Your High School Badge

Outcome 1:

Homework – 1.1

For the conditions in *figure 1.1.1* below calculate;

(a) the combined resistance of R_1 and R_2.
(b) the total resistance of the network R_1, R_2 and R_3
(c) the current 'I' supplied by the battery.
(d) the P.D. (potential difference) V_p across the parallel resistors R_1 and R_2 and the P.D. V_3 across R_3.
(e) the current I_1 flowing in R_1 and I_2 flowing in R_2.

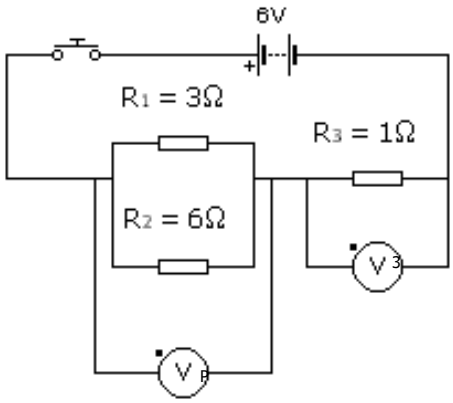


Figure 1.1.1

Homework – 1.2

(a) state Kirchhoff's 1st and 2nd laws.
(b) For the circuit below calculate;
  (i) the total effective resistance between points A and B in the network.
  (ii) the P.D. across R_2 and the P.D. across R_3.
  (iii) the current flowing in each resistor I_1, I_2 and I_3.

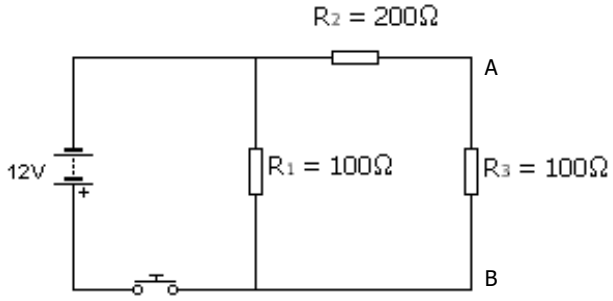
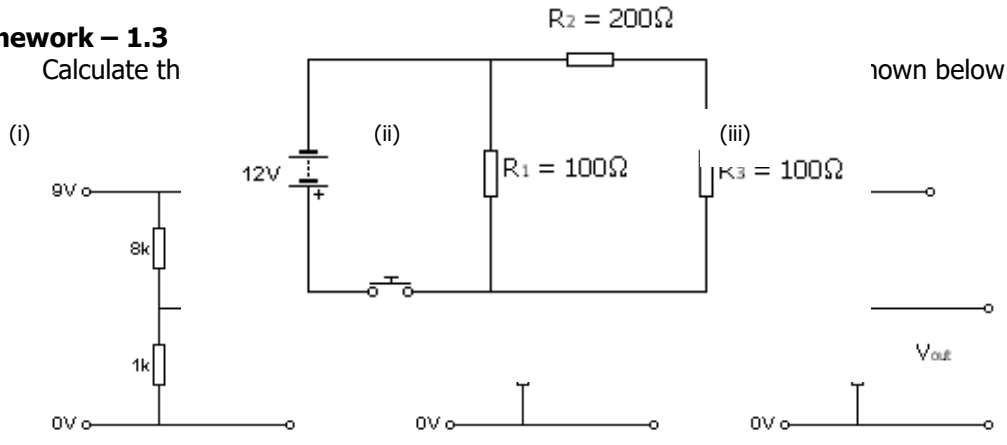


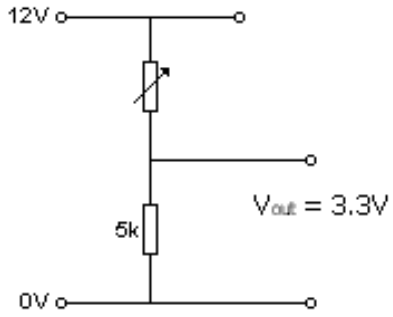
Figure 1.2.1

Homework – 1.3

(a) Calculate th ıown below



(b) Calculate the variable resistor setting in the potential divider shown.



