Galashiels Academy

National 5 Physics

Electricity & Energy

Consolidation and Revision Questions

Name:	**Class:**

Electricity and Energy Questions		Date Due	Mark
1	Work Done	_____	/20
2	Weight & Gravitational Potential Energy	_____	/20
3	Kinetic Energy	_____	/20
4	Conservation of Energy	_____	/20
5	Efficiency	_____	/20
6	Current	_____	/20
7	Electric Charge	_____	/20
8	Series Circuits	_____	/20
9	Parallel Circuits	_____	/20
10	Ohm's Law	_____	/20
11	Resistors in Series and Parallel	_____	/20
12	Solar Cells, Capacitors and LED's	_____	/20
13	Voltage Dividers	_____	/20
14	Power	_____	/20
15	Specific Heat Capacity	_____	/20
16	Pressure	_____	/20
17	Gas Laws	_____	/20

Exercise 1: Work Done

1. What is meant by the term "work" **2**

2. Copy and Complete the table **6**

	Work Done / J	*Force* / N	*Distance* / m
(a)		100	30
(b)		25	6.2
(c)	300 000		150
(d)	40		2
(e)	1250	125	
(f)	144 000	3200	

3. What is the work done by a shopper pushing a shopping trolley with an average force of 480 N over a distance of 35 metres? **2**

4. What is the average force applied by a mother pushing a pram for a distance of 500 metres if her total work is 150 000 J? **2**

5. What is the distance that a boy pushes his bike if he does 240 000 J of work and applies a constant force of 6000 N? **2**

6. A group of 6 snow dogs pull a sledge with an average force of 600 N each. What is the distance that the sledge has been pulled when the total work done by all of the dogs is 90 MJ? **2**

7. In a P.E. lesson, a pupil of mass 58 kg climbs 12 metres up a rope. What is the work done by the pupil during this climb? **2**

8. The Australian Grand Prix is a race where the winning car drives 308 km.
The work done by a car that completes the full race is 2.43×10^9 J. What is the average engine force of the car? **2**

Total 20

Exercise 2: Weight & Gravitational Potential Energy

1. Copy and complete the table **6**

	Weight / N	*Mass* / kg	*Gravitational Field Strength* ($N\ kg^{-1}$)
(a)		3	10
(b)		0.25	9
(c)	300		10
(d)	210		7
(e)	520	65	
(f)	3640	140	

2. A pupil with a mass of 52 kg climbs a 9 metre rope in a PE lesson. **6**

a. What is the weight of the pupil?

b. What is the work done by the pupil in order to climb the rope?

c. What is the gravitational potential energy gained by the pupil?

3. A 450 g ball is dropped from a 1.5 metre high table on to the ground. What is the gravitational potential energy lost by the ball? **2**

4. A 450 g ball is thrown 1.5 metres into the air. What is the gravitational potential energy gained by the ball? **2**

5. A high jumper gains 1107 J of gravitational potential energy as she jumps 2.05 metres in to the air. What is the mass of the high jumper? **2**

6. A helicopter has a mass of 4800 kg and a gravitational potential energy of 7.2 MJ. How far from the ground is the helicopter? **2**

Total 20

Exercise 3: Kinetic Energy

1 Copy and complete the table **6**

	Kinetic Energy / J	*Mass* / kg	*Speed* / m s^{-1}
(a)		6	3
(b)		72	4.5
(c)	101 250		15
(d)	0.75		0.5
(e)	800	25	
(f)	4.8 x 10^{-3}	1.5 x 10^{-2}	

2 A go-kart has a kinetic energy of 30 J when it has a speed of 0.5 m s^{-1}. **2**
What is the mass of the car?

3. What is the kinetic energy of a sprinter with a mass of 75 kg running at 9.5 m s^{-1}? **2**

4. A toy car has a kinetic energy of 24.5 mJ when it has a speed of 0.7 m s^{-1}. **2**
What is the mass of the toy car?

5. An aeroplane has a mass of 3.5 x 10^{5} kg and a kinetic energy of 3.9375 GJ. **2**
What is the speed of the aeroplane?

