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Further guidance

P5 Electric circuits – Foundation Workbook answers

1	a	i	Correct bold words: the same, repel, electrons, negative	
		ii	Arrow pointing left	
		iii	The cloth had no charge before it was used. After rubbing, electrons (negative charge) were transferred from the cloth to the polythene, leaving the cloth with a resultant positive charge.	
		iv	Like charges... repel each other. Opposite charges... attract each other.	
	b	i	Correct bold words: repel, attract	
		ii	Negative	
		iii	Attract	
	c	i	All hairs get the same charge and so they repel each other.	
		ii	Neutral	
2	a		When the spark jumps across the gap, → the lamp lights up. → This implies that the electric current, → which makes the lamp light up, → is a movement of charges. → These are the same charges that jump across the gap to make a spark.	
	b		<ul style="list-style-type: none"> • When Bethan first pushes... – Charge moves throughout the circuit... • Bethan gets tired after pushing ... – Stored energy is transferred out of the battery. • The others feel their hands getting hot. – The battery does work on all other... • If any one of the others grips the rope ... – Putting in an insulator stops the flow... • At any time, the amount of rope ... – The current is not used up. It is the same... 	
	c	i	<ul style="list-style-type: none"> • Conductor – will carry an electric current – has free electrons • Insulator – does not carry an electric current – has no free electrons 	
		ii	<ul style="list-style-type: none"> • The top/right end of the wire is positive. • Arrow for 'the current' is in the opposite direction to arrow for 'flow of electrons'. 	
		d	i	Missing words: ammeter, 0.01
			ii	<ul style="list-style-type: none"> • Arrows pointing up to '10' in each of the ammeters • Missing words: the same
	3	a		10 mA
b			Statement X	
c			Arrow pointing up to '10'	
d			10 mA	
e			10 mA	
f			Ammeter pointing up to '10'	

Further guidance

	g	20 mA
	h	Statement Y
	i	Arrow pointing to '20'
	j	Arrow pointing to '20'
	k	Correct bold words: parallel, current, sum, bigger than, decrease
4	a	<p>Electrical resistance:</p> <ul style="list-style-type: none"> opposes the flow of charge caused by ions in the solid measured in ohms, Ω <p>Electric current:</p> <ul style="list-style-type: none"> a flow of charge carried by electrons measure in amperes (amps), A
	b	<p>Correct bold words:</p> <ul style="list-style-type: none"> size more, small smaller, bigger big
	c	i Correct bold words: (top left box) bigger, (bottom left box) smaller
		ii <ul style="list-style-type: none"> Two resistors in series ... – Because the moving charges have to ... Two resistors in parallel ... – Because there are more paths ...
	d	Correct numbers: (top left) 4, (bottom left) 2, (middle) 1, (top right) 3, (bottom right) 5
5	a	Missing words: battery, voltage, bigger, bigger, proportional, double
	b	i The circuit on the right has the biggest push. (✓)
		ii The circuit on the right has the biggest current. (✗)
		iii Left circuit: voltage 6.0 V Right circuit: voltage 9.0 V
		iv Left circuit: current 48 mA Right circuit: current 72 mA
	c	i Missing word: proportional
		ii They will be half the previous values.
		iii Line on graph drawn exactly half way between the existing line and the horizontal axis.
	d	Missing words: ohms = volts / amperes (amps)