Homework – 1.4

A 2.5k linear potentiometer is used as a potential divider for a 9V supply *figure 1.4.1*. The 'wiper' on the 'pot' is set at B, a point four fifths of the way along the track from point C at the end of the potentiometer.

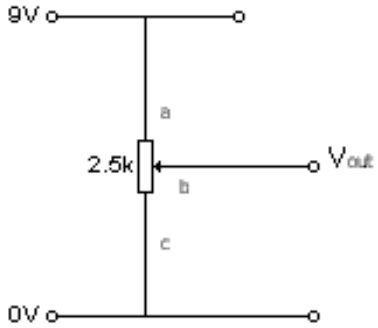


Figure 1.4.1

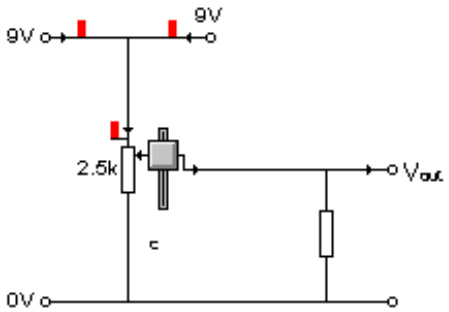


Figure 1.4.2

(a) What is the resistance of length B, C of the track.
(b) What is the output voltage V_{out} at this setting.
(c) If a resistor is now connected as a 'load' across the output as shown in figure 1.4.2, what effect will this have on the output voltage when
  (i) the load resistance is 20k and,
  (ii) when the load resistance is 2k.
  (iii) Comment on your findings.

Homework – 1.5

The *figure 1.5.1* below shows a diagramatic sketch of a simple bi-polar (junction transistor) configuration.

(a) Copy the diagram and complete the transistor symbol to represent an N.P.N device and identify.
  (i) the emitter
  (ii) the base
  (iii) the collector.

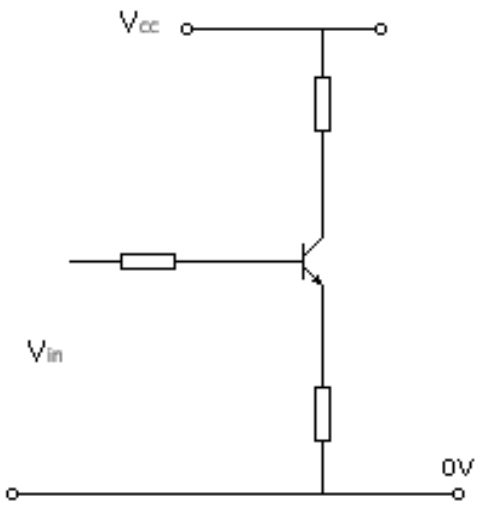


Figure 1.5.1

(b) Label the diagram showing
- (i) V_b – base voltage relative to ground.
- (ii) V_e – emitter voltage relative to ground.
- (iii) V_{ce} – voltage between collector and emitter junctions.
- (iv) V_{be} – voltage between base and emitter junctions.
- (v) V_l – voltage across load resistor.

(c) On the diagram clearly show the conventional current flow for;
- (i) I_c – collector current.
- (ii) I_b – base current.
- (iii) I_e – emitter current.

(d) Indicate the output when connected in "common emitter mode".

(e) Explain the term current gain as applied to the transistor.

(f) Clearly descibe the operation of the transistor explaining what is meant by 'saturation'.

