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Mark Scheme (Results)
Summer 2016

Pearson Edexcel GCE
in Design & Technology (6GR03/01) Paper 1

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Publications Code 6GR03_01_1606_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Mark
1(a)	Any **two** of the following: 1. Pallet trucks **(1)** 2. Forklift / fork trucks **(1)** **3.** Towing vehicles / pull truck **(1)** 4. Unit load vehicles **(1)** 5. Light load (vehicles) **(1)** 6. Assembly line vehicles **(1)** 7. Heavy burden carrier vehicles **(1)** 8. Automatic guided carts **(1)** **Do not accept crane or conveyor.** **(2 x 1)**	**(2)**
1(b)	An outline covering **four** of the following points: 1. Control via a central / on-board computer **(1)** 2. Programmed route or fixed route/path **(1)** 3. Radio frequency wires / magnetic strip embedded in the factory floor **(1)** 4. Painted line / floor mounted strip **(1)** 5. Input sensors **(1)** 6. Laser guidance **(1)** 7. GPS guidance **(1)** 8. Inertial (gyroscopic) navigation **(1)** 9. Automated failsafe systems embedded in guidance systems / collision control **(1)** 10. Barcode scanning **(1)** **(4 x 1)**	**(4)**
	Total for question	**6**

Question Number	Answer	Mark
2(a)	Any **one** of the following: 1. The science of designing products / systems / environments for human use **(1)** by applying the characteristics of human users to the design of a product **(1)** 2. The relationship / link between the product / environment and the user **(1)** making the product easy to use / appropriately sized / safe / comfortable / functional **(1)** 3. Designing a product that is a good fit / comfortable to the human body **(1)** taking into account the age / nationality / gender of the user / the range of movement that can be executed / anthropometric data **(1)** **(2 x 1)**	**(2)**
2(b)	1. By producing a single design **(1)** that is valid for everyone / accommodates all body sizes and shapes / suits everyone other than the 95th percentile and above (e.g. a door opening) **(1)** 2. Designing a range of objects **(1)** that cover all possibilities / body types / shapes / sizes to suit the 5th to 95th percentile (e.g. clothes) **(1)** 3. Designing a product that is adaptable to different dimensions **(1)** so that it can can be adjusted to provide a comfortable fit for the end user to suit the 5th to 95th percentile (e.g. an adjustable chair) **(1)** 4. Designing an accessory that adapts itself to the original design **(1)** to amend the fit for different users designed for the 50th percentile (e.g. a car booster seat for children) **(1)** (2 x 2)	**(4)**
2(c)	Any **three** of the following: 1. Twin pistol grip / handles (1) appropriate size/shape to fit the hands of the intended user (1) 2. Position of directional controls / buttons / joysticks (1) allow ease of operation by falling within the range of comfortable lateral movement of the user's thumb (1) 3. Triggers / buttons on front of handset (1) are positioned where the index finger would naturally rest when holding the handset (1) 4. Angle between control pads and handles / width of controller (1) allows the user to adopt a natural position (1) 5. Curves / curved edges (1) provide comfort in use (1) 6. Size of buttons (1) provide ease of use / correctly sized for human fingers / thumbs (1) Do not credit any response which is not evident from figure 1. (3 x 2)	**(6)**
	Total for question	**12**

Question Number	Answer	Mark
3	A discussion covering **six** of the following points: 1. Robots do not have as an impressive array of senses as humans (touch, vision, hearing, pattern recognition) **(1)** 2. Robots do not have the ability to learn and make decisions when the required data does not exist, making minor amendments to production methods/techniques difficult **(1)** 3. Robots cannot react to unexpected conditions not anticipated by the programmer **(1)** 4. Errors will remain uncorrected and will repeat **(1)** 5. Robots are not as flexible as humans and are harder to program to perform specific tasks therefore are suited to continuous production **(1)** 6. Human operators have to be excluded from robot working areas due to safety issues resulting in the stoppage of production when human intervention is needed **(1)** 7. Difficulty/high cost of making robot cells safe, including collision sensors **(1)** 8. Maintenance issues as different brands of robot use different control systems, so maintenance crews require a range of specialist training / highly skilled crews required **(1)** 9. Disruption to production during maintenance **(1)** 10. Problems with a single isolated unit (robot) stops the whole production line **(1)** 11. Requires 24/7 monitoring **(1)** 12. No standard robot programming language implemented, which can cause operating problems between different brands **(1)** 13. Historically there has been a risk of industrial unrest when robotics are introduced but they are now accepted as standard production practice in some industries **(1)** **(6 x1)**	**(6)**
	Total for question	**6**

