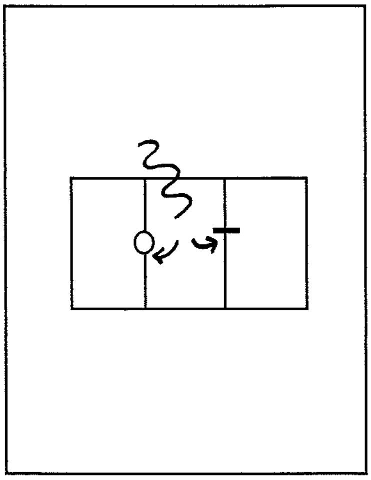
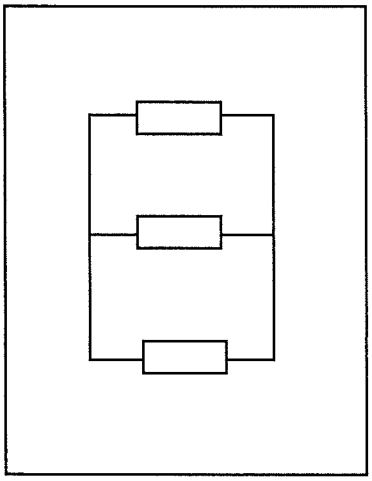
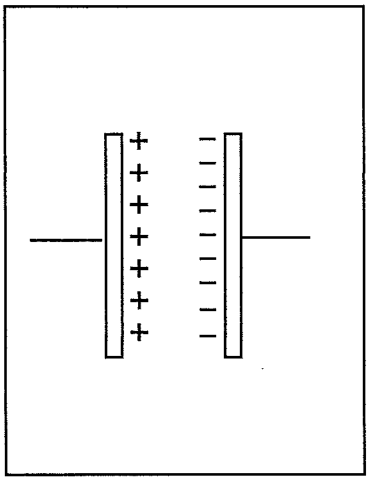
Higher Physics

Unit 2

Electricity







Tutorial Questions

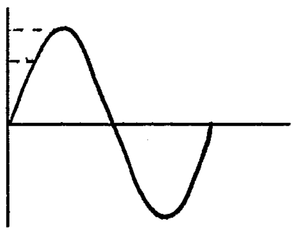
Higher Physics   Unit 3   Electricity   Unit Questions

1. a.c/d.c circuits

(1) Which type of electricity has a constant size and direction?

(2) Which type of electricity has a constantly changing size and direction?

(3) Here is diagram of an **a.c.** electrical signal.



(a) What do we call the maximum voltage or current in every ac cycle

(b) What do we call the value which is about 70% of this maximum?

(4) The peak voltage of an ac signal is 25V. Calculate the rms voltage.

(5) The peak current is 13.8mA from an ac supply. Calculate the rms current

(6) The rms voltage across a resistor 4.2V. What is the peak voltage

(7) The rms current in a hair dryer is 1.2A. What is the peak current?

(8) When using formula like P=IV or V=IR which values do we use - peak or rms?

(9) In a circuit a bulb is run off a 12V peak voltage. If the rms current is 1.8A calculate the power of the bulb.

(10) The peak current and peak voltage across a resistor are 16mA and 4V. Calculate its resistance.

(11) The peak voltage across a 70Ω resistor is 15.2V. calculate the rms current?

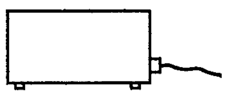
(12) UK mains voltage is quoted at 230V is this the peak or rms?

(13) The heating element in a toaster operates at 1700W when plugged into the mains.

(a) What is the rms voltage

(b) Calculate the rms current

(c) What is the peak current?

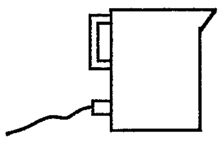


(14) The power of a kettle plugged into the mains is 2.5kW.

(a) Calculate the rms current. (Hint P=IV)

(b) Calculate the peak current.

(c) What is the resistance of the element?



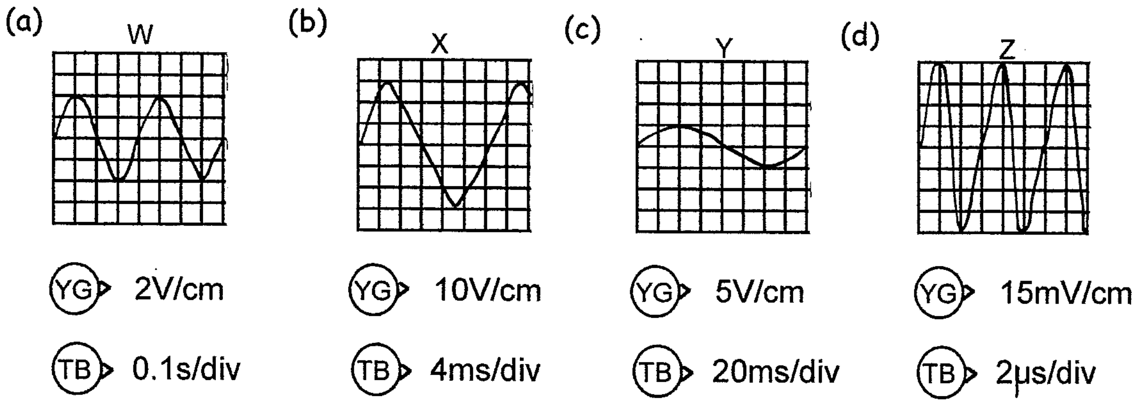
Ans (4) 17.7V (5) 9.8mA (6) 5.9V (7) 1.7A (9) 15.3W (10) 250Ω (11) 0.15A
(12) rms (13) (a) 230V (b) 7.4A (c) 10.5A (14) (a) 10.9A (b) 15.4A (c) 21.1Ω

(15) A heater is run from a 60V dc supply. What value of ac voltage would produce the same heating effect - 60V peak or 60V rms.

(16) The rms current used by a kettle is 8A. Why would you not use a 9A fuse to protect the flex?

(17) Here are 4 oscilloscope traces W- Z showing ac traces. For each state the

(i) peak voltage (ii) rms voltage (iii) period (iv) frequency

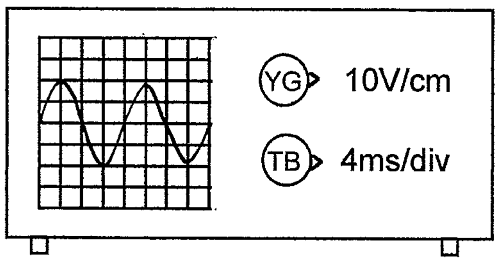


(18) Does INCREASING the time base from 4ms/div to 8ms/div make the beam move across the screen faster or slower?

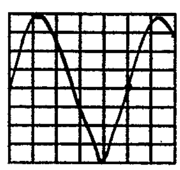
(19) Here is an oscilloscope trace of an ac voltage.

(a) What would happen to the trace if the Y-gain was increased to 20V/cm?