Further guidance

6	a	i	<ul style="list-style-type: none"> Variable resistor – move a slider or dial – change the relative volume of music... Thermistor – change its temperature – switch on an immersion heater... LDR – put it in the light or dark – switch on an outside light when it gets dark. 	
		ii	Light Dependent Resistor	
		iii	At lower light levels	
		iv	At lower temperatures	
	b		Labels from top left: ammeter, voltmeter, filament lamp, resistor, variable resistor, thermistor, single cell, power supply, LDR	
7	a		<ul style="list-style-type: none"> The battery pushes on the charge... – The pump pushes on the water... The resistor heats up... – The water heats up... The charge loses potential energy... – the water loses potential energy... The potential energy lost by the charge... – The water loses the same potential ... 	
		b	Missing words: <ul style="list-style-type: none"> potential difference, volts potential difference potential difference 	
		c	<ul style="list-style-type: none"> Correct bold word: equals Potential difference across the battery equals potential difference across first resistor plus potential difference across second resistor 	
		d	i	Missing values: (circuit 1) 12 V, (circuit 2) 4 V, (circuit 3) 10 V
		ii	Rings: (circuit 1) none, (circuit 2) bottom resistor, (circuit 3) bottom resistor	
		iii	Bigger	
8	a		Correct bold words: <ul style="list-style-type: none"> the same as bigger than 	
		b	i	Ticks: (circuit 1) bottom resistor R2, (circuit 2) top resistor, (circuit 3) top resistor
			ii	<ul style="list-style-type: none"> p.d. across R1 = $0.04 \text{ A} \times 100 \Omega = 4.0 \text{ V}$ p.d. across R2 = $0.04 \text{ A} \times 200 \Omega = 8.0 \text{ V}$
			iii	Yes
		iv	12 V	
	c	i	Missing words: across, voltmeter, parallel	
		ii	Voltmeter drawn on circuit 3 in parallel with the top resistor	
9	a	i	Switch A is on the left, switch B is on the right	
		ii	The hairdryer would overheat and be damaged (and perhaps cause a fire).	

Further guidance

		iii	Missing values: <ul style="list-style-type: none"> • $230 \text{ V} / 46 \Omega = 5.0 \text{ A}$ • 0.5 V (i.e. $230 \text{ V} / 460 \Omega$) • 5.5 A
		iv	<ul style="list-style-type: none"> • Go through a component (line): flow, charge • Go across a component (ring): potential difference, voltage
10	a	i	Missing words: watts, volts, amps
		ii	Power = $230 \text{ V} \times 0.3 \text{ A} = 69 \text{ W}$
	b		Correct bold words: brighter, more, 230 V, more, bigger
	c	i	1.32 A
		ii	11 bulbs
		iii	The cable will overheat and could cause a fire.
		iv	Fuse could go either at the top left or bottom left of the circuit.
		v	The fuse will blow if the current reaches 5 A, stopping any current in the circuit.
11	a	i	Missing words: <ul style="list-style-type: none"> • watts, seconds • kilowatts, hours
		ii	<ul style="list-style-type: none"> • 0.06 kW • Energy = $0.06 \text{ kW} \times 3 \text{ hours} = 0.18 \text{ kWh}$
		iii	Cost = $10\text{p per kWh} \times 0.18 \text{ kWh} = 1.8\text{p}$
	b	i	The width of the arrow for light is a quarter (25%) of the width of the arrow for work done by the supply.
		ii	Fluorescent
	c		Efficiency = $150 / 400 = 37.5 \%$
12	a		<ul style="list-style-type: none"> • Pull the north pole out of the coil – flicks to the left • Hold the magnet stationary in the coil – no movement • Push the south pole into the coil – flicks to the left • Pull the south pole out of the coil – flicks to the right
	b	i	The needle goes back and forth.
		ii	The magnet produces a magnetic field in the coil. → This field is constantly changing → because the magnet is turning. → The changing field induces → a changing voltage in the coil.

Further guidance

		iii	<p>Turn the handle faster.</p> <p>Put a soft iron core in the coil.</p> <p>Use a stronger magnet.</p> <p>Increase the number of turns of the coil.</p>
13	a	i	Labels clockwise from top right: induced alternating current, secondary coil, soft iron core, primary coil, a.c. supply (NB no label top left)
		ii	Correct bold words: primary, magnetic, induces, fewer, step down, less
		iii	<p>d.c. (straight line):</p> <ul style="list-style-type: none"> • Its voltage has a constant value. • It is produced by batteries. • It won't pass through a transformer. <p>a.c. (curvy line):</p> <ul style="list-style-type: none"> • Its voltage is constantly changing. • It is produced by generators. • It comes from the mains supply.

