1 Which statement, involving multiples and sub-multiples of the base unit metre (m), is correct?

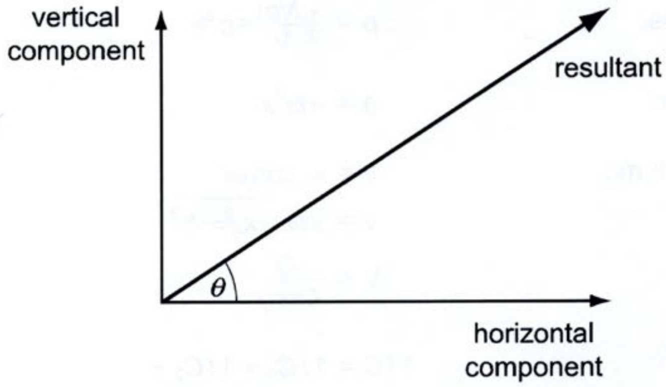
× **A** 1 pm = 10^{-9} m 10^{-12}

× **B** 1 nm = 10^{-6} m 10^{-9}

× **C** 1 mm = 10^{6} µm 10^{-3}

D 1 km = 10^{6} mm $1 \times 10^{3} = 10^{6} \times 10^{-3} = 10^{3}$

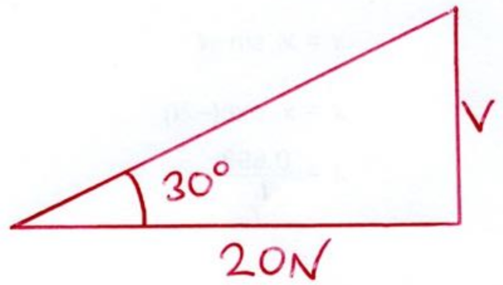
2 The diagram shows a resultant force and its horizontal and vertical components.



The horizontal component is 20.0 N and θ = 30°. What is the vertical component?

A 8.7 N **B** 10.0 N **C** 11.5 N **D** 17.3 N

Space for working

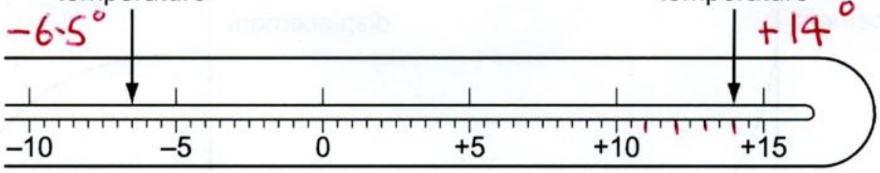


$\tan 30^\circ = \frac{V}{20}$

$\therefore V = 20 \tan 30^\circ = 11.5\ N$

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

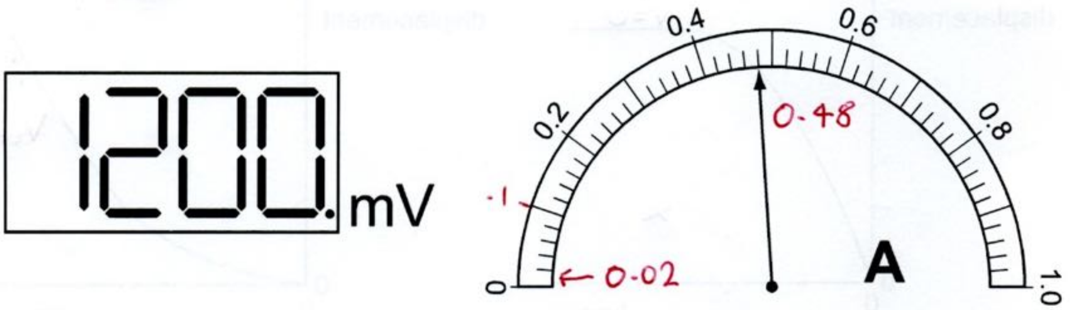
1 div = 0.5°



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

4 The diagrams show digital voltmeter and analogue ammeter readings from a circuit in which electrical heating is occurring.



What is the electrical power of the heater?