(b) What would happen to the trace if the time base was decreased to 2ms/div



(20) A trace from a 100Hz/20V peak supply shows a wave with a wavelength of 5 horizontal boxes and a peak of 4 vertical boxes



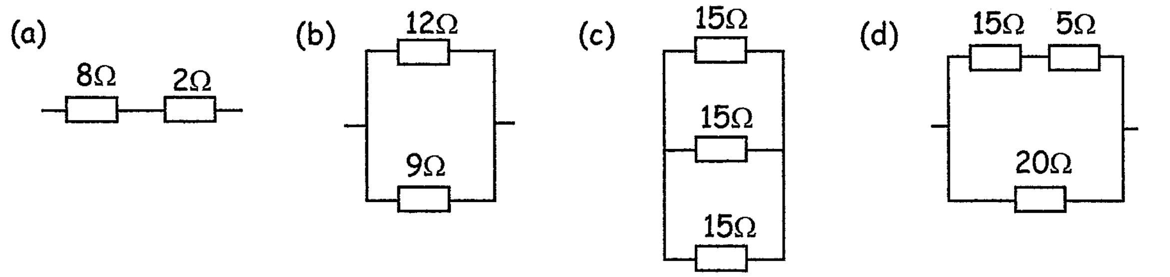
(a) What is the Y gain setting?

(b) What is the time base setting (hint - work backwards)

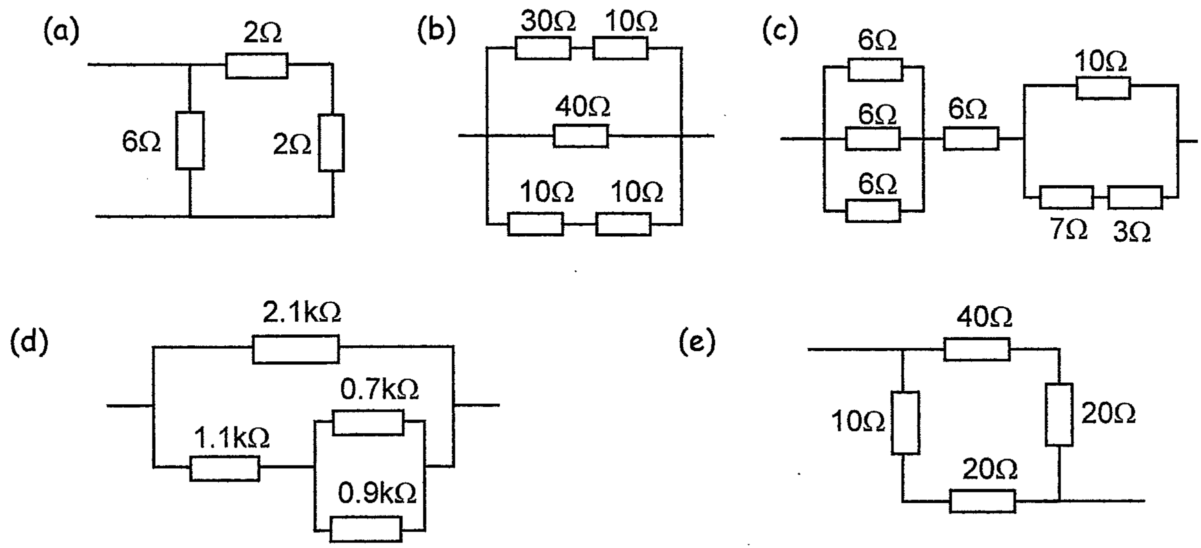
Ans (15) 60Vrms (17)(**a**)(i) 4V (ii) 2.8V (iii) 0.4s (iv) 2.5Hz (**b**) (i) 30V (ii) 21.2V (iii) 24ms (iv) 41.7Hz (**c**)(i) 5V (ii) 3.5V (iii) 160ms (iv)6.25Hz (**d**)(i) 60mV (ii) 42,2mV (iii)6μs (iv)166,667Hz (20)(a) 5V/cm (b)2ms/div

2. Circuits Total resistance V=IR

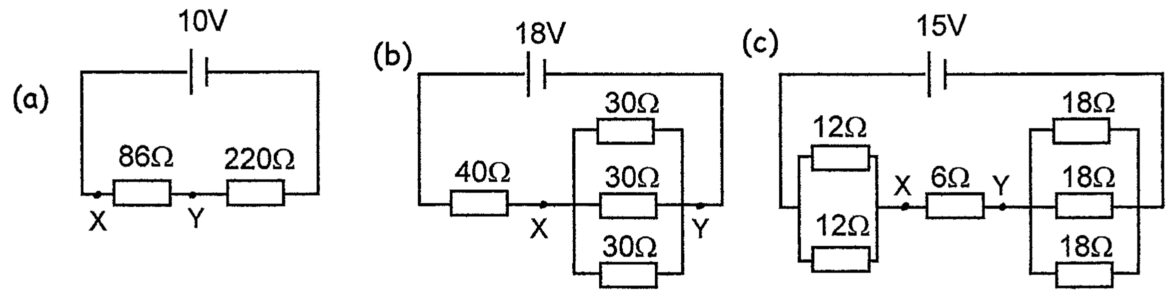
(21) Here are 4 circuits work out the total resistance



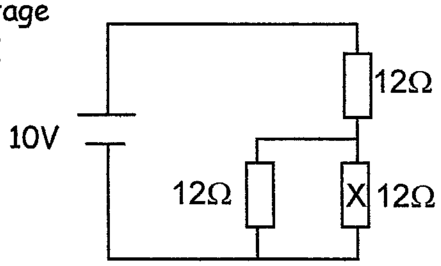
(22) Calculate the resistance of these circuits.



(23) Use the voltage divider formula to calculate the voltage between X and Y (Hint - simplify b ad c to series circuits)

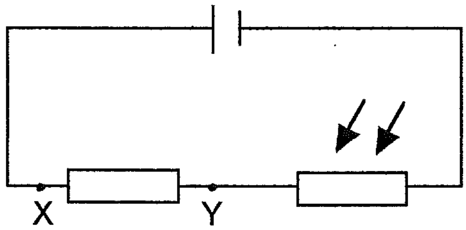


(24) Calculate the voltage across resistor X



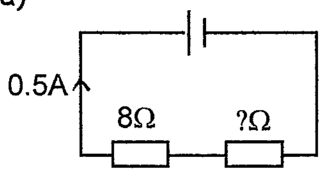
Ans (21)(a) 10Ω (b) 5.1Ω (c) 5Ω (d) 10Ω (22)(a) 2.4Ω (b)10Ω (c) 13Ω (d) 873Ω (e) 20Ω (23)(a) 2.8V (b) 3.6V (c) 5V (24) 3.3V

(25) This diagram shows an LDR in series witha resistor
What happens to voltage XY when it gets brighter?

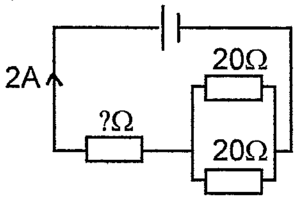


(26) Look at these two circuits - work out the missing resistance. Hint - if you know total current and max voltage you can find total resistance.