Question Number	Answer	Mark
4(a)	Any **one** of the following: 1. 3D printing / additive manufacturing **(1)** 2. Stereolithography **(1)** 3. Selective laser sintering **(1)** 4. Fused deposition modelling **(1)** 5. Direct metal laser sintering **(1)** 6. Electron beam melting **(1)** **(1 x 1)**	**(1)**
4(b)	Any **two** of the following: 1. Virtual models can undergo (repeated) computer testing **(1) by** using the physical properties of the proposed materials **(1)** 2. Virtual models can be viewed in a range of materials / colours / finishes are photorealistic **(1)** reducing the need to produce a range of physical models / give the client a choice **(1)** 3. Can adjust the scale of the modelling **(1)** allows some areas of the model to be seen in more detail **(1)** 4. Modifications can be made easily / seen immediately in the model **(1)** reducing overall design time / time to market **(1)** 5. Model doesn't have to be produced / manufactured **(1)** allowing earlier decisions to be made **(1)** 6. More cost effective **(1)** no materials cost / rapid prototyping machine not required **(1)** 7. Virtual models enable the automatic calculation of material content / mass **(1)** so accurate estimates of cost can be achieved **(1)** 8. Virtual models can be sent as an email attachment **(1)** allowing clients / other members of the design team to view the model remotely / comment on the design **(1)** 9. Virtual models are environmentally friendly **(1)** because no materials / physical resources are used **(1)** 10. Can be used for larger structures such as buildings **(1)** allowing the designer to take a virtual tour / explore within the structure **(1)** **(2 x 2)**	**(4)**

4(c)	A discussion covering any **five** of the following: 1. A full and immediate account of the transactions involving the company's products **(1)** 2. Data can be input into spreadsheets for sales / profit analysis **(1)** 3. The means to monitor the performance of all product lines **(1)** 4. Allows the company to react more quickly to changes in consumer demand **(1)** 5. Accurate information for identifying consumer buying trends **(1)** 6. A full and responsive stock control system / provision of 'real time' updates **(1)** 7. Ensures that stock is always available **(1)** 8. Increases efficiency of stock rotation **(1)** 9. Manual 'stock takes' are no longer required **(1)** 10. Tracking of products **(1)** 11. Prevents over ordering which ties up capital **(1)** 12. Eliminates pricing errors at the checkout stage **(1)** 13. Efficient checkout procedure via the scanning of barcodes / increases customer throughput **(1)** 14. Allows self-service scanning / checkout **(1)** 15. Allows special offer deals to be automatically applied **(1)** 16. No need to update price labels when prices change **(1)** 17. Can recall product information and price via scanning **(1)** **(5 x 1)**	**(5)**
	Total for question	**10**

Question Number	Answer	Mark
5(a)	A discussion covering **four** of the following: 1. Economic regeneration of the local area following investment by the multinational company **(1)** 2. Increased employment in manufacturing and service industries via direct employment in the new industry and indirectly through regeneration and the increased demand for services **(1)** 3. Development of a trained / skilled / educated workforce **(1)** 4. Enables the country to expand its manufacturing base **(1)** 5. Increases the average wage of the nation / improvements to the standard of living / wealth of the population **(1)** 6. Improved awareness of health and safety issues encourages the move towards the implementation of health and safety legislation **(1)** 7. Local infrastructure / transportation systems / amenities are improved which could attract further offshore manufacturing **(1)** 8. Inflow of money improves the countries balance of payments allowing an increase in trade with other countries **(1)** 9. Introduction of new technologies to the country helps to develop the technological capability of the workforce **(1)** 10. Improved housing / accommodation for workers **(1)** 11. Increased morale of the local population **(1)** 12. Increased awareness of the area to encourage further investment **(1)** 13. Healthcare for the local population may be provided **(1)** **(4 x 1)**	**(4)**

