Candidate Name	Centre Number	Candidate Number
		2

GCE AS/A level

1142/01

ELECTRONICS
ET2

A.M. THURSDAY, 19 May 2011

1¼ hours

For Examiner's Use Only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**6**	
3.	**4**	
4.	**6**	
5.	**7**	
6.	**6**	
7.	**8**	
8.	**4**	
9.	**13**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will need a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks available for this paper is 60.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded to show all working. Credit is given for correct working even when the final answer given is incorrect.

INFORMATION FOR THE USE OF CANDIDATES IN ET2

Preferred Values for resistors

The figures shown below and their decade multiples and sub-multiples are the E24 series of preferred values.

10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

Standard Multipliers

Prefix	Multiplier
T	$\times 10^{12}$
G	$\times 10^{9}$
M	$\times 10^{6}$
k	$\times 10^{3}$

Prefix	Multiplier
m	$\times 10^{-3}$
µ	$\times 10^{-6}$
n	$\times 10^{-9}$
p	$\times 10^{-12}$

Charging Capacitor

$$V_c = V_o\,(1 - e^{-t/RC})$$

$$t = -RC\ln\left(1 - \frac{V_c}{V_o}\right)$$

Discharging Capacitor

$$V_c = V_o\,e^{-t/RC}$$

$$t = -RC\ln\left(\frac{V_c}{V_o}\right)$$

Alternating Voltages

$$V_o = V_{rms}\sqrt{2}$$

Silicon Diode

$$V_F \approx 0{\cdot}7\text{V}$$

Bipolar Transistor

$$h_{FE} = \frac{I_C}{I_B}$$

$$V_{BE} \approx 0{\cdot}7\text{V}$$

MOSFETs

$$I_D = g_M\,V_{GS}$$

555 Monostable

$$T = 1.1\,RC$$

555 Astable

$$t_H = 0.7\,(R_A + R_B)C$$

$$t_L = 0.7\,R_BC$$

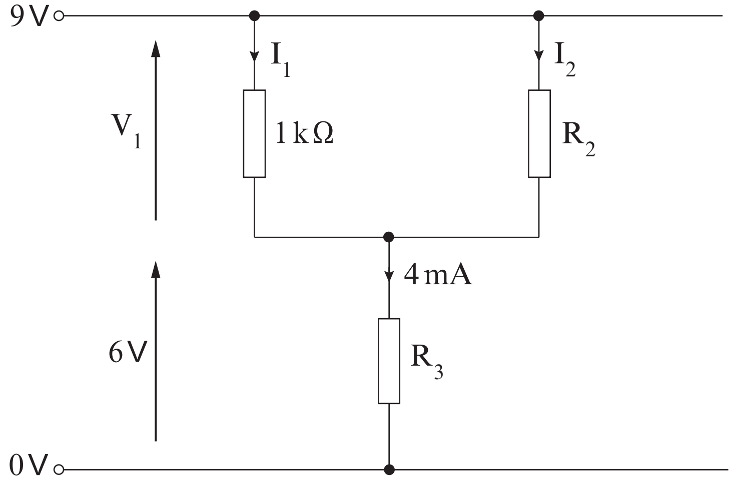
$$f = \frac{1{\cdot}44}{(R_A + 2R_B)C}$$

Schmitt Astable

$$f \approx \frac{1}{RC}$$

Examiner only

1. Use the information given in the circuit diagram to determine the values of the quantities listed below.



(a) V_1 ....

....

(b) I_1 ....

....

(c) I_2 ....

....

(d) R_2 ....

....

(e) R_3 ....

....

[6]