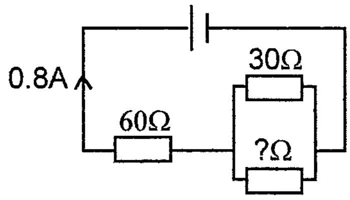
(a)



(b)

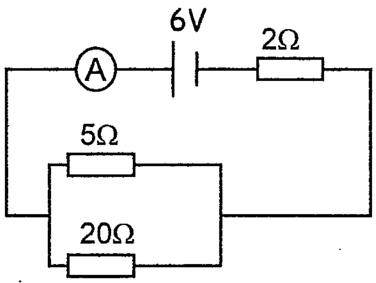


(c)



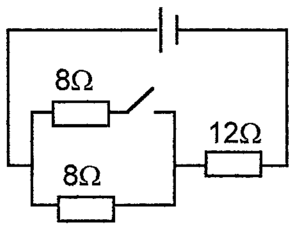
(27) Look at this circuit

(a) Calculate the current measured by the ammeter
(b) Calculate the current in the 20Ω resistor



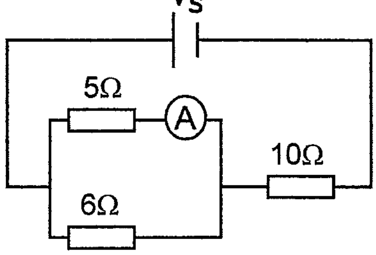
(28) Calculate the voltage across the 12Ω resistor when

(a) the switch is open
(b) the switch is closed



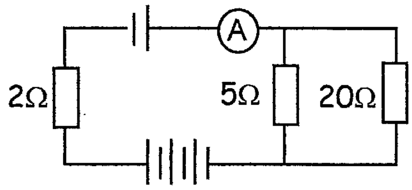
(29) The current measured by the ammeter is 1.8A.

Calculate the supply voltage V_S
(Hint:voltage across branches)

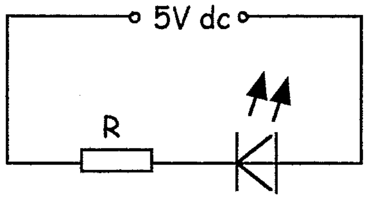


Ans: (26)(a) 12Ω (b) 8Ω (c) 30Ω (27)(a) 1A (b)0.2A (28)(a) 21.6V (b) 27V (29) 42V

(30) (a) Calculate the effective voltage in this circuit. Each cell = 2V.
(b) Calculate the total resistance.
(c) Calculate the current measured by ammeter.



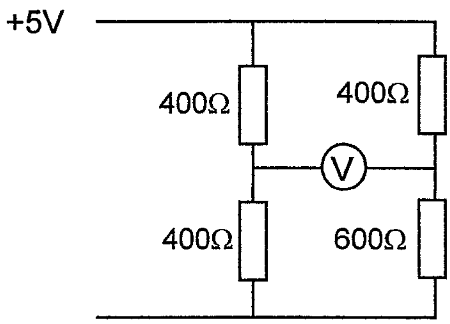
(31) Calculate the value of R when LED is working at its rated values.
The LED is rated at 20mA/1,5V



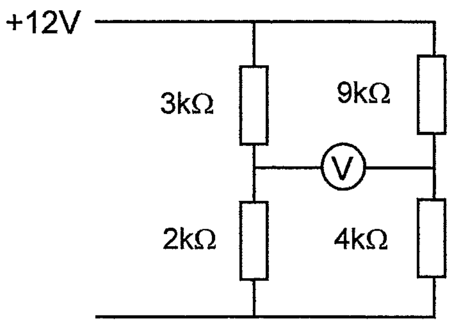
Wheatstone bridge

(32) Calculate the voltage between A and B in these wheatstone bridges.

(a)



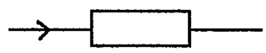
(b)



3. Energy and Power

$P=E/t$ $P=IV$ $P=I^2R$ $P = V^2/R$

(33) The current through a 20Ω resistor is 0.8A.

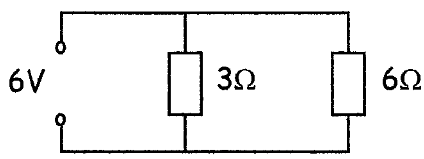


(a) Calculate the power developed.
(b) How much electrical energy is dissipated in 2minutes

(34) A 15V supply produces a current of 2A in a lamp for 7mins. Calculate the electrical energy transferred in the lamp in this time

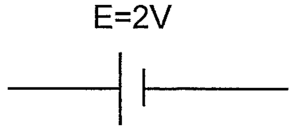
(35) A kettle plugged into a 230V socket uses 900kJ of electrical energy in 5mins. Calculate the resistance of the kettle's element.

(36) What is the power dissipated in the 3Ω resistor



Ans: (30)(a)4V (b) 4Ω (c) 1A (31) 175Ω (32)(a) 0.5V (b) 1.1V (33)(a) 12.8W (b)1536J (34) 12600J (35) 17.6Ω (36) 12W

4. Internal resistance $E = IR + Ir$



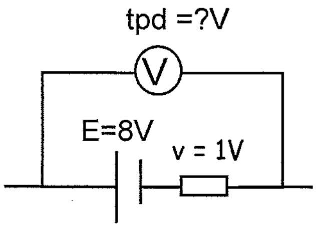
(37) The EMF E of a battery is the maximum __________ given to each coulomb passing through the battery.

(38) The terminal potential difference V or tpd is the ___________ measured across the terminals of the __________. It is the useful __________ available to the external __________. In open circuit, when no current flows tpd = ________.

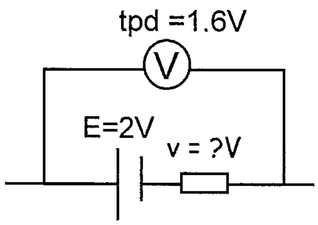
(39) The lost voltage v is the voltage lost while driving ___________ through the battery. We imagine it is dropped across an _______________ resistor r.

(40) Calculate the unknown value in each of these diagrams

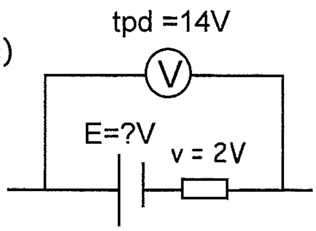
(a)



(b)



(c)

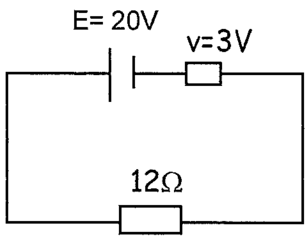


(41) If the Emf of a battery is 10V and the lost voltage is 2V, the tpd = ___V

(42) If the tpd = 20V and the lost voltage is 3V the Emf = ___V

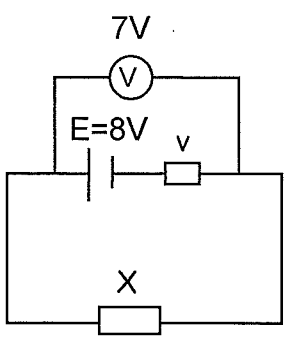
(43) If the Emf is 60V and the tpd = 55V, the lost voltage = ___V

(44) Look at this circuit



- (a) What is the tpd?
- (b) So what is the voltage across 12Ω resistor?
- (c) Calculate the current in the circuit?
- (d) Therefore calculate the internal resistance.

