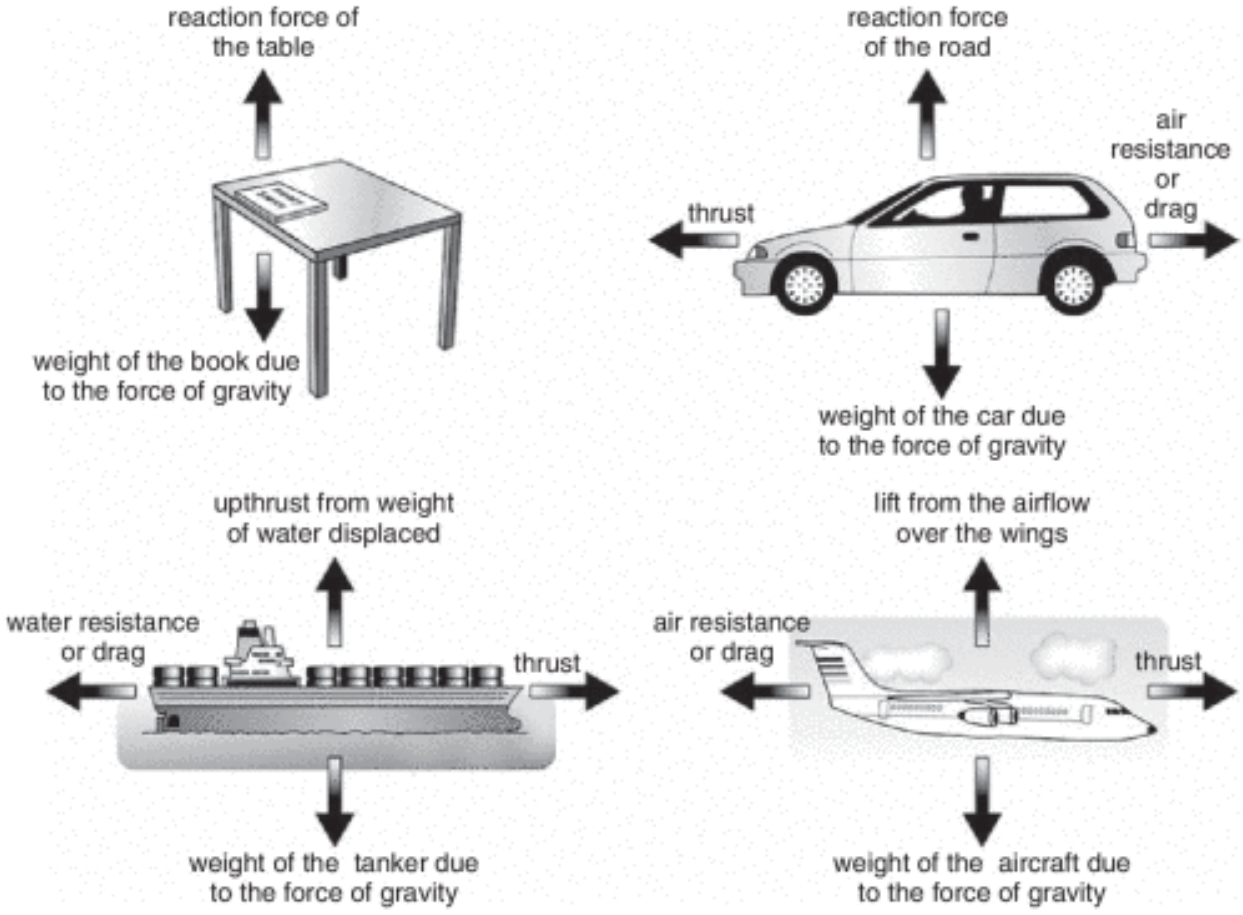
- any item that is hard is a rock (bricks, hardened clay, concrete, as well as limestone or granite are all thought of as rocks);
- rain occurs when the clouds are full (rain/precipitation occurs when warm moist air meets colder air; the water vapour in the warm air changes from a gas to a liquid and forms rain drops).

