Limitation of Physical Measurements
TOPIC QUESTIONS (2)

Level	AS Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

1. A student uses a digital ammeter to measure a current. The reading of the ammeter is found to fluctuate between
1.98 A and 2.02 A.

The manufacturer of the ammeter states that any reading has a systematic uncertainty of

±1%.Which value of current should be quoted by the student?

  A. (1.98 ± 0.04) A

  B. (2.00 ± 0.02) A

  C. (2.02 ± 0.02) A

  D. (2.00 ± 0.04) A

2. The uncertainty in the value of the momentum of a trolley passing between two points X and Y varies with thechoice of measuring devices.

Measurements for the same trolley made by different instruments were recorded as follows:

1	distance between X and Y using a metre rule with cm divisions = 0.55 m
2	distance between X and Y using a metre rule with mm divisions = 0.547 m
3	timings using a wristwatch measuring to the nearest 0.5s at X = 0.0s and at Y = 4.5 s
4	timings using light gates measuring to the nearest 0.1s at X = 0.0s and at Y = 4.3 s
5	mass of trolley using a balance measuring to the nearest g = 6.4 × 10^{-2} kg
6	mass of trolley using a balance measuring to the nearest 10g = 6 × 10^{-2} kg

Which measurements, one for each quantity measured, leads to the least uncertainty in the value of themomentum of the trolley?

  A. 1, 3 and 6

  B. 1, 4 and 6

  C. 2, 3 and 6

  D. 2, 4 and 5

3. In an experiment to determine the acceleration of free fall g, a ball bearing is held by an electromagnet.

When the current to the electromagnet is switched off, a clock starts, and the ball bearing falls. After falling adistance h, the ball bearing strikes a switch to stop the clock which measures the time t of the

fall.

Systematic errors may cause t and h to be measured incorrectly.

Which of the following **must** cause g to appear greater than 9.81 m s^{-2}?

  A. h measured as being smaller than it actually is and t is measured correctly

  B. h measured as being smaller than it actually is and t measured as being larger than it actually is

  C. h measured as being larger than it actually is and t measured as being larger than it actually is

  D. h is measured correctly and t measured as being smaller than it actually is

4. The measurement of a physical quantity may be subject to random errors and systematic errors. Which statement is **correct**?

  A. random errors can be reduced by taking the average of several measurements

  B. random errors are always caused by the person taking the measurement

  C. a systematic error cannot be reduced by adjusting the apparatus

  D. a systematic error results in a different reading each time the measurement is taken

5. In an experiment, a radio-controlled car takes 2.50 ± 0.05 s to travel 40.0 ± 0.1 m. What is the car's average speed and the uncertainty in this value?

  A. 16 ± 1 m s^{-1}

  B. 16.0 ± 0.2 m s^{-1}

  C. 16.0 ± 0.4 m s^{-1}

  D. 16.00 ± 0.36 m s^{-1}

6. Four students each made a series of measurements of the acceleration of free fall g. The table shows the resultsobtained.

Which set of results could be described as precise but not accurate?

	g / m s^{-2}			
A	9.81	9.79	9.84	9.83
B	9.81	10.12	9.89	9.94
C	9.45	9.21	8.99	8.76
D	8.45	8.46	8.50	8.41