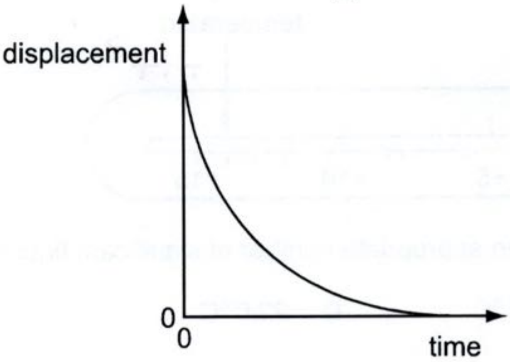
A 0.53 W **B** 0.58 W **C** 530 W **D** 580 W

Space for working

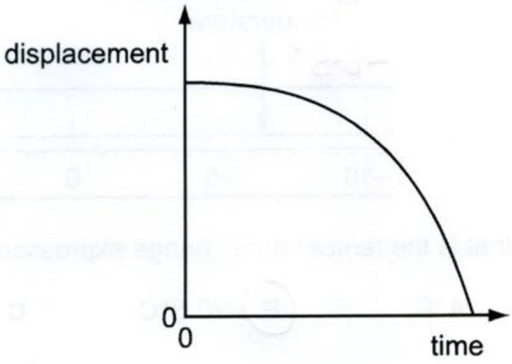
$P = IV = 1200 \times 10^{-3} \times 0.48 = 0.576$ W

5 Which displacement-time graph best represents the motion of a falling sphere, the initial acceleration of which eventually reduces until it begins to travel at constant terminal velocity?

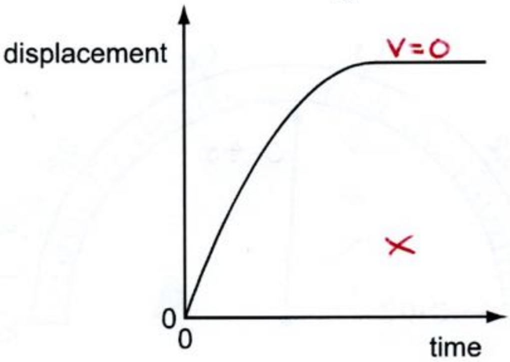
A



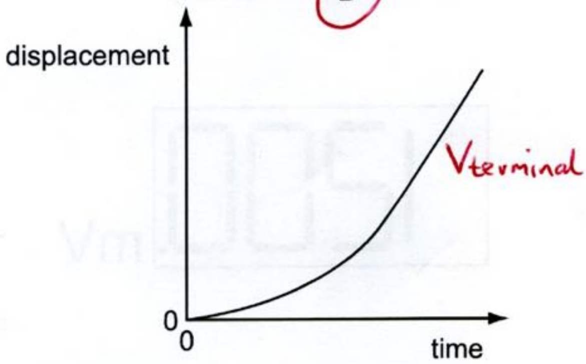
B



C



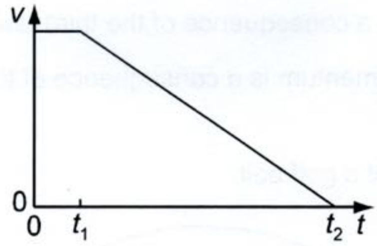
D



Space for working

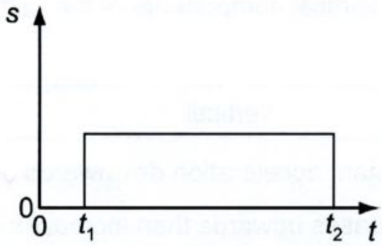
6 When a car driver sees a hazard ahead, she applies the brakes as soon as she can and brings the car to rest.

The graph shows how the speed v of the car varies with time t after she sees the hazard.

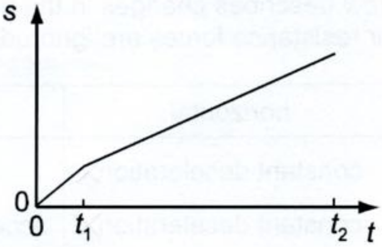


Which graph represents the variation with time t of the distance s travelled by the car after she has seen the hazard?

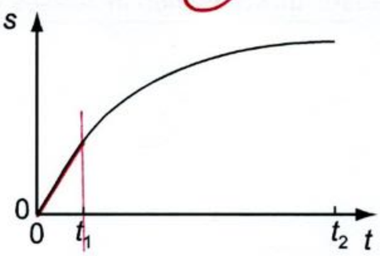
A



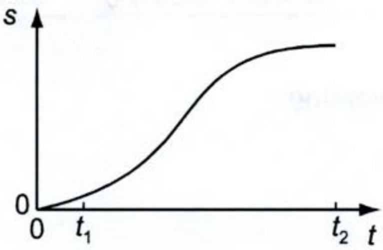
B



C



D



Space for working

7 Which statement about Newton's laws of motion is correct?

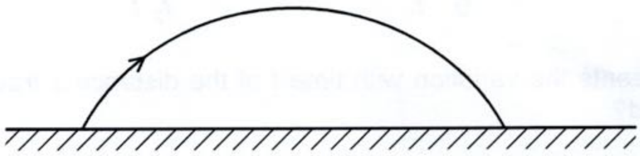
A The first law follows from the second law.