6. A toy car has a kinetic energy of 1.1 J when it has a speed of 0.5 m s^{-1}. **2**
What is the mass of the toy boat?

7. A car of mass 1200 kg is driving down a motorway with a speed of 70 mph

a. Convert the speed of the car in to metres per second. (1 mile = 1609 metres) **2**

b. Calculate the kinetic energy of the car **2**

Total 20

Exercise 4: Conservation of Energy

1.	A 57 g tennis ball is dropped from a height of 90 cm		
	a.	What is the gravitational potential energy of the tennis ball before it is dropped?	**2**
	b.	What is the kinetic energy of the ball as it lands?	**2**
	c.	What is the vertical speed of the ball as it lands on the ground?	**2**
2.	After retrieving his 46 g golf ball from a bush, a golfer takes a penalty drop by holding the ball at arm's length and allowing it to drop a height of 1.5 m to the ground.		
	a.	What is the gravitational potential energy of the ball just before it is dropped?	**2**
	b.	What is the speed of the ball when it hits the ground?	**2**
	c.	What is the speed of the ball when it is 0.75 metres above the ground?	**2**
3.	An 85 kg skydiver jumps out of an aeroplane which is at a height of 3800 metres. The parachute is opened at a height of 1300 metres above the ground.		
	a.	What is the speed of the skydiver just before the parachute is opened	**2**
	b.	In reality, the speed of the skydiver is 55 m/s at this point. Explain the difference in the speed calculated in part (a) and the actual speed of the diver	**2**
4.	A bouncy ball of mass 50 g is thrown into the air with a kinetic energy of 1.6 J		**2**
	a.	What is the gravitational potential energy of the bouncy ball at its highest point?	**2**
	b.	What is the maximum height that the ball will reach?	
		Total 20	

Exercise 5: Efficiency

1. State the main energy changes in each of the following appliances: **6**

Lamp, Microwave, Yo-yo, Solar panel, TV and *Radio*

2. Copy and Complete the table: **6**

	Efficiency / %	***E_{out}* / J**	***E_{in}* / J**
(a)		1500	2500
(b)		5×10^6	0.1×10^9
(c)	43		6500
(d)	38		3.2×10^7
(e)	5	5400	
(f)	16	7.8×10^5	

3. In one minute, a motor in a food mixer uses up 25 kJ of electrical energy. The kinetic energy given off by the motor in this time is 8750 J

a. What is the total energy output of the motor? **2**

b. How much energy was NOT turned in to kinetic energy? **2**

c. What has happened to the 'missing' energy? **2**

4. What is the efficiency of the motor in the food mixer (from question 3) that gives out 8750 J of kinetic energy when it uses up 25 kJ of electrical energy **2**

Total 20

Exercise 6: Current

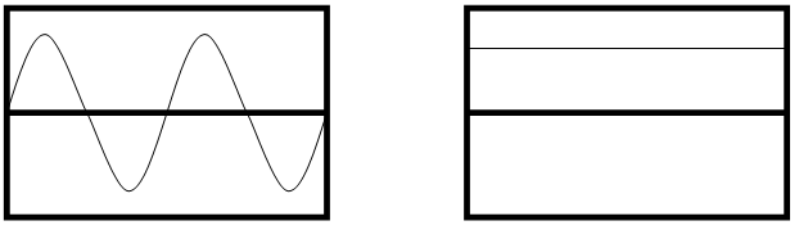
1. Copy and complete the table **6**

	Charge / C	*Current / A*	*Time / s*
(a)		0.5	30
(b)		0.14	25
(c)	4.2		15
(d)	3200		1280
(e)	1.6×10^{-3}	3.2×10^{-4}	
(f)	270	0.3	

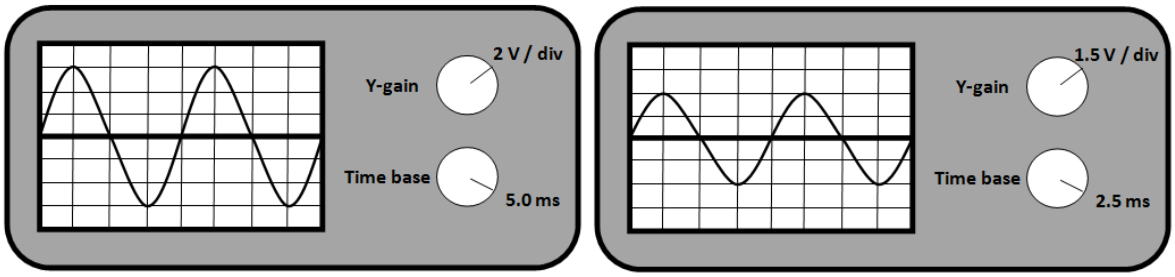
2. A current of 6.5 A flows through a hairdryer for 5 minutes. What is the charge that flows through the hairdryer during this time? **2**

3. State the difference between direct and alternating current. **2**

4. Copy these oscilloscope traces and indicate which one represents an alternating current and which one represents a direct current. **4**



