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MARKSCHEME

November 2001

DESIGN TECHNOLOGY

Higher Level

Paper 2

11 pages

Section B

Extended response questions - quality of construction

- Extended response questions for HL P2 carry a mark total of 20. Of these marks, 17 are awarded for content and 3 for the quality of construction of the answer.

- Three aspects are considered:
  expression of relevant ideas with clarity
  linking of ideas (relevant or irrelevant) in a logical sequence
  for design using appropriate communication methods.

- The 3 quality marks are to be awarded according to the following criteria:

Clarity of argument:

1 mark Consistently expresses relevant ideas with clarity.

'Designer' logic:

1 mark Demonstrates planning; design contexts and relevant examples; prioritises issues

Communication:

1 mark Employs techniques; (graphs, flowcharts, algorithms, appropriate communication, diagrams, annotations of graphs, tables and charts, 2D / 3D sketches *etc*.)

- It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.

- Candidates that score very highly on the content marks need not necessarily automatically gain the two points for the quality of construction (and vice versa).

- The important point is to be consistent in the awarding of the quality points. For **sample scripts for moderation** the reason why quality marks have been awarded should be stated.

- Indicate the award of quality marks by writing **Q3**, **Q2**, **Q1** or **Q0** in **red** at the end of the answer.

SECTION A

1. (a) (i) Award ***[1 max]*** for 'height of the support frame';

(ii) Award ***[2 max]*** for correct area, *i.e.* 2 m × 2 m = 4 m^2
or 2 000 mm × 2 000 mm = 4 000 000 mm^2;
Award ***[1]*** for correct length or breadth only**;**
Award no marks if units are missing;

(b) (i) *Award **[1]** for each correct statement up to **[2 max]***
- floor surface;
- desk texture;
- stability of the structure;
- safe surface and edges (no sharp projections);
- light requirements;
- heat requirements;

(ii) *Award **[1]** for each of the following up to **[3 max]***
$ 2000 = +14.3%;
therefore could choose oak on frame B;
or plastic on frame A;
or teak on frame B;
or ash on frame B;

(c) (i) *Award **[1]** for each correct statement up to **[2 max]***
- surface finish;
- cost;
- colour match to proposed or existing decor;
- resistance to staining;
- resistance to abrasion;
- resistance to damp conditions (spilt coffee);

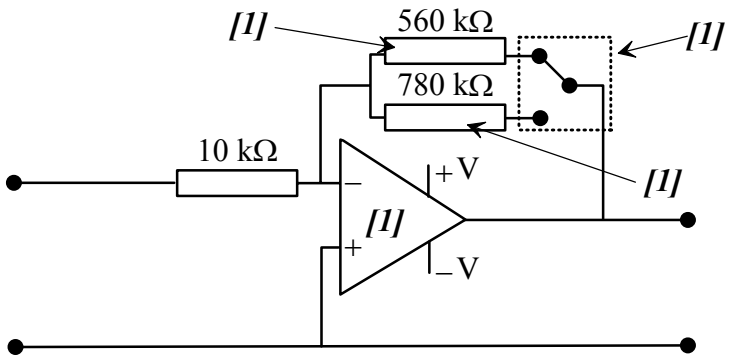
(ii) *Award **[1]** for each correct statement up to **[2 max]***
- more complex geometry;
- uses more material;
- more expensive to manufacture;
- more design overheads;

(iii) *Award up to **[3 max]** for a statement that says essentially:*
'The design of Frame A is a cantilever and therefore the maximum bending ***[1]*** moment takes place at the supported end. To resist the bending, a thicker cross-section is required ***[1]***. In the case of Frame B the load is uniformly distributed ***[1]*** and therefore the member can have a uniform cross-section ***[1]***.'

