OCR
Oxford Cambridge and RSA

Practice Paper December 2018

A Level in Design and Technology: Design Engineering

H404/01 Principles of Design Engineering

Duration: 1 hour 30 minutes

MAXIMUM MARK 80

Last updated 03/12/2018

MARKING INSTRUCTIONS

PREPARATION FOR MARKING ON RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca.
3. Log-in to RM Assessor and mark the **required number** of practice responses ('scripts') and the **required number** of standardisation responses.
4. After the standardisation meeting: YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING INSTRIUCTIONS – FOR MARKING ON SCREEN

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.
5. **Crossed Out Responses**

   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   Rubric Error Responses – Optional Questions

   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

   Multiple Choice Question Responses

   When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
   When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the additional pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
   a. Where generic answer booklets are used, all pages must contain an annotation, or RM Assessor will not allow you to submit the script. Where no response is given by a candidate on a whole page the 'BP' annotation **must** be applied.
   b. Where additional objects are present, all pages must contain an annotation, or RM Assessor will not allow you to submit the script. Where no response is given by a candidate on a whole page the 'BP' annotation **must** be applied.
   c. Where structured answer booklets are used, the 'BP' annotation **must** be applied to all pages where no response is given by a candidate.

7. Where candidates have a choice of questions across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. (*The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.*)

8. Award No Response (NR) if:
   - there is nothing written in the answer space.

   Award Zero '0' if:

   - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

   Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

9. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.** If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or e-mail.
10. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
11. These are the annotations, (including abbreviations), used in RM Assessor, which are used when marking:

Symbol	Description	Comment
	Tick	worthy of credit
	?	unclear
	S	error of spelling
	E	error of grammar, punctuation or expression
	F	error of fact

	^	omission
	H Line	to draw an attention to an error
	H Wavy Line	to draw attention to something
……	Highlight	as directed by PE
	REL	irrelevant point
	REP	conspicuous repetition
	L	illegible word or phrase
	BP	Blank Page – this annotation **must** be used on all blank pages within an answer booklet and on each page of an additional object where there is no candidate response.

SUBJECT–SPECIFIC MARKING INSTRUCTIONS

Introduction

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. You should ensure that you have copies of these materials:

- the specification, especially the assessment objectives
- the question paper and its rubrics
- the mark scheme.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR

booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**. Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Information and instructions for examiners

The co-ordination scripts provide you with *examples* of the standard of each band. The marks awarded for these scripts will have been agreed by the Team Leaders and will be discussed fully at the Examiners' Co-ordination Meeting.

The specific task-related indicative content for each question will help you to understand how the band descriptors may be applied. However, this indicative content **does not** constitute the mark scheme: it is material that candidates **might** use, grouped according to each assessment objective tested by the question. It is hoped that candidates will respond to questions in a variety of ways. Rigid demands for 'what must be a good answer' would lead to a distorted assessment. Candidates' answers must be relevant to the question. Beware of prepared answers that do not show the candidate's thought and which have not been adapted to the thrust of the question. Beware also of answers where candidates attempt to reproduce interpretations and concepts that they have been taught but have only partially understood.

Using the Mark Scheme

Please study this Mark Scheme carefully. The Mark Scheme is an integral part of the process that begins with the setting of the question paper and ends with the awarding of grades. Question papers and Mark Schemes are developed in association with each other so that issues of differentiation and positive achievement can be addressed from the very start.

This Mark Scheme is a working document; it is not exhaustive; it does not provide 'correct' answers. The Mark Scheme can only provide 'best guesses' about how the question will work out, and it is subject to revision after we have looked at a wide range of scripts.

The Examiners' Standardisation Meeting will ensure that the Mark Scheme covers the range of candidates' responses to the questions, and that all Examiners understand and apply the Mark Scheme in the same way. The Mark Scheme will be discussed and amended at the meeting, and administrative procedures will be confirmed. Co-ordination scripts will be issued at the meeting to exemplify aspects of candidates' responses and achievements; the co-ordination scripts then become part of this Mark Scheme.

Before the Standardisation Meeting, you should read and mark in pencil a number of scripts, in order to gain an impression of the range of responses and achievement that may be expected.

Please read carefully all the scripts in your allocation and make every effort to look positively for achievement throughout the ability range. Always be prepared to use the full range of marks.