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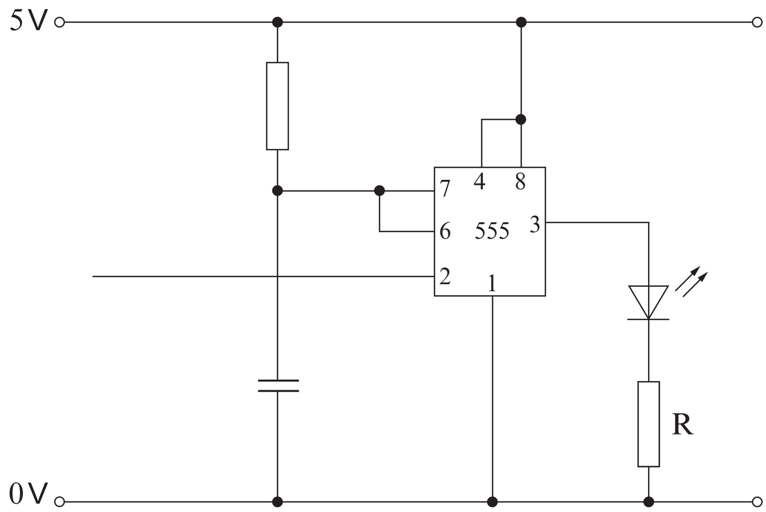
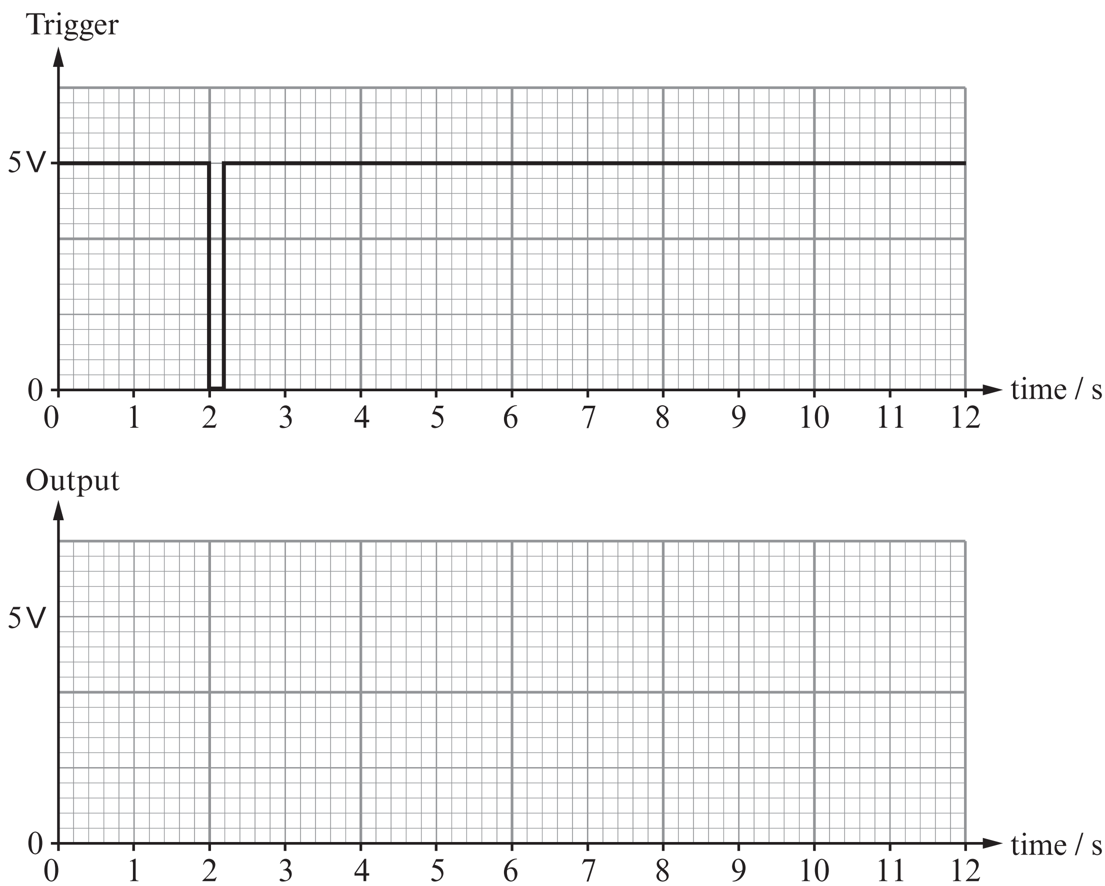
Examiner only

2. The following diagram shows an incomplete circuit for a 555 monostable timer with a period of 5 seconds.



(a) Add a switch and any other necessary component to the diagram to complete the trigger section of the monostable. The circuit is negative edge triggered. [2]

(b) Complete the graph below to show the output signal from the 555 in response to the trigger signal.
The voltage on pin 3 of the 555 timer is 5V when high.



