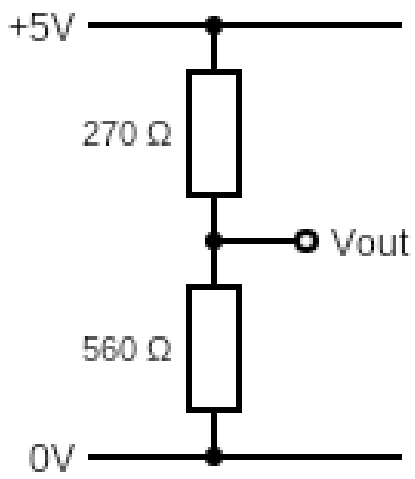
Exam-style questions

Q1 (a) The following circuit is used as a voltage source.



Thevenin's theorem is used to produce an equivalent circuit.

[3]

(i) Calculate the open circuit voltage V_{OC}.

. . . . . .

. . . . . .

(ii) Calculate the short circuit current I_{SC}.

. . . . . .

. . . . . .

(i) Calculate the equivalent resistance R_O.

. . . . . .

. . . . . .

(b) (i) Draw the equivalent circuit with a load resistance connected across the output terminals.

[1]

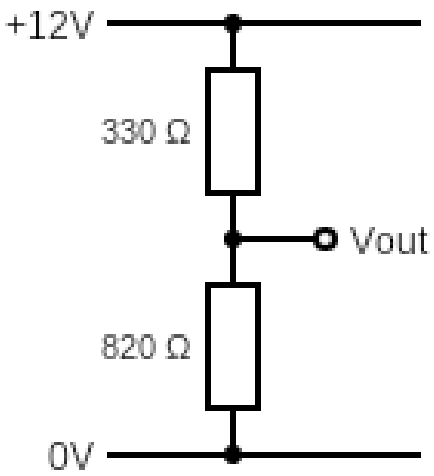
(ii) Use the equivalent circuit to calculate the voltage drop across the output terminals when the load current is 10mA.

[2]

. . . . . .

. . . . . .

Q2 (a) The following circuit is used as a voltage source.



Thevenin's theorem is used to produce an equivalent circuit.

[3]

(i) Calculate the open circuit voltage V_{OC}.

. . . . . .

. . . . . .

(ii) Calculate the short circuit current I_{SC}.

. . . . . .

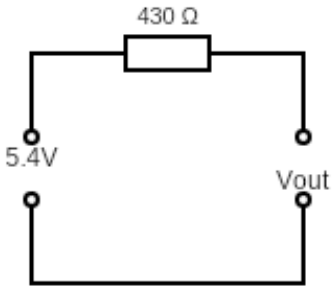
. . . . . .

(i) Calculate the equivalent resistance R_O.

. . . . . .

. . . . . .

(b) The Thevenin equivalent circuit for a **different** voltage source is shown below.



The output voltage VOUT must not drop below 4.5V when a load is connected to the circuit. Determine the minimum allowable load resistance to achieve this.

[3]

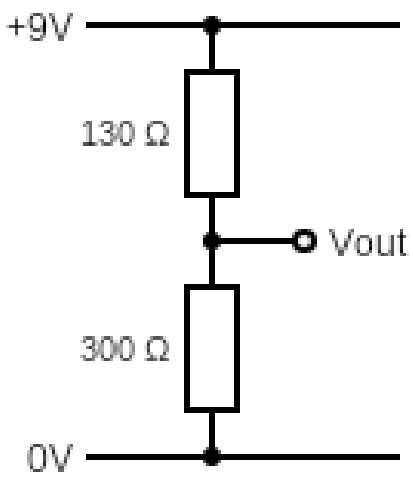
. . . . . .

. . . . . .

. . . . . .

. . . . . .

Q3 (a) The following circuit is used as a voltage source.



Thevenin's theorem is used to produce an equivalent circuit.

[3]

(i) Calculate the open circuit voltage V_{OC}.

. . . . . .

. . . . . .

(ii) Calculate the short circuit current I_{SC}.

. . . . . .

. . . . . .