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Marking Scripts
Answers must be marked using the level descriptors in the marking grids and a mark awarded for each Assessment Objective.
The points in the mark scheme are **indicative content only** and offer some question specific guidance. Credit should be given for other points and different views, if they seem possible and are well argued or supported by good evidence.

You must avoid negative marking - don't deduct marks for individual errors. All marks should be allocated by reference to the assessment grid.

Any queries on unexpected answers please consult your Principal Examiner.

Using annotations
- Take great care to place a tick (see below) against any valid points that lead you to think at all favourably of the answer.
- **Do not leave any page unmarked** (as a last resort tick the very bottom of a page to indicate that you have read it - otherwise Team Leaders/Principal Examiners cannot tell whether account has been taken of that page).
- Underline errors and place the appropriate symbol in the margin.
- Indicate that you have looked at every page of the answer booklet by placing the **BP** symbol at the top and bottom of any blank pages.

Ticks: these are the simplest, quickest and most efficient means for examiners to convey approval to Senior Examiners, and they should be inserted where they can be most effective. If the point you wish to highlight is in the middle of a paragraph, then put the tick in the middle of a line in the middle of a paragraph. Overuse of the tick tends to devalue its effectiveness.

Do use ticks to draw attention to anything worthy of credit [even single words].

Do not use ticks as a substitute for marking/assessment; marks for questions must be determined by reference to the assessment grid, **NOT** by mechanical addition of ticks.

Highlighting: use highlighting as directed by your Principal Examiner.

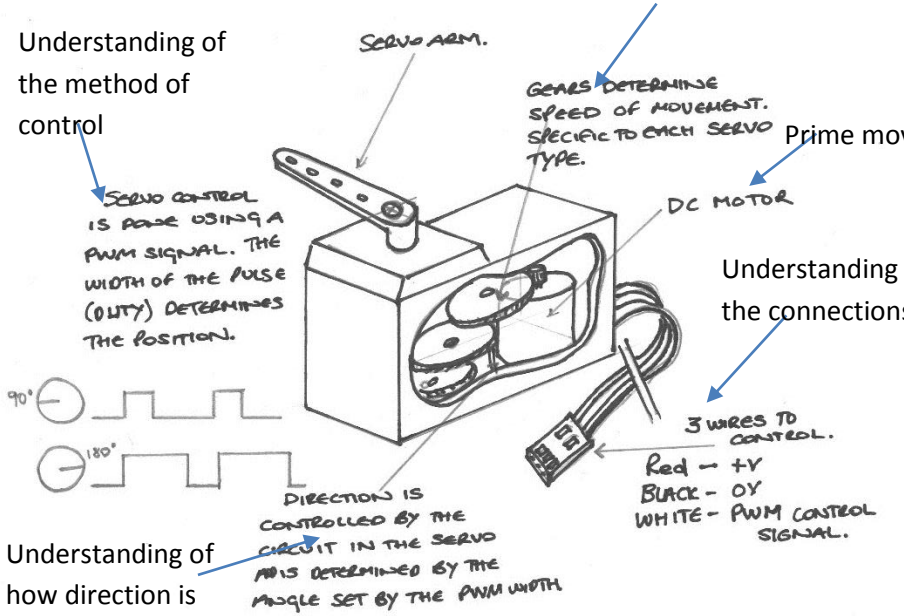
Question	Indicative Content	Marks	Guidance
1a	Possible reasons may include: • Social media increasingly encourages people to post personal videos (1). • The cost of gimbals is steadily reducing (1). • The improving technology is making gimbals lighter and more portable (1). • Users like the quality of the videos that can be shot (1). • Any other valid suggestion.	**2**	One mark for identifying each of two reasons why using a handheld gimbal with mobile phones has recently increased in popularity.
1b	Possible issues may include: • Analysis of the environment in which the product may be used (1). • User requirements/stakeholder needs (1). • Types and sizes of phones/cameras (1). • Economic/market considerations (1). • Existing product/SWOT analysis (1). • Ways of raising capital (1). • Technology available – motors/batteries etc (1). • Any other valid suggestion.	**3**	One mark for identifying each of three issues the company would need to investigate before deciding whether to proceed.