B The third law follows from the second law.

C Conservation of energy is a consequence of the third law.

D Conservation of linear momentum is a consequence of the first law.

8 The diagram shows the path of a golf ball.

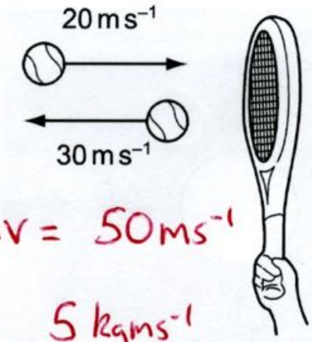


Which row describes changes in the horizontal and vertical components of the golf ball's velocity, when air resistance forces are ignored?

	horizontal	vertical
A	constant deceleration	constant acceleration downwards
B	constant deceleration	acceleration decreases upwards then increases downwards
C	constant velocity	constant acceleration downwards
D	constant velocity	acceleration decreases upwards then increases downwards

Space for working

9 A tennis ball of mass 100 g is struck by a tennis racket. The velocity of the ball is changed as shown.



$\Delta v = 50 ms^{-1}$

$50 \times 0.1\,kg = 5\,kgms^{-1}$

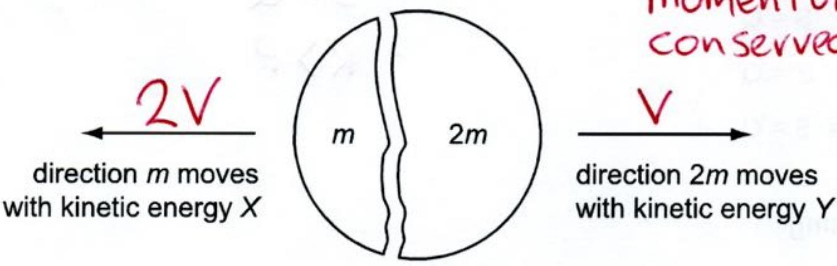
What is the magnitude of the change in momentum of the ball?

A $1\,kg\,m\,s^{-1}$ **B** $5\,kg\,m\,s^{-1}$ **C** $1000\,kg\,m\,s^{-1}$ **D** $5000\,kg\,m\,s^{-1}$

10 A stationary body explodes into two components of masses *m* and 2*m*.

The components gain kinetic energies *X* and *Y* respectively.

momentum is conserved



What is the value of the ratio $\frac{X}{Y}$?

A $\frac{1}{4}$ **B** $\frac{1}{2}$ **C** $\frac{2}{1}$ **D** $\frac{4}{1}$

Space for working

X m has $\frac{1}{2}\times$mass & $2\times$ velocity → $2\times E_K$ of Y

$E_K = \frac{1}{2}mv^2$

Y 2m has $2\times$ mass & $\frac{1}{2}\times$ velocity → $\frac{1}{2}\times E_K$ of X

$X/Y = 2/1$

14 The forward motion of a motor-boat is opposed by forces F which vary with the boat's speed v in accordance with the relation $F = kv^2$, where k is a constant.

The effective power of the propellers required to maintain the speed v is P.

$F = kv^2$

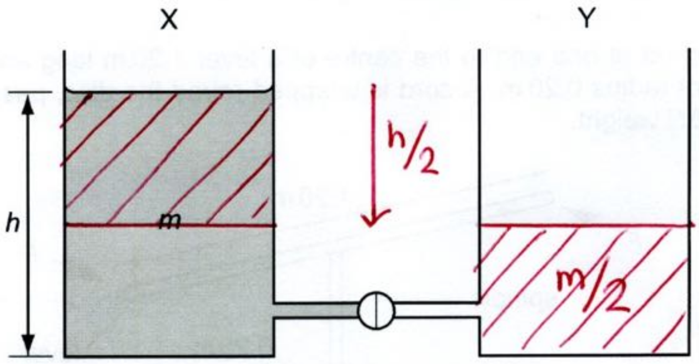
Which expression relates k, P and v?

