

| Question number | Answer   | Mark |
|-----------------|--|------|
| 17(a)           | <ul style="list-style-type: none"> <li>Use ratio of resistors to determine initial p.d. across LED or final p.d. across capacitor<br/> <b>Or</b> Use of <math>I = V/R</math> to determine initial current and final current (1)</li> <li>Use of <math>V = V_0 e^{\frac{-t}{RC}}</math><br/> <b>Or</b> Use of <math>I = I_0 e^{\frac{-t}{RC}}</math> (1)</li> <li><math>C = 0.56 \text{ F}</math> (1)</li> <li>Need to choose 0.58 F so it doesn't take less than the required time (1)</li> </ul> <p><u>Example of calculation</u><br/> Initial p.d. across LED = <math>12 \text{ V} \times 340 \Omega / (860 \Omega + 340 \Omega)</math><br/> = 3.4 V<br/> V across LED proportional to V across capacitor<br/> <math>1.4 \text{ V} = 3.4 \text{ V} e^{-(10 \times 60 \text{ s} / 1200 \Omega \times C)}</math></p> <ul style="list-style-type: none"> <li><math>C = 0.56 \text{ F}</math></li> </ul> | (4)  |
| 17 (b)          | <ul style="list-style-type: none"> <li>From the graph, as p.d. decreases the resistance increases (1)</li> <li>Therefore the time constant increases (1)</li> <li>The light will take longer to switch off (1)</li> </ul>  | (3)  |
| 17(c)           | <ul style="list-style-type: none"> <li>The capacitor is an energy store (1)</li> <li>The overall charge on the capacitor is zero (1)</li> <li>The capacitor separates charge (1)</li> </ul>  | (3)  |
|                 | Total for question 17  | 10   |