Homework – 1.6

In the circuit shown below state whether the transistor will be switched on if,

(a) R_1 = 10k ; R_2 = 1k ; V_{cc} = +4.5V

(b) R_1 = 10k ; R_2 = 100k ; V_{cc} = +4.5V

(c) R_1 = 4k7 ; R_2 = 10k ; V_{cc} = +15V

(d) R_1 = 2k2 ; R_2 = 10k ; V_{cc} = +24V

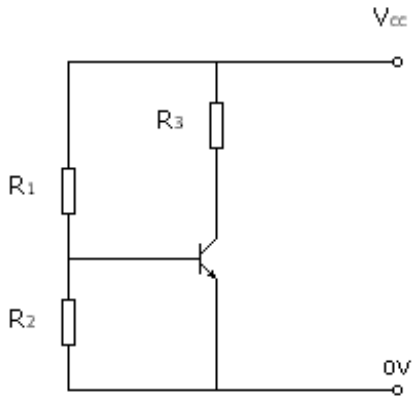


Figure 1.6.1

Homework – 1.7

In the circuit shown below the base emitter junction voltage V_{be} is 0.7V.

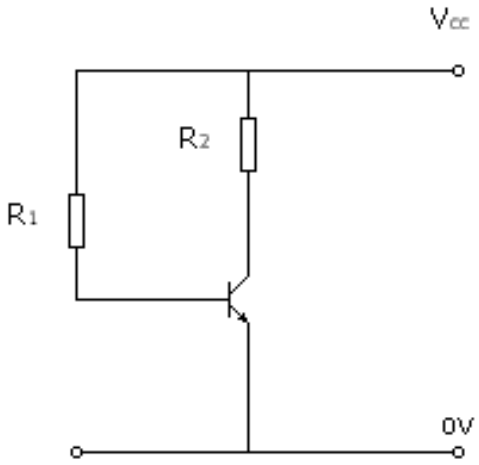


Figure 1.7.1

(a) If V_{cc} = +4.5V, I_c = 25mA and R_1 = 3k9, calculate
- (i) the base current I_b.
- (ii) the current gain A_I.

(b) If I_b = 20µA and I_c = 2mA and V_{cc} = 9V, calculate;
- (i) R_1
- (ii) R_2
- (iii) A_I

(c) If V_{cc} = 6V, R_1 = 100k, R_2 = 1k, calculate
- (i) the P.D. across R_1
- (ii) I_b
- (iii) I_c if h_{fe} = 60
- (iv) The P.D across R_2

(d) If V_{cc} = 6V and I_b = 20µA, calculate the value of R_1

Homework – 1.8

In the circuit shown below calculate the value of R_b if the base current is 10µA.

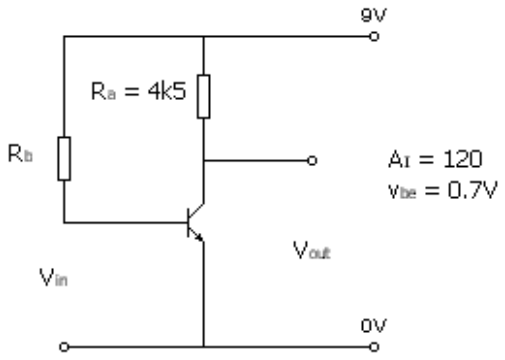


Figure 1.8.1

Determine also the output voltage V_c.

Homework – 1.9

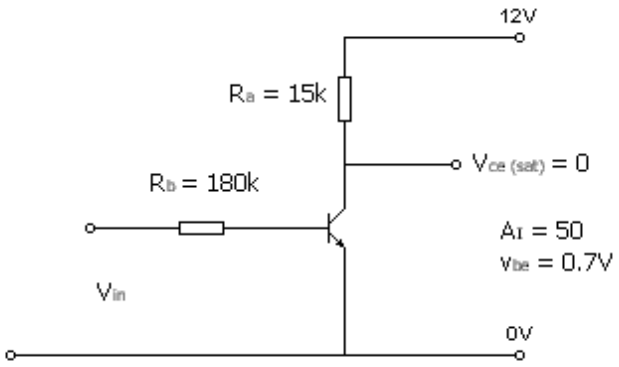


Figure 1.9.1

In the circuit above determine the value of I_c, I_b and V_i which will result in saturation of the transistor.