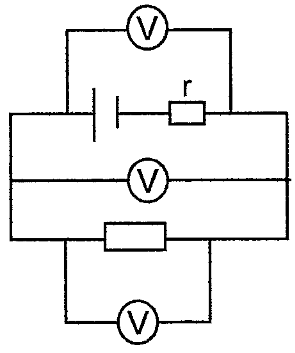
(45) Look at this circuit. The voltmeter reads 7V



- (a) What do we call the reading on the voltmeter?
- (b) If the voltmeter was placed across the resistor X what would it read?
- (c) What is the lost voltage?

Ans (40)(a) 7V (b) 0.4V (c) 16V (41)(a) 8V (42) 23V (43) 5V (44)(a)17V (b) 17V (c) 1.42A (d) 2.1Ω (45)(a) tpd (b) 7V (c) 1V

(46) (a) In this circuit the voltmeters are measuring the same value. What is it - the tpd, Emf or lost voltage?



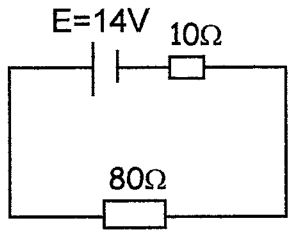
(b) Why do we sometimes call the tpd the useful voltage?

(c) What happens to the lost voltage if the value of internal resistance increases?

(d) So what happens to the tpd

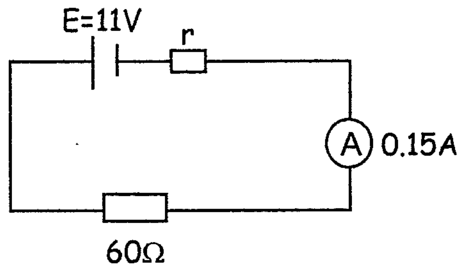
(47) E = tpd + lost volts. Write this equation down using the terms E, I, R and r.

(48) Look at this circuit. Calculate



(a) the tpd
(b) the lost voltage
(c) the current in the circuit.

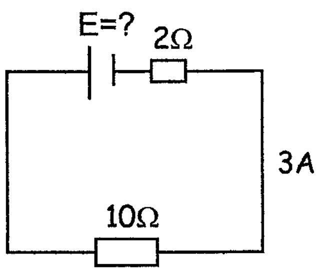
(49) This circuit shows a source of emf of 11V with an internal resistance. It is attached to a load 60Ω resistor



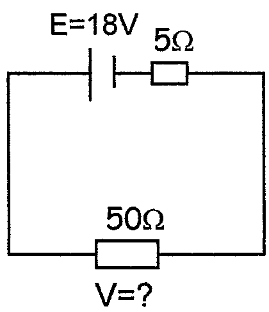
(a) If the reading on the ammeter is 0.15A calculate the tpd.
(b) Calculate the lost voltage.
(c) Therefore calculate the resistance of the internal resistance.

(50) In each circuit showing a battery with an internal resistance work out the missing term.

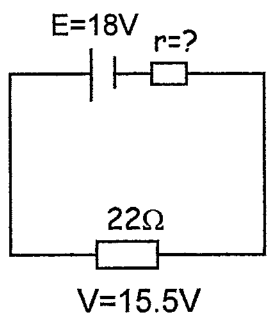
(a)



(b)

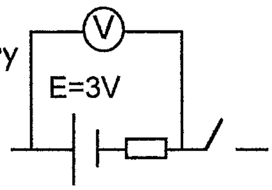


(c)



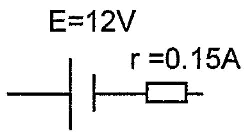
Ans (46)(a) tpd (48)(a) 12.4V (b) 1.6V (c) 0.16A (49)(a) 9V (b) 2V (c) 13.3Ω
(50)a) 36V (b) 16.4V (c) 3.5Ω

(51) The emf of a battery is 3V. The switch is opened and a voltmeter is placed across the terminals of the battery



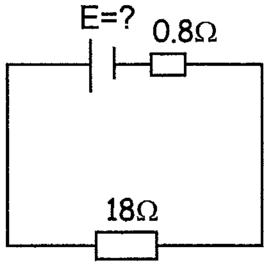
(a) What is the tpd in open circuit.
(b) What is another term for this value

(52) A wire is accidentally placed across the terminals of a battery as shown.



(a) What is the short circuit current?
(b) Why is this dangerous?

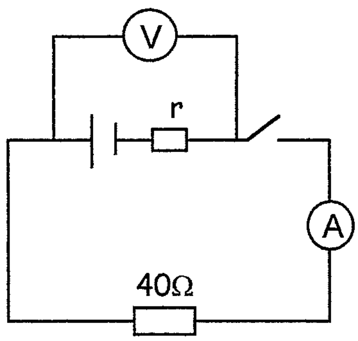
(53) In this circuit the short circuit current is 15.8A.



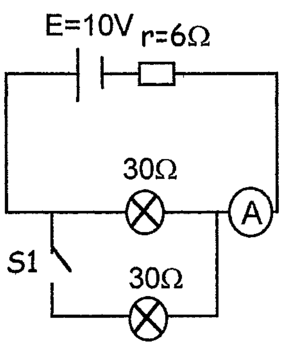
(a) Calculate the Emf? (12.6V)
(b) What is the tpd. (12.1V)

(54) In this circuit the reading on the voltmeter is 12V when the switch is open

(a) What is the emf?
(b) When the switch is closed the current in the circuit is 0.25A. What is the new reading on the voltmeter
(c) Calculate the internal resistance of the battery.
(d) What would the short circuit current be if a wire was connected across the terminals of the battery?



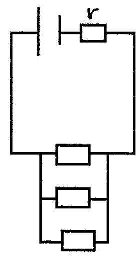
(55) A student puts together the following circuit. The voltmeter measures the tpd.



(a) Calculate the tpd when S1 is open.
(b) So what is the lost voltage at this point?
(c) Calculate tpd when S1 is closed.
(d) So what is the lost volts?
(e) Therefore what happens to the brightness when bulbs are place in parallel?

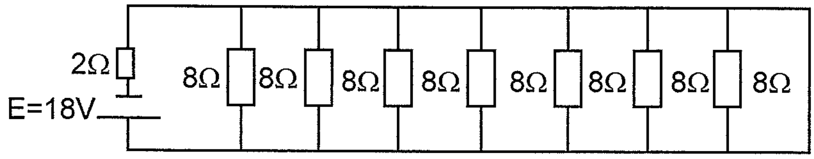
Ans (51)(a) 3V (b) Emf (52)(a) 80A (53)(a) 12.6V (b)12.1V (54)(a)12V (b) 10V (c) 8Ω (d)1.5A (55)(a)8.3V (b) 1.7V (c)7.1V (d) 2.9V (c) dimmer

(56) A pupil starts putting resistors in parallel in her circuit.