Further guidance

P5 Electric circuits – Higher Workbook answers

1	a	i	Correct bold words: the same, repel, electrons, negative	
		ii	Arrow pointing left	
		iii	The cloth had no charge before it was used. After rubbing, electrons (negative charge) were transferred from the cloth to the polythene, leaving the cloth with a resultant positive charge.	
		iv	Like charges... repel each other. Opposite charges... attract each other.	
b	i	Correct bold words: repel, attract		
	ii	Negative		
	iii	Attract		
c	i	All hairs get the same charge and so they repel each other.		
	ii	Neutral		
2	a		When the spark jumps across the gap, → the lamp lights up. → This implies that the electric current, → which makes the lamp light up, → is a movement of charges. → These are the same charges that jump across the gap to make a spark.	
	b		<ul style="list-style-type: none"> When Bethan first pushes... – Charge moves throughout the circuit... Bethan gets tired after pushing ... – Stored energy is transferred out of the battery. The others feel their hands getting hot. – The battery does work on all other... If any one of the others grips the rope ... – Putting in an insulator stops the flow... At any time, the amount of rope ... – The current is not used up. It is the same... 	
		c	i	<ul style="list-style-type: none"> Conductor – will carry an electric current – has free electrons Insulator – does not carry an electric current – has no free electrons
			ii	<ul style="list-style-type: none"> The top/right end of the wire is positive. Arrow for 'the current' is in the opposite direction to arrow for 'flow of electrons'.
		d	i	Missing words: ammeter, 0.01
			ii	<ul style="list-style-type: none"> Arrows pointing up to '10' in each of the ammeters Missing words: the same
	3	a	6 mA	
b		Arrows pointing to '6'		
c		6 mA		
d		Statement X		
e		Arrows pointing to '6'		
f		6 mA		

Further guidance

	g	Arrows pointing to '6'
	h	12 mA
	i	Statement Y
	j	Arrows pointing to '12'
	k	The first statement is true. (The current through the third resistor...)
4	a	<p>Electrical resistance:</p> <ul style="list-style-type: none"> opposes the flow of charge caused by ions in the solid measured in ohms, Ω <p>Electric current:</p> <ul style="list-style-type: none"> a flow of charge carried by electrons measure in amperes (amps), A
	b	<p>Correct bold words:</p> <ul style="list-style-type: none"> size more, small smaller, bigger big
	c	i Correct bold words: (top left box) bigger, (bottom left box) smaller
		ii <ul style="list-style-type: none"> Two resistors in series ... – Because the moving charges have to ... Two resistors in parallel ... – Because there are more paths ...
	d	Correct numbers: (top left) 4, (bottom left) 2, (middle) 1, (top right) 3, (bottom right) 5
5	a	Missing words: battery, voltage, bigger, bigger, proportional, double
	b	i Voltages: (left) 6 V, (middle) 9 V, (right) 1.5 V
		ii Current: (left) 48 mA, (middle) 72 mA, (right) 12 mA
	c	i Missing word: proportional
		ii They will be half the previous values.
		iii Line on graph drawn exactly half way between the existing line and the horizontal axis.
	d	Missing words: ohms = volts / amperes (amps)
6	a	i <ul style="list-style-type: none"> Variable resistor – move a slider or dial – change the relative volume of music... Thermistor – change its temperature – switch on an immersion heater... LDR – put it in the light or dark – switch on an outside light when it gets dark.
		ii Light Dependent Resistor
		iii At lower light levels