5(b)	Any **two** of the following: 1. Increased transportation of finished products to key markets **(1)** adds to the cost of the product/reduces response time to changes in demand / increased carbon footprint for the company **(1)** 2. Public perception of use of overseas 'sweatshops' **(1)** could lead to a boycotting/reduced demand for the company's product **(1)** 3. Lack of existing educated/skilled workforce **(1)** costs time and money developing the required skills **(1)** 4. Potential political instability of developing country **(1)** could put the overseas assets of the company at risk/could cause disruptions to supplies **(1)** 5. Lack of infrastructure (road / rail / ports) within the developing country **(1)** increases the need for capital investment **(1)** 6. Different time zones **(1)** means that communications with head office will be difficult **(1)** 7. Spare and replacement parts will need to be 'shipped' **(1)** causing delays / inefficiencies in production **(1)** 8. High initial investment **(1)** because of lack of facilities and infrastructure **(1)** **(2 x 2)**	**(4)**
	Total for question	**8**

Question Number	Answer	Mark
6(a)*	Eileen Gray's 'Bibendum' chair A response that identifies any **four** of the following marking points: 1. Form (and style) over function **(1)** 2. Celebrated the mechanised modern world **(1)** 3. Embraced both hand crafted and machine production **(1)** 4. Mass produced products in affordable materials **(1)** 5. Responded to the human need for pleasure and escape **(1)** 6. Opulent style a reaction to the forced austerity of the first world war **(1)** 7. Eclectic style (hence not all features of the movement are present in the chair) **(1)** 8. Geometric forms and patterns / sharp edges / zig-zags / fan motifs / surface decoration **(1)** 9. Symmetry and repetition **(1)** 10. Influence of primitive arts Egyptian, African and Aztec **(1)** 11. Use of expensive materials such as enamel, ivory, bronze and polished stone **(1)** 12. Use of chrome (as seen in the base of the chair), glass and Bakelite enabled designs to be manufactured at low cost **(1)** 13. Modern materials (for the time) e.g. tubular steel / aluminium **(1)** Reference may be made to the chair in the picture when linked to the philosophy and style of the design movement	**(4)**
6(b)*	Marcel Breuer's 'Wassily' chair A response that identifies any **four** of the following marking points: 1. Functional design (form follows function) **(1)** 2. Less is more / minimalist **(1)** 3. High end functional product with artistic pretensions (works well but looks good) **(1)** 4. Simple geometry / pure form with clean lines **(1)** 5. Elimination of unnecessary clutter / decoration **(1)** 6. Use of modern materials such as tubular steel **(1)** 7. Products look machine made rather than following natural forms (products for a machine age) **(1)** 8. Everyday objects for everyday people – functional, cheap and mass produced so ordinary working class people can afford them **(1)** 9. Base for art found in handicrafts **(1)** Reference may be made to the chair in the picture when linked to the philosophy and style of the design movement	**4**
	Total for question	**8**

Question Number	Answer	Mark
7(a)	Any **one** of the following: 1. Artificially inserting a gene / DNA from one plant into another **(1)** to prove a change / improvement / advantage to the trees' biological characteristics **(1)** 2. The scientific alteration to the structure of genetic material **(1)** to correct genetic defects / make improvements to the plant / tree **(1)** **(1 x 2)**	**(2)**