5. For each trace find the **peak voltage** and the **frequency** **4**

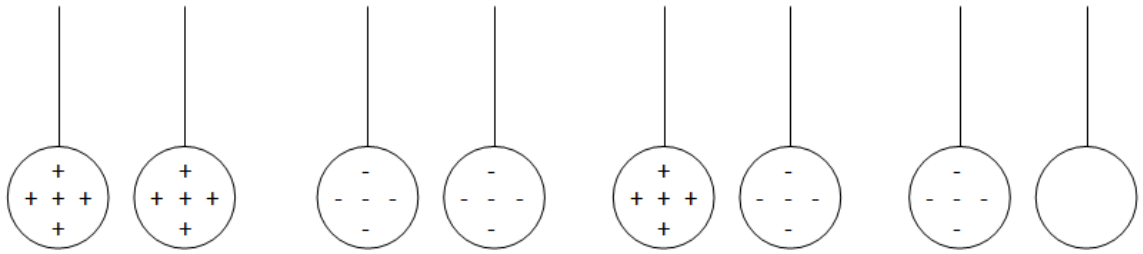


6. An electric kettle has 9.5 A of current flowing through it as it boils water. How long does it take the kettle to boil if 1995 C of charge flows through it before it switches off? **2**

Total 20

Exercise 7: Electric Charge

1. In a classroom experiment, two metal spheres are hung from a thread, as shown. Copy the diagrams and show the direction of movement of each sphere. **4**

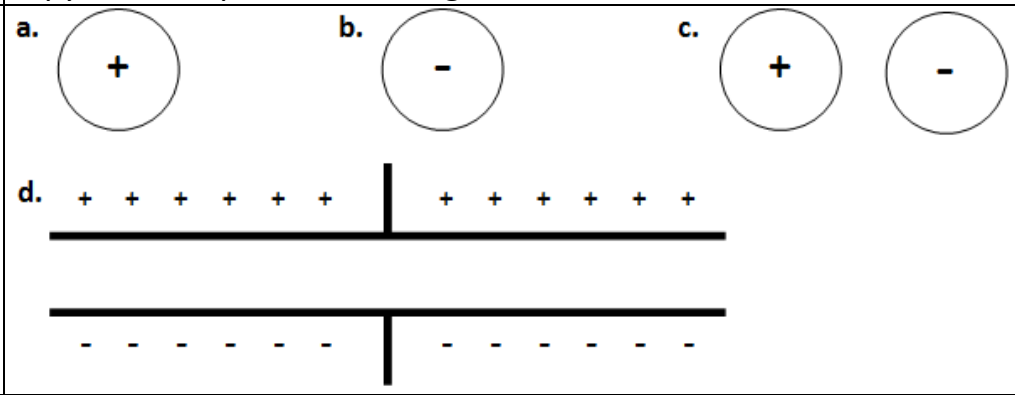


2. Cling film is used to keep to keep food fresh, it is sticky because of charges.

a. Describe how a piece of cling film becomes charged. **2**

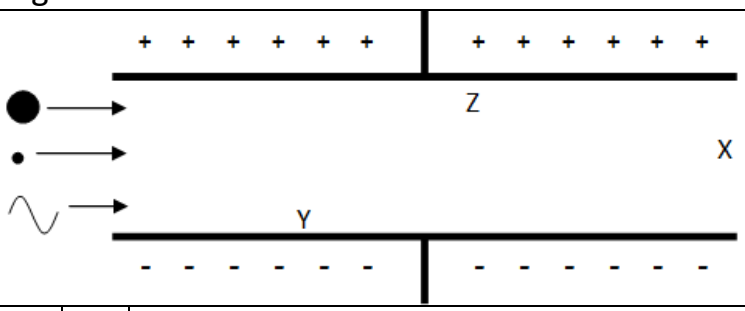
b. Explain why cling film will stick to a plastic bowl for a long time but loses its sticking power quickly when placed on a metal bowl. **2**

3. Copy and complete these diagrams to show the direction of the electric field **4**



4. Copy this diagram and add the paths of the following particles entering at right angles to the electric field: **a.** Electron **b.** Proton **c.** Neutron **6**

5. An alpha particle, a beta particle and a gamma ray enter an electric field at right angles to the field. Which letter shows the most likely position of each particle?



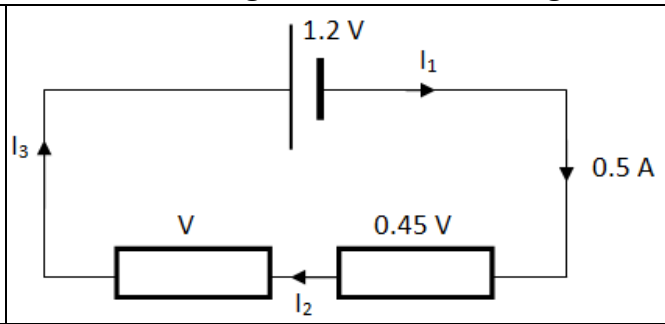
Total 20

Exercise 8: Series Circuits

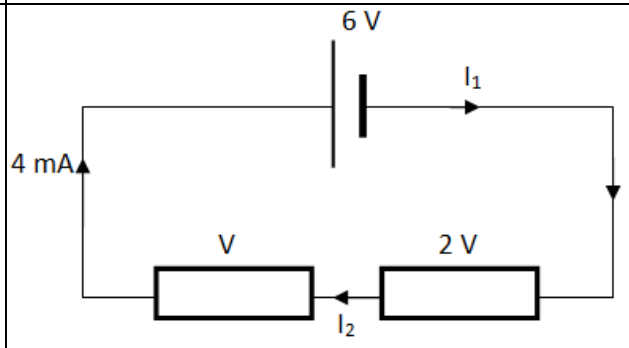
1. State the rules for calculating current and voltage in series circuits. **2**