[2]

Examiner only

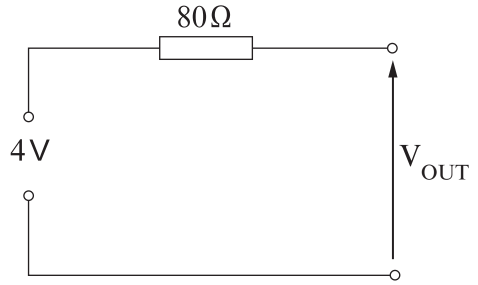
(c) The forward voltage drop across the LED is 2V.

Calculate the value for resistor R required to limit the current through the LED to a maximum of 20mA. [2]

....

....

3. The Thevenin **equivalent circuit** for a voltage source is shown below.



(a) Use the space provided to draw the equivalent circuit with a 120Ω resistor connected across the output terminals.
Calculate the value of V_{OUT}.

....

....

....

.... [2]

(b) Use the space provided to draw the equivalent circuit with **two** 120Ω resistors connected in parallel across the output terminals.
Calculate the new value of V_{OUT}.

....

....

....

.... [2]

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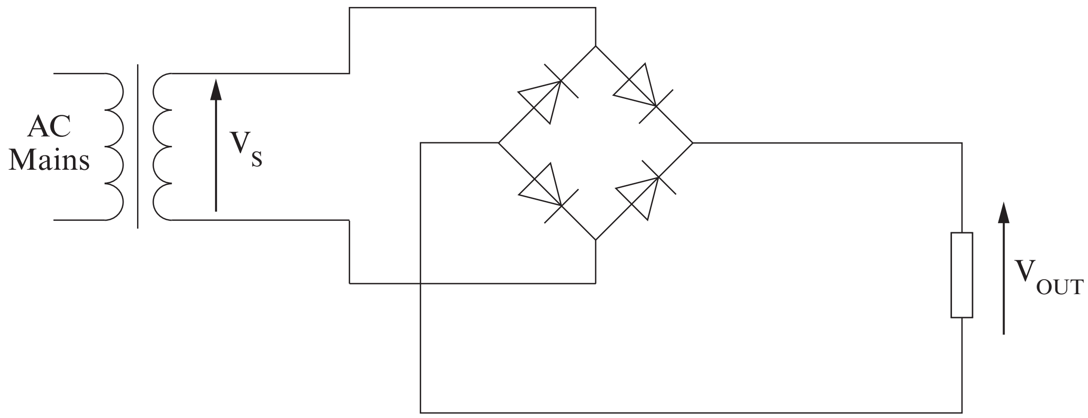
Turn over.

4. The following diagram shows part of the circuit of a full-wave-rectified power supply.



(a) The **peak** value of the secondary voltage of the transformer (V_S) is 6 V. Calculate the **peak** value of the full-wave-rectified voltage V_{OUT}.

....

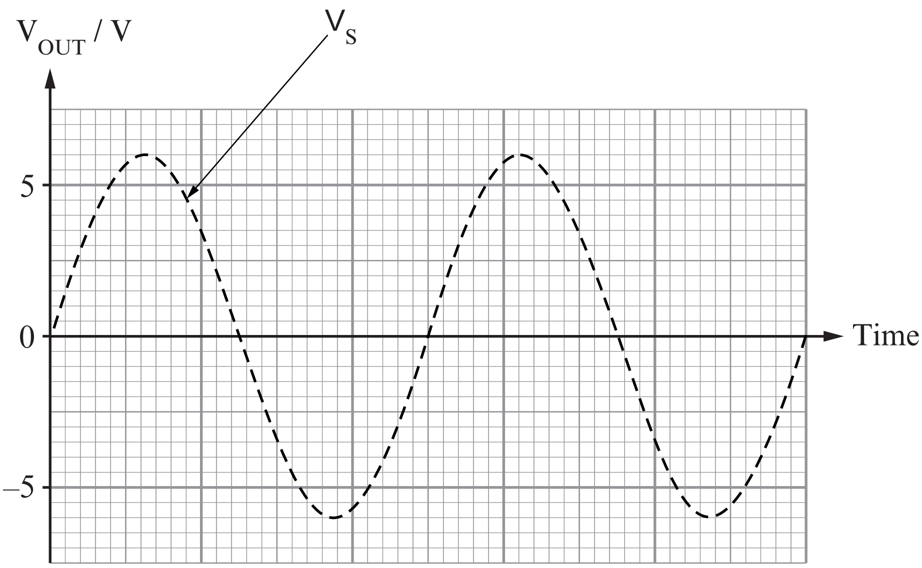
[1]

(b) On the axes provided below:

(i) Sketch the graph to show the output voltage V_{OUT},

(ii) Label the axes with any relevant voltages.

