3.18-3 Science: Working Scientifically and Practical Skills Set 3: 1-hour Pack

Total Marks

ISEB Common Entrance 13+ Science · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A student electrolyses copper sulfate solution using two copper electrodes and a fixed current of 0.5 A. She removes, dries carefully and reweighs the cathode (negative electrode) every 5 minutes to find the mass of copper deposited on it.

Time (min): 0, 5, 10, 15, 20

Mass of copper deposited (g): 0.00, 0.16, 0.31, 0.47, 0.62

(a) Calculate the mean rate of copper deposition between 0 and 10 minutes, in g/min. **(2)**

.....

(b) Describe the relationship between time and the mass of copper deposited shown by this data. **(2)**

.....

.....

(c) Explain why the cathode must be carefully dried before it is reweighed each time. **(1)**

.....

(d) State one variable, other than the identity of the electrodes, that should be kept constant throughout this investigation to ensure the results are valid. **(1)**

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2 A cyclist's motion is recorded on a distance-time graph. Between 0 s and 10 s, the graph is a straight line rising from 0 m to 20 m. Between 10 s and 20 s, the graph is a horizontal (flat) line at 20 m.

(a) Calculate the speed of the cyclist during the first 10 seconds. **(2)**

.....

(b) Describe the motion of the cyclist between 10 s and 20 s, and explain how the graph shows this. **(2)**

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3 Name the apparatus used to deliver exactly 10.0 cm^3 of concentrated acid in a safe, measured way.

(1)

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4 A substance's mass increases from 0 g to 0.62 g over 20 minutes. Calculate the mean rate of mass increase in g/min.

(1)

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5 A voltmeter is set up but its needle does not point to 0 V with no voltage applied. State the name given to this type of error.

(1)

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6 Iron is deposited at 0.56 g per 10 minutes. Calculate the rate, in g/min.

(1)

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7 A mass balance shows a reading of 0.5 kg when nothing is placed on it. State the name of this error.

(1)

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8 A gas is evolved from a reaction at a concentration of 25 g/dm^3, taking 50 s. Calculate the reaction rate in s^{-1}.

(1)

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9 Calculate the reaction rate in s^{-1} if a reaction takes 200 s to complete at a given concentration.

(1)

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10 A thermometer reads 2°C when placed in ice water at 0°C. What is this error called?

(1)

---

11 Before switching on a circuit, a voltmeter's needle is not positioned at zero. Name this type of error.

(1)

---

12 A steel ball falls 0.60 m in 3.0 s at terminal velocity. Calculate the velocity to 2 significant figures.

(1)

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13 Breathing rate measurements (breaths/min): 15, 16, 14, 17, 52. Calculate the mean, excluding the anomalous result.

(1)

---

14 Silver was deposited on an electrode at a rate shown by these masses over time. At 0 min = 0.00 g, at 5 min = 0.20 g, at 10 min = 0.40 g. Calculate the mean rate of deposition between 0 and 5 minutes in g/min.

(1)

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15 Grip strength (N): 380, 390, 385, 395, 430. Ignoring the anomaly, calculate the mean.

(1)

---

16 A student times a ball bearing falling through oil, recording the distance as 0.30 m and the time as 2.5 s. Calculate the terminal velocity, to 2 significant figures, in m/s.

(1)

---

17 A precipitate forms with these masses: at 0 min = 0 g, at 6 min = 0.30 g, at 12 min = 0.60 g. Calculate the mean rate of formation in g/min.

(1)

---

18 A sphere falls 0.30 m in 1.5 s at terminal velocity. To 2 significant figures, calculate the velocity.

(1)

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19 State the name given to the error when a force meter shows 0.2 N before any force is applied.

(1)

---

20 At a concentration of 30 g/dm^3, the reaction took 40 seconds. Calculate the rate, in s^{-1}.

(1)

---

21 Reaction times measured four times: 0.25 s, 0.24 s, 0.26 s, 0.18 s. Calculate the mean reaction time excluding the anomalous result.

(1)

---

22 Temperature measurements (°C): 30, 33, 36, 39, 42, 35, 45. Excluding the anomalous reading, what is the overall change?

(1)

---

23 Temperature change in an experiment: initial 20°C, then 24°C, 29°C, 34°C, 25°C, 38°C. Calculate the overall rise ignoring the anomalous reading.

(1)

---

24 A weighing scale shows 50 g when nothing is placed on it. Name this type of instrument error.

(1)

---

25 A ball bearing falls 0.80 m in 4.0 s at terminal velocity. Calculate the terminal velocity, to 2 significant figures.

(1)

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26 Pulse readings (bpm): 68, 70, 69, 71, 105. Calculate the mean, excluding the anomalous reading.