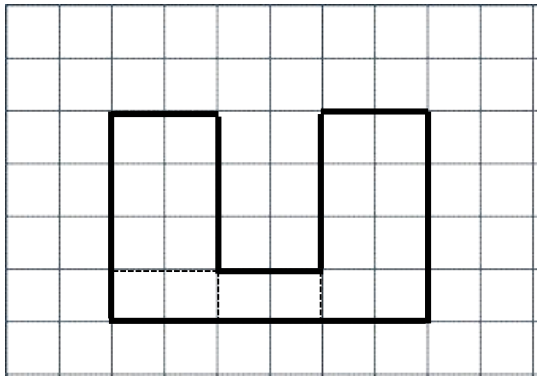
Question	Indicative Content	Marks	Guidance
1ci	**Indicative content:** Possible limitations of the handheld gimbal control system may include: • The control system may not be fast enough to respond to quick/rapid hand movements, especially in the filming of faster motion. • High frequency vibration may be too fast for the system to respond too. • The processing speed of the microcontroller may be too slow to react to sudden movements of the gimbal, resulting in missed movements and erratic responses. • Inertia of the mechanical system will slow down the response time. • Limited torque from the motors will slow down the response time. • Limited torque of the motors will limit the size/weight of the camera unit used on the Gimbal. • The motors may not rotate a full 360° so they may hit an end stop, meaning the limit of travel will be reduced. • Movements that do not involve rotation will not be cancelled out, these movements could be side to side or up and down motion (X and Z axis). • The weight of the gimbal (combination of phone mount and motors) could cause the gimbal to be weighty for the end user. • Any other valid suggestion.	**6** For MB3 to be awarded there will be two or three limitations of the handheld gimbal control system discussed. If candidates do not provide an analytical/evaluative response then only L1 can be awarded.	**Level 3 [5-6 marks]** The candidate has a clear understanding of the handheld gimbal control system. They produce a thorough discussion in relation to the question by explaining a number of limitations of the system. The explanation of limitations is clear and well-developed and a number of different perspectives are considered. **Level 2 [3-4 marks]** The candidate has a reasonable understanding of the handheld gimbal control system. They produce a sound discussion in relation to the question by explaining a number of limitations that can result from the use of the system. The explanations of limitations is sufficient although one or two opportunities are missed for expanding individual points made around the product in question. **Level 1 [1-2 marks]** The candidate has a basic knowledge of the handheld gimbal system. Any reference to this system is descriptive in nature and has little appreciation of the limitations that can result from the use of the system. The response contains no analysis or evaluation. 0 marks = No answer or answer not worthy of credit.

Question	Indicative Content	Marks	Guidance
1cii	2.7 – 2.5 = 0.2V (1). 5 / 300 (= 0.0167 V/degree (to 3sf)) (1). Angle = 0.2* / (5 / 300)) = 12° (1).	**3**	Award three marks as follows: One mark for calculating increase in Vout. One mark for calculating the volt per degree output from potentiometer. One mark for calculating the angle turned. Allow for rounding. Allow 11.9° to 12.1° If correct answer is given without working out shown award full marks. Where an incorrect answer is given working out should be used to credit appropriate marks. *Allow error carried forward (ECF) where correct working out is shown.
1ciii	Possible reasons may include: • It has a wide power supply range (1) so will suit a variety of batteries (1). • Its low power consumption (1) which means that batteries will last a long time (1). • Very sensitive (1), so that any slight movements will be picked up (1). • Any other valid suggestion.	**2**	One mark for analysing the data in the table to identify a reason why sensor is suitable for use. One mark for explaining why the sensor is suitable for use on the handheld gimbal.

Question	Indicative Content	Marks	Guidance
1di	Possible reasons may include: • Modern materials such as rare earth magnets have a very strong magnetic field (1). This enables the motor to produce a high torque (1) / the motor can be very compact and lightweight (1) / the motor will be very powerful (1) / ideal for flying machines (1). • High performance alloys enable the rotor to be lightweight (1). This enables the rotor to spin at a higher speed (1). • Any other valid suggestion.	**2**	Up to two marks for explaining why modern materials are used in electronic motors. Any suitable modern material could be used as the basis for the answer. Do not accept smart material-based answer.
1dii	Possible responses may include: • Brushless motor (1). o These are high torque (1) / lightweight (1) / and can hold an angular position (1) / very quiet in operation (1). • Servo motor (1). o These will rotate to a given angle, then stop (1). They are fast (1) and have high torque (1). • Stepper motor (1). o These will rotate through a fixed angle per step (1). They have a high holding torque (1). • Any other valid suggestion.	**2**	One mark for identifying a suitable motor. One mark for explaining why motor would be suitable for use in the handheld gimbal.