7(b)	A balanced response should be put forward. Consideration of both advantages and disadvantages must be included for full marks. If only one is considered, award a maximum of 7 marks. Advantages: 1. Reduction of lignin in tree growth **(1)** 2. Reduces the use of toxic chemicals used in the paper industry to break down the lignin **(1)** 3. Produces trees with faster growth rate / more renewable / efficient production / increased yield **(1)** 4. Trees grown specifically for the paper and board industry **(1)** 5. Enzymes break down the timber fibres more effectively **(1)** 6. Paper fibres can be more effectively bonded **(1)** 7. Aids the resistance of trees to disease / insect attack **(1)** 8. Better forest management / reduces deforestation / sustainable sourcing **(1)** 9. More effective recycling **(1)** 10. Fewer pesticides used as disease resistant **(1)** 11. Paper treated to biodegrade more easily and quickly **(1)** 12. Increases speed of paper production **(1)** 13. Lighter colour reduces the requirement for bleaching **(1)** 14. Reduced energy required to produce paper **(1)** Disadvantages: 15. Long term side effects not yet apparent **(1)** 16. 'Escape' of modified genes into natural ecosystems / impact upon ecosystems / must be grown away from other trees **(1)** 17. Could have an adverse impact on the quality of timber produced for structural use **(1)** 18. Development of tolerance to the modified trait by insects or disease organisms **(1)** 19. Rapid growth could cause shorter more intense rotations, resulting in greater water demand and reduced opportunity for nutrient recycling **(1)** 20. More expensive raw material because of development costs **(1)** 21. Concerns about ethics and pressure groups / public perception **(1)** 22. Reduced biodiversity **(1)** 23. Impacts on animal habitats **(1)** **(1 x 8)**	**(8)**
	Total for question	**10**

Question Number	Answer	Mark
8(a)	Any **one** of the following: 1. Undertake an energy audit / evaluation / life cycle analysis (LCA) to identify areas of high energy consumption **(1)** and consider alternative methods of production using more energy efficient processes **(1)** 2. Ensure that existing plant is running at peak efficiency **(1)** by regular maintenance and servicing (1) 3. Consider the efficiency of materials handling / avoid double handling / minimise material movement **(1)** / reducing the energy used for transporting materials **(1)** 4. Replacing out-dated and inefficient machinery **(1)** as modern equipment is more energy efficient **(1)** 5. Switch off machinery when not in use **(1)** reduces energy use **(1)** 6. Reclaiming energy / heat losses **(1)** to heat the building / generate electricity **(1)** **(1 x 2)**	**(2)**

***8(b)**	A balanced response should be put forward. Consideration of both advantages and disadvantages must be included for full marks. If only one is considered, award a maximum of 7 marks. Advantages: 1. Power generation costs are low compared with other fuels **(1)** 2. A clean energy source with no greenhouse gas emissions **(1)** 3. Large amounts of energy are readily available **(1)** 4. Uses an abundant fuel source **(1)** 5. Small amounts of uranium produces large amounts of energy **(1)** 6. Mitigates the greenhouse effect if used to replace fossil-fuel derived electricity **(1)** 7. Surplus heat can be used for local district heating **(1)** 8. Only small quantities of waste are generated **(1)** 9. Reliable/consistent supply of energy **(1)** 10. Nuclear power stations are relatively small when compared with fossil fuelled power stations **(1)** 11. Depletion of fossil fuels means that alternative fuel sources are required **(1)** 12. Increasing population increases demand for electricity **(1)** 13. Transportation moving towards electrically powered vehicles will result in a larger increase in demand for electricity **(1)** 14. Many existing power stations are old and outdated and require replacement **(1)** 15. UK's power production is already close to working at maximum capacity **(1)** 16. Increasing demand for clean energy with lower CO_2 emissions **(1)** 17. Need for 'core' energy production as most renewable sources e.g. wind, solar, wave do not produce a reliable constant source 24/7 **(1)** 18. Small modular reactors manufactured in a factory can be brought to site fully constructed **(1)** 19. Helps the Government to meet internationally agreed emissions targets **(1)** 20. Modern systems incorporate more fail safe technologies **(1)** Disadvantages: 21. Unpopular / mistrust with public due to media coverage of accidents (Chernobyl and Japan) / safety concerns **(1)** 22. Radio active waste has to be indefinitely stored **(1)** 23. Potential for severe radioactive contamination by leakage / accident / sabotage **(1)** 24. Could lead to the development of nuclear weapons **(1)** 25. Mining / transportation of uranium causes environmental damage and pollution **(1)** 26. High initial development costs **(1)** 27. Potential health risks for workers in the power industry **(1)**	

	28. Decommissioning costs can negate economic benefits if not factored into LCA costings **(1)** 29. Requires large amounts of cooling water to avoid meltdown / located by bodies of water **(1)** 30. Associated terrorist risks **(1)** 31. Power plants have limited lifespan **(1)** 32. Non-renewable finite material **(1)** (1 x 8)	**(8)**
	Total for question	**10**