Further guidance

Contents

There are no further activities or notes associated with this module.

A3 Scientific detection – Workbook answers

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<tr><td>1</td><td>a</td><td>i</td><td>Law enforcement – crime scene investigator, forensic scientist, DNA profiler</td></tr>
<tr><td></td><td></td><td>ii</td><td>Environmental protection – environmental protection officer, drinking water inspector</td></tr>
<tr><td></td><td></td><td>iii</td><td>Public analyst, trading standards officer</td></tr>
<tr><td></td><td>b</td><td></td><td>• Monitoring air quality – EA
• Analysis of crime scene samples – FSS
• Improving the water quality of freshwater lakes – EA
• Advising the public about healthy eating – FSA
• Investigating outbreaks of food poisoning – FSA
• Investigating cases of soil pollution – EA
• Checking the safety of food packaging – FSA
• Fingerprint examination and matching – FSS</td></tr>
<tr><td>2</td><td>a</td><td></td><td>
<table>
<tr><th rowspan="2">Task</th><th colspan="3">Good laboratory practice</th></tr>
<tr><th>Health and safety</th><th>Staff training</th><th>Equipment maintenance</th></tr>
<tr><td>Send the laboratory coats to the laundry</td><td>✓</td><td></td><td></td></tr>
<tr><td>Put away the clean glassware</td><td></td><td></td><td>✓</td></tr>
<tr><td>Clean and check an electronic balance</td><td></td><td></td><td>✓</td></tr>
<tr><td>Use a checklist to confirm the fire extinguishers, first aid kits, and emergency equipment are in place</td><td>✓</td><td></td><td></td></tr>
<tr><td>Write a standard operating procedure for the new equipment and present it to a safety committee meeting for approval</td><td>✓</td><td></td><td></td></tr>
<tr><td>Show a colleague how to operate the new equipment</td><td></td><td>✓</td><td></td></tr>
</table>
</td></tr>
<tr><td></td><td>b</td><td>i</td><td>Too high – B
Acceptable – A, C, D, E
Too low – F</td></tr>
<tr><td></td><td></td><td>ii</td><td>It is acceptable, but only just</td></tr>
<tr><td></td><td>c</td><td>i</td><td>It shows that the laboratory meets the required standards.</td></tr>
<tr><td></td><td></td><td>ii</td><td>A list of tests that the laboratory is accredited to carry out.</td></tr>
<tr><td>3</td><td>a</td><td></td><td>Different scientists in different laboratories can carry out the procedure in exactly the same way, and present their results in the same way, so results from different scientists can be compared reliably.</td></tr>
</table>

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	b		Special weights of known mass
	c*		Missing words: top, graduation. lines up, 0.88
4	**a**	**i**	12.5 m (Lotte)
		ii	Not very – it should be to at least one decimal place to be compared reliably with the other values.
		iii	He was able to estimate by eye how many hundredths of a metre there were.
		iv	15.3 m × 10.0 m = 153 m2
	b*	**i**	15.3 m ± 10 cm
		ii	Area = width × length, so the level on uncertainly is multiplied
5	**a**	**i**	Any three of: size (length), claws/no claws, length of antennae in relation to body, size of eyes, presence of absence of limbs of rear segments
		ii	A = 40 cm, B = 1.25 cm
		iii	Possible responses: colour, speed of movement, location on the beach, behaviour
		iv	Labelling/annotation, adding colour or shading
		v	Photographs, photos/sketches at different angles (e.g. underside view, side view, plane view)
6	**a**		Colours at pH: 1 red, 3 red, 5 red, 7 purple, 9 blue, 11 blue, 13 blue
	b		The soil is acidic.
	c		The pH of the soil (to the nearest whole number)
	d		Missing words: qualitative, semi-quantitative
	e		pH 4 orange, pH 6 yellow, pH 8 green, pH 10 purple
7	**a**		Graph is a straight line rising from the origin – concentration increasing directly with intensity (similar to graph on page 43 of the textbook)
	b		Missing words: colour, intensity, compared, semi-quantitative
	c		

