Significant figures in calculations

Worked solutions

GCSE science calculations

This topic online

1 Round each value to the number of significant figures given.

a. A current of 0.04672 A, to 2 significant figures.

b. An energy of 38 650 J, to 3 significant figures.

(2 marks)

a) the zeros at the front are not significant

0.046|72

the next digit is 7, so round up

0.047 A

b) count 3 figures from the first non-zero digit

386|50

the next digit is 5, so round up and keep the place holder zeros

38 700 J

2 Callum uses a stopwatch and a micrometer in a lab practical.

a. He times a trolley at 12.348 s. Round this to 3 significant figures.

b. He measures the diameter of a wire as 0.0009058 m. Round this to 2 significant figures.

(2 marks)

a) the next digit is 4, so do not round up

12.3|48

12.3 s

b) start counting at the 9; the 0 after it counts

0.00090|58

the next digit is 5, so round up

0.00091 m

3 The current through a 47 Ω resistor is 0.35 A.

Calculate the potential difference across the resistor. Give your answer to 2 significant figures.

(2 marks)

Potential difference = current × resistance

$V = 0.35 \times 47$

$V = 16.45$

16 V (2 s.f.)

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4 A tennis ball of mass 58 g is served at a speed of 23 m/s.

Calculate the kinetic energy of the ball. Give your answer to 2 significant figures. (3 marks)

Kinetic energy = 0.5 × mass × speed^2

58 g = 58 ÷ 1000 = 0.058 kg

$E_k = 0.5 \times 0.058 \times 23^2$

$E_k = 15.341$

15 J (2 s.f.)

5 Grace measures a brass weight. Its mass is 264 g and its volume is 31.0 cm^3.

1 cm^3 = 1 × 10^{-6} m^3

Calculate the density of the brass in kg/m^3. Give your answer to an appropriate number of significant figures. (3 marks)

Density = mass ÷ volume

264 g = 0.264 kg

31.0 cm^3 = 31.0 × 10^{-6} = 3.10 × 10^{-5} m^3

$$\rho = \frac{0.264}{3.10 \times 10^{-5}}$$

$\rho = 8516.1...$

the data are to 3 s.f., so give 3 s.f.

8520 kg/m^3 (3 s.f.)

6 A 5.0 W phone charger is used for 47 minutes.

Calculate the energy transferred by the charger. Give your answer to 2 significant figures. (3 marks)

Energy transferred = power × time

47 minutes = 47 × 60 = 2820 s

$E = 5.0 \times 2820$

$E = 14\,100$

keep the zeros as place holders

14 000 J (2 s.f.)

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7 A lamp has a potential difference of 6.0 V across it. The current through the lamp is 0.28 A.
Calculate the resistance of the lamp. Give your answer to 2 significant figures. (3 marks)

Potential difference = current × resistance

$6.0 = 0.28 \times R$

$R = 6.0 \div 0.28$

$R = 21.428...$

21 Ω (2 s.f.)

8 A hand dryer has a power of 1.3 kW. It transfers 45 kJ of energy to dry Priya's hands.
Calculate how long the hand dryer is on for. Give your answer to 2 significant figures. (3 marks)

Energy transferred = power × time

45 kJ = 45 000 J

1.3 kW = 1300 W

$45\,000 = 1300 \times t$

$t = 45\,000 \div 1300$

$t = 34.61...$

35 s (2 s.f.)

9 A cyclist speeds up from 4.0 m/s to 13 m/s. Her acceleration is 2.4 m/s^2.
Calculate the time taken. Give your answer to 2 significant figures. (3 marks)

Acceleration = change in velocity ÷ time taken

$\Delta v = 13 - 4.0 = 9.0$ m/s

$2.4 = \frac{9.0}{t}$

$t = 9.0 \div 2.4$

$t = 3.75$

the next digit is 5, so round up

3.8 s (2 s.f.)

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10 A football of mass 0.45 kg rolls 26 m across a pitch in 4.5 s at a constant speed.

a. Calculate the kinetic energy of the football. Give your answer to 2 significant figures.

b. Ryan rounded the speed to 5.8 m/s before working out the kinetic energy. He got 7.6 J. Explain why his answer is different from yours.

Show your working.

(4 marks)

a) Distance travelled = speed x time

$26 = v \times 4.5$

$v = 26 \div 4.5$

$v = 5.777...$ m/s

keep the full value in the calculator

Kinetic energy = 0.5 x mass x speed^2

$Ek = 0.5 \times 0.45 \times 5.777...^2$

$Ek = 7.511...$

7.5 J (2 s.f.)

b) Ryan rounded too early

$0.5 \times 0.45 \times 5.8^2 = 7.569$

5.8 is too big and squaring makes the error bigger

round only at the end

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11 **Higher tier**

Zainab drops a 0.65 kg ball from a height of 2.3 m. Gravitational field strength = 9.8 N/kg.

Assume all the gravitational potential energy of the ball is transferred to kinetic energy.

Calculate the speed of the ball just before it hits the ground. Give your answer to 2 significant figures.

Show your working.

(5 marks)

Gravitational potential energy = mass × gravitational field strength × height

$E_p = 0.65 \times 9.8 \times 2.3$

$E_p = 14.651\ J$

Kinetic energy = 0.5 × mass × speed^2, and $E_k = E_p$

$14.651 = 0.5 \times 0.65 \times v^2$

$14.651 = 0.325 \times v^2$

$v^2 = 14.651 \div 0.325$

$v^2 = 45.08$

$v = \sqrt{45.08}$

$v = 6.714...$

6.7 m/s (2 s.f.)

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12 A motor on a building site lifts a 12 kg bucket of sand through a height of 3.5 m. The motor has an input power of 25 W and takes 24 s to lift the bucket.

Gravitational field strength = 9.8 N/kg.

Calculate the efficiency of the motor. Give your answer as a percentage to 2 significant figures.

Show your working.

(5 marks)

Useful output: gravitational potential energy = mass x gravitational field strength x height

$E_p = 12 \times 9.8 \times 3.5$

$E_p = 411.6\ J$

Total input: energy transferred = power x time

$E = 25 \times 24$

$E = 600\ J$

Efficiency = useful output energy transfer ÷ total input energy transfer

$\text{efficiency} = \frac{411.6}{600}$

$\text{efficiency} = 0.686$

$0.686 \times 100 = 68.6\%$

69% (2 s.f.)

13 Femi connects a resistor and a lamp in series to a 6.0 V supply. The potential difference across the resistor is 4.6 V. The current in the circuit is 0.38 A.

Calculate the resistance of the resistor. Give your answer to 2 significant figures.

(3 marks)

Use the p.d. across the resistor (4.6 V), not the supply p.d. (6.0 V)

Potential difference = current x resistance

$4.6 = 0.38 \times R$

$R = 4.6 \div 0.38$

$R = 12.105...\ \Omega$

the next digit is 1, so do not round up

12 Ω

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