$P = Fv \therefore F = \frac{P}{v}$

A $k = \frac{P}{v}$ **B** $k = \frac{P}{v^2}$ **C** $k = \frac{P}{v^3}$ **D** $k = \frac{P}{v^4}$

$\therefore \frac{P}{v} = kv^2$

15 The diagram shows two identical vessels X and Y connected by a short pipe with a tap.



Initially, X is filled with water of mass m to a depth h, and Y is empty.

When the tap is opened, water flows from X to Y until the depths of water in both vessels are equal.

How much potential energy is lost by the water during this process? (g = acceleration of free fall)

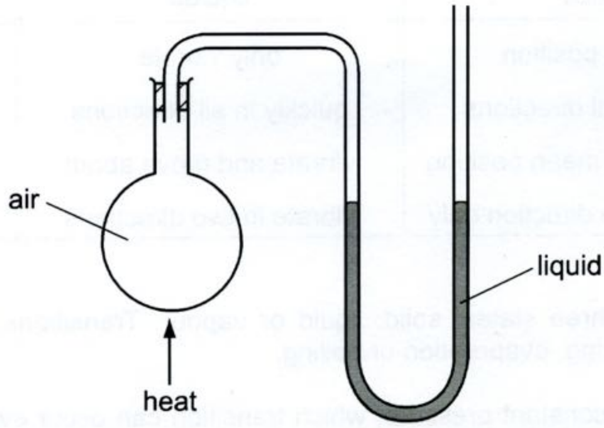
A 0 **B** $\frac{mgh}{4}$ **C** $\frac{mgh}{2}$ **D** mgh

Space for working

$\Delta E = mg\Delta h = \frac{m}{2} \times g \times \frac{h}{2}$

$= \frac{mgh}{4}$

~~18~~ The diagram shows a flask connected to a U-tube containing liquid. The flask contains air at atmospheric pressure.



The flask is now gently heated and the liquid level in the right-hand side of the U-tube rises through a distance h. The density of the liquid is ρ.

What is the increase in pressure of the heated air in the flask?

A $h\rho$ **B** $\frac{1}{2}h\rho g$ **C** $h\rho g$ **D** $2h\rho g$

19 Four materials are formed into rods of the same dimensions.

At room temperature, which can sustain the largest plastic deformation?

A the ductile material aluminium

B the ~~brittle~~ material carbon

C the ~~brittle~~ material glass

D the ductile material steel

Space for working

20 Two steel wires P and Q have lengths l and $2l$ respectively, and cross-sectional areas A and $\frac{A}{2}$ respectively. Both wires obey Hooke's law.

$E = \frac{FL}{Ax}$ ∴

What is the ratio $\frac{\text{tension in P}}{\text{tension in Q}}$ when both wires are stretched to the same extension?

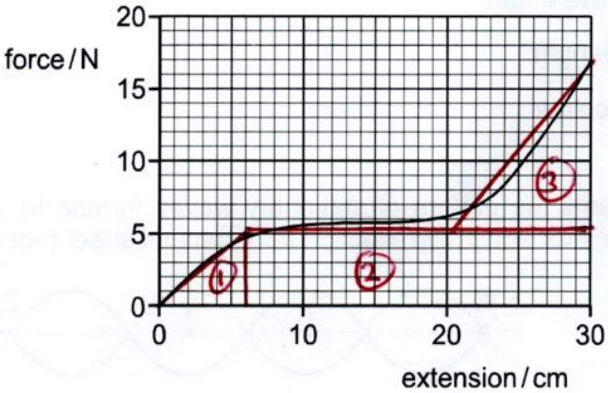
$\times 2$

A $\frac{1}{4}$ **B** $\frac{1}{2}$ **C** $\frac{2}{1}$ **D** $\frac{4}{1}$

$x = \frac{FL}{AE}$ const $\times \frac{1}{2}$

F_Q must be $\frac{1}{4}$ F_P ∴

21 A rubber band is stretched by hanging weights on it and the force-extension graph is plotted from the results.



What is the best estimate of the strain energy stored in the rubber band when it is extended 30 cm?

A 2.0 J **B** 2.6 J **C** 5.1 J **D** 200 J

Space for working

(1) $= \frac{1}{2} \times 0.06 \times 5.5 = 0.165$

(2) $= 0.24 \times 5.5 = 1.32$

(3) $= \frac{1}{2} \times 0.10 \times 11.5 = 0.575$

$2.06 \approx 2.0\text{ J}$

22 Diffraction is the name given to the

A addition of two coherent waves to produce a stationary wave pattern.