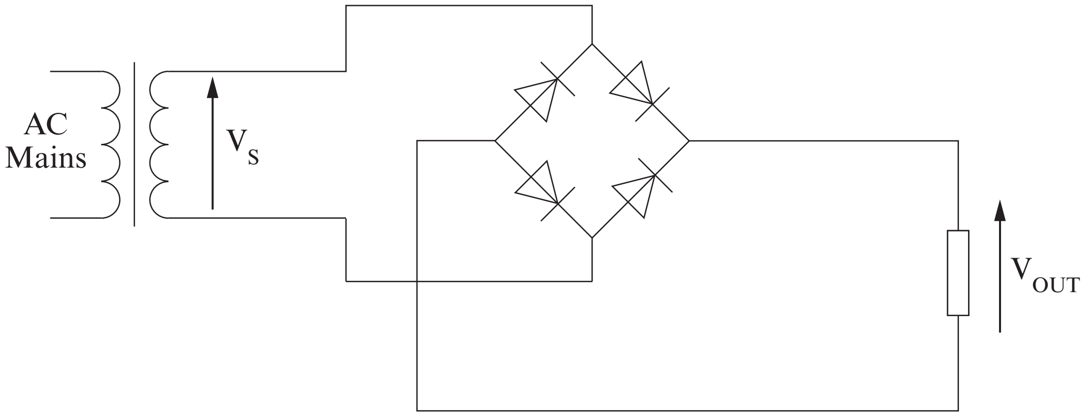
The voltage across the secondary windings of the transformer (V_S) is shown as a dotted waveform and has a peak voltage of 6 V.



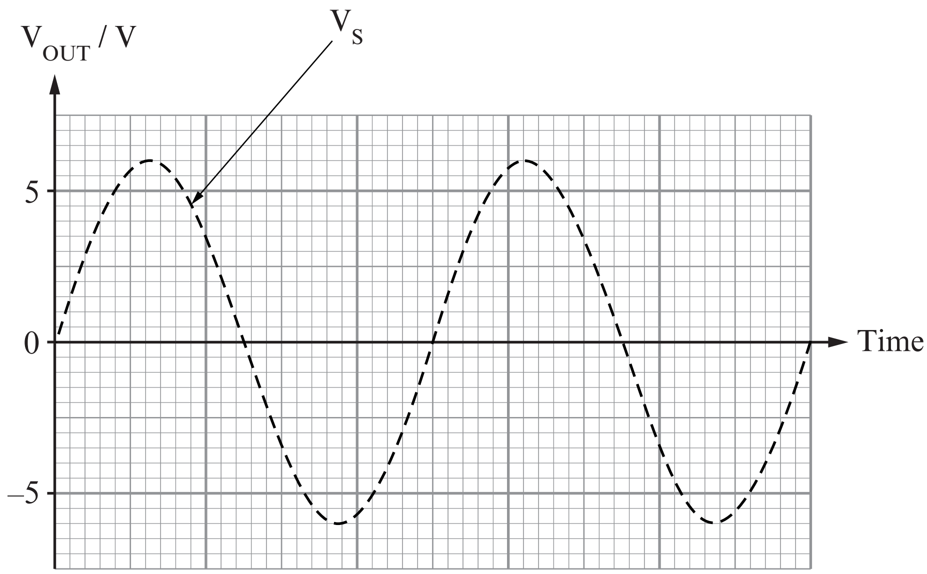
[2]

Examiner only

(c) (i) Complete the circuit diagram by adding a capacitor to smooth the output. [1]



(ii) A large current is drawn from the smoothed full-wave-rectified power supply. Use the next set of axes to sketch the voltage V_{OUT}.



