Potential Dividers (1/2)

AS Physics

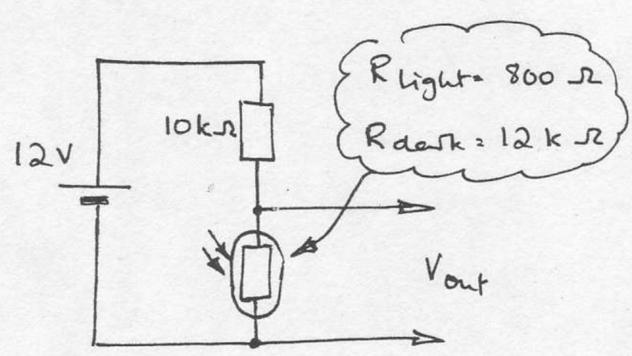
1\. (a) State and explain what happens to the ldr resistance when it is illuminated (3)

(b) State and explain what happens to Vout when the ldr is illuminated (3)

(c) Calculate the value of Vout...

(i) in the dark

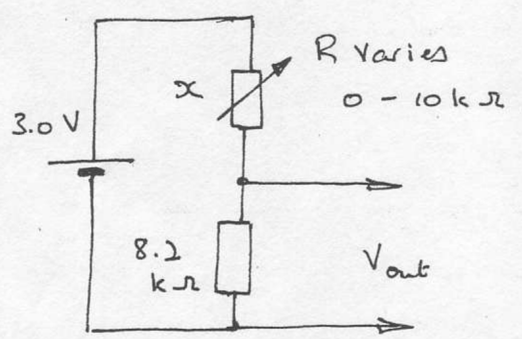
(ii) in the light (3)



2\. (a) Explain what x is and what it does in the circuit (2)

(b) What is the range of values of Vout that can be produced? (3)

(c) If Vout = 1.5 V, what is the resistance of x? (1)



3\. This potential divider circuit acts as a temperature sensor.

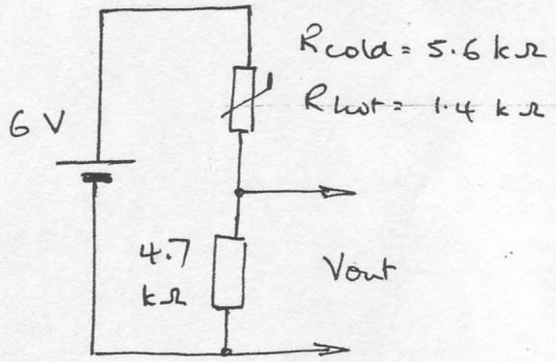
(a) Explain how it works (5)

(b) Calculate the values of Vout...

(i) cold

(ii) hot (3)

(c) You want to be able to adjust Vout to be 2.5 V when the thermistor is hot. Explain how to modify the circuit to do this. (3)

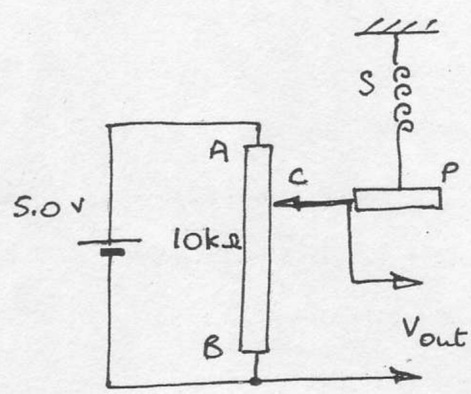


4\. This is an electronic scales.

AB is a resistance coil, 5 cm from A to B, with a total resistance of 10k Ω.

Sliding contact C can move up + down.

Contact C is fixed to platform P, which hangs from spring S, which has a spring constant of 250 Nm⁻¹.



Q.4 continued

When there is no load on platform P, contact C is at A.

(a) Calculate V out with....

(i) No load on platform P (1)

(ii) A weight of 4.0 N on P. (4)

(b) Sketch a graph to show how Vout depends on the weight on platform P, up to the maximum weight the device can measure (5)

(c) By using your graph, or otherwise, state what weight is on platform P when Vout = 1.5 V. (2)

Potential Dividers — ANSWERS — AS Phys...

1. (a) Light energy makes the atoms in the semiconductor ldr vibrate with a bigger amplitude (1)... this releases more electrons (1) able to move + carry current... so R ↓ (1) /3

b) R ldr decreases ... so it has a smaller share (1) of the total (1) resistance ... so Vout decreases. (1) /3

c) i) dark $V_{out} = 12 \times \frac{12}{10+12} = \underline{6.5\ V}$ (1)(1) (you can work in kΩ)

ii) light $V_{out} = 12 \times \frac{800}{10\,000 + 800} = \underline{0.89}$ (1) V (be careful!) /3

2. (a) X is a variable resistor (1) ... used to adjust Vout to certain value (1)

b) for $R_X = 0\ \Omega$ (1) $V_{out} = 3 \times \frac{8.2}{(8.2+0)} = \underline{3.0\ V}$ (1) 2 s.f.

for $R_X = 10\ k\Omega$ $V_{out} = 3.0 \times \frac{8.2}{8.2+10} = \underline{1.4\ V}$ (1) 2 s.f. /3

(c) Think! $V_{out} = \frac{1}{2}$ of V_{in} ... so $R_X = 8.2\ k\Omega$!! (1) /1

3. (a) When it gets hotter... atoms in thermistor vibrate with bigger amplitude (1)... this releases electrons to move + carry current (1)... so R thermistor decreases (1)... so it has a smaller share of the total resistance (1)... so it takes a smaller share of Vin (1)... ... so Vout increases (1) — 5 max

(b) all in kΩ

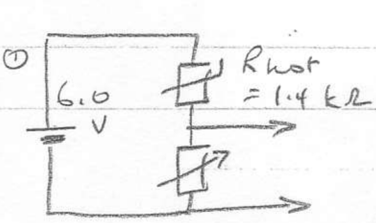
Cold $V_{out} = 6.0 \times 4.7/(4.7 + 5.6) = 2.7\ V$

Hot $V_{out} = 6.0 \times 4.7/(4.7 + 1.4) = 4.6\ V$

Check with (a) !

(c) Replace 4.7 kΩ resistor by a variable resistor (1)

Adjust it to give Vout = 2.5 V when thermistor is hot. (1)



What value? $2.5\ V_{out} = 6.0\ V_{in} \times \left(\frac{R}{R+1.4}\right)$

So $2.5(R+1.4) = 6.0R$

$2.5R + 3.5 = 6R$ so $3.5 = 6R - 2.5R = 3.5R$ so $R = \underline{1.0\ k\Omega}$ (1)

— answer to Q 4 missing — don't know why — sorry!

TJW
Jan '05