7. A fixed quantity x_0 is measured many times in an experiment that has experimental uncertainty. A graph isplotted to show the number n of times that a particular value x is obtained.
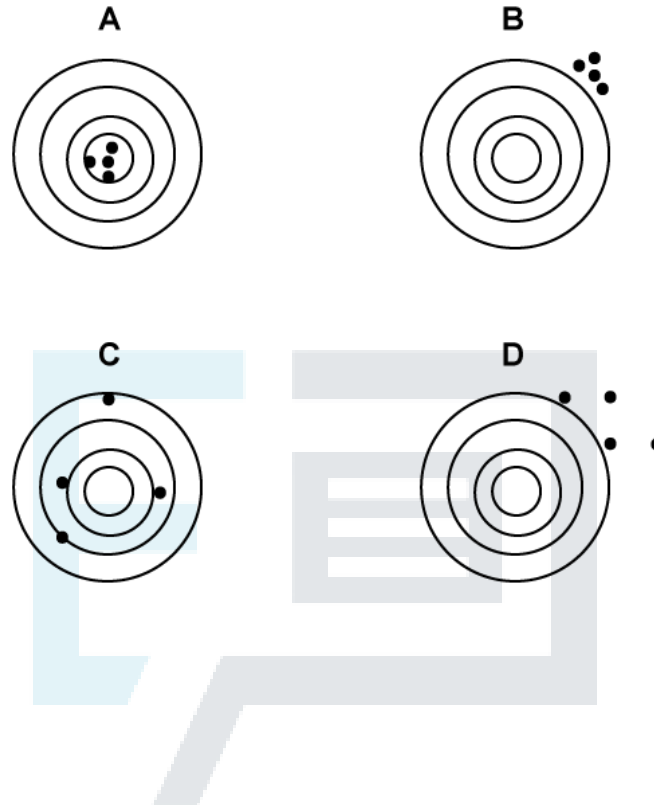
Which graph could be obtained if the measurement of x_0 has a high precision and a low accuracy?
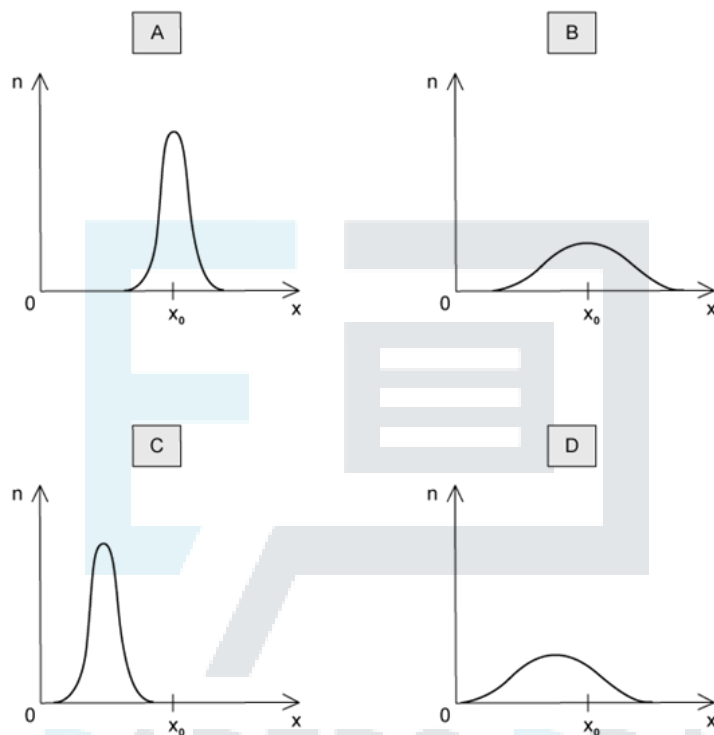
8. Four people participate in a shooting competition. Each person gets four shots. The diagram shows the targetboards of each participant after their turn.

Which target has a low precision and a high accuracy?

9. The diagram below shows the   intensity peaks produced in four

different diffraction experiments.Which of the following shows the intensity peaks with the

highest resolution?
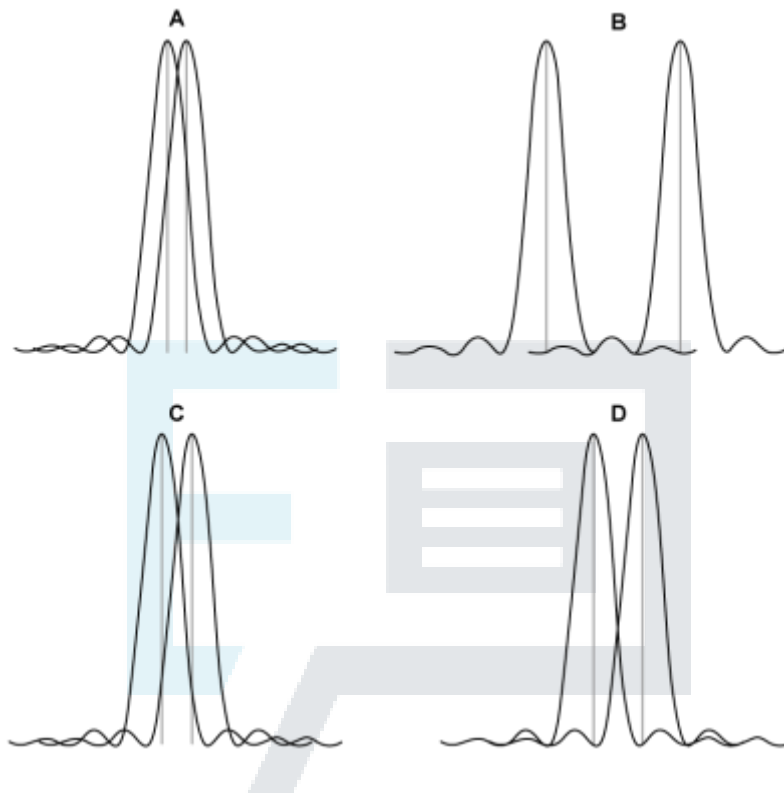
10. An ammeter has a systematic error of -0.05 A. The ammeter is then connected to a circuit and shows a readingof 2.45 A.
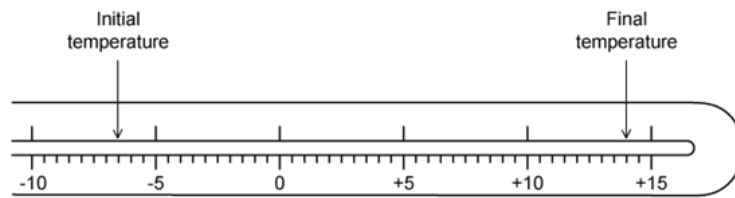
What should the real reading

