(a)(i) An LED is made up of a N-type and p-type semiconductor fused together. The p-type is connected to the anode and the n-type connected to the cathode. a thin wire connects the p-type to the cathode. when a the semiconductor is fordwoard braseed, the electron flows and at the junction drops down from the conduction band to the valence band, releasing its excess energy as light. a magnifying material covers the semiconductor to magnify the light emitted.

(ii) * An LED is much less likely to break due to violent shaking,

* due to less soldering components & wiring, & fragile glass components, so used in aeroplanes are appropriate

* LEDs draw much less voltage & current, & this would be

appropriate as signal lights such as in a traffic light, which are constantly requiring to be oppened.

* LED's turning on & switching off times are much quicker than that of light globes, thus they may be useful as indication lights. Such as in a hospital, switching on when something is wrong.

* LED's last for a much longer period of time than ordinary light globes so in applications again such as traffic lights, where regularly changing bulbs difficult, LED's would be appropriate.

(32)

b) i) 1) As the illumination of light falling upon the LDR increases, the resistance of the LDR decreases exponentially.

2) When the illumination is 4 lux, from the graph the resistance of the LDR is 500 Ω

(ii) $V = IR$

$R_T = \frac{V}{I}$

$= \frac{12}{4.8 \times 10^{-3}}$

$R_T = 2500\,\Omega$

Data
$V = 12V$
$I = 4.8 \times 10^{-3}$
$R_T = 2500\,\Omega$
$R_{LDR} = 800\,\Omega$
$R_R = ?\ 1700\,\Omega$

at 2lux $R_{LDR} = 800\,\Omega$

$\therefore R_R = R_T - R_{LDR}$

$= 2500 - 800$

$R_R = 1700\,\Omega$

$\therefore$ The resistance of the relay is $1700\,\Omega$.

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(c)(i) an ideal amp has infinite gain. an ideal amp also has infinite input resistance so that the output resistance is 0. Input voltage should be 0 V for maximum gain.

(ii) $\frac{V_{out}}{V_{in}} = \frac{2.0}{-50 \times 10^{-6}}$

$= -40,000$

(iii) This amp is not suitable because the output voltage is 'clipped' because the input voltage has a greater range than is shown when input voltage of 200 and 250 microvolt both produce output of -8 V. This would create distortion from the output.

[illegible]

d) Thermionic devices were bulky, slow and complicated on large scales. Development and research led to the development of the transistor which replaced the ~~them~~ thermionic devices. The transistor allowed alot more windows of opportunity to be opened due to its small size and efficiency/reliability. It started a rapid growth in electronics that relied on transistors as a building block. Computers benefited greatly as they could now be built smaller and quicker, resulting in a greater acceptance and wider use. With the development of integrated circuits (ICs) which pack millions of transistors into a small chip, Integrated

→ computers have become much faster and cheaper to produce.

circuits are now getting even smaller as new 0.13 micron processing plants are opening allowing transistors to be closer and smaller than ever before. The IC has allowed computers to reach a cost accessible to the home user and has ment a great increase in computers and our reliance upon them. Unfortunatly there are limitations to the development of IC's. As they get smaller and smaller distances between the inbuilt components light can no longer be used to etch them. It's possible that in the feature x-rays will allow IC's to continue to shrink and contain more transistors. Due to our heavy reliance on IC's it is almost guaranteed that future research will allow their continued development or a solution to replace and improve upon them. But for the time being computers have reached speeds of 3GHz thanks to the impact of IC's which is more speed then most computer software will need for a great time to come.