2. Calculate the missing currents and voltages in these series circuits **10**

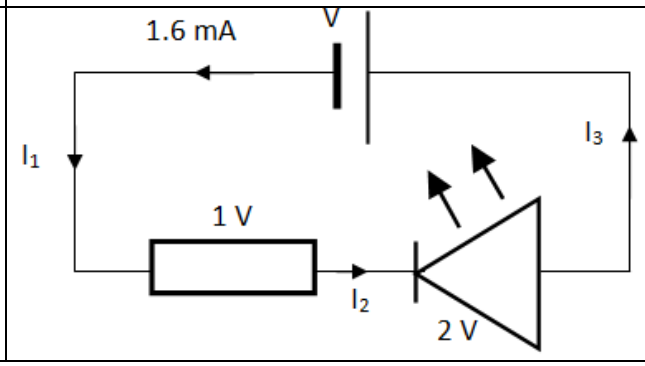
a.



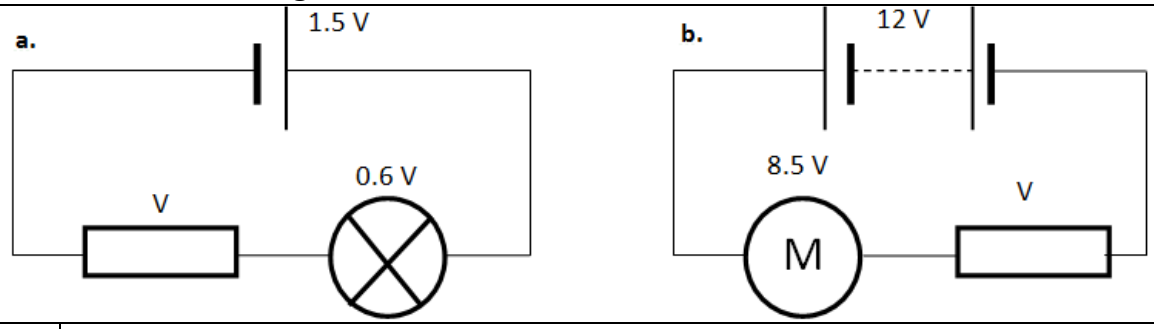
b.



c.



3. Calculate the voltage across the resistor in each of these series circuits **4**



4. In the circuit in question 3 part (a), the lamp uses up 36 J of electrical energy in one minute.

a. How much electrical energy is converted in to heat energy by the resistor in one minute? **2**

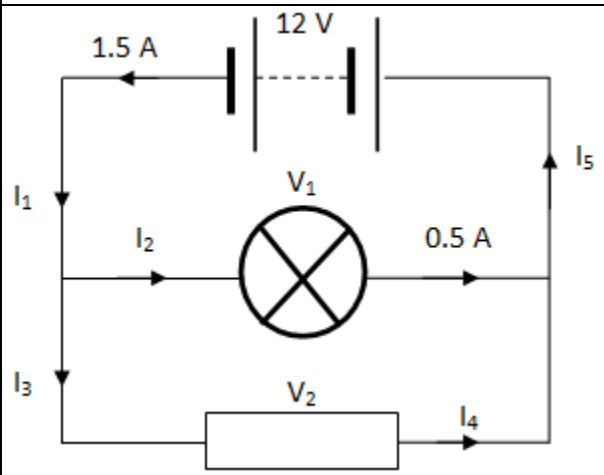
b. How much electrical energy is given off by the cell in one minute? **2**