be?

A. 2.35 A

  B. 2.40 A

  C. 2.50 A

  D. 2.55 A

11. The diagram shows the stem of a Celsius thermometer marked to show initial and final temperature values.

What is the temperature change expressed to an appropriate number of significant figures?

A. 14°C

B. 20.5°C

C. 21°C

D. 22.0°C

12. kilowatt−hour (kW h) is equivalent to

A 6.3×10^{18} eV

B 6.3×10^{21} eV

C 2.3×10^{22} eV

D 2.3×10^{25} eV

13. Which is equivalent to the ohm?

A $J\,C^{-2}\,s^{-1}$

B $J\,C^{-2}\,s$

C $J\,s$

D $J\,s^{-1}$

14. What is a correct unit for the area under a force–time graph?

A N m

B kg m s^{-1}

C kg m s^{-2}
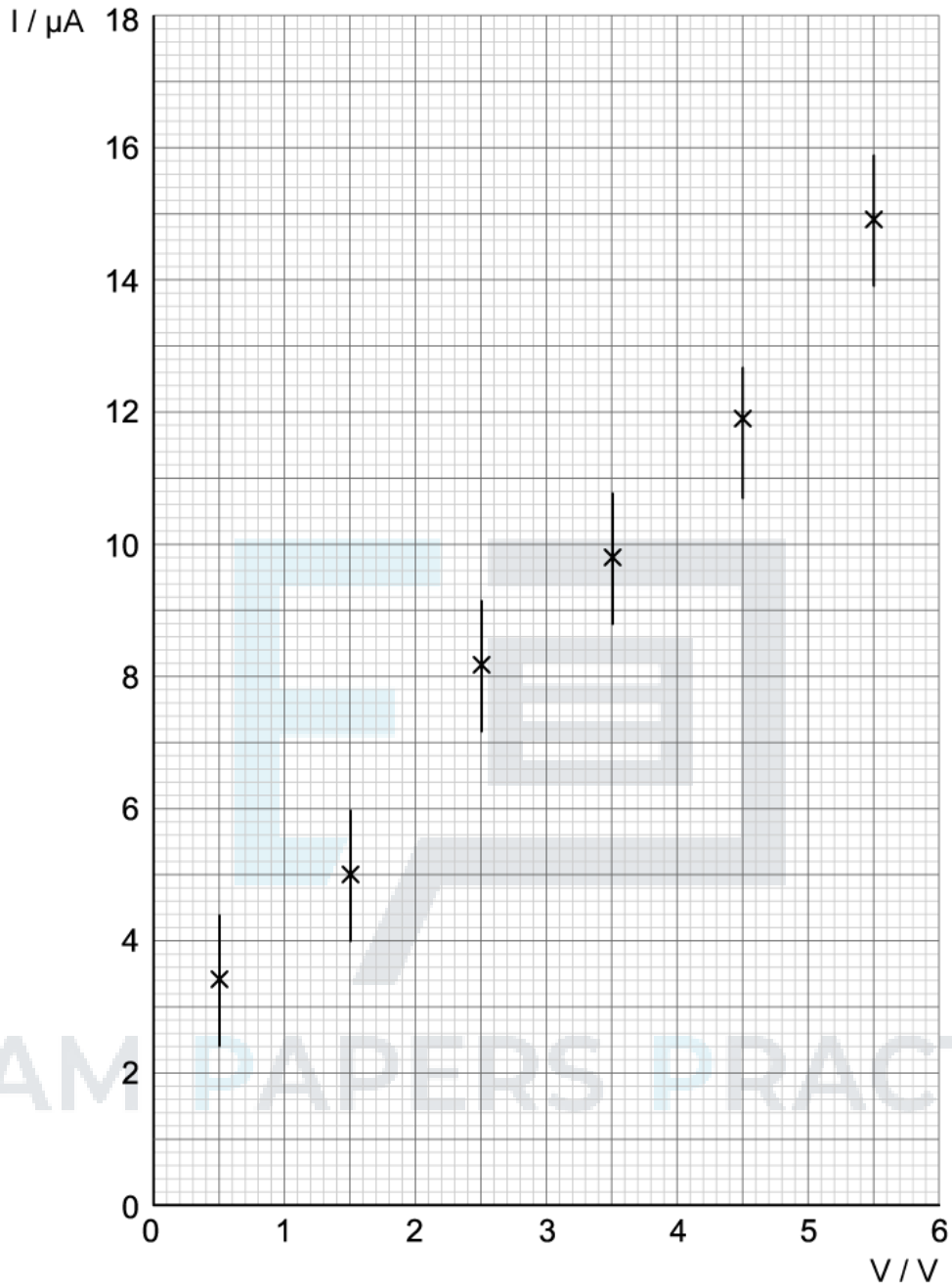
D N s^{-1}

15. Two gamma photons are   produced when a muon and an

antimuon annihilate each other.What is the minimum frequency of the gamma radiation that

could be produced?

   A 2.55×10^{16} Hz

   B 5.10×10^{16} Hz

   C 2.55×10^{22} Hz

   D 5.10×10^{22} Hz

16. A researcher plots a graph to investigate the variation of current and potential difference of a resistor, as shownin the diagram.

After realising they have read the manufacturers label of their electrical equipment incorrectly, they determine the size of the error bars shown should decrease.

Which row correctly describes how this will affect the value of the maximum gradient G_{max}, the minimum gradient G_{min}, and the resistance of the resistor R?

	G_{max}	G_{min}	R
A	increase	increase	increase
B	decrease	decrease	decrease
C	increase	decrease	no change
D	decrease	increase	no change

