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MARKSCHEME

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DESIGN TECHNOLOGY

Standard Level

Paper 3

13 pages

Option A – Raw material to final product

A1. (a) ***[1]*** *for identification of appropriate substrate*
Grain or paper waste (because of cellulose or other hydrocarbon content).

(b) ***[1]*** *for* ***one*** *nutritional advantage of myco-protein*
High protein **or** low cholesterol **or** high fibre content **or** low salt content.

(c) ***[2]*** *for appropriate suggestion*
Heat stops growth of fungus ***[1]*** and renders the cells nonviable ***[1]*** stops further fermentation ***[1]***

(d) ***[2]*** *for brief explanation of* ***how***
The myco-protein which is a dough is mixed with a binding agent ***[1]*** and flavouring agents ***[1]*** and then put through a forming machine to give it the right shape, *e.g.* chicken thigh shape ***[1]***.

A2. ***[2]*** *for explanation*
Coke is basically carbon (C) and is converted in the blast furnace to carbon monoxide which reacts with iron oxide to reduce it to iron metal.

or an equation:

$$3CO(g) + Fe_2O_3(s) = 2Fe(l) + 3CO_2(g)$$

A3. ***[1]*** *for definition to the effect below*
The process of drying out timber after conversion.

[2] *for appropriate explanation –* ***one*** *reason only is enough for* ***[2]***

Problem with 'green' timber is its moisture content. There are many reasons for drying wood.

Four main reasons include:
- to increase dimensional stability. Wood shrinks across the grain (not along the grain) when it dries. If wood is cut to size before it is seasoned, it will shrink during drying and thus be undersized in its final form.
- to reduce or eliminate attack by decay or stain. Wood that is dried below 20% content is not susceptible to decay or sap staining.
- to reduce the weight. The weight of lumber will be reduced by 35% or more by removing most of the water in the wood or, as we say, by 'seasoning.'
- to increase the strength. As wood dries, the stiffness, hardness and strength of the wood increases. Most species of wood increase their strength characteristics by 50% or more during the process of drying to 15% moisture content.

A4. ***[1]*** *per distinct point up to a maximum of* ***[4]***
Commercial success requires people to purchase the product. People compare new products with familiar products and are very reluctant to try new products. Look and smell are important. If product looks different or smells different then it is less attractive.

Option B – Products in context

B1. (a) ***[1]*** *for identification of appropriate plastic from table*
Type 1 **or** Type 2

(b) ***[1]***
High density polyethylene **or** polyethylene terephthalate

(c) ***[1]*** *for appropriate suggestion*
Food containers

(d) ***[2]*** *for brief explanation of why*
Difficulty in quantities that make recycling feasible ***[1]***. Need to be collected together to enable economic viability of recycling ***[1]***. Collection an issue ***[1]***.

(e) ***[2]*** *for appropriate explanation*
Because they are mixed plastics and therefore have more than one component ***[1]***.
Individual components are difficult and uneconomic to recycle ***[1]***.

B2. ***[1]*** *for each of correct characteristics from list below, up to* ***[2]*** *maximum*
- low in capital cost.
- use local materials wherever possible.
- create jobs (employing local skills and labour).
- involve decentralised renewable energy sources.
- make technology understandable to the people who use it and so promotes future innovation.
- flexible, *i.e.* are sustainable or can be adapted to fit changing circumstances.
- are not detrimental to the quality of life or the environment.

B3. ***[2]*** *for definition to the effect below* ***[1]*** *for definition of resource* ***[1]*** *for reserve*
A resource is the amount of material in or on the planet that is potentially available for human resources whereas a reserve is that proportion of a resource that can be gained economically using existing technologies.

B4. ***[1]*** *per distinct point up to a maximum of* ***[4]***
Automation is a volume process involving machines controlled by computers ***[1]***. Using computers automated production systems could be controlled ***[1]***. Computers hold enormous amounts of data ***[1]***. More reliable ***[1]***. Collection of quality control data ***[1]***. Links to database can achieve stock control and reordering ***[1]***. Computer control allows 24 hour per day working ***[1]***.