(a) What happens to the total resistance of the circuit as more resistors are placed in parallel?
(b) So is more or less current drawn from the battery?
(c) Now we know lost voltage v = Ir, so what happens to the lost voltage?
(d) Therefore what happens to the useful voltage or tpd available to the external circuit?

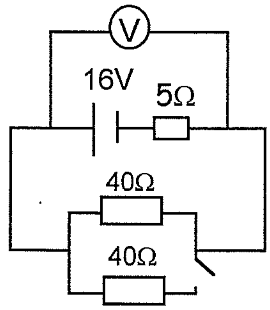
(57) Look at this circuit.
Calculate



(a) the external resistance
(b) The tpd

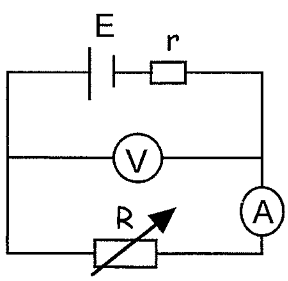
(58) As more resistors are placed in parallel the resistance of the circuit __A__ so the current __B__. As lost volts = Ir the lost voltage __C__. So the tpd available to the external circuit __D__. State missing values A-D

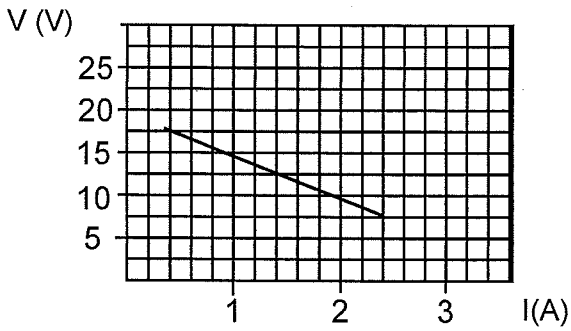
(59) Look at this circuit. Calculate the reading on the voltmeter when the switch is



(a) open
then (b) closed

(60) A pupil decreases the resistance of the variable resistor and notes the current and tpd. He then draws a graph as shown





(a) From the graph calculate the internal resistance of the cell.
(b) From the graph state the Emf of the battery.
(c) Calculate the short circuit current.

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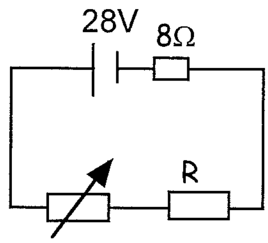
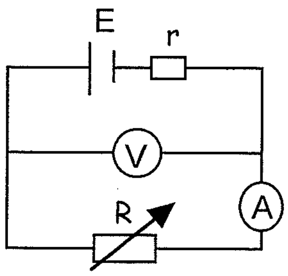
(57)(a) 1Ω (b) 6V (59)(a) 14.2V (b) 12.8V (60)(a) 5Ω (b)20V (c) 4A

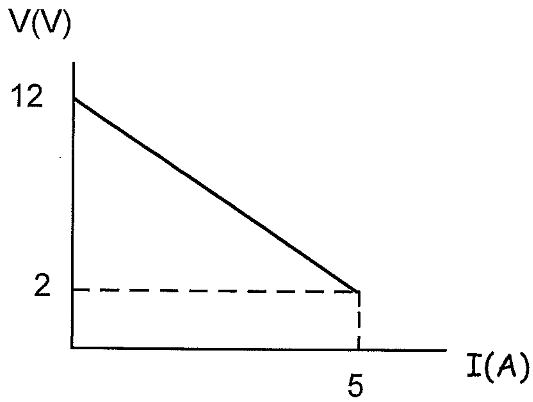
(61) At one point the resistance of the variable resistor is 120Ω. At this point the current is 0,14A. calculate the value of R.



Extra Question

A pupil decreases the resistance of the variable resistor and notes the current and tpd. She then draws a graph as shown.





(a) From the graph calculate the internal resistance of the cell.
(b) From the graph state the Emf of the battery.
(c) Calculate the short circuit current.

Ans (61) 67Ω Extra Question: (a) 2Ω (b) 12V (c) 6A

5. Capacitors

$C = Q/V$ $E = 1/2QV = 1/2CV^2 = 1/2Q^2/C$ $Q = It$

(62) 4C are place on a capacitor and the pd between the plates is 1V

(a) What is the capacitance of the plates
(b) So capacitance is the charge required to produce a pd of __V between the plates
(c) How much charge would create a pd of 5V between the plates?

(63) A capacitor has a capacitance of 10F.

(a) This means that __C of charge are required to produce a pd of 1V between the plates.
(b) What would pd between plates be if 30C was placed on the plates.

(64) 6C placed on a capacitor produces 18V between the plates. What is the capacitance of the capacitor?

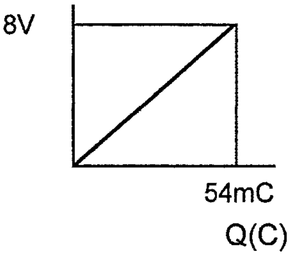
(65) A capacitor is charged with 78mC of charge producing a pd of 5V. What is the capacitance of the capacitor?

(66) The capacitance of a capacitor is 680mF. How much charge is required to produce a pd of 12V between plates?

(67) A capacitor has a capacitance of 470μC. If 34mC is paced on the plates calculate the pd between the plates.

Energy stored on capacitor

(68) This graph shows how the charge on the plates is related to the pd between the plates.



(a) Describe the relationship.
(b) Calculate the total energy stored on the plates?
(c) Calculate the capacitance of the capacitor

(69) A capacitor with a charge of 50μC on the plates has a pd of 9V between the plates. Calculate the electrical energy stored on the plates

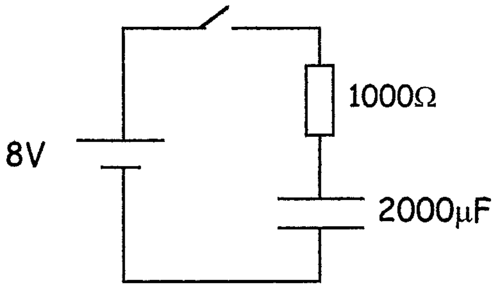
(70) The capacitance of a capacitor is 1500μC. If the charge stored on the plates is 0.18C calculate the electrical energy stored on the plates.

(71) The energy stored on a 450mF capacitor is 12J. What charge was on the plates?