(i) Calculate the equivalent resistance R_O.

. . . . . .

. . . . . .

(b) The voltage source is used to drive two output devices each having a resistance of 100Ω.

(i) Draw the equivalent circuit with the two output devices connected **in parallel** across the output terminals.

[1]

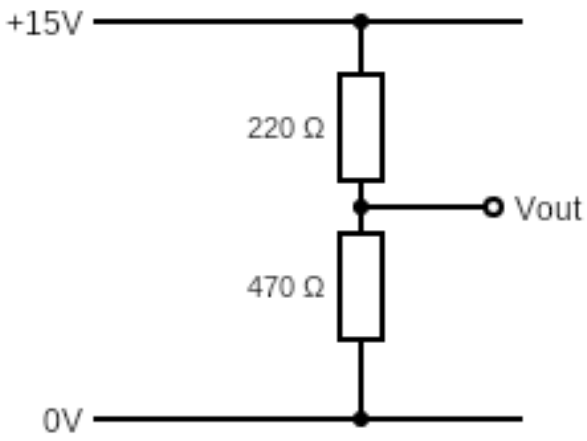
(ii) Use the equivalent circuit to calculate the power dissipated in **one** of the output devices.

[3]

. . . . . .

. . . . . .

Q4 The following circuit is used as a voltage source.



Thevenin's theorem is used to produce an equivalent circuit.

[3]

(i) Calculate the open circuit voltage V_{OC}.

. . . . . .

. . . . . .

(ii) Calculate the short circuit current I_{SC}.

. . . . . .

. . . . . .

(i) Calculate the equivalent resistance R_O.

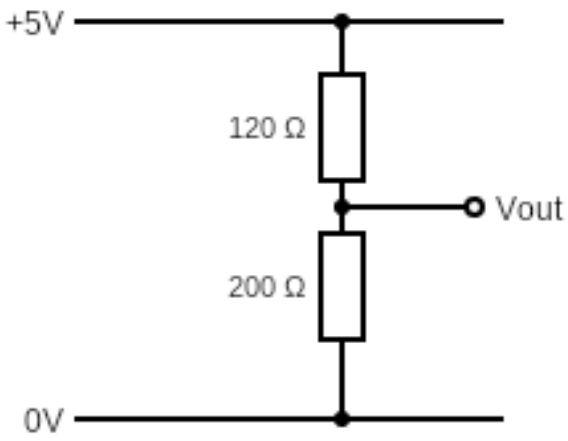
. . . . . .

. . . . . .

(b) Draw the equivalent circuit with a load resistance connected across the output terminals.

[1]

Q5 The following circuit is used as a voltage source.



Thevenin's theorem is used to produce an equivalent circuit.

[3]

(i) Calculate the open circuit voltage V_{OC}.

. . . . . .

. . . . . .

(ii) Calculate the short circuit current I_{SC}.

. . . . . .

. . . . . .

(i) Calculate the equivalent resistance R_O.

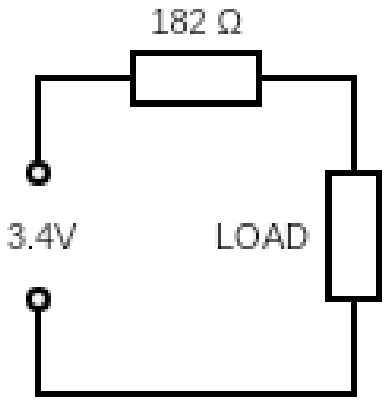
. . . . . .

. . . . . .

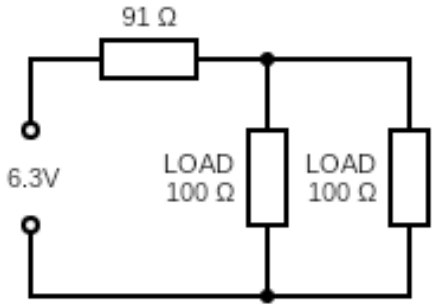
(b) Draw the equivalent circuit with a load resistance connected across the output terminals.