Option C – Mechatronics

C1. (a) ***[1]*** *for T – no other response possible*
T

(b) ***[1]***
$40\mu V\ ^{\circ}C^{-1}$

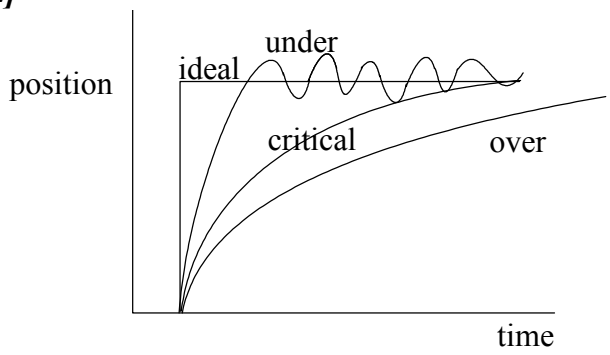
(c) ***[2]*** *for appropriate response.* ***[1]*** for calculation, ***[1]*** *for answer with units. If student has selected a different thermocouple in (b) but done the calculation in (c) correctly albeit with the wrong numbers then allow marks.*
$200 \times 40 = 8000\ \mu V$

(d) ***[2]*** *for brief explanation of* ***how***
$\frac{5000000}{8000} = 625$

C2. ***[2]*** *for explanation*
a.c. motors can operate at high speed ***[1]*** without much variation in speed which is what is required in a hairdryer ***[1]***.
a.c. motors are less complex ***[1]***, and thus there is less to go wrong ***[1]***.
a.c. motors are lighter ***[1]*** and this is better for a handheld appliance ***[1]***.

C3. (a) ***[1]*** *for definition to the effect below*
Insufficient negative feedback leading to overshooting and oscillations in a servo mechanism.

(b) ***[2]***



the system will achieve the required position in a reasonable time without overshooting and oscillating

C4. ***[1]*** *per distinct point up to a maximum of* ***[4]***
The op amp can take two inputs – one reference signal set to a pre-set value and the other signal *e.g.* from a light dependent resistor or thermistor. The two signals are compared and if below pre-set value a 0 output, above that a 1 output.

Option D – Food technology

D1. (a) ***[1]*** *for identification of appropriate substrate*
Upper gastro-intestinal tract symptoms (nausea, vomiting).

(b) ***[1]***
2 hrs – 6 days (usually 12 – 36 hours)

(c) *Up to* ***[2]*** *for appropriate suggestion*
Bacillus cereus ***[1]*** Fried rice ***[1]***

(d) ***[2]*** *for brief explanation*
Cook rice and eat immediately ***[1]*** therefore no time for growth of bacteria ***[1]***
Cook rice and store in fridge/freezer ***[1]*** therefore temperature too low to support bacterial growth ***[1]***
Prepare in hygienic surroundings/good personal hygiene ***[1]*** therefore no contamination of rice before storage ***[1]***

D2. ***[2]*** *for explanation* ***[1]***
Ability to compare food products, especially blended products *e.g.* Tea/wine ***[1]*** look holistically at product ***[1]*** and checking that it meets the specification ***[1]***.
Feedback from consumers ***[1]*** to inform product development ***[1]***.

D3. (a) ***[1]*** *for definition to the effect below*
The formation of a gel *e.g.* with gelatin or by the heat treatment of starch.

(b) ***[2]***
Uncooked starch products have a gritty/not smooth texture ***[1]***. Heating causes gelatinisation of starch and thickening of product and makes it smoother ***[1]***. Resolves grittiness ***[1]***.

D4. ***[1]*** *per distinct point up to a maximum of* ***[4]***
Organoleptic properties are taste, smell, appearance, texture, feel and colour

- taste – snack products are more strongly flavoured for children and teenagers than for adult market where taste tends to be more sophisticated.
- texture is modified according to dentition of consumers – homogenised foods for babies.
- colour – no colour added to baby products.
- sound – fun products for children – popcorn, rice krispies, *etc*.

Option E – Computer aided design and manufacturing

E1. (a) ***[1]*** *for definition to effect of*
The ability to simulate a real situation on a screen and interact with it in a near natural way.

(b) ***[2]*** *for explanation*
Can view designs, *e.g.* buildings before built. Can project ideas in 3-D.
Consumer can see what design is likely to be like before spending money thus more cost-effective.

(c) ***[3]***, ***[1]*** *per distinct reason*
- saves time
- saves raw materials
- saves energy
- saves money

E2. ***[2]*** *for explanation*
Spreadsheets can be used for numeric modelling and can enable a designer to do what-if type operations. Can plug the equations into the spreadsheet and then change factors and see effect on material amounts, strength, *etc*.

E3. (a) ***[1]*** *for definition*
that links design and manufacture of products to the point of sale/consumer

(b) ***[1]*** for advantage ***[1]*** for disadvantage

Advantages:
Parts easily manufactured and changed.
Less lead time, labour, waste.
Better machine utilisation.
Improved productivity and quality control.
Greater consistency.
Fewer errors.
Higher quality finish.

Disadvantages:
High initial investment.
Training issues.
Staffing issues.
Job losses.