(1)

---

27 A reaction took 200 seconds to complete. Calculate the rate of reaction, in s^{-1}.

(1)

---

28 Five measurements of leaf width are recorded: 4.2 cm, 4.1 cm, 4.2 cm, 8.5 cm, 4.0 cm. Calculate the mean, ignoring the anomalous value.

(1)

---

29 A ball bearing falls 0.40 m in 2.5 s at terminal velocity. Calculate the terminal velocity, to 2 significant figures.

(1)

---

30 An ammeter shows 0.2 A with no current flowing. State the name of this error.

(1)

---

31 Calculate the mean rate of crystal growth from 0 to 8 minutes, where the mass goes from 0.00 g to 0.48 g, in g/min.

(1)

---

32 A reaction was completed in 25 seconds. Calculate the rate of reaction, in s^{-1}.

(1)

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33 A reaction of two chemicals shows these temperatures: 0 min = 18°C, 1 min = 25°C, 2 min = 31°C, 3 min = 27°C, 4 min = 40°C. Calculate the overall rise ignoring the anomalous reading.

(1)

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34 A burette has graduations every 0.2 cm^3. State the smallest change in volume that can be reliably measured.

(1)

---

35 A student measures the height of a seedling four times: 12 cm, 13 cm, 26 cm, 12 cm. Calculate the mean height, excluding the anomalous result.

(1)

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36 Temperature (°C): 20, 24, 28, 32, 36, 29, 40. Excluding the anomalous reading, what is the overall temperature rise?

(1)

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37 In a reaction, a precipitate forms at different rates at different temperatures. At a concentration of 15 g/dm^3, the precipitate took 120 s to form. Calculate the rate in s^{-1}.

(1)

---

38 Name the piece of glassware used to accurately dispense exactly 20.0 cm^3 of potassium hydroxide solution.

(1)

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39 Four measurements of hand grip strength in newtons are: 45 N, 46 N, 44 N, 72 N. Calculate the mean excluding the anomalous reading.

(1)

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40 A marble travels 0.80 m at terminal velocity in 4.0 s. Calculate the terminal velocity to 2 significant figures.

(1)

---

41 Silver is deposited at the cathode at 0.48 g in 30 minutes. Calculate the rate of deposition, in g/min.

(1)

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42 The reaction was completed in 50 seconds. Calculate the rate, in s^{-1}.

(1)

---

43 A marble falls 0.40 m in 3.2 s. Calculate its terminal velocity, to 2 significant figures.

(1)

---

44 Name the piece of apparatus for measuring 20 cm^3 of acid precisely.

(1)

---

45 A student measures her breathing rate four times: 18 breaths/min, 20 breaths/min, 19 breaths/min, 34 breaths/min. Calculate the mean, excluding the anomalous result.

(1)

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46 Readings: 25, 28, 31, 34, 37, 30, 40°C. Ignoring the anomalous value, calculate the temperature rise over the experiment.

(1)

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47 Temperature readings from a reaction: start 15°C, then 22°C, 28°C, 35°C, 26°C, 42°C. Calculate the overall rise excluding the anomalous reading.

(1)

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48 Copper is deposited at the cathode: 0.24 g in 15 minutes. Calculate the rate of deposition, in g/min.

(1)

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49 A copper electrode is weighed before and after electroplating. It loses 0.32 g in 20 minutes. Calculate the rate of copper loss, in g/min.

(1)

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Mark scheme · 3.18-3 Science: Working Scientifically and Practical Skills Set 3: 1-hour Pack

Question 1

(a) rate = mass / time = 0.31 / 10 oe **M1**

(a) = 0.031 g/min cao **A1**

(a) Answer: 0.031 g/min

(b) mass deposited increases steadily (at an approximately constant rate) as time increases oe **B1**

(b) the relationship is directly proportional (the mass increases by roughly the same amount, about 0.15-0.16 g, every 5 minutes) oe **B1**

(b) Answer: The mass of copper deposited increases steadily with time, at an approximately constant rate. The relationship is directly proportional: roughly equal amounts (about 0.15-0.16 g) are deposited every 5 minutes.

(c) any solution left on the electrode would add to its mass, giving a reading that is too high and not a true measure of the copper deposited oe **B1**

(c) Answer: If any solution is left on the electrode, it would add extra mass to the reading, making the mass of copper deposited appear larger than it really is.