Physics

Motion and forces

1 A force is a **push,** a **pull**, a twist or a turn. When an object is stationary or moving at a constant speed in a straight line the forces acting on it are said to be **balanced**. Unbalanced forces cause objects to start moving and **speed** up, slow down and come to a stop, or change **direction**. Unbalanced forces also bring about changes in **shape**. If an object has no **driving** force moving it along, it will always slow down and stop because of friction. Friction also includes **air** resistance and **water** resistance. Friction always increases as the speed of a moving object increases. Friction can also be useful. Without friction, standing up, riding a bicycle or driving around in cars would be very **difficult**.

2



(*Note*: 2 marks for the balanced forces in each example)

3 (c) all of the above

4 (c) all of the above

5 (b) newtons (N)

6 On the surface of the Earth, the hammer would hit the ground first. The feather would be seriously affected by air resistance, which would slow down its fall. On the Moon there is no air. The hammer and the feather would fall together and hit the surface at the same time.

7 Mass and weight are separate things. The mass of an object is simply the amount of **matter** in it. Mass is measured in **kilograms** (kg). The mass of an object remains the same regardless of whether it is found on Earth or in space. Interestingly, any two objects with mass exert a **force** on each other but this is only noticeable when one of the objects is particularly massive. This force of attraction between all masses is called gravity. Weight is a force. As a result, weight is measured in **newtons** (N). The weight of an object changes depending on where it is in the Universe. All objects on the surface of the Earth are pulled towards it with a force of about 10 N/kg. The Moon is much less massive than the Earth. All objects on the surface of the Moon are pulled towards it with a force of about 1.6 N/kg. An object on the surface of the Earth therefore weighs **more** than the same object on the surface of the Moon even though it has exactly the **same** mass.

8 True. An example of gravity forces acting between two objects at a distance is **between** the Earth and the Moon. The Earth's gravitational pull keeps the Moon in orbit although the two objects are not in contact with each other.

9 The movement of an object can be described in terms of its speed or how **fast or quickly** it is going. The speed of an object can be calculated easily if we know the **distance** it travels and the **time** taken to travel that distance. Speed is usually measured in **metres per second** (m/s). The movement of an object can also be described in terms of its velocity. The term velocity should be used in preference to speed when the **direction** in which an object is moving is given. Objects do not always travel at a constant speed or velocity, however. They can always speed up or change direction. Objects which speed up, change direction or do both at the same time are said to **accelerate**.

Sound

1 **A** outer ear; **B** middle ear; **C** inner ear; **D** pinna; **E** ear canal; **F** ear drum; **G** hammer; **H** anvil; **I** stirrup; **J** cochlea; **K** auditory nerve; **L** Eustachian tube; **M** semi-circular canals

Ears allow us to hear. We have two ears in order to help locate sound sources accurately. Sounds entering the ears cause the ear drums to **vibrate**, which in turn force the three small bones of the middle ear to move. Specialised cells within the cochlea (sensitive to vibration and movement) change sound energy to electrical energy. Electrical impulses travel via the auditory nerve to the brain where they are **processed** and interpreted as sound. Unwanted or disagreeable sound is called **noise**. Exposure to particularly loud sounds even for short periods of time can damage the ear drum and lead to partial or complete **deafness**. The ears are never 'switched off'. The Eustachian tube in each ear is responsible for maintaining **pressure** balance between the middle ear and the outside world. The semi-circular canals are concerned with **balance** and orientation and not hearing.

2 (a) about 330 m/s

3 Sound travels in waves. These waves are described as **longitudinal** waves.

4 (a) piano – strings struck by key mechanism

(b) drum – skin struck by a drum stick or hand

(c) recorder – air blown into it

(d) guitar – strings plucked or strummed

Pitch can be altered by changing the thickness, the length and the tightness of the strings. Volume can be changed by plucking or strumming with more or less force.

Light

1 **A** eyelid; **B** iris; **C** cornea; **D** pupil; **E** lens; **F** aqueous humour; **G** ciliary muscle; **H** sclera (white of eye); **I** retina; **J** vitreous humour; **K** optic nerve

Eyes allow us to see. Each eye has a series of **muscles** which allow movement within the retaining eye socket. Two eyes provide **binocular** vision, which provides depth perception and distance judgement. Light enters the eye through the cornea and lens which focus the light rays onto a **light**-sensitive layer called the retina. Specialised cells within the retina called **cones** (sensitive to colour) and **rods** (sensitive to 'greys') change light energy to electrical energy. Electrical impulses travel via the optic nerve to the brain where they are **processed** and interpreted as sight. Between the cornea and the lens is the iris. The iris determines the **colour** of the eye. At the centre of the iris is the pupil. The pupil changes size in response to the amount of **light** entering the eye. This means that in areas with **bright** light the pupil will be **smaller** than in darker areas.