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Homework – 1.10

In the circuit shown below calculate the output voltage and the voltage gain of the circuit for the conditions shown. State any assumptions you make.

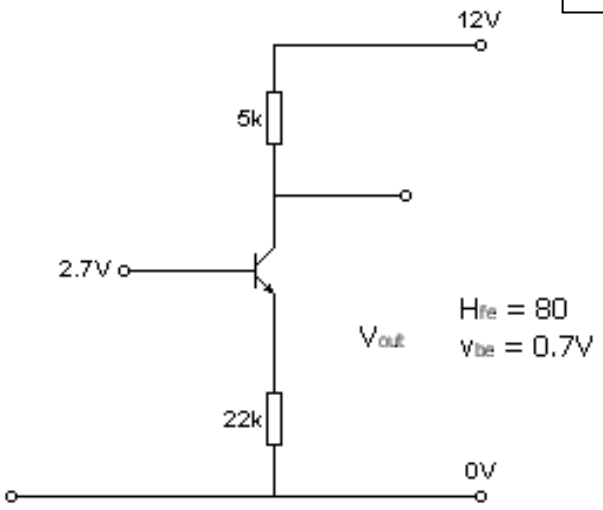


Figure 1.10.1

Homework – 1.11

For each of the six simple transistor circuits shown below, *figure 1.11.1,* calculate;

(a) the emitter voltage; (V_e)

(b) the emitter current (I_e);

(d) the base current (I_b).

(i)

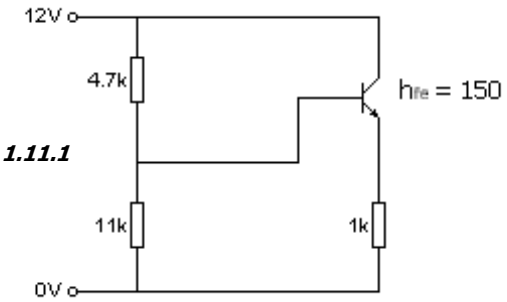


Figure 1.11.1

(ii)

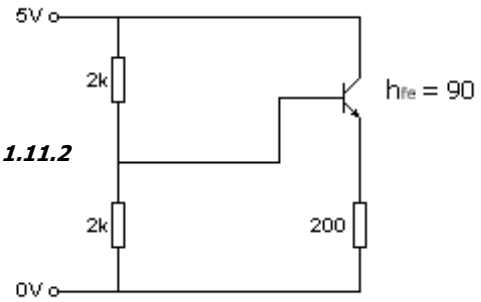


Figure 1.11.2

(iii)

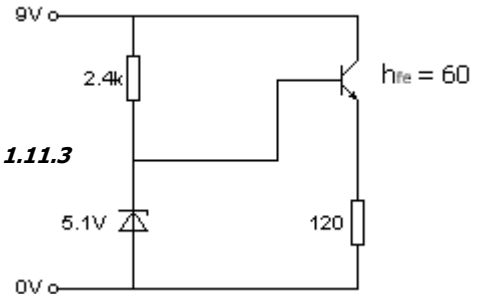


Figure 1.11.3

(iV)

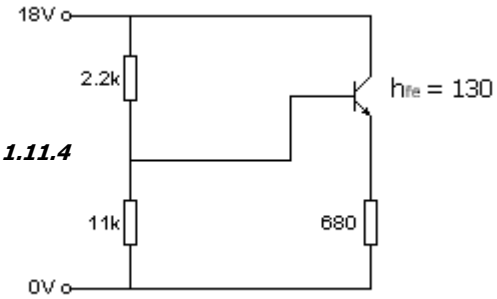


Figure 1.11.4

(V)