Question	Indicative Content	Marks	Guidance
1diii	Possible responses may include: **Brushless**: several wires (sometimes three), connected to several phases in the motor. Current is switched on/off in a cycle in the phases causing the motor to rotate through a small angle each time. Direction depends on sequence of phase switching, speed on switching rate, position is changed by the rotation through a given angle. **Servo**: usually 3-wire, two power, and one wire is a pwm control signal. Position of the servo is controlled by the width of the pwm pulse, through a 180° rotation. Direction is automatic – servo rotates to the angle determined by the pwm width. Max speed determined by the servo specifications. **Stepper**: several wires connected to several phases in the motor. Similar operation to brushless.	**4**	Award four marks as follows: One mark for showing signals required. One mark for showing how signals affect direction of motor. One mark for showing how signals affect speed of motor. One mark for showing how signals affect position of motor. Award marks even if a different motor is identified to part (ii).

Question	Indicative Content	Marks	Guidance
	Example answer:  Any other valid suggestion.		

2a)		**3**	Award three marks as follows: One mark for analysing **Fig. 2.1** to correctly outline the U-shape. One mark for correct dimensions on grid paper. One mark for correct hidden detail lines. Hidden detail lines do not need to be drawn dotted but they must be clearly indicated as hidden.
2b	Sin (27) = S / 385 (1). S = 385 x sin (27) (= 174.79) (1). S = 175mm (1).	**3**	Award three marks as follows: One mark for apply trigonometry formula. One mark for manipulating trigonometry formula. One mark for rounding answer to nearest mm. If correct answer is given without working out shown award full marks. Working out must be shown in order to award appropriate marks.

2ci	Ratio of lever arm lengths 85 / 40 = 2.125 (1). Tensile force F = 25 x 2.125* = 53.125N (1).	**2**	Award two marks as follows: One mark for determining appropriate ratio of level arm lengths. One mark for calculating tensile force F. If correct answer is given without working out shown award full marks. Working out must be shown in order to award appropriate marks. *Allow error carried forward (ECF) where correct working out is shown.
2cii	1.6mm diameter = 0.8mm radius (1) 0.8mm = 0.0008m (1) Cross sectional area of wire = π x 0.0008* = $2.01 \times 10^{-6} m^2$ (1)	**3**	Award three marks as follows: One mark for converting the diameter of the wire to radius. One mark for converting mm into m. One mark for calculating the cross sectional area of the wire in m^2 to 3 significant figures. If correct answer is given without working out shown award full marks. *Allow error carried forward (ECF) where correct working out is shown.

2ciii	Stress = Force / Cross-sectional area (1) Stress = 300 / $2.01 \times 10^{-6} m^2$*(1) Stress = 1492537 Pa(Nm^{-2}) (1) Also accept = 149 MPa(NM^{-2}) or 149000 Pa(NM^{-2})	**3**	Award three marks as follows: One mark for identifying the correct equation for calculating Stress. One mark for Inputting the correct numbers into the equation. One mark for calculating the stress in the wire. If correct answer is given without working out shown award full marks. *Allow error carried forward (ECF) where correct working out is shown.
2civ	Recognition that they will require: Young's Modulus = Stress / Strain $180 \times 10^9 = 149 \times 10^6$* / Strain (1) Strain = 149×10^6* / 180×10^9 = 0.000827 or 8.28×10^{-4} (1) Extension = Strain x Original length 0.000828 or (8.28×10^{-4}) x 1500 = 1.24mm (1)	**3**	Award three marks as follows: One mark for identifying the need to use Young's Modulus and inputting the known values. One mark for calculating the Strain. One mark for calculating the extension of the cable in mm to 3 significant figures. If correct answer is given without working out shown award full marks. *Allow error carried forward (ECF) where correct working out is shown.