Further guidance

		iv	At lower temperatures
	b		Labels from top left: ammeter, voltmeter, filament lamp, resistor, variable resistor, thermistor, single cell, power supply, LDR
7	a		<ul style="list-style-type: none"> • The battery pushes on the charge... – The pump pushes on the water... • The resistor heats up... – The water heats up... • The charge loses potential energy... – the water loses potential energy... • The potential energy lost by the charge... – The water loses the same potential ...
	b		Missing words: <ul style="list-style-type: none"> • potential difference, volts • potential difference • potential difference
	c		<ul style="list-style-type: none"> • Correct bold word: equals • Potential difference across the battery equals potential difference across first resistor plus potential difference across second resistor
	d		<ul style="list-style-type: none"> • The bigger the potential difference across the battery, the bigger the push. – The harder the battery pushes the charge, the more work it does. • There is a drop in potential across each of the resistors. – The charge does work as it moves through a resistor. • There is a bigger potential difference across the bigger resistor. – The charge does more work as it goes through a bigger resistor. • The sum of potential differences across two equal resistors equals the potential difference across the battery. – Energy is conserved in the circuit: there is no net gain or loss of energy.
8	a		Correct bold words: <ul style="list-style-type: none"> • the same as • bigger than
	b	i	Ticks: (circuit 1) bottom resistor R2, (circuit 2) top resistor, (circuit 3) top resistor
		ii	Current = $12\text{ V} / 300\ \Omega = 0.04\text{ A}$
		iii	<ul style="list-style-type: none"> • p.d. across R1 = $0.04\text{ A} \times 100\ \Omega = 4.0\text{ V}$ • p.d. across R2 = $0.04\text{ A} \times 200\ \Omega = 8.0\text{ V}$
		iv	Yes
		v	The sum of the p.d.s equals the p.d. across the battery because energy is conserved.
		vi	Voltmeter drawn on circuit 3 in parallel with the top resistor
9	a		Correct bold words: the same, is equal to
	b	i	Switch A is on the left, switch B is on the right
		ii	The hairdryer would overheat and be damaged (and perhaps cause a fire).

Further guidance

		iii	Missing values: <ul style="list-style-type: none"> • $230 \text{ V} / 46 \Omega = 5.0 \text{ A}$ • 0.5 V (i.e. $230 \text{ V} / 460 \Omega$) • 5.5 A
		iv	Correct bold words: the same as, current, more, decrease
		v	<ul style="list-style-type: none"> • Go through a component (line): flow, charge • Go across a component (ring): potential difference, voltage
10	a	i	Missing words: watts, volts, amps
		ii	$I = P/V$
		iii	$I = 60/230 = 0.26 \text{ A}$
	b		Correct bold words: brighter, more, 230 V, more, bigger
	c	i	1.32 A
		ii	11 bulbs
		iii	The cable will overheat and could cause a fire.
		iv	Fuse could go either at the top left or bottom left of the circuit.
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11	a	i	Missing words: <ul style="list-style-type: none"> • watts, seconds • kilowatts, hours
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		iii	Cost = $10\text{p per kWh} \times 0.18 \text{ kWh} = 1.8\text{p}$
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12	a		<ul style="list-style-type: none"> • Pull the north pole out of the coil – flicks to the left • Hold the magnet stationary in the coil – no movement • Push the south pole into the coil – flicks to the left • Pull the south pole out of the coil – flicks to the right
	b	i	Diagram completed: second wave drawn to match first wave
		ii	Missing magnet positions: upright with dark end at the top, horizontal with dark end to the left
		iii	50

Further guidance

		iv	Turn the spindle faster. Increase the number of turns of the coil. Put a soft iron core inside the coil. Use a stronger magnet.
13	a	i	Labels clockwise from top right: induced alternating current, secondary coil, soft iron core, primary coil, a.c. supply (NB no label top left)
		ii	Correct bold words: primary, magnetic, induces, fewer, step down, less
		iii	$V_s = 12 \text{ V}$ ($24/460 \times 230$)
		iv	d.c. (straight line): <ul style="list-style-type: none"> • Its voltage has a constant value. • It is produced by batteries. • It won't pass through a transformer. a.c. (curvy line): <ul style="list-style-type: none"> • Its voltage is constantly changing. • It is produced by generators. • It comes from the mains supply.