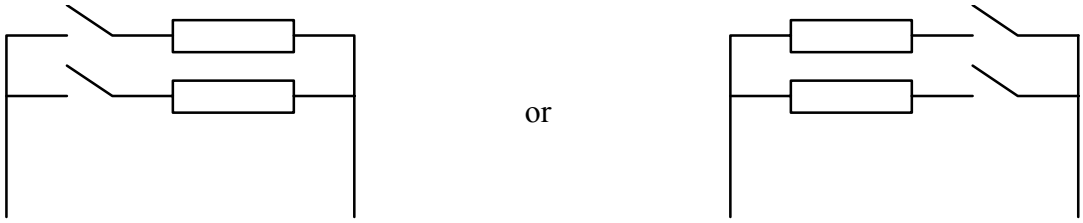
(d) *Award up to **[3 max]** for a statement that contains **three** distinct points:*
'The new module has a 120° ***[1]*** angled section that would allow it to tessellate into a circular configuration ***[1]*** by using three of the units ***[1]***. This would allow a more flexible arrangement and utilise the central floor area of a larger office ***[1]***. It could be used to form team operating stations ***[1]*** and allow the designer of the office space more configurations ***[1]***.'

2. (a) Award ***[1]*** for –56;
Award ***[1]*** for –78;

(b) *Award up to* ***[4 max]***



Award ***[1]*** for each resistor in place and correctly valued ***[2]***;
Award ***[1]*** for the switch (It could be placed to the left of the resistors.) Allow ***[1]*** for the op amp. Allow two switches as in:



3. *Award* ***[1]*** *for each correct answer up to* ***[2 max]***
- Silicon Dioxide (SiO_2);
- Sodium Oxide (Na_2O);
- Calcium Oxide (CaO);

4. (a) *Award* ***[1]*** *for each statement, up to* ***[2 max]****, that says essentially:*
- user trials to see if product meets consumer requirements;
- expert appraisal to see if product meets safety regulations, *etc.*;
- performance tests to evaluate safety issues;

(b) *Award up to* ***[4 max]*** *for a statement that says essentially:*
'Can be manufactured ***[1]***, performs as expected ***[1]***; needs to be modified ***[1]***; to provide data for future product development ***[1]***;' to see if product meets design specification ***[1]***; to see if it can be manufactured more cheaply ***[1]***;

Award ***[1]*** for identifying a reason and ***[1]*** for additional information.

SECTION B

5. (a) (i) *Award **[1]** for definition:*
'The ratio of the distance moved by the effort in a simple machine to the distance moved by the load in the same time. Also referred to as VR. It can also be calculated from length of effort arm ÷ length of load arm (of a lever).'

Allow a condensed form of the formula: Velocity ratio equals the distance moved by the load divided by distance moved by effort.

(ii) *Award up to **[4 max]**, **[3]** for the calculations, **[1]** for wheel circumference, **[2]** for number of revolutions in one minute to cover 15 m and **[1]** for the required VR.*
wheel circumference $33 \times 3.14 = 103.6$ mm ***[1]***;
no of revs in 1 minute 144.78 $\text{rev}\,\text{min}^{-1}$ required ***[2]***;
velocity ratio VR = 0.01608:1 (*allow 0.016)* ***[1]***;

(b) *Award **[1]** for each description as follows up to **[4 max]**:*
- a pulley system ***[1]*** could be used with a small pulley on the motor ***[1]*** and a large one on the wheel (or axle driving the wheels) ***[1]***;
- a gear system ***[1]*** could be used with a small gear ***[1]*** on the motor and a large gear ***[1]*** on the wheels (or axle driving the wheel). Allow large/small gear or gear with large/small number of teeth;

OR annotated drawing explaining the same things.

(c) *Award marks as indicated up to **[8 max]**:*

either
- a gear system accurately described in theory ***[2]***;
- VR calculated and number of gear teeth stated ***[2]***;
- a clear description of the method used for reversing the direction of drive by the addition of an extra gear (idler) in the system ***[4]***;

or
A pulley drive ***[1]*** system showing the size of pulleys ***[1]*** and ways in which the belt is retained ***[1]*** either 'V' or 'U' groove. A method of maintaining the maximum amount of belt in contact (jockey pulley) ***[1]***. A clear description of how the belt is crossed or other method of achieving a reversal of direction ***[4]***;

6. (a) (i) *Award **[1]** for each correct statement up to **[2 max]***
- heating factory/cooling factory/plant;
- driving machines;
- manufacturing processes;
- material shaping;
- materials chosen;
- fabrication;