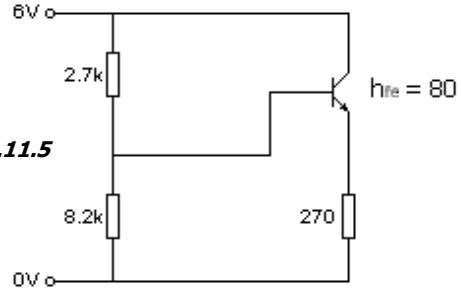


Figure 1.11.5

(Vi)

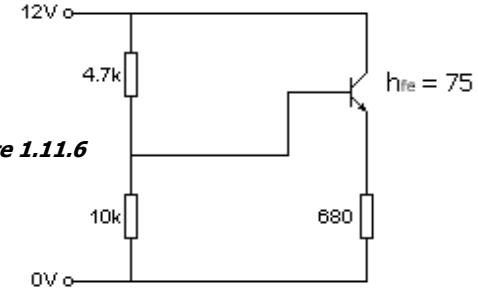


Figure 1.11.6

Homework – 1.12

In the circuit shown, *figure 1.12.1,* the transistor has a gain of 50 (hfe). Complete the table, *fig.Q8b* by calculating the values of;

(i) base current, I_b;

(ii) the collector current, I_c;

(iii) V out, for each value of V_{in} given.

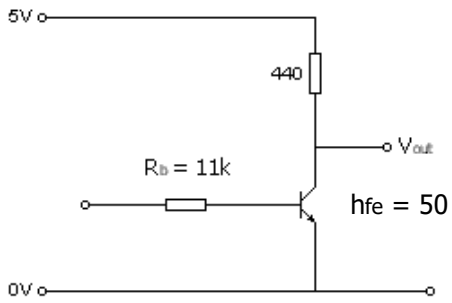
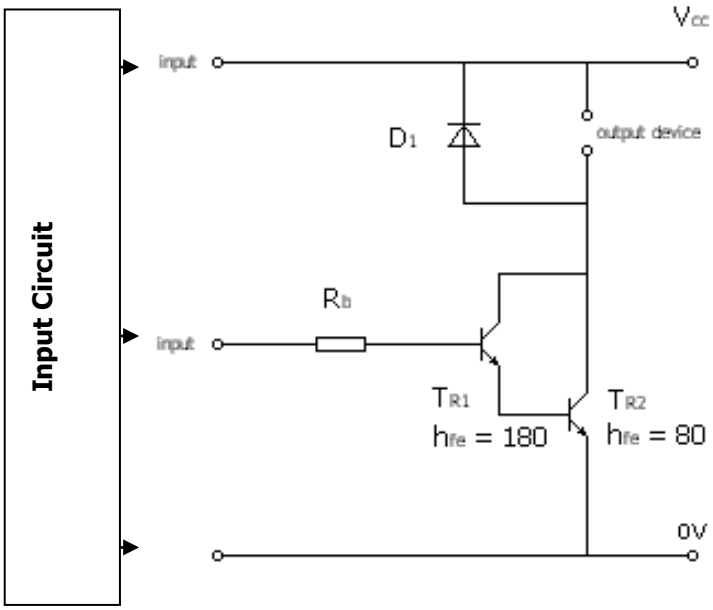


Figure 1.12.1

Homework – 1.13

The diagram below is part of a circuit which is suitable for processing the input from various types of sensors and providing an appropriate output.



(a) (i) Name the switching circuit shown and describe its operation and advantage.
(iii) State the overall gain h_{fe} for the arrangement.

(b) State the purpose of the diode D1 in the circuit.

(c) For each of the applications given below, sketch the input part of the circuit diagram that would be suitable and the output device which would be appropriate.
(i) Thermostat for the aquarium.
(ii) A rain detector to automatically close skylights.
(iii) A window "open" alarm.
(iv) Automatic window shades for bright sunlight.