[2]

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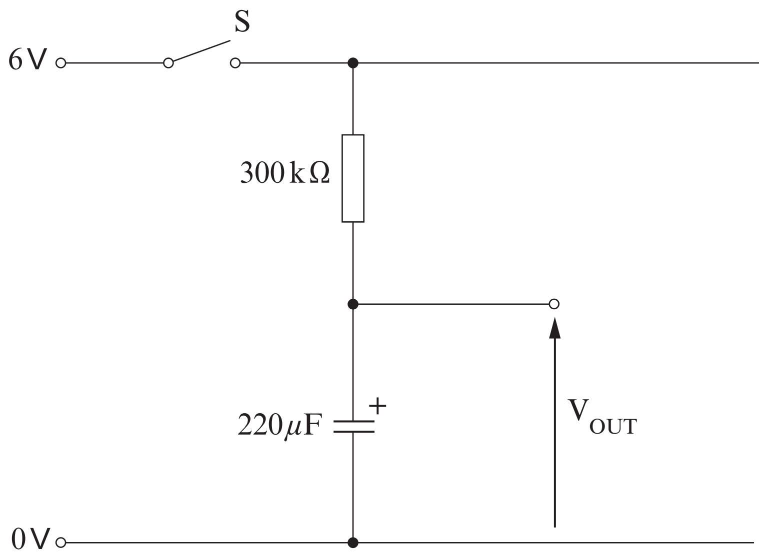
Turn over.

Examiner only

5. The capacitor shown in the following circuit is initially discharged.



(a) Calculate the time constant of the circuit

....

.... [2]

(b) Switch S is closed at time t = 0.

(i) Determine the time taken for V_{OUT} to reach 3V.

....

.... [2]

(ii) Calculate the value of V_{OUT} at time t = 20 s.

....

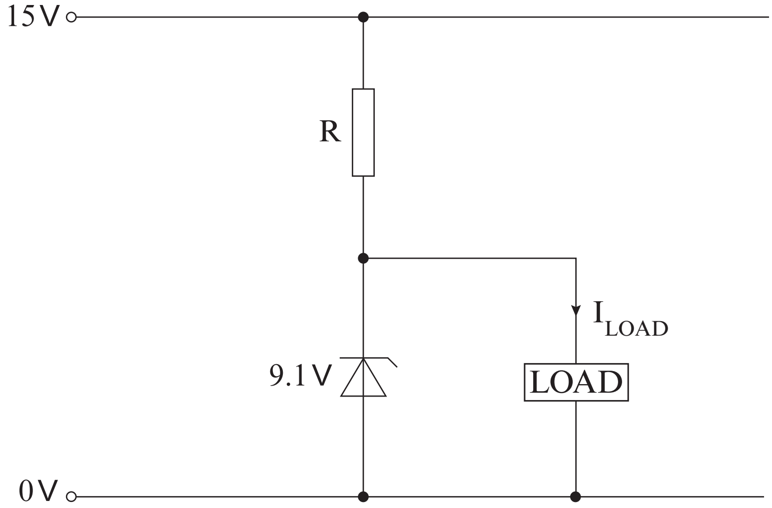
....

.... [2]

(iii) Estimate the time taken for V_{OUT} to reach 6V.

.... [1]

6. The following diagram shows a simple regulated power supply. The 9.1V zener diode requires a current of at least 10mA to maintain the zener voltage.



The power supply must be able to supply a load current, I_{LOAD}, of 300mA.

(a) Calculate the ideal value for resistor R to allow a load current of 300mA.

....

....

.... [3]

(b) The load is now disconnected from the power supply.

(i) What is the new value of current through the zener diode?

.... [1]

(ii) Calculate the power dissipated in the zener diode.

....

....

.... [1]

(c) Select the preferred value of resistor for R from the E24 series. Give a reason for your choice.

....

.... [1]