(ii) *Award **[1]** up to **[3 max]** for statements that essentially say:*
- the motor of the vacuum cleaner needs to be efficient;
- the motor must use less energy;
- the materials chosen should be made by energy efficient methods;
- user perception of low energy use will/will not sell the item;
- recycling the materials at the end of life should be possibly ***[1]*** energy efficient ***[1]***;

(b) *Award marks as allocated up to **[4 max]** for a statement that essentially says:*
'The siting of a plant will be made using multiple criteria of which one is energy availability ***[1].*** If the plant is using cheap material but needs high energy to create added value then the siting of the plant would be made on the basis of whether it is cheaper to move the material to the energy or the energy to the material. (*e.g.* Aluminium smelting) ***[1].***
- access to energy ***[1]***;
- access to raw materials ***[1]***;
- access to skilled labour source ***[0]***;

(c) *Maximising the life of the product up to **[4 marks]***
- choice of materials *e.g.* metals may corrode, plastics may degrade ***[1]***;
- replaceable parts if breakdown ***[1]***;
- minimise planned obsolescence ***[1]***;

*Minimising energy use up to **[4 max]***
- minimise weight so cheaper to distribute ***[1]***;
- recyclable materials that use less energy for recycling ***[1]***;
- amount of energy used in manufacturing ***[1]***;
- amount of material used, less material, less energy use ***[1]***;
- minimise friction in moving parts ***[1]***;
- make product as energy efficient as possible ***[1]***;

[3] available for the clarity, logic of the arguments and the quality of the answer *i.e.* use of graphs, charts, table *etc.*

7. (a) *Award **[1]** for:*

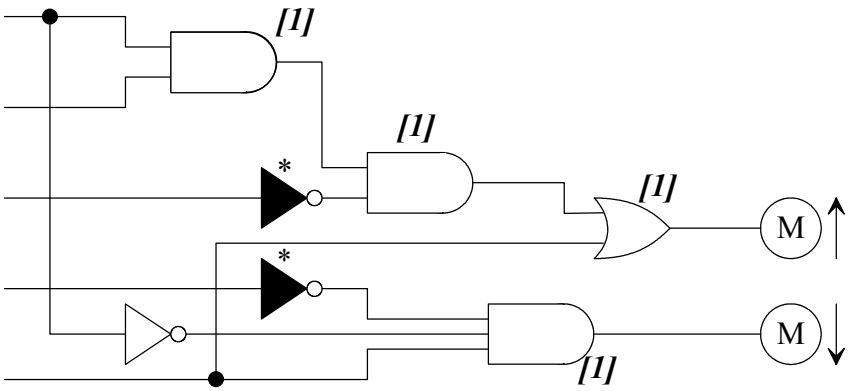
M (**Please note**: European, British and American symbols also acceptable)

(b) (i) *Award **[1]** for each criterion from the list below up to **[2 max]***
- must operate in all weather conditions;
- must give a signal without direct contact with the vehicle;
- must be resistant to damp/hot/dry/cold conditions;
- must require little maintenance;
- must be impact resistant;

(ii) *Award **[1]** for any from the list below up to **[1 max]***
Many movement / position sensors are light operated, pressure operated, magnetically operated switches and strain gauges
- pressure sensor;
- light sensor (LDR);
- magnetically operated;
- strain gauge;

(c) *Award up to **[4 max]** for a statement that says essentially*
- the barrier must not come down on top of a car or person ***[2]***;
- the area should be difficult for a person to stray into;
- the system must be 'fail safe' *i.e.* any failure in the control system should not allow the barrier to move up or down or randomly;
- the sensors should only operate for the designed purpose, *e.g.* the entry sensor should only respond to a car, not a cat or person or child;

(d) *Award marks as allocated up to **[9 max]***
[1] entry sensor; ***[1]*** ticket dispenser; ***[1]*** up barrier limit; ***[1]*** down barrier limit; ***[1]*** obstruction sensor;



Award up to ***[9 max]*** for a logic circuit that does not allow the motor to raise the barrier unless the entry sensor and the ticket dispenser provide a signal*.
The motor must stop when the limit switch either gives a signal or fails to give a signal. The barrier must come down when there is (no) signal from the down barrier limit switch and no signal from the entry sensor but it must remain up or be sent up if the obstruction sensor gives a signal.