17. A steel wire is stretched in an experiment to determine the Young modulus for steel.The uncertainties in the measurements are given below.

measurement	uncertainty
load on wire	±2%
length of wire	±0.2%
diameter of wire	±1.5%
extension	±1%

What is the percentage uncertainty in
the Young modulus?A. 1.3%

B. 1.8%

C. 4.7%

D. 6.2%

18. Some students carry out an experiment to determine the resistivity of a metal wire.

They determine the resistance from measurements of potential difference between the ends of the wire and thecorresponding current.

They measure the length of the wire with a ruler and the diameter of the wire using a micrometer. Eachmeasurement is made with an uncertainty of 1 %.

Which measurement gives the largest uncertainty in the calculated value of the resistivity?

A. current

B. diameter

C. length

D. potential difference

19. Which of the following experimental techniques would **not** reduce the random error of the quantity beinginvestigated?

A. Calibrating the Y-sensitivity of the oscilloscope before measuring a voltage

B. Timing a large number of oscillations to determine a time period

C. Plotting a graph of voltage and current readings for an ohmic device and using its gradient to determineresistance

D. Measuring several internodal distances on a standing wave to find the mean internodal distance

20. The diagrams show digital voltmeter and analogue ammeter readings from a circuit in which electrical heating isoccurring.
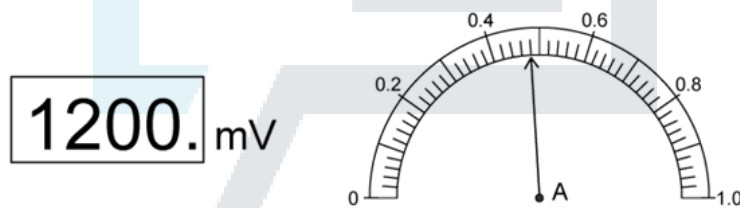
What is the electrical

power of the heater?

A. 0.53 W

B. 0.58 W

C. 530 W

D. 580 W