Test kit	**Qualitative result**	**Semi-quantitative result**
Pregnancy test	✓	
Glucose test strip		✓
Pool-water test strips		✓
Soil test kits		✓
Carbon monoxide detector	✓	

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8	**a**		Missing words: (light source) → filter → test solution → light-sensitive cell → meter
	b		…the meter to zero
	c		Correctly plotted graph (similar to graph on page 43 of the textbook)
	d		X = 1.9 g/dm3, Y = 0.6 g/dm3, Z = 1.5 g/dm3
	e		Missing words: intensity, concentration, quantitative
9	**a**		• The colour matching kit – simple, easy to use, low cost; it gives semi-quantitative results; 2 different test available, so it is useful for a testing a wide range of features. • The colorimeter kit – more advanced, so possibly less easy to use, but it gives more accurate quantitative results, and ensures consistency when comparing results.
	b*		Missing words: high, consistent, narrow, sensitivity
10	**a**	**i**	Correctly labelled diagram: • the mobile phase is the tinted area (the solvent) • the stationary phase is the white area (the paper) • the solvent front is the top edge of the tinted area in the front view
		ii	Horizontal arrows on the second diagram (side view) moving in both directions between the spots of X and Y in the stationary and mobile phases (i.e. between the white and tinted areas)
		iii	A vertical arrow on the first diagram (front view) pointing up from the top of the solvent front to the top of the paper
		iv	Vertical arrows on the first diagram (front view) pointing up from each of the spots (i.e. the spots above X and Y)
	b		The spot would not move.
	c*		Missing words: attraction, faster, slower, separate
11	**a**	**i**	3
		ii	E102, E124
	b*		Rf = 0.2
	c		The curry sauce contains two permitted colours but possibly/probably contains Sudan 1 which is banned.
	d		Repeat the chromatography of sample S with a sample of Sudan 1 at the same time, to see if the spots match.
12		**i**	D
		ii	A
		iii	A, B, C

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<table>
<tr><td>13*</td><td>a</td><td></td><td>• It is quicker than paper chromatography.
• It can separate a wider range of mixtures.</td></tr>
<tr><td></td><td>b</td><td>i</td><td>The spots are invisible.</td></tr>
<tr><td></td><td></td><td>ii</td><td>It has reacted with the spots to produce coloured compounds that can be seen.</td></tr>
<tr><td></td><td></td><td>iii</td><td>Sample S contains substances A and C.</td></tr>
<tr><td>14</td><td>a</td><td></td><td>Labels from top to bottom: eyepiece, coarse focus, fine focus, objective lenses, stage, mirror. See diagram on textbook page 28.</td></tr>
<tr><td></td><td>b</td><td></td><td>Put on protective clothing. → Place 5 drops of yeast suspension in a test tube. → Add 5 drops of methylene blue solution. → Shake to mix the liquids. → Place one drop of the mixture in the centre of a clean slide. → Use a mounted needle to lower a cover slip over the liquid. → Remove any surplus with a tissue. → Dispose of waste material into a suitable container. → The slide is ready for microscopic examination.</td></tr>
<tr><td>15</td><td>a</td><td></td><td>
<table>
<tr><td>eyepiece</td><td>objective</td><td>final</td></tr>
<tr><td>× 10</td><td>× 10</td><td>× 100</td></tr>
<tr><td>× 10</td><td>× 20</td><td>× 200</td></tr>
<tr><td>× 10</td><td>× 40</td><td>× 400</td></tr>
</table>
From left to right: red blood cells 1mm diameter (× 100), 2 mm (× 200), 4 mm (× 400)
</td></tr>
<tr><td></td><td>b</td><td></td><td>Missing words: resolved, × 1500, magnification, higher</td></tr>
<tr><td>16</td><td>a</td><td></td><td>A number of water samples should be collected from different parts of the stream at a range of depths to give a picture of the stream as a whole.</td></tr>
<tr><td></td><td>b</td><td></td><td>Samples are immediately sealed, labelled then refrigerated.</td></tr>
<tr><td></td><td>c</td><td></td><td>They wear protective clothing and put all samples into sealed bags or bottles.</td></tr>
<tr><td></td><td>d</td><td></td><td>A seal that, if broken, cannot be re-sealed to look the same as before.</td></tr>
<tr><td></td><td>e</td><td></td><td>Get a screw-top jar, wash thoroughly under running water from the cold tap (to remove all traces of other substances), fill with cold water, seal the lid, dry and label.
The label must say where the sample came from (which tap, which room, which property) and give the exact time and date.</td></tr>
<tr><td>17</td><td>a</td><td></td><td>They would move through the gel towards the positive electrode.</td></tr>
<tr><td></td><td>b</td><td></td><td>The shortest fragments would move fastest while the longest fragments would move slowest. The sample would split into three bands.</td></tr>
<tr><td></td><td>c</td><td></td><td>D</td></tr>
<tr><td></td><td>d</td><td></td><td>A and C</td></tr>
</table>