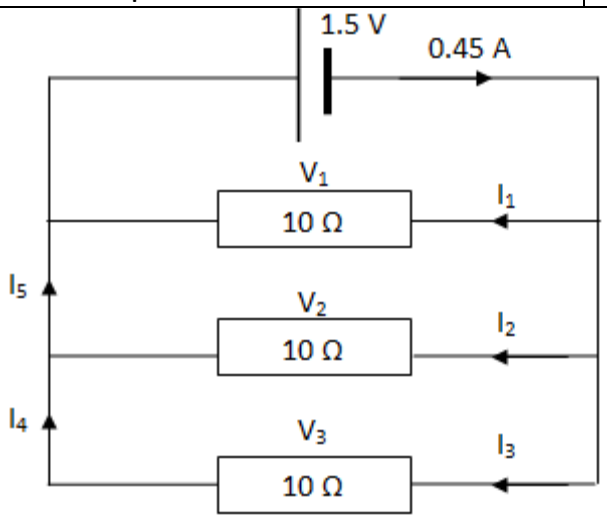
Total 20

Exercise 9: Parallel Circuits

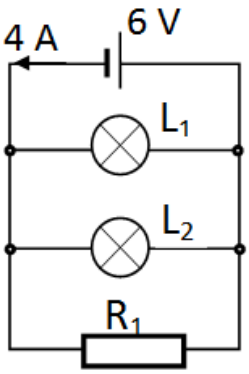
1. State the two rules for finding current and voltage in a parallel circuit. **2**

2. Calculate the missing currents and voltages in these parallel circuits **15**





3. A resistor & 2 bulbs are connected in parallel to a 6 V supply



a. What is the voltage across L_2 **1**

b. A current of 1·8 A flows through each of the bulbs. What is the current flowing through the resistor? **2**

Total 20

Exercise 10: Ohm's Law

1 What is meant by the 'resistance' of a component? **1**

2. What are the units for resistance?

3. Copy and complete this table **6**

	Voltage / V	*Current / A*	*Resistance / Ω*
(a)		0.4	150
(b)		0.05	40
(c)	12		60
(d)	8		400
(e)	230	5	
(f)	10	0.08	

4. What is the resistance of a lamp that allows 600 mA of current to flow through it when there is a potential difference of 12 V across it **2**

5. What is the current flowing through a piece of 10 kΩ resistance wire when a voltage of 15 V is across it? **2**

6. What is the voltage across a 1500 Ω resistor that has a current of 10 mA flowing through it? **2**

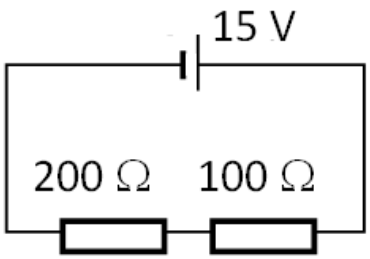
7. What is the voltage across a 125 Ω lamp that has a current of 1.84 A flowing through it? **2**

8. What is the voltage across a 125 Ω lamp that has a current of 1.84 A flowing through it? **2**

Total 20

Exercise 11: Resistors in Series and Parallel

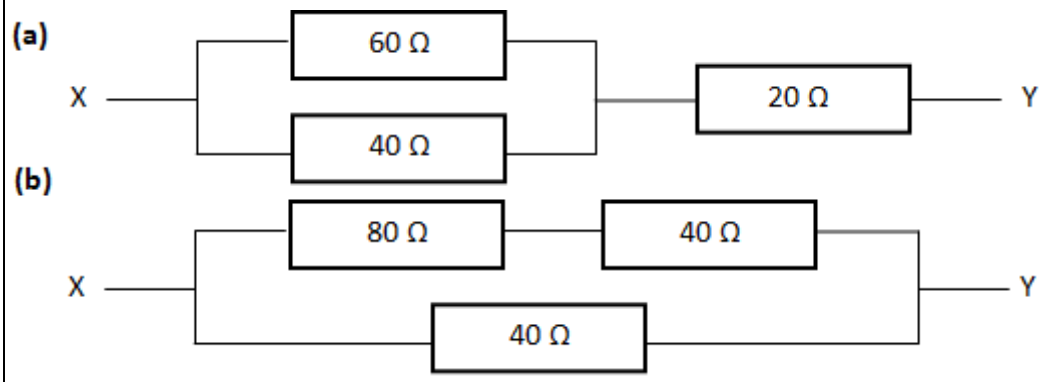
1. Two resistors are connected in series to a supply as shown in the diagram



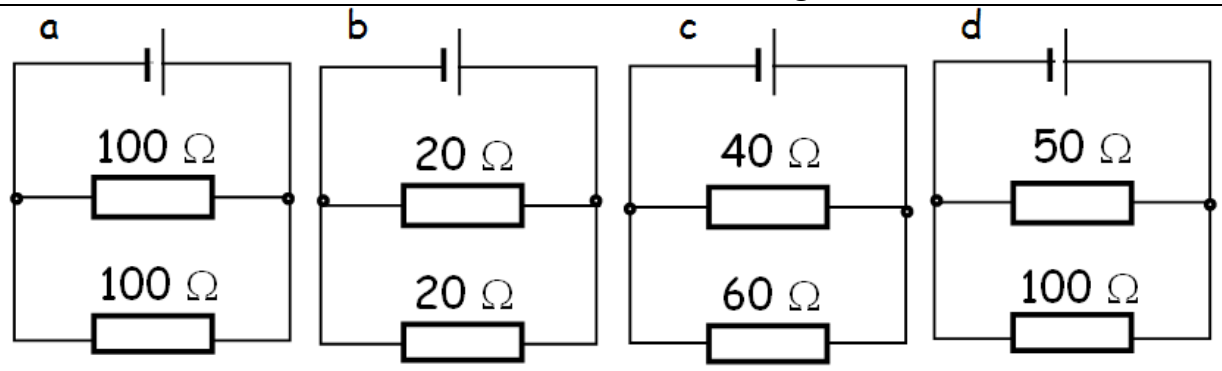
a. The current in the 200 Ω resistor is 0·05 A. What is the current in the other resistor? **1**