2di	Number of users above 90kg = 2 + 1 = 3 (1). Percentage = (3* / 30) x 100 = 10% (1).	**2**	Award two marks as follows: One mark for analysing **Fig. 2.4** to identify the number of users above 90kg. One mark for calculating the percentage of users. If correct answer is given without working out shown award full marks. Working out must be shown in order to award appropriate marks. *Allow error carried forward (ECF) where correct working out is shown.
2dii	The 50th centile is the same as the median value and the median value is the 15th / 16th value in the data set (1). The median value is in the 75–80kg class, which is less than 84kg (1).	**2**	Award two marks as follows: One mark for understanding that the 50th centile is the same as the median value and one mark for confirming the median value. One mark for showing the 50th percentile is less than 84kg. Other methods may be used to correctly prove that the 50th centile is in the 75-80kg class.

3ai	Possible responses may include: • Mining chemicals to make batteries (1). This can scar the environment (1). • Building of factories to manufacture the product (1). This can have a negative impact on the landscape and environment (1) • Building of factories to manufacture/distribute the product (1). This can lead to the creation of jobs in the local community (1) • Any other valid suggestion.	**2**	Up to two marks for describing how a social footprint is created by the manufacture of a product. Macro or micro level answer may be given.
3aii	Possible responses may include: • Timber is a natural material which must be grown in forests (1), it can take up a substantial area of land to grow and be cultivated (1). Whilst the production of timber is nearly carbon neutral (1), energy is needed to process and transport the timber to the market source (1). • Whilst timbers can take several decades to grow (1), softwoods grow significantly faster than hardwoods (1). Therefore the use of softwoods in the construction and furniture industry produces a smaller ecological footprint (1). Throughout the production of products the waste material created from the various processes is often used for fuel or for the production of manufactured materials i.e. MDF (1). • Any other valid suggestion.	**4**	Up to four marks for describing the ecological footprint that results when using timber in products. Individual points made or individual points with appropriate extension are all credit worthy.

3b*	**Indicative content:** **Product manufacture:** Sourcing materials: • Energy needed to extract or recycle metals (steel, aluminium copper) and polymers – pollution and waste products. • Manufacture of harmful/toxic refrigerant gasses – energy used, pollutants created. • Manufacture of electronic components – chemicals extracted, energy, pollution. Product assembly: • Energy to press steel sheets into shape. • Energy to form thermoplastics into shape. • Manufacture of PCBs – energy, pollution • Filling of refrigerant gas – risk of leaks. • Product assembly in factory – energy for lighting/heating/machinery. **Use:** • Energy used during product use. • Standby energy – product always on – considerable energy used over product lifetime. • Energy rating of product. • Improved thermal insulation of fridge to reduce energy requirements. **End of life:** • Risk of release of refrigerant gas into environment. • Much of product could be recycled. • Take back scheme by manufacturer. • Risk of dumping in landfill. • Gas can be safely removed and reused. • Thermal insulation materials can be difficult to recycle. • Steel can be recycled. • Use of RoHS directive should reduce use of harmful materials.	**8** **For MB3 to be awarded there will be a number of LCA stages discussed.** **If candidates do not provide an analytical/ evaluative response then only L1 can be awarded.**	**Level 3 [6-8 marks]** The candidate has a clear understanding of a LCA. They produce a thorough discussion in relation to the question by explaining the stages of the LCA that would be applied to a domestic refrigerator. The explanation of the stages is clear and well-developed and there is a clear sense of start point and end point within the narrative. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated with the use of examples.* **Level 2 [3-5 marks]** The candidate has a reasonable understanding of the LCA. They produce a sound discussion in relation to the question by explaining a number of stages of the LCA that would be applied to a domestic refrigerator. The explanation of the application of the LCA is sufficient although one or two opportunities for expanding the explanation around the stages of the LCA are missed as well as directly relating the answer to the product in question. *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.*

	Transport: • At all stages, transportation to move materials/parts/products around. • Globalisation may involve huge distances being travelled around world. • Fuel used, pollution produced. • Bulky product so takes up a lot of space on transport vessel.		**Level 1 [1-2 marks]** The candidate has a basic knowledge of the LCA. Any reference to the LCA will be generic in nature and has little appreciation of either the stages involved or the product in question. The response contains no analysis or evaluation. *The information has some relevance and is presented with limited structure of detail. The information is supported by limited evidence.* 0 marks = No answer or answer not worthy of credit.
4a	Possible reasons may include: • Adds rigidity to the panels without adding extra material/weight to it (1). • Adds an aesthetic styling to the sides of the machine (1). • Aids and assists the owner moving and lifting the machine by adding more grip area to hold on too (1). • Any other valid suggestion.	**1**	One mark for identifying a reason why the side panels of the washing machine have been manufactured in this way.