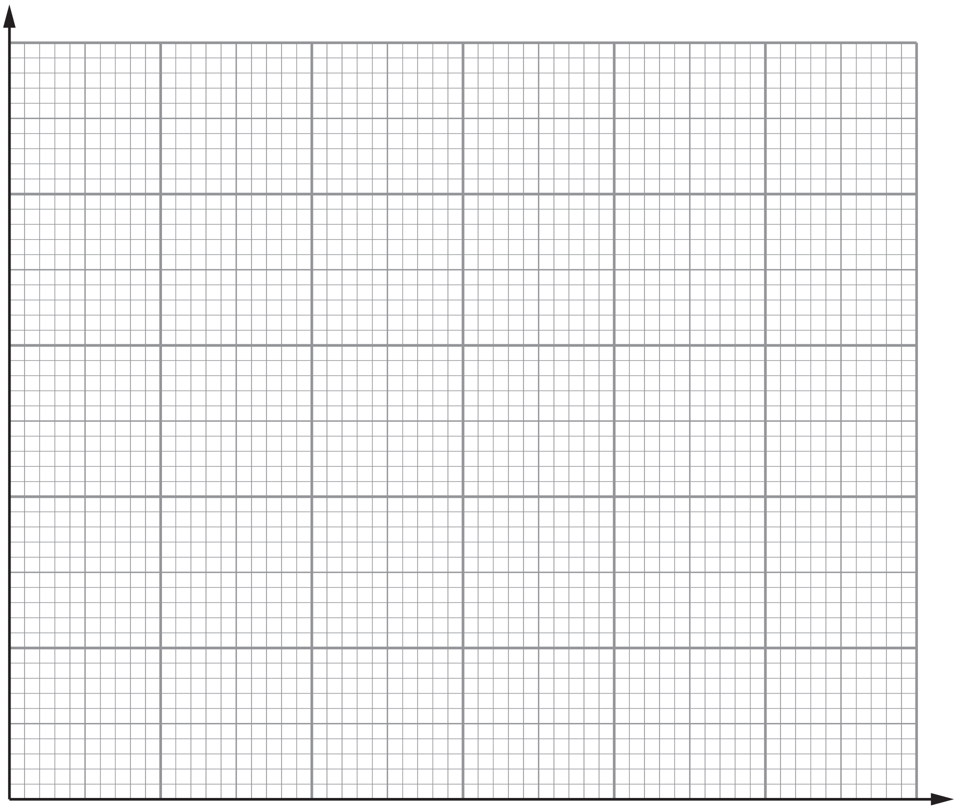
 Turn over.

7. *(a)* The table below shows the results obtained when the resistance of a light-dependent resistor (LDR) is measured at different levels of illumination (light intensity).

Illumination (lux)	Resistance (kΩ)
100	9.6
200	5.9
300	4.1
400	3.2
600	2.3
800	1.9
1000	1.7

(i) Plot a graph of resistance against illumination on the axes below. Label both axes with your chosen scale.

Resistance / kΩ



Illumination / lux

[3]

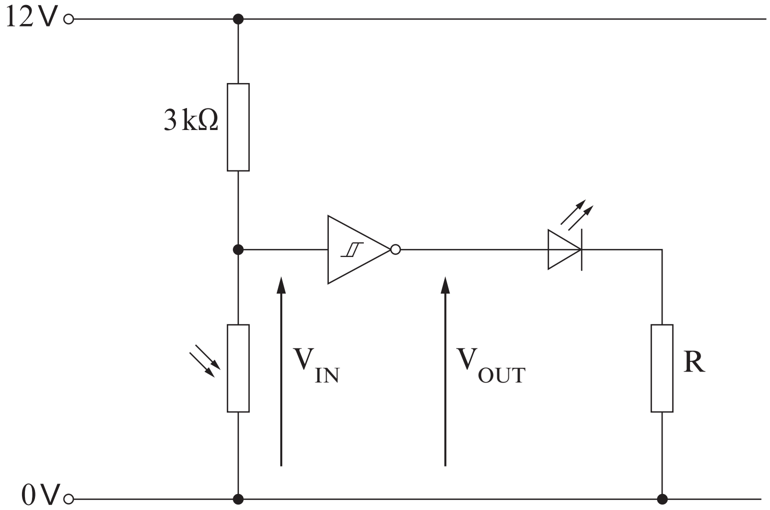
(ii) Use the graph to determine the resistance of the LDR at 150 lux.

....

[1]

Examiner only

(b) The LDR is connected to a 3 kΩ resistor to form a light-sensing unit for a simple light meter that warns when the light level is too high.



Calculate the value of V_{IN} at 150 lux.

....

[1]

(c) Here is part of a data sheet for the Schmitt Inverter:

When connected to 12 V supply:

- Logic 0 = 0 V
- Logic 1 = 12 V
- The output changes from logic 0 to logic 1 when a **falling** input voltage reaches 6 V
- The output changes from logic 1 to logic 0 when a **rising** input voltage reaches 8 V

Give the value of V_{OUT} at 150 lux and state whether the LED is on or off.