Ans (62)(a) 4F (b) 1V (c) 20C (63(a) 10C (b) 3V (64)0.3F (65) 0.016F (66) 8.2C (67) 72V (68)(a) V Q (b) 0.22J (c) 6.75mF (69) 2×10^{-3}J (70) 10.8J (71) 3.3C

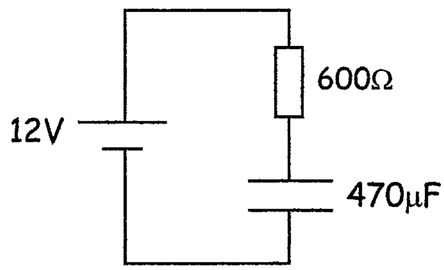
Charging a capacitor

(72) This circuit is used to charge a 2000μF capacitor. The capacitor is originally uncharged. The switch is now closed



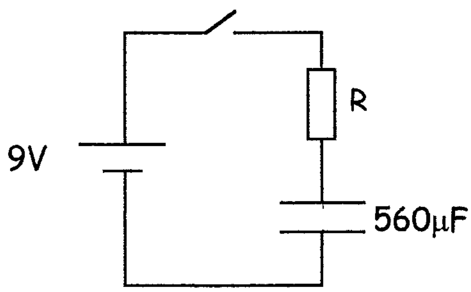
(a) Calculate the initial charging current
(b) Why does the current decrease during charging?
(c) What is the final pd between the capacitor plates?
(d) Calculate the final energy stored on the plates.

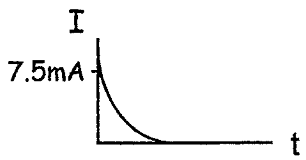
(73) This capacitor is being charged using a 12V supply as shown



(a) After a few seconds the voltage across the resistor reads 10V. What is the voltage across the capacitor at this point
(b) What is the current in the circuit at this point?
(c) After some more time the voltage across the resistor is 3V what is the voltage across the capacitor
(d) What is the current in the circuit at this point?
(e) What is the voltage across the capacitor when it is fully charged?
(f) Therefore what is the voltage across the resistor at this point?
(g) What is the final energy stored on the capacitor when it it is fully charged?

(74) This circuit is used to charge this capacitor. Just as the switch is closed the initial charging current was 7.5mA. Graph of I vs t for resistor is shown.

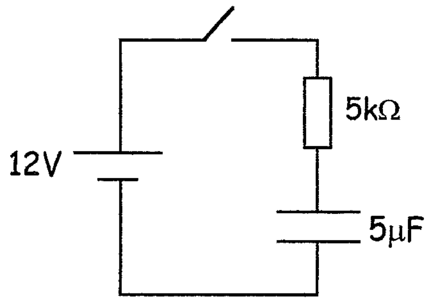




(a) Calculate the size of the resistor R
(b) At one point the current is 6mA. Calculate the voltage across the capacitor at this time
(c) Calculate the maximum energy stored on the capacitor.
(d) In a 2nd experiment R is replaced with a resistor twice as large. Redraw the graph and using a dotted line show the new trace you would expect.
Values should be shown y axis.

(75) The circuit shown is used to charge a capacitor

The capacitor is initially uncharged. The switch is closed and a few minutes later the charge on the capacitor is 20uC.

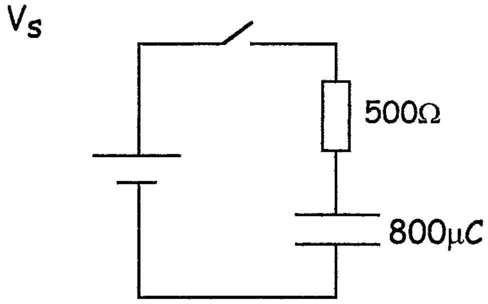


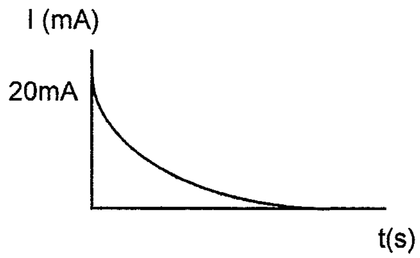
(a) Calculate the current in the circuit at this time. (Hint C=Q/V) (1.6mA)

The capacitor is replaced with a 10uF capacitor
How would this effect the

(b) final voltage across the capacitor.
(c) time it takes to fully charge.
(d) final charge stored on the capacitor.

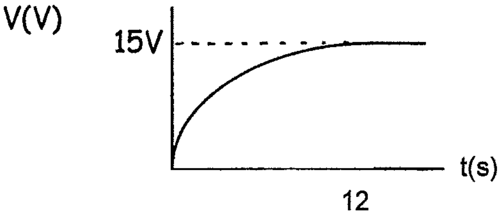
(76) In the following circuit a graph of current vs time is sketched.

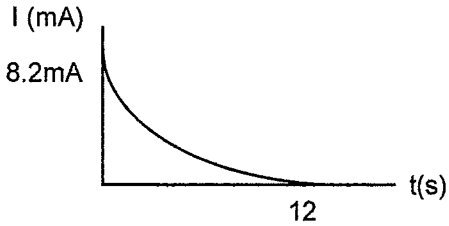




(a) Calculate the supply voltage Vs
(b) What is the voltage across the capacitor when the current in the circuit is 5mA?
(c) Calculate the final energy stored on the capacitor
(d) The 500Ω resistor is replaced with a 1200Ω resistor and the experiment repeated. Sketch the shape of the new graph. Show value on y axis.

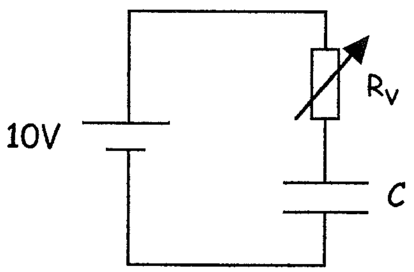
(77) A 800mF capacitor is charged using a set up similar to the above circuit. The graphs of current in the resistor and voltage across the capacitor during charging are shown.





(a) State the supply voltage
(b) Calculate the charge stored on the capacitor when it is fully charged.
(c) Calculate the final energy stored on the capacitor

(78) A capacitor is charged using a constant charging current of 0.8mA.



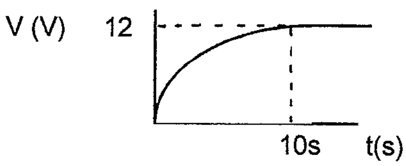
(a) How is a steady charging current achieved?

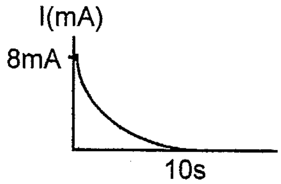
(b) At one point the voltage across the capacitor was 6V. What was the resistance of the resistor at this point.

(c) If it takes 12s to fully charge the capacitor calculate the final charge stored on the capacitor.

(d) What is capacitance of the capacitor?

(79) These diagrams show the voltage across a capacitor and current in the circuit when a capacitor is being charged





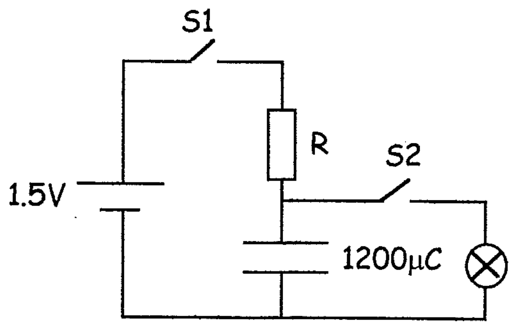
(a) Use information on graph to calculate the resistance of circuit.