B bending of waves round an obstacle.

C change of direction when waves cross the boundary between one medium and another.

D splitting of white light into colours.

23 Which wave properties change when light passes from air into glass?

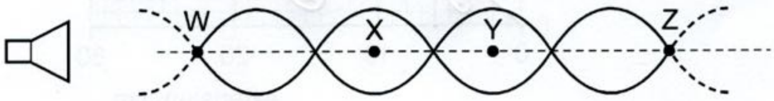
A colour and speed

B frequency and wavelength

C speed and wavelength

D wavelength and colour

24 The diagram represents the pattern of stationary waves formed by the superposition of sound waves from a loudspeaker and their reflection from a metal sheet (not shown).



W, X, Y and Z are four points on the line through the centre of these waves.

Which statement about these stationary waves is correct?

× **A** An antinode is formed at the surface of the metal sheet. No a node

✓ **B** A node is a quarter of a wavelength from an adjacent antinode.

× **C** The oscillations at X are in phase with those at Y. 180° out of phase

× **D** The stationary waves oscillate at right angles to the line WZ. No its a longitudinal wave.

Space for working

 $d = \frac{1}{N}$

25 A diffraction grating with N lines per metre is used to deflect light of various wavelengths λ.

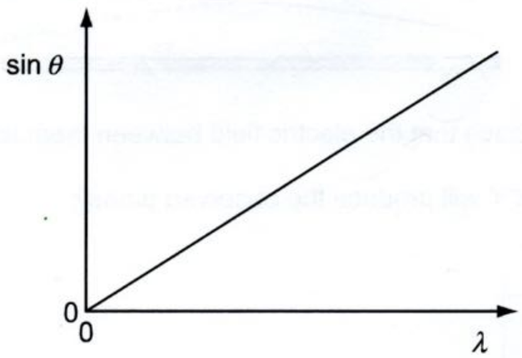
The diagram shows a relation between the deflection angles θ for different values of λ in the n^{th} order interference pattern.

$n\lambda = d \sin\theta$

$n\lambda = \dfrac{\sin\theta}{N}$

$\sin\theta = \underbrace{Nn}_{= m}\ \lambda$

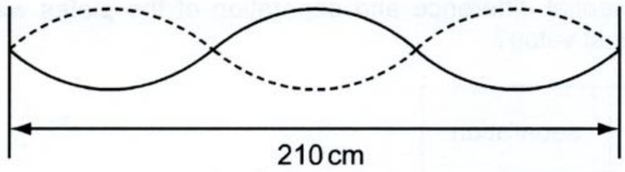
$y \quad = \quad m \quad x$



What is the gradient of the graph?

A Nn **B** $\dfrac{N}{n}$ **C** $\dfrac{n}{N}$ **D** $\dfrac{1}{Nn}$

26 A stationary wave of frequency 80.0 Hz is set up on a stretched string of length 210 cm.



$\lambda = \frac{2}{3} \times 2.1\,\text{m}$

$= 1.4\,\text{m}$

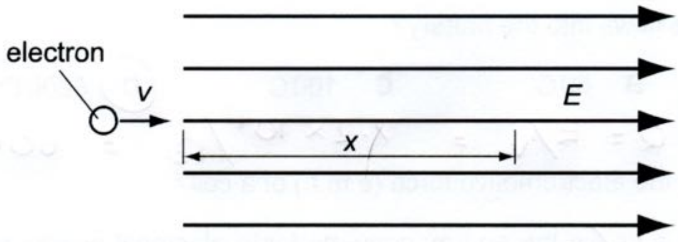
What is the speed of the waves that produce this stationary wave?

A $56.0\,\text{m s}^{-1}$ **B** $112\,\text{m s}^{-1}$ **C** $5600\,\text{m s}^{-1}$ **D** $11\,200\,\text{m s}^{-1}$

Space for working

$v = f\lambda = 80 \times 1.4 = 112\,\text{ms}^{-1}$

29 The diagram shows an electron, with charge e, mass m, and velocity v, entering a uniform electric field of strength E.



The direction of the field and the electron's motion are both horizontal and to the right.

Which expression gives the distance x through which the electron travels before it stops momentarily?