....

[1]

(d) (i) Determine the resistance of the LDR when V_{IN} is 6 V and the LED just comes on.

....

(ii) Determine the illumination level when the LED just comes on.

....

[2]

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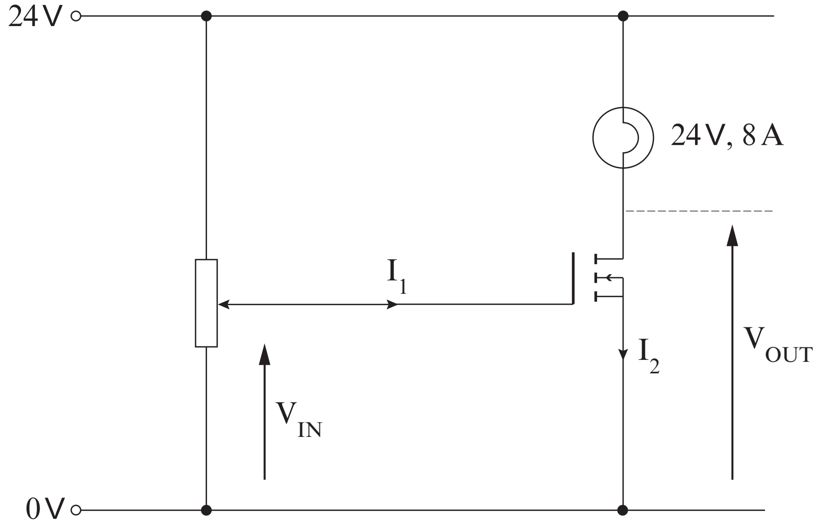
Turn over.

Examiner only

8. The following circuit is set up to check some parameters of a MOSFET.



(a) The following results were obtained with the MOSFET just saturated:

V_{IN} / V	V_{OUT} / V	I_2 / A
3.8	1.45	7.96

Use the results to calculate:

(i) the value of g_M ,

....

.... [1]

(ii) the value of r_{DSon}

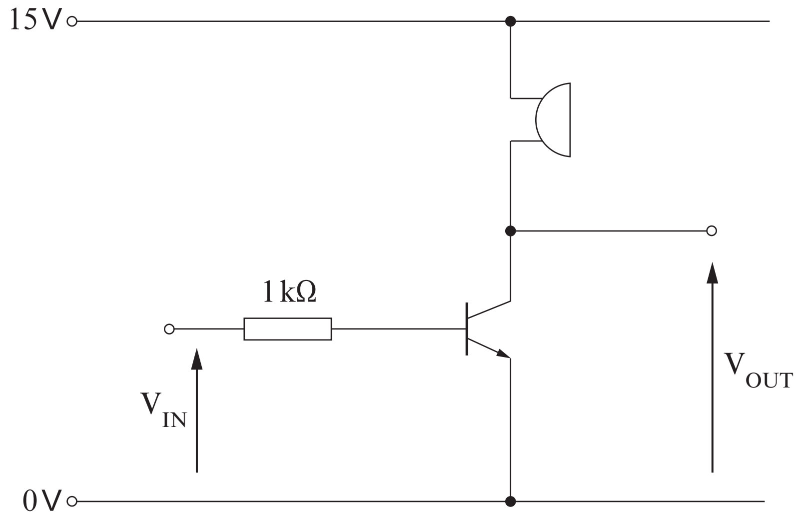
....

.... [2]

(b) Estimate the value of I_1. .... [1]

Examiner only

9. Here is a transistor switch circuit used to control a buzzer.



(a) The transistor has a current gain, h_{FE} = 75.
The buzzer has a resistance of 50Ω.
The value of V_{IN} is sufficient **just** to saturate the transistor.

Calculate:

(i) the collector current,

....

.... [1]

(ii) the base current,

.... [1]

(iii) the value of V_{IN}.

....