b. The voltage across the 100 Ω resistor is 5 V. What is the voltage across the 200 Ω resistor? **1**

2. Find the total resistance between x and y in the following circuits. **4**



3. Calculate the total resistance of each of the following circuits **8**

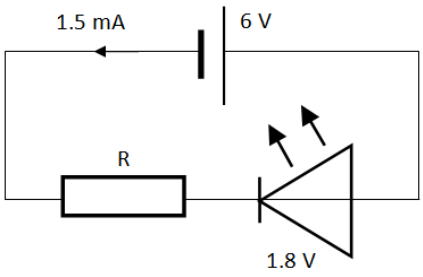
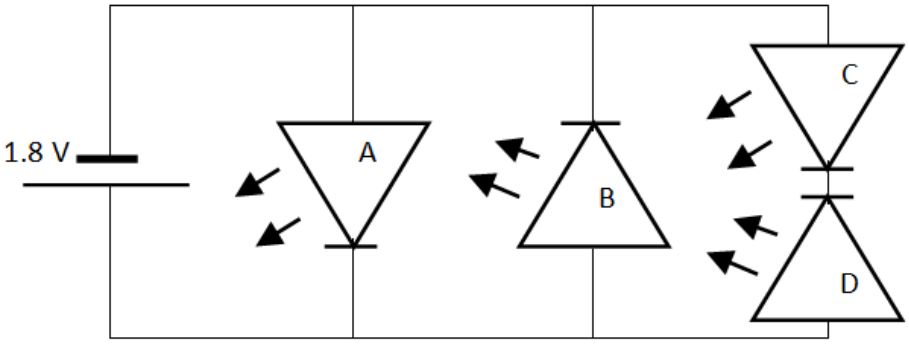