A $x = \dfrac{mv}{E}$ **B** $x = \dfrac{mv}{Ee}$ **C** $x = \dfrac{mv^2}{2E}$ **D** $x = \dfrac{mv^2}{2Ee}$

30 Which amount of charge, flowing in the given time, will produce the largest current?

	charge / C	time / s
A	4	$\frac{1}{4}$
B	4	1
C	1	4
D	$\frac{1}{4}$	4

Space for working

31 A 12 V battery is charged for 20 minutes by connecting it to a source of electromotive force (e.m.f.). The battery is supplied with 7.2×10^4 J of energy in this time.

How much charge flows into the battery?

A 5.0 C **B** 60 C **C** 100 C **D** 6000 C

$E = QV \quad \therefore \quad Q = E/V = 7.2 \times 10^4 / 12 = 6000\ C$

32 What is meant by the electromotive force (e.m.f.) of a cell?

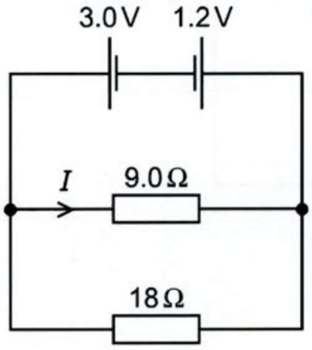
A The e.m.f. of a cell is the energy converted into electrical energy when unit charge passes through the cell. ✓

B The e.m.f. of a cell is the energy transferred by the cell in driving unit charge through the external resistance. ✗

C The e.m.f. of a cell is the energy transferred by the cell in driving unit charge through the internal resistance of the cell. ✗

D The e.m.f. of a cell is the amount of energy needed to bring a unit positive charge from infinity to its positive pole. ✗

33 Two cells of e.m.f. 3.0 V and 1.2 V and negligible internal resistance are connected to resistors of resistance 9.0 Ω and 18 Ω as shown.



$3 - 1.2 = 1.8V$

$I = V/R = \frac{1.8V}{9\Omega} = 0.2A$

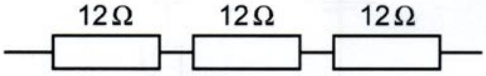
What is the value of the current I in the 9.0 Ω resistor?

A 0.10 A **B** 0.20 A **C** 0.30 A **D** 0.47 A

Space for working

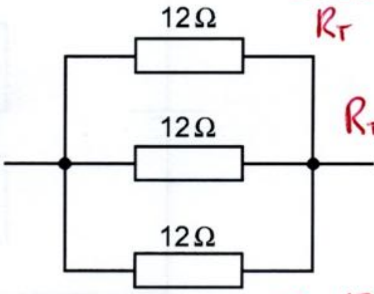
34 Six identical 12 Ω resistors are arranged in two groups, one with three in series and the other with three in parallel.

$R_T = R_1 + R_2 + R_3 + \ldots$



$36\,\Omega$

series



parallel

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$R_T = \,/3 = 4\,\Omega$

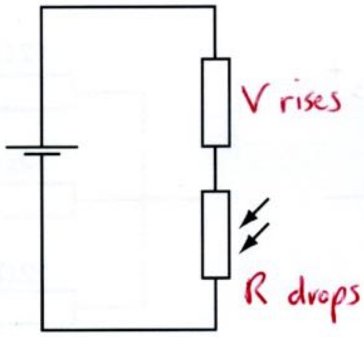
OR $12/3 = 4\,\Omega$

What are the combined resistances of each of these two arrangements?

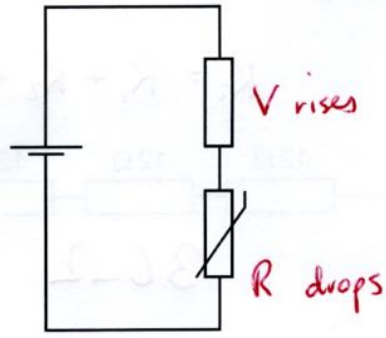
	series	parallel
A	4.0 Ω	0.25 Ω
B	4.0 Ω	36 Ω
C	36 Ω	0.25 Ω
D	36 Ω	4.0 Ω

Space for working

35 The diagrams show a light-dependent resistor in circuit P, and a thermistor in circuit Q.



circuit P



circuit Q

How does the potential difference across the fixed resistor in each circuit change when both the brightness of the light on the light-dependent resistor and the temperature of the thermistor are increased?

	circuit P	circuit Q
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

END

36 How do the nucleon (mass) number and proton (atomic) number of two isotopes of an element compare?

	nucleon number	proton number
A	different	different
B	different	same
C	same	different
D	same	same

Space for working