.... [2]

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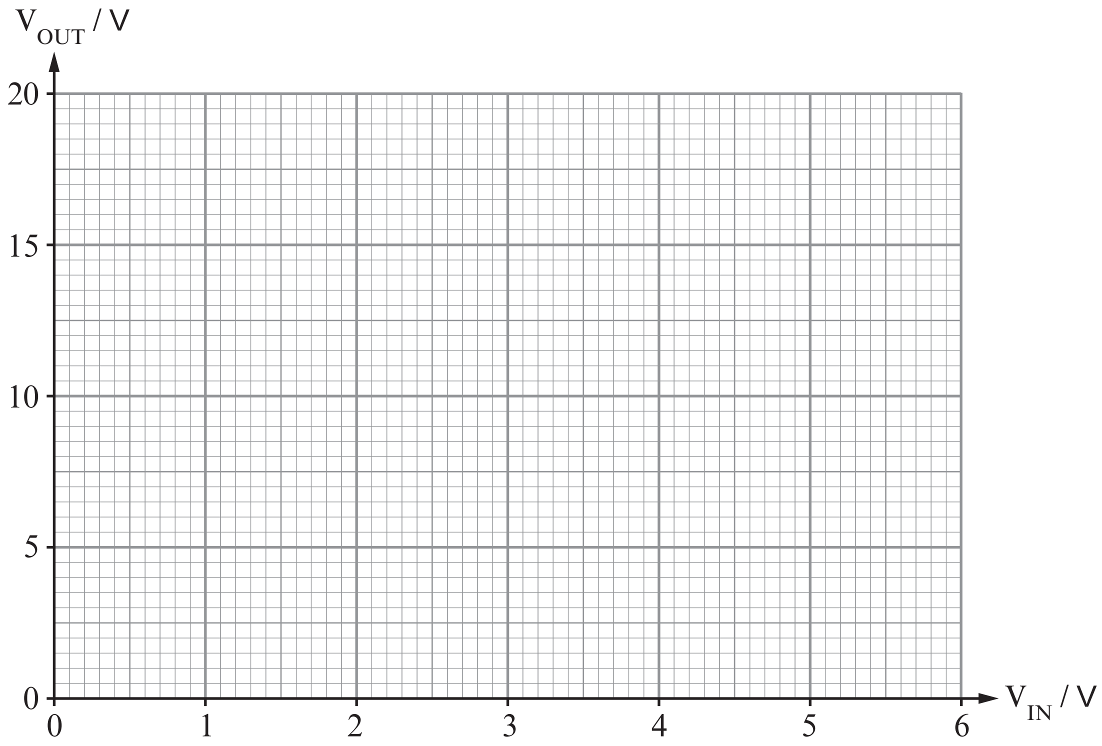
Turn over.

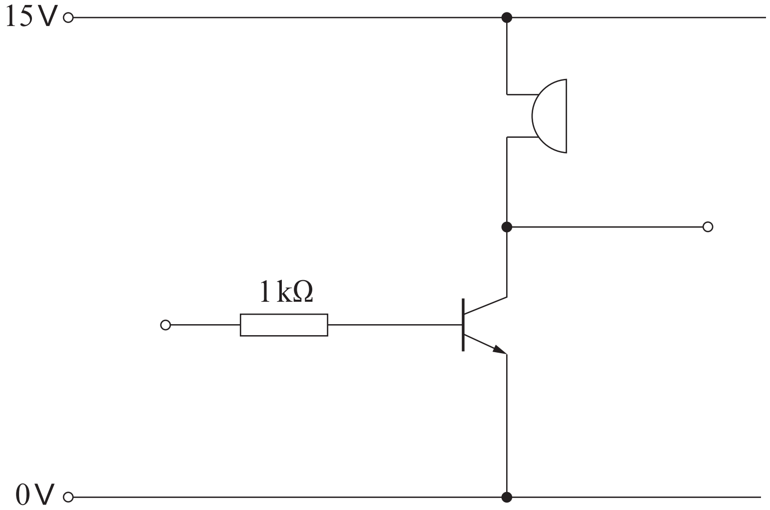
Examiner only

(b) Draw a graph to show how V_{OUT} changes as V_{IN} is increased from 0 to 6V.



[3]

(c) The switching circuit is used to monitor the temperature in a greenhouse. When the temperature gets too high, the buzzer sounds.
Add the temperature sensing sub-system to the circuit diagram below.



[2]

(d) At a certain temperature V_{IN} is 3V.

(i) Use the graph to determine the value of V_{OUT}. [1]

....

....

(ii) Calculate the new value of the collector current. [2]

....

....

(iii) Calculate the power dissipated in the transistor. [1]

....

....