E4. ***[1]*** *per distinct point up to a maximum of* ***[4]***

- better quality control - greater consistency, fewer errors, higher quality of finish, less waste.
- greater variety of products – can design in product modifications easily and customise products to customer requirements.
- less lead time from design to manufacture.
- better machine utilisation.
- less labour, job losses.
- changes in nature of job – more menial tasks, less craft skills required.
- organisation of the workplace ad the working environment probably makes workplace safer for employees.

Option F – Invention, innovation and design

F1. (a) ***[1]*** *for identification of appropriate reason*
There is no line-of-sight connection to the orbiting satellite.

(b) ***[2]*** *for appropriate explanation*
There are not enough tall buildings/high hills everywhere.
In some places the density of users is so low that it is not economically viable.

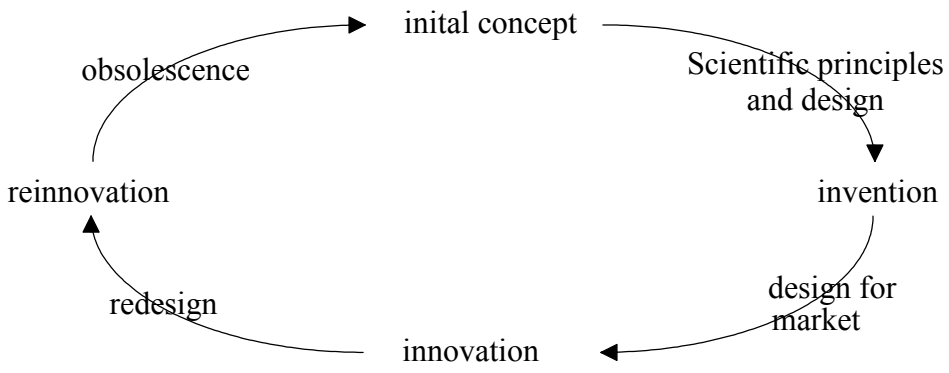
(c) ***[1]*** *for appropriate suggestion*
At sea or in other areas of world where no buildings, hills, *e.g.* desert. In remote areas for armies, *etc*.

(d) ***[2]*** *for brief explanation of* ***how***
Land-based mobile phone systems better solution smaller power packs, handsets can go into pocket or handbag, cheaper, *etc*. thus need satisfied and later introduction of satellite phone led to failure of innovation.

F2. ***[2]*** *for explanation*
Flexibility *i.e.* different ratios possible ***[1]***
Effect – saves on effort going up hills ***[1]***

F3. (a) ***[1]*** *for definition to the effect below*
The process of discovering a principle, a technical advance in a particular field, often resulting in a novel product.

(b) ***[2]***



[1] for invention/innovation and redesign only
[2] for every thing and in right order

F4. ***[1]*** *per distinct point up to a maximum of* ***[4]***
Market pull is where consumers demand products with particular features, *e.g.* fuzzy logic on washing machine so all manufacturers need to consider having fuzzy logic models available. Technology push is where a technological innovation, *e.g.* miniaturisation enables a product to be developed, *e.g.* smaller mobile phones. Push and pull are present in most successful innovations. The ideas do not apply to imitative products, only where the first origin of the idea appears to be generated.

Option G – Health by design

G1. (a) ***[1]***
Myopia – rays of light from distant object are focussed in front of retina.

(b) ***[1]*** *for selecting correct lens*
Concave lens – lens A

(c) ***[2]*** *for appropriate explanation*
The lens opens out the rays ***[1]*** so they focus on the retina ***[1]***.

(d) ***[2]*** *for brief explanation*
High refractive index glass can be thinner ***[1]*** but provide same degree of refraction of light ***[1]***.
Therefore lenses weigh less ***[1]*** and are more comfortable ***[1]***.

G2. ***[2]*** *for explanation*
No dangerous X-rays involved therefore hazards are reduced for patient and staff operating machines.

G3. ***[1]*** *for disadvantage from list below*
- more expensive
- need to be sterilised
- narrow range of shapes and sizes
- not disposable

G4. ***[1]*** *for definition to the effect below up to a maximum of* ***[2]***
- range
- sensitivity
- linearity
- safety
- accuracy

G5. ***[1]*** *per distinct point up to a maximum of* ***[4]***
Testing sticks are more reliable, cheap, give instant results, reduce contamination and are more quantitative.

Diabetic empowered to regulate their own glucose intake and balance with insulin. Continual monitoring by doctors not required. Diabetics thus freer to lead normal lives. Also likely to be better more consistent monitoring on hour by hour basis which would not be possible if doctors involved except in a hospital environment.