2 **Primary**: a torch, a burning candle, the Sun

Secondary: the Moon

3 (a) 300 000 km/s

4 Light travels in waves. These waves are described as **transverse** waves.

5 (b) red, blue and green

6 (c) red, blue and yellow

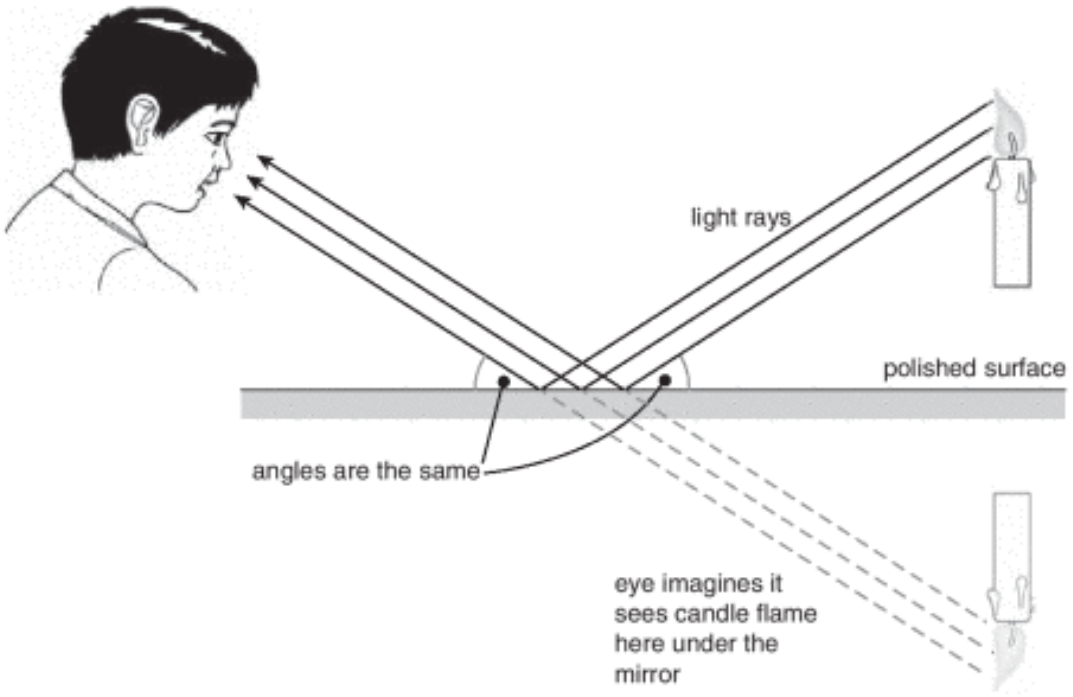
7 red, orange, yellow, green, blue, indigo and violet

8 (a) Green objects absorb all colour wavelengths except for green.

(b) Objects appear white because they **reflect** all of the light that falls on them. Objects appear black because they **absorb** all of the light that falls on them.

9 Shadows are formed when light is blocked. When the light from a projector is blocked by an object, the shadow formed on a wall, for example, can be made **bigger** by increasing the distance between the object and the screen or by decreasing the distance between the projector and the object. Some shadows are 'black'. Some shadows appear with a dark central area and a fuzzy, grey outline. The dark part of the shadow is known as the **umbra**. The fuzzy, grey outline is known as the **penumbra**.

10



11 Polished surfaces reflect light perfectly resulting in a clear reflection. Rough surfaces reflect light at different angles resulting in a diffuse reflection.

12 transparent — allows light to pass and objects to be seen clearly

translucent — allows light to pass but objects appear blurred

opaque — blocks light and images completely

Electricity and magnetism

1 (a) True

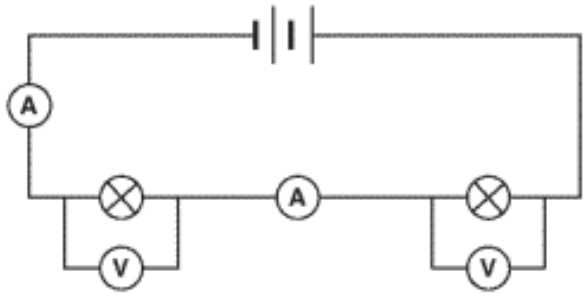
(b) Unscrewing one bulb from its holder will cause the other bulb to go out.