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	e		Two examples, e.g. forensic investigation (identifying criminals), checking parentage (in people and animals), protecting wildlife (detecting illegally traded animals), testing foods for GM ingredients
18*	**a**		Size of particles, and how big the charge is
	b	**i**	Sample A has one band matching that on the extreme right of sample S (closest to the +ve electrode).
		ii	Sample B has two bands, matching that on the extreme left (nearest the –ve electrode) and the middle band of sample S.
		iii	Sample C has two bands matching the first two on the left of sample S (i.e. the two closest to the –ve electrode).
19	**a**		For a correctly labelled diagram see textbook page 36.
	b		Non-volatile solids will not move through the mobile phase (gas) so will not show up on the chromatogram.
	c		Missing words: qualitative, quantitative
	d*		Components move through the column at a rate that depends on how easily they evaporate and move into the gas phase. A chemical that evaporates easily spends more time in the gas phase and moves through the column faster.
	e*		This chemical has low levels of three impurities, because there are small peaks at 0.78, 1.38, and 4.85 compared to one large peak at 2.50.
	f*		For example, to trace the source of pollution by oil or chemical spills.
20	**a**		Atom – the smallest part of an element Electrons – negatively charged particles surrounding a nucleus Nucleus – positively charged central core of an atom
	b		Missing words: electrons, air, living, magnifying, light
	c		One advantage, e.g. greater depth of field; much higher resolution (so you can see much smaller objects and detail)
	d		One advantage, e.g. you can examine living specimens; they are cheaper and easier to use
	e		One example, e.g. the surface of structures (biological specimens); structure of fibres (forensic examinations)
21*	**a**		Missing words: separate, limited, beams, electron, light, magnification
	b		You will see part of the structure in focus, but parts above and below this will be blurred.
	c		For example, you can see the structure of surfaces in much greater detail because the image is viewed in 3D.
22	**a**		1 km = 1000 m 1 m = 1000 mm 1 mm = 1000 µm

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	b	**i**	Human, because of the irregular pattern of scales is the closest match, and the surface is smoother unlike that of cat or rat
		ii	Approx. 80–85 µm
		iii	Approx. 34
		iv	The hair sample comprises irregular-shaped overlapping scales on its surface. The scales lie in one direction, flat over each other along the length of the hair.

23 **a**

	Light microscopes	**Electron microscopes**
What sort of specimens can be examined?	Living or non-living	Non-living only
Preparation needed	Slides (temporary or permanent)	Dried and specially mounted
Maximum magnification	× 1500	× 500 000
Good points about the image	You can see it in its natural state	You can see it in much greater detail
Limitations	Narrow depth of field	Specimen in a vacuum so don't see its natural state

b

	Paper chromatography	**Thin-layer chromatography**	**Gas chromatography**
Type of sample	mixtures of a limited range of soluble compounds	mixtures of many soluble compounds	mixtures of volatile compounds
Sensitivity	least sensitive – needs relatively large samples	more sensitive	most sensitive – tiny samples
Separating power	will separate a few compounds	will separate many compounds	will separate complex mixtures
Limits of detection	visibility and amount of substance	visibility and amount of substance	the sensitivity of the detector – GC is very sensitive
Qualitative or quantitative results	qualitative (but spots can sometimes be extracted and quantified separately)		quantitative
Other advantages and disadvantages	cheap and easy to use	easy to use and quick	can measure amounts in tiny samples