4. Draw circuit diagrams to show how by using only 20Ω resistors you can make a total resistance of **6**

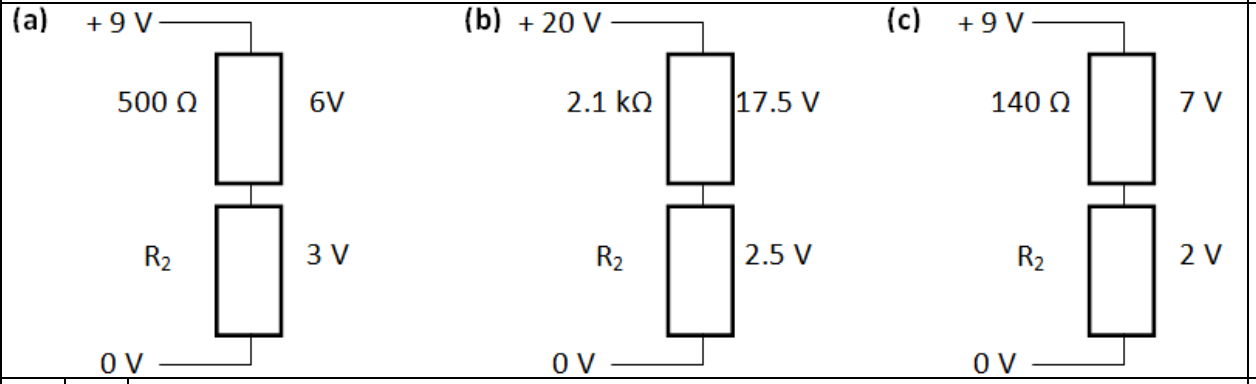
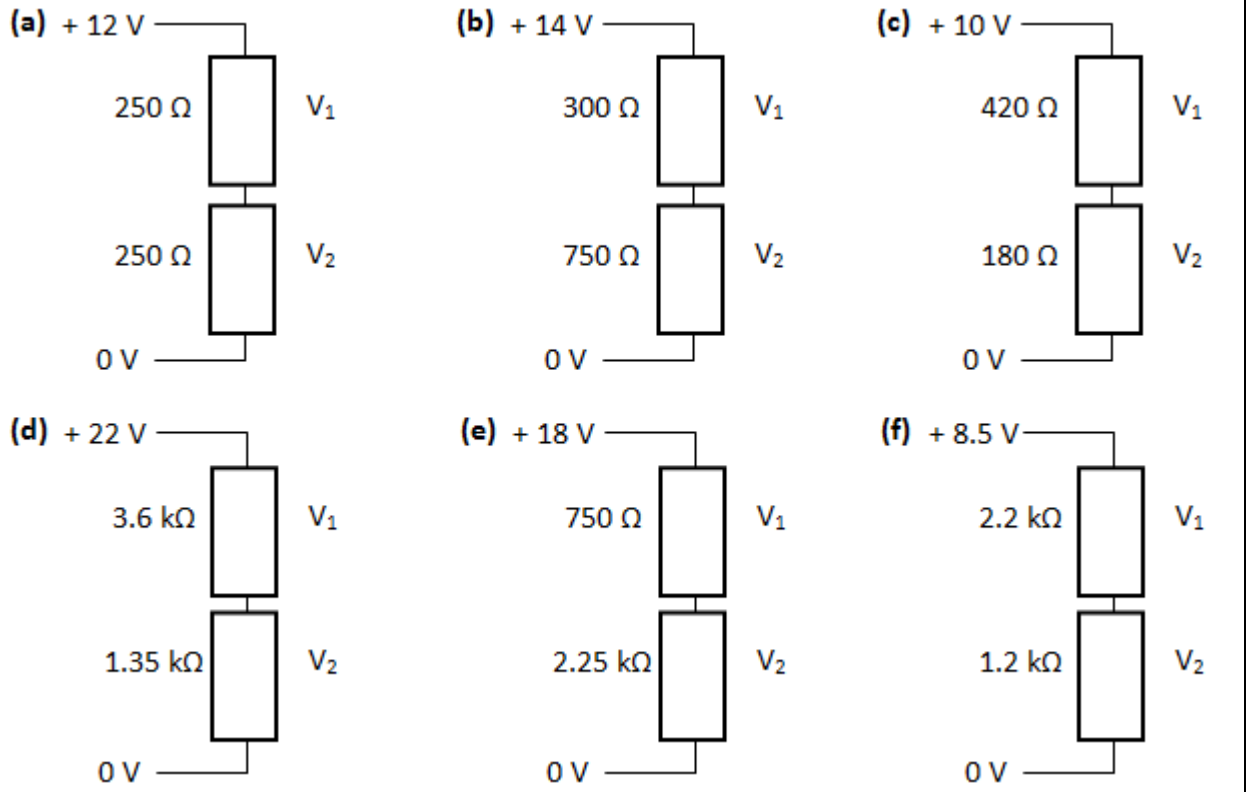
a) 40 Ω b) 60 Ω c) 10 Ω d) 50 Ω e) 5 Ω f) 75Ω

Total 20

Exercise 12: Solar Cells, Capacitors and LED's

1.	a.	What is the energy conversion in a solar cell	**2**
	b.	What happens to the voltage generated by a solar cell as the light incident on it becomes brighter?	**2**
2.	What is the purpose of a capacitor in a circuit?		**1**
	Name two factors that affect the time taken for a capacitor to charge		**2**
3.	What is the energy change that takes place in an LED?		**2**
4.	An LED is connected in series with a cell and a resistor, as shown. The LED operates when the voltage across it is 1.8 V and the current flowing through it is 1.5 mA.		
			
	a.	Why is the LED connected in series with a resistor?	**2**
	b.	What value of resistor is required for the LED to operate?	**2**
5.	Which of these LEDs will light?		**2**
			
		Total 15	

Exercise 13: Voltage Dividers

1.	What happens to the voltage across a resistor as the resistance of the it is increased	**2**
2.	Calculate the value of resistor R_2 in each of these voltage divider circuits	**6**
		
3.	Calculate the voltages V_1 and V_2 in each of these voltage divider circuits.	**12**
		
		Total 20

Exercise 14: Power

1. A student makes a statement: *'The power of a light bulb is 60 W.'*
What does this statement mean, in terms of energy? **2**

2. Copy and complete this table **6**

	***Power* / W**	***Energy* / J**	***Time* / s**
(a)		800	10
(b)		5100	60
(c)	1500		30
(d)	1450		900
(e)	218	54 500	
(f)	1500	210 000	

3. What is the power of a radio that uses up 27 kJ of electrical energy in five minutes? **2**

4. How much electrical energy is used up by a 725 W fridge in one day? **2**

5. How long will it take a 1.2 kW vacuum cleaner to use up 720 kJ of electrical energy? **2**

6. Copy and complete the table: **6**

	***Power* / W**	***Current* / A**	***Voltage* / V**
(a)		0.3	4.5
(b)		1.5	12
(c)	750		25
(d)	1150		230
(e)	40	0.8	
(f)	30	0.75	