(c) The same current flows through all parts of a series circuit, so 0.2 A.

(d) The total voltage is shared between components. The bulbs are identical, so 1.5 V.

(e) Rearranging Ohm's Law gives R = V/I, so R = 1.5/0.2 or 7.5 ohms (the total resistance of the whole circuit would be 15 ohms – both bulbs).

(f)



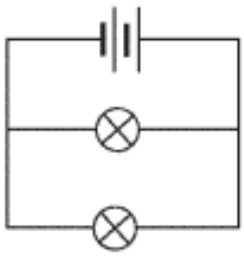
(g) The battery supplies the circuit with electricity and therefore energy. The electrical energy is transferred through the connecting wires to the circuit components, the bulbs, where it is changed or converted to light and heat.

(h) True – the three identical bulbs will be equally bright.

False – the three identical bulbs will be less bright than the two bulbs in the previous series circuit.

Adding a third bulb increases the resistance of the circuit as a whole and thus decreases the intensity of the bulbs' brightness.

(i)



(j) When bulbs are connected in parallel, the overall resistance of the circuit is reduced. Both bulbs would glow with equal brightness but more brightly than in the series circuit.

If one of the bulbs is removed then the other bulb would continue to glow as the circuit is still closed.

2 **A** filament lamp or bulb; **B** cell; **C** battery; **D** switch; **E** resistor; **F** motor; **G** buzzer

3 **Conductor**: a material which allows electricity to flow through it

Insulator: a material which does not allow electricity to flow through it

Current: the flow of electrons or electricity around a circuit

Voltage: the energy of the electrical flow (sometimes referred to as the force that pushes the current around)

Resistance: the difficulty electricity has in passing through a conductor (a resistor is anything that opposes the flow of current)

Power: the rate at which energy is transferred to, say, a circuit component

4 **Good conductors**: copper, aluminium, gold

Poor conductors: skin, water

Insulators: rubber, wood, air

5 Some materials are magnetic. That means that they are both **attracted** to magnets and can be **magnetised**. Magnetic materials include the metals **iron** and **steel (not stainless)** as well as nickel and cobalt. All magnets have **north** and **south** poles. The rule of magnets states that **unlike** poles attract while **like** poles **repel**. That means that when **opposite** poles of magnets are brought close together it is possible to feel an **attractive** force between them. When **like** poles of magnets are brought close together it is possible to feel a **repelling** force between them. A simple compass is nothing more than a freely moving magnet which aligns itself with the Earth's magnetic field. The end of the magnet which points north is referred to as the **north**-seeking pole. The rule of magnets tells us, therefore, that what we refer to as geographical north is actually the Earth's magnetic **south** pole.

6 The magnetic field strength can be changed by altering the size of the current flowing through the wire, the number of winds of wire around the nail, and what material the nail is made of.

The Earth and space

1 The Universe is, quite literally, everything that exists: **matter** (from atoms and molecules to stars and galaxies), **radiation** (visible light together with the rest of the electromagnetic spectrum) and **space** (the vast emptiness within and between galaxies). The Universe is about 12 **billion** years old and most probably emerged from an explosive event referred to as the **Big Bang**. The Universe has been growing in size or **expanding** ever since.

2 Galaxies are assemblages of **stars**, nebulae and other interstellar materials. A typical galaxy contains more than **100** billion stars and measures about **100 000** light years across. Galaxies are classified into four main groups depending on their appearance: **spirals**, barred spirals, **ellipticals** and irregulars. Galaxies are not randomly scattered throughout the Universe; they occur in clusters: **rich** clusters of hundreds or thousands of galaxies and **poor** clusters of a few tens. Our own Sun is located within the Orion Arm of what is referred to as the **Milky Way** galaxy, one of about 30 other galaxies known as the Local Group.