4bi	Possible reasons may include: • Allows for a reduction in rotational speed (1). • Allows an increase in torque (1). • Allows motor to sit beneath drum, reducing depth of washing machine (1). • Allows for a small amount of flexing between input/output shafts (1). • Quiet in operation (compared to gears or chain drive) (1). • Any other valid suggestion.	**3**	One mark for identifying each of three reasons why a belt and pulley drive system would be used in the washing machine. No credit for: • 'allows slipping'; • transfers drive from motor to drum.
4bii	384/32 = 12 (1). 12*x1600 = 19200 rpm (1).	**2**	Award two marks as follows: One mark for calculating the ratio between the two pulleys (Gear Ratio). One mark for calculating the rotational speed of the motor. If correct answer is given without working out shown award full marks. Working out must be shown in order to award appropriate marks. *Allow error carried forward (ECF) where correct working out is shown.

4biii	Possible responses may include: • The signal from an input transducer (slotted opto, Tachometer etc) is fed back to the controller (1). This feedback signal is compared to the required speed (1). The controller adjusts the speed of the motor to minimise the difference between the feedback speed and the required speed (1). • Any other valid suggestion.	**3**	Up to three marks for describing how a closed loop control system is used to regulate the rotational speed of the washing machine drum. Reference/acknowledgment should be made to the input transducer used to sense the rotational speed of the drum. Individual points made or individual points with appropriate extension are all credit worthy.
4c	Possible ways may include: • Opportunity to display more than alphanumeric characters (1) which means that the functions of the machine can be clearly displayed to the user, explaining them in more detail (video/pictorial tutorials) (1). • Opportunity to display symbols, images etc (1) which means that the product can be sold throughout a global market without the need to change the processors as symbols and images and a generic language (1). • Graphics and icons can be more ergonomic than text or on/off lights (1) which means that the user will be able to use the machine more efficiently and reduce the chances of human error during use (1). • Graphical screens have the options to have soft keys/touch screen (1) Meaning the machine will have less buttons, making it easier to clean and less intimidating to the user. It also gives a 'more expensive/, luxury feel to the product (1). • Any other valid suggestion.	**4**	One mark for identifying a way that a graphical display can enhance a user interface. One mark for explaining why this graphical display enhances the user interface on the washing machine. Specific reference to the context in question is needed for marks to be awarded.

4d	**Indicative content:** Destructive tests may include: • Repeated opening/closing of door (by robotic mechanism) until failure. • Tensile testing of belt until failure. • Time-to-failure tests of the washing machine. • Overload tests (excess laundry). • Product shake/vibration tests for unbalanced load. • Temperature overheat tests. • Fire tests. • Electrical voltage overload tests to test for electrical safety. • Any other valid suggestion. Non-destructive tests may include: • Basic functional tests. • Leak tests. • Failsafe tests – checking that machine stops under unsafe conditions. • Temperature cut-out tests. • Load imbalance sensor tests. • Water overfill cut-out. • Door interlock tests. • Visual quality control checks at stages of manufacture. • Quantitative testing at stages of manufacture. • PCB testing. • Testing for software upgrades. • Any other valid suggestion.	**8** **For MB3 to be awarded there will be a number of destructive and non-destructive tests discussed.** **If candidates do not provide an analytical/ evaluative response then only L1 can be awarded.**	**Level 3 [6-8 marks]** The candidate has a clear understanding of destructive and non-destructive testing methods. They produce a thorough discussion in relation to the question by explaining how the different types of testing would be used to judge fitness for purpose of the product. The explanation of the methods is clear and well-developed and a number of different angles are considered when discussing suitability for purpose. **Level 2 [3-5 marks]** The candidate has a reasonable understanding of the testing methods. They produce a sound discussion in relation to the question by explaining how destructive and/or destructive tests can be used to assess the products fitness for purpose. The explanation of the testing methods is sufficient although one or two opportunities for expanding the explanation around the testing methods are missed as well as directly relating the answer to the product in question. **Level 1 [1-2 marks]** The candidate has a basic knowledge of the testing methods. Any reference to the testing will be generic in nature and has little appreciation of how the testing contributes to fitness for purpose or the

			product in question. The response contains no analysis or evaluation. 0 marks = No answer or answer not worthy