Total 20

Exercise 15: Specific Heat Capacity

1. What is the difference between heat and temperature? **1**

2. Copy and Complete the table **8**

	Heat Energy / J	*Specific Heat Capacity / J kg^{-1} °C^{-1}*	*Mass / kg*	*Change in Temperature / °C*
(a)		2350	2.0	10
(b)		902	5.0	25
(c)	36 900		4.5	2
(d)	6885		0.75	34
(e)	10 080	2100		12
(f)	105 600	480		40
(g)	2400	128	2.5	
(h)	27 690	2130	3.25	

5. A 2.4 kg lump of brass is heated up by a Bunsen burner. When 9120 J of heat energy has been absorbed, the temperature of the brass increases by 10 °C. What is the specific heat capacity of the brass? **2**

6. A pane of glass has a mass of 800 g. What is the temperature change of the glass if it is heated by 1000 J of heat energy? **2**

7. A block of lead is heated from 24 °C to 28°C by a heat source that gives off 6144 J of heat energy. What is the mass of the lead block? **2**

8. What is the heat energy required to heat 3.0 kg of water from 20 °C to 80°C? **2**

9. Describe how heat travels by: **3**

a. Conduction

b. Convection

c. Radiation

Total 20

Exercise 16: Pressure

1. Explain the term pressure using the words *force* and *area* **1**

2. Copy and Complete the table **5**

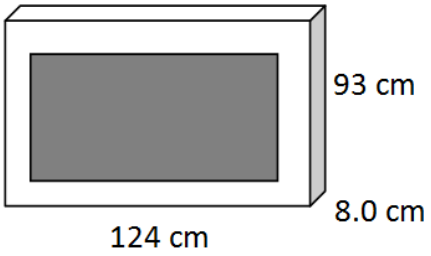
	***Pressure* / Pa**	***Force* / N**	***Area* / m^2**
(a)		120	1.6
(b)		4000	0.5
(c)	1.1×10^5		2.0
(d)	9000		8.0×10^{-2}
(e)	12 000	7.2×10^5	

3. A 480 g tin of baked beans is a cylinder with a radius of 3.2 cm. It is placed on a kitchen counter. What is the pressure on the counter caused by the tin? **2**

4. A car of mass 1250 kg is driven on to a bridge. The pressure on the surface of the bridge when all four tyres are on the ground is 39.0 kPa. What is the contact area of *one* tyre on the bridge? **2**

5. Are you more likely to fall through an icy lake if you are on your tip toes or lying flat on your back with your arms and legs stretched out? Explain your answer. **2**

6. A television has a length of 124 cm, a height of 93 cm and a depth of 8.0 cm
If it has a mass of 30 kg, what is the



a. Maximum pressure that the television can exert on a surface? **2**

b. Minimum pressure that the television can exert on a surface? **2**

7. By measuring your weight and the area of your feet, calculate the pressure that you exert on the floor when:

a. You stand normally **2**

b. You stand on one foot **2**

Total 20

Exercise 17: Gas Laws

1.	Explain, using the kinetic theory of particles, what happens to the particles in a liquid when it melts and becomes a gas.	**2**
2.	Explain, using kinetic theory, how the air in a bicycle tyre creates pressure on the inside surface of the tyre	**2**
3.	Why does the Kelvin temperature scale start at -273 °C?	**2**
4.	Convert these temperatures from degrees Celsius to Kelvin.	**4**
	a. 0 °C b. 20 °C c. -273 °C d. 100 °C	
5.	Explain, using the appropriate gas law, why it is important that car tyres are not filled up with so much air that the air pressure is above the car manufacturer's guidelines?	**2**
6.	At a temperature of 20 °C, the pressure of a fixed mass of gas in a sealed container is found to be 104 kPa. The gas is heated to a uniform temperature of 90 °C using a heat bath. What is the pressure of the gas at a temperature of 90 °C?	**2**
7.	The pressure of the air in a lorry tyre is found to be 2.58×10^5 Pa at the end of a journey. Once the tyre has cooled down, the temperature of the air inside the tyre is found to be 10 °C with the pressure decreasing to 2.41×10^5 Pa. What was the temperature of the air in the tyre at the end of the journey? Give your answer in degrees Celsius.	**2**
8.	A 5 cm^3 syringe is filled with air and the pressure of the air is found to be 1.01×10^5 Pa. The syringe plunger is then pushed until there is 3 cm^3 of air. What is the new air pressure?	**2**
9.	A scuba diving air tank has a volume of 7.5 litres and is filled with air at a pressure of 1.21×10^7 Pa. What volume of air will be released by the tank at atmospheric pressure (1.01×10^5 Pa)?	**2**
	Total 20	