(b) Sketch each graph and using a dotted line to show the graphs which would represent the charging of a larger capacitor

(c) If a larger capacitor was used would it take more or less charge to charge the capacitor to maximum voltage?

Discharging a capacitor

(80) A capacitor is charged up in a mobile phone when switch 1 is closed. When fully charged S1 is opened. The camera button (switch 2) is pressed and the flash goes off. the capacitor empties in a time of 0.2ms.



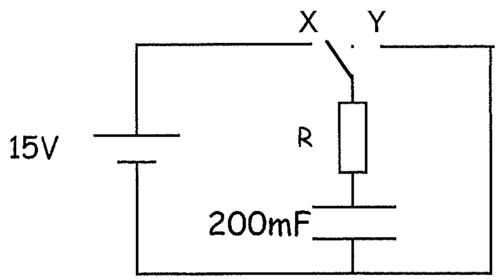
(a) Calculate the charge stored on the capacitor when fully charged.

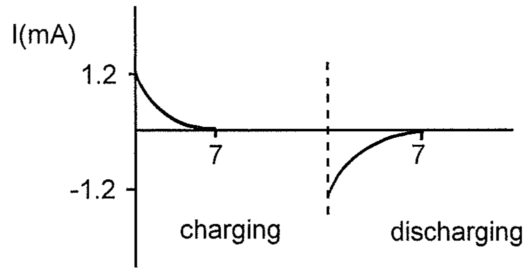
(b) Calculate the energy stored by the capacitor when fully charged.

(c) Calculate the power output of the bulb.

Ans (72)(a) 8mA (c) 8V (d) 0.064J (73)(a) 2V (b) 0.017A (c) 9V (d) 5mA (e) 12V (f) 0V (g) 0.03J (74)(a) 1200Ω (b) 1.8V (c) 0.02J (75) 1.6mA (b) same (c) longer (76)(a) 10V (b) 7.5V (c) 0.04J (77)(a) 15V (b) 12C (c) 90J

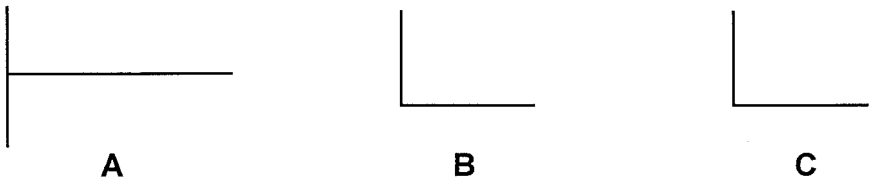
(81) The following circuit is used to charge then discharge a capacitor. Graphs of current in the circuit during charging and discharging are shown





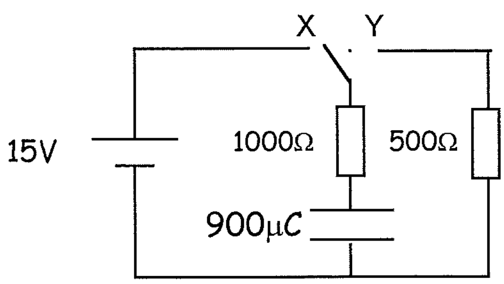
(a) What is the resistance of R?
(b) The resistor is now replace with one of half the resistance and the experiment repeated. Sketch the new graphs. Show values on y axis.

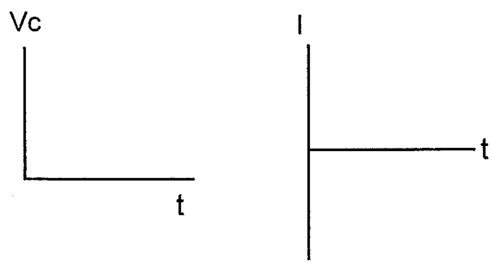
(82) Look at these 3 graphs



(a) Which one shows the current in a circuit during discharging?
(b) Which one could show the voltage across the resistor or current through the resistor during charging?
(c) Which one shows the voltage across the resistor during charging?

(83) The following capacitor is charged when switch is at X. The switch is then connected to Y and the capacitor discharges.





(a) Why will it take longer to discharge compared to charging?
(b) Calculate the maximum charging current.
(c) Calculate the maximum discharge current.
(d) Calculate the maximum energy stored on the capacitor when charged.
(e) Copy and complete the two graphs showing how the voltage across the capacitor and the current in the circuit changes with time as the capacitor **discharges**. Values are required on the y-axis.

Electricity True or False

(84)

(a) The larger the capacitor the more charge is required to achieve 1V between plates.

(b) The current falls to zero during charging a capacitor because the resistance of the resistor is being gradually increased

(c) Capacitance tells you the amount of charge required to create a pd of 10V between the plates.

(d) The area under a graph of voltage across capacitor vs charge stored = energy stored on the capacitor.

(e) The emf of a battery is the maximum amount of energy given to each coulomb of charge.

(f) The tpd can be measured across the battery or load resistor

(g) The lost voltage = Emf + tpd

(h) In a circuit containing a battery with an internal resistance the tpd is always bigger than the emf

(i) In open circuit tpd = Emf as there is no lost voltage.

(j) In a short circuit the current is high because all the emf is dumped across the internal resistor.

(k) As more resistors are added in parallel across a load resistor the resistance of a circuit decreases, so increasing the current and therefore increasing the lost voltage. Therefore the tpd falls.

(l) If four 40Ω resistors are placed in parallel the resistance is 160Ω.

(m) If you know the emf and the current in a circuit you can find the total resistance.

(n) In an ac circuit the current constantly changes direction but its size stays the same.

(o) The rms value of voltage is about 70% of the peak.

(p) When we use formulae P=IV or Q=It or V=IR we always use the peak values of current and voltage.

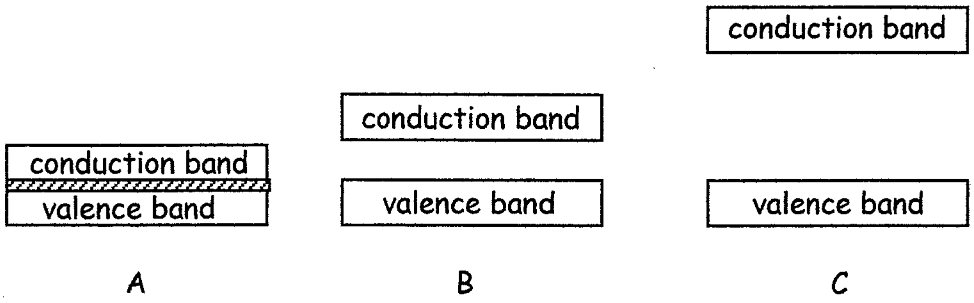
(q) If the rms current in a kettle is 8A it is not a good idea to fit a 9A fuse as the current in the kettle will peak at 11.3A so the fuse will blow each time the kettle is switched on.