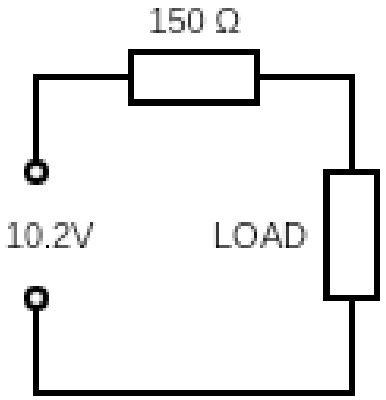
[1]

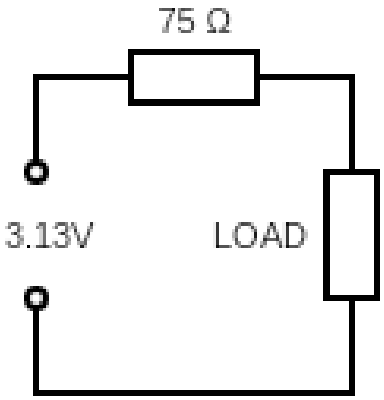
Answers for the exam-style questions

Question		Answer	Marks
1	ai	$5 \times \frac{560}{560+270} = 3.4V$ (1)	1
	aii	$5 \div 270 = 0.0185A$ or $18.5mA$ (1)	1
	aiii	$3.4 \div 0.0185 = 182\Omega$ allow ecf i and ii (1)	1
	bi	Circuit **and** labels correct. allow ecf ai and aiii (1) 	1
	bii	$182 \times 0.01 = 1.82V$ (1) $V_{out} = 3.4 - 1.82 = 1.58V$ (1)	2
Total marks			6

Question		**Answer**	**Marks**
2	ai	$12 \times \frac{820}{820+330} = 8.56V$ (1)	1
	aii	$12 \div 330 = 0.0364A$ or $36.4mA$ (1)	1
	aiii	$8.56 \div 0.0364 = 235\Omega$ allow ecf i and ii (1)	1
	b	$V_R = 5.4 - 4.5 = 0.9V$ (1) $I = 0.9 \div 430 = 2.1mA$ (1) $R_L = 4.5 \div 0.0021 = 2140\Omega$ or $2.1k\Omega$ (1)	3
		alternative method $V_R = 5.4 - 4.5 = 0.9V$ (1) $\frac{4.5}{0.9} = \frac{R_L}{430}$ (1) $R_L = 2140\Omega$ or $2.1k\Omega$ (1)	
Total marks			6

Question		Answer	Marks
3	ai	$9 \times \frac{300}{300+130} = 6.3V$ (1)	1
	aii	$9 \div 130 = 0.069A$ or $69mA$ (1)	1
	aiii	$6.3 \div 0.069 = 91\Omega$ allow ecf i and ii (1)	1
	bi	Circuit **and** labels correct. allow ecf ai and aiii (1) 	1
	bii	Combined resistance of parallel pair 50Ω (1) $V_{out} = 6.3 \times \frac{50}{50+91} = 2.23V$ (1) $P = \frac{V^2}{R} = \frac{2.23^2}{100} = 0.0499W$ or $50mW$ (1)	3
		alternatives allow use of $P = IV$ for $I = 45mA$ and $V = 2.23V$ or $P = I^2R$ for $I = 22.5mA$	
Total marks			7

Question		Answer	Marks
4	ai	$15 \times \frac{470}{470+220} = 10.2V$ (1)	1
	aii	$15 \div 220 = 0.068A$ or $68mA$ (1)	1
	aiii	$10.2 \div 0.068 = 150\Omega$ allow ecf i and ii (1)	1
	b	Circuit **and** labels correct. allow ecf ai and aiii (1) 	1
Total marks			4

Question		Answer	Marks
5	ai	$5 \times \frac{200}{200+120} = 3.13V$ (1)	1
	aii	$5 \div 120 = 0.0417A$ or $42mA$ (1)	1
	aiii	$3.13 \div 0.042 = 75\Omega$ allow ecf i and ii (1)	1
	b	Circuit **and** labels correct. allow ecf ai and aiii (1) 	1
Total marks			4