Mark scheme based on information in the help sheet. Students should be given additional credit for appropriately selecting points from any of the other sources given.

On balance, Evaluating technologies.

<table>
<tr><td colspan="2">Hydrogen Fuel Cells.</td></tr>
<tr><td>Advantages</td><td>Disadvantages</td></tr>
<tr><td>They are very light.</td><td>They cannot store electrical energy (must be used up right away)</td></tr>
<tr><td>They are very efficient (75% efficiency, compared to 20-25% in car gasoline engine and 35-40% in coal power plants).</td><td>They need a continuous flow of fuel (reactants for redox reaction).</td></tr>
<tr><td rowspan="4">They are very clean (environmentally friendly) and portable – less pollution and no greenhouse gases released in process (as in the burning of fossil fuels.</td><td>They require hydrogen gas, which is dangerous to store and transport, as well as being harmful to the environment to produce (with the processes such as the cracking of ethane to produce it).</td></tr>
<tr><td>They require expensive electrodes and other equipment.</td></tr>
<tr><td>They could result in corrosion or catalytic failures.</td></tr>
<tr><td>(1 mark for each advantage and disadvantage drawn from the list provided or other sources max 8)</td></tr>
<tr><td colspan="2">Evaluation (on balance I think…because…)
Students should support their conclusion with an appropriate use of the points they have given above eg
I think we should invest in the production of hydrogen fuel cells as an alternative to combustion engines or rechargeable batteries as they are light and very efficient. Although there are environmental effects in producing the</td></tr>
</table>

hydrogen fuel, this is happening in an industrial location and can more easily be managed then when individual vehicles emit pollutants

(2 marks, appropriate conclusion, based on evidence)

Rechargeable batteries (NiCa) and lead-acid batteries	
Advantages	Disadvantages
They are rechargeable (unlike lead batteries)	*Cadmium is extremely toxic, so batteries must be correctly disposed of with caution, as they have the potential to harm the environment*
They are lightweight (compared to lead batteries)	*Rechargeable batteries are more expensive than lead-acid storage batteries and produce a lower voltage.*
The electrode material can be easily regenerated.	*They experience the memory effect: if NiCad batteries are charged while only partially discharged, an unreactive surface builds up on the electrode sheets, reducing their ability to react and produce electricity. Thus, these batteries will have a shorter life the more they are charged while partially discharged.*
They have a longer life than lead-acid storage batteries.	*(1 mark for each advantage and disadvantage drawn from the list provided or other sources max 8)*
Evaluation (on balance I think…because…) *Students should support their conclusion with an appropriate use of the points they have given above eg* *Rechargeable batteries are not the way to power electric vehicles because of the memory effect. Drivers will find it inconvenient to run the battery until it is completely discharged and therefore the battery will have a short life which is problematic given the cost of manufacture.* *(2 marks, appropriate conclusion, based on evidence)*	