Ans (78)(b) 5000Ω (c) 9.6×10^{-3}C (d) 9.6×10^{-4}F (80)(a) 1.8×10^{-3}C (b) 1.35×10^{-3}J (c) 6.75W (81)(a) 12,500Ω (83)(b) 0.015A (c) 0.01A (d) 0.1J

6. Semiconductors   E=hf $v=f\lambda$ E=QV

(85) (a) In which material are there lots of free charge carriers?
(b) In which type of material are there no free charge carriers
(c) In which state is the conductivity be altered by doping?

(86) Look at these 3 energy diagrams.



(a) What do we call the distance between the valence and conduction bands?
(b) Which one shows an insulator?
(c) Which one shows a conductor?
(d) Which one shows a semiconductor?

(87) In which material is the valence band completely full and there are no free electrons in the conduction band?

(88) In which material is the valence band completely full and there are also free electrons in the conduction band?

(89) In which material is the energy gap between the valance and conduction band smaller than an insulator but larger than a conductor?

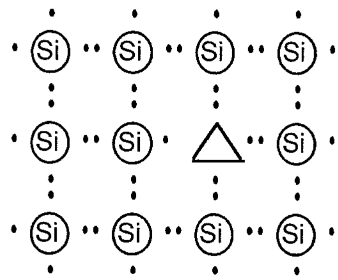
(90) (a) Describe a way in which electrons reach the conduction band from the valence band in a semiconductor?
(b) Is there enough energy to do this at room temperature?

(91) What happens to a materials resistance as its conductivity increases.

(92) What do we call the process that is used to increase the conductivity of a pure semiconductor (without heating).

(93) (a) A sample of pure germanium (four electrons in outer shell) is doped with phosphorous with five electrons in its outer shell. What kind of semiconductor is formed?
(b) What are the majority charge carriers in an n type semiconductor?
(c) Why does an n type semiconductor still have an overall neutral charge?

(94) In this diagram pure silicon is doped. The black dots show the outer electrons.

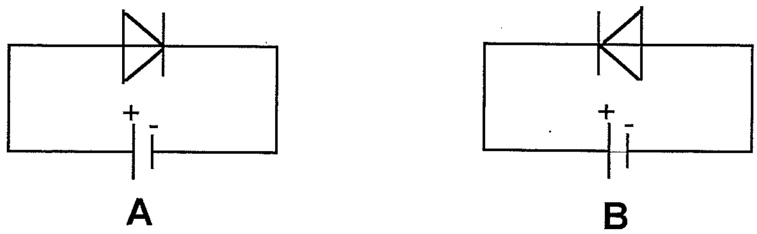


(a) How many outer electrons does a silicon atom have?
(b) How many outer electrons does the doping atom have?
(c) What do we call the space which is left?
(d) Which type of semiconductor has been created?
(e) What are the majority charge carriers in an p type semiconductor?

(95) When a p and n semiconductor are grown together we create a pn junction diode

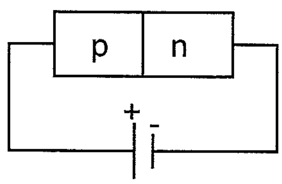
(a) Draw the symbol for a pn junction diode
(b) What do we call the area formed at the junction?
(c) Are there any free charge carriers in this layer?
(d) In a forward biased circuit are charge carriers pulled away from the junction or across the junction?

(96) Look at these two pn junction diodes in circuits A and B.



(a) Which diagram shows a forward biased pn junction diode
(b) Which diagram shows a reverse biased pn junction diode

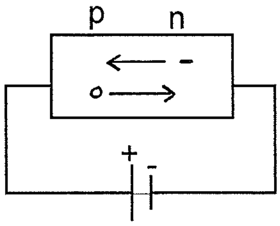
(97) Look at this pn junction diode



(a) Is this diode forward or reverse biased?
(b) To which side of the battery do negative charge carriers (electrons) flow
(c) To which side of the battery do positive charge carriers (holes) flow
(d) When the electrons travel across the junction are they in the conduction or valence band?

(98) (a) In an ordinary junction diode in forward bias a hole and electron occasionally recombine. Describe the type of light emitted.

(b) In an LED, which type of light is created when the hole and electrons recombine?

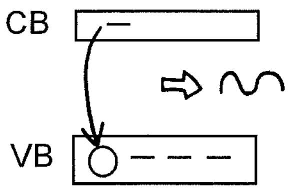


(c) Why does the LED need to be in forward bias to create light?

(d) Draw the symbol for an LED.

(e) In terms of conduction and valence bands describe how light is produced by an LED.

(99) In an LED the recombination energy of a recombined electron and hole is 3.12×10^{-19}J

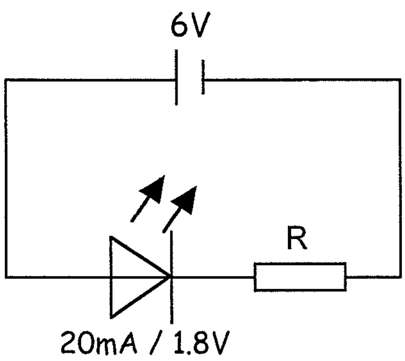


(a) Calculate the frequency of the photon of light emitted.
(b) Calculate the wavelength of the photon of light emitted
(c) What colour is this light?
(d) What factor about the construction of the LED determines the colour of light produced?

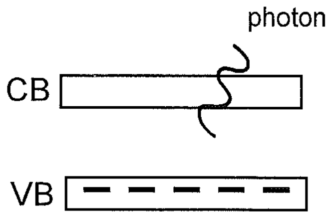
(100) A photon of wavelength 4.6×10^{-7}m is emitted from an LED. calculate the energy gap between the valence and conduction band

(101) State two advantages of LEDs over ordinary filament bulbs.

(102) Calculate the size of protective resistor R required to allow this LED to work at its stated values of 1.8V and 20mA.



(103) A pn junction diode can be made to convert light energy to electrical energy.

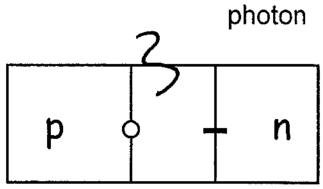


(a) What do we call this type of diode?
(b) Draw its symbol.

(c) Using the diagram to describe how light creates electricity.

(d) How would increasing the irradiance of the light increase the current?
(e) What is this effect called?

(104) A photon with freq 6.2×10^{14}Hz strikes the depletion layer of a photodiode.
What is the maximum pd created across the junction?



(105) A solar panel made of millions of photodiodes produces a near constant current of 1.8mA for 3hours one summer afternoon. The owner uses the charge to charge up a capacitor

(a) How much charge is created in 3 hours
(b) If the capacitor has a capacitance of 120mF calculate the voltage across the plates after 3hrs.

Ans (99)(a) 4.7×10^{14}Hz (b) 6.4x10-7m (640nm) (c) red (d) energy gap between Valence and conduction bands (100) 4.3×10^{-19}J (102) 210Ω (104) 2.6V (105)(a) 19.4C (b) 162V