3 Universe, local group of galaxies, Milky Way, Solar System, Earth–Sun–Moon system, Sun, Earth, Moon

4

Sun	to	a star (ball of hot, glowing gas)
planets	to	rocky and gassy objects which orbit the Sun
moons	to	natural satellites which orbit planets
asteroids	to	lumps of rock often referred to as minor planets
comets	to	chunks of ice and other material often seen with a tail
meteoroids	to	small particles of dust and rock fragments

5 (a) Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto

(b) Mercury, Venus, Earth, Mars

(c) Jupiter, Saturn, Uranus, Neptune

(d) False – Venus is, because of its dense atmosphere and greenhouse effect.

(e) Jupiter

(f) Saturn

(g) Mercury and Venus

(h) Jupiter, Saturn, Uranus, Neptune

(i) True

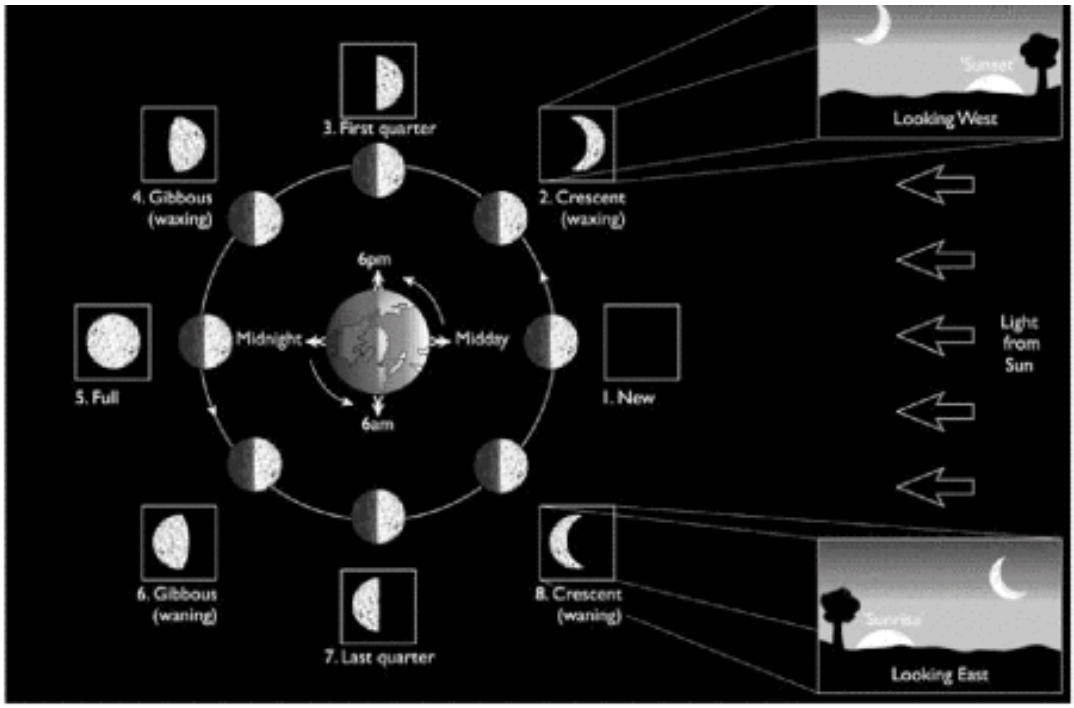
6 **A** where the Sun never 'sets'; **B** where the Sun never 'rises'; **C** where more than 12 hours of daylight are experienced; **D** where exactly 12 hours of daylight are experienced; **E** where less than 12 hours of daylight are experienced; **F** light from the Sun

7 (a) approximately 24 hours

8 The **tilt** of the Earth's axis relative to the plane of its orbit around the Sun causes the seasons. In the UK, the year-long cycle of seasons includes spring, summer, autumn and winter. In June, the **northern** hemisphere is tilted **towards** the Sun and experiences summer while the **southern** hemisphere is tilted away and experiences **winter**. The effects are dramatic. In the UK, for example, summer days are **long**, the Sun 'rises' **high** above the horizon so the Sun's rays reach the surface of the Earth at a **high** angle, and the Earth is **heated** by the Sun for **more** than 12 hours. The Sun's heating effect is **more** efficient and summers are warm. In December the opposite occurs.

9 (c) 365.25 days

10



11 (b) once a month