(d) any one of: the current, the concentration/volume of copper sulfate solution, the temperature oe **B1**

(d) Answer: Any one of: the current (kept fixed at 0.5 A); the concentration and volume of copper sulfate solution; the temperature.

Question 2

(a) speed = distance / time = 20 / 10 oe **M1**

(a) = 2 m/s cao **A1**

(a) Answer: 2 m/s

(b) the cyclist is stationary (not moving) oe **B1**

(b) because the line on the graph is horizontal/flat, showing the distance is not changing over time oe **B1**

(b) Answer: The cyclist is stationary. The graph shows this because the line is horizontal (flat), meaning the distance travelled is not changing as time passes.

Question 3

A (volumetric/graduated) pipette (oe) **B1**

Answer: A (volumetric/graduated) pipette

Question 4

0.031 g/min (oe) **B1**

Answer: 0.031 g/min

Question 5

A zero error (oe) **B1**

Answer: A zero error

Question 6

0.056 g/min (oe) **B1**

Answer: 0.056 g/min

Question 7

A zero error (oe) **B1**

Answer: A zero error

Question 8

0.02 s^{-1} (oe) **B1**

Answer: 0.02 s^{-1}

Question 9

0.005 s^{-1} (oe) **B1**

Answer: 0.005 s^{-1}

Question 10

A zero error (oe) **B1**

Answer: A zero error

Question 11

A zero error (oe) **B1**

Answer: A zero error

Question 12

0.20 m/s (oe) **B1**

Answer: 0.20 m/s

Question 13

15.5 breaths/min (oe) **B1**

Answer: 15.5 breaths/min

Question 14

0.04 g/min (oe) **B1**

Answer: 0.04 g/min

Question 15

387.5 N (oe) **B1**

Answer: 387.5 N

Question 16

0.12 m/s (oe) **B1**

Answer: 0.12 m/s

Question 17

0.05 g/min (oe) **B1**

Answer: 0.05 g/min

Question 18

0.20 m/s (oe) **B1**

Answer: 0.20 m/s

Question 19

A zero error (oe) **B1**

Answer: A zero error

Question 20

0.025 s^{-1} (oe) **B1**

Answer: 0.025 s^{-1}

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Question 21

0.25 s (oe) **B1**

Answer: 0.25 s

Question 22

15°C (oe) **B1**

Answer: 15°C

Question 23

18°C (oe) **B1**

Answer: 18°C

Question 24

A zero error (oe) **B1**

Answer: A zero error

Question 25

0.20 m/s (oe) **B1**

Answer: 0.20 m/s

Question 26

69.5 bpm (oe) **B1**

Answer: 69.5 bpm

Question 27

$0.005\ s^{-1}$ (oe) **B1**

Answer: $0.005\ s^{-1}$

Question 28

4.1 cm (oe) **B1**

Answer: 4.1 cm

Question 29

0.16 m/s (oe) **B1**

Answer: 0.16 m/s

Question 30

A zero error (oe) **B1**

Answer: A zero error

Question 31

0.06 g/min (oe) **B1**

Answer: 0.06 g/min

Question 32

$0.04\ s^{-1}$ (oe) **B1**

Answer: $0.04\ s^{-1}$

Question 33

22°C (oe) **B1**

Answer: 22°C

Question 34

$0.1\ cm^3$ (oe) **B1**

Answer: $0.1\ cm^3$

Question 35

12.3 cm (oe) **B1**

Answer: 12.3 cm

Question 36

20°C (oe) **B1**

Answer: 20°C

Question 37

$0.0083\ s^{-1}$ (oe) **B1**

Answer: $0.0083\ s^{-1}$

Question 38

A (volumetric/graduated) pipette (oe) **B1**

Answer: A (volumetric/graduated) pipette

Question 39

45 N (oe) **B1**

Answer: 45 N

Question 40

0.20 m/s (oe) **B1**

Answer: 0.20 m/s

Question 41

0.016 g/min (oe) **B1**

Answer: 0.016 g/min

Question 42

$0.02\ s^{-1}$ (oe) **B1**

Answer: $0.02\ s^{-1}$

Question 43

0.13 m/s (oe) **B1**

Answer: 0.13 m/s

Question 44

A pipette (oe) **B1**

Answer: A pipette

Question 45

19 breaths/min (oe) **B1**

Answer: 19 breaths/min

Question 46

15°C (oe) **B1**

Answer: 15°C

Question 47

27°C (oe) **B1**

Answer: 27°C

Question 48

0.016 g/min (oe) **B1**

Answer: 0.016 g/min

Question 49

0.016 g/min (oe) **B1**

Answer: 0.016 g/min

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