Example Exam Paper

Question	Multiple Choice Options	Answer
Which of the following heights above ground would be considered a Low Earth Orbit	a) 16,000 metres b) 1,600 metres c) 26,000 metres d) 160 metres	B Low Earth Orbit (LEO) is between 800 and 2,000metres above the ground.
Which of the following would NOT be a design consideration for a UAV?	a) Potential operational height b) Safe speed c) Height of operator d) Legal restrictions	C The height of the operator is not really important in the design, though the control functions of the control console or device would be.
Which of the following would be a cost saving consideration when designing a new robot?	a) Extensive use of rare earth metals b) Construction with newly developed polymers c) Employing leading programmers in the field d) Using open source software such as ROS	D Robot Operating System (ROS) is a free, community supported and developed operating system designed specifically for robots.
Which of the following is not a recognised microsatellite form?	a) Kilosatellie b) Picosatellite c) Nanosatellite d) Femtosatellite	A
What temperature does liquid oxygen burn at when used in rockets?	a) 100oC b) 300oC c) 1,000oC d) 3,000oC	D
What metal powder is now used in rocket launch fuel because it is very reactive with oxygen?	a) Lead b) Aluminium c) Magnesium d) Neptunium	B Aluminium is used in Aluminium-ice or ALICE
Which of the following statements is one of the laws of robotics devised by science fiction writer Isaac Asimov?	a) A robot may not injure a human being or, through inaction, allow a human being to come to harm b) A robot may not work as a television presenter on news programs because of the serious nature of news c) A robot may never stand as the President of the United States of America d) A robot must not be allowed to feel pain as it will then be too human like	A
Most UV devices are constructed with a material called FRP. This stands for:	a) Freon Regulated Plastic b) Fibre Reinforced Plastic c) Fibre Reinforced Polymer d) Fully Redundant Polymer	B

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The radio frequencies most suitable for communication with microsatellites are?	a) 3Hz to 30Hz b) 300MHz to 30GHz c) 30GHz to 3THz d) 30MHz to 30GHz	D
Which of the following is a reason for UAV's propellers to be based on a KV of 500-1,000?	a) Save battery power b) Kill less insects in the blades c) More flight stability d) Make less noise in sensitive area	C

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An engineer wants to create a large complicated 3D model of a rocket to test some ideas. Explain how he might design the model so he can try out his ideas and make changes efficiently.	Some idea of using a 3D modelling software that allows for different views and easy changes.	1
Materials used for most of the devices in this qualification are required to be both light and strong. Give two clear reasons, with examples, why you think this is the case.	Candidates should appreciate that "most" devices here, other than robots, require the ability to fly and that flight is difficult due to various forces, especially gravity. If a material is light, it will require less energy to move. (1) However, it will be subject to heat and distortion from various forces such as pressure, so it also needs to be strong to withstand these forces (1). Something similar to these examples will suffice.	2
Many companies now sell software packages to schools that use an artificial intelligence based on learning methods to schools, particularly in teaching subjects like maths. These systems fine tune themselves to give each students their own detailed learning programme. Briefly describe two advantages and one disadvantage of this type of AI system.	Candidates should be able to apply their own knowledge of AI to this particular example. They should be able to show that they understand the advantage to AI is it is constantly working to improve itself and will analyse all aspects of a student's learning to make sure it gives more examples to areas where the student's learning is weaker (1). Another advantage is that it is not personally involved so will only positively reinforce the students and not tell them off, which could be negative in its impact (1). A possible disadvantage is linked to the previous point as the AI will not know the student personally so may not help them learn effectively so that when they take an exam they might fail as they work the way the machine has trained them, rather than answering the questions. (1) Any similar example that shows the lack of human touch in this process. Someone who is excellent at a computer flying game could not step into the cockpit of a real plane and fly it easily.	3
A UAV manufacturer is building a UAV and looking for excellent flight stability. They have an input motor running at 6.75 volts and the motor is rated at 850KV. What will be the resulting rpm of the motor?	The formula is V x KV, so the answer would be 6.75V x 850rpm/V or 5,737.50rpm	1
Briefly discuss two things that affect microsatellites while in space and what adjustments need to be made to lessen their impact.	There are 3 main things listed in the specification: atmosphere, solar power and debris. Candidates need to pick two of these and give clear examples of what can be done. For example: the drag of the atmosphere means the satellite gets pulled closer to earth, so thrusters need to be fired a few times a year to keep it at the right distance (1). Lots of space junk is flying about in the atmosphere in LEO, so the satellite needs to be moved, if possible, to	2

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	avoid these objects. (1)	
It is estimated that there are currently 500,000 pieces of space debris in the lower levels of the Earth's atmosphere. Describe two potential problems with this material.	The main problem with this debris is damage to existing devices that are still in use. (1). The International Space Station has lots of small holes in its solar panels from debris smashing into it and the control centre needs to move it frequently from larger objects. The other problem is that some of this may well come back to earth and can be very destructive if it survives burning up in the atmosphere. (1). Something similar as long as it is clearly explained.	2
A UAV has a single propeller with a rotational speed of 1,500rpm. It has a battery with enough power to fly for 2.5 hours. How many revolutions will the propeller make with the life of the battery before it runs out? Show your working or reason	Candidates should be able to do some basic mathematics. The answer here is essential 1,500 X 60 (revs per minute, per hour) X 2.5, so 225,000 revolutions. 1 mark for an idea of working it out, 1 for the answer.	2
If your school decided that it wants to launch large rockets using combustible fuel material, what sort of license would the teacher in charge of launches require and why?	Large rockets tend to use materials similar to the high explosives used in large public fireworks, at least in terms of danger (1), so the person in charge would need to have a license to handle explosives (1). Candidates should give a clear reason of what licenses is required and why. It is not specific to the question, but they could get 1 mark for discussing health and safety.	2
Why are many robots built using open source software?	Open source allows the creators of the robots more flexibility to design their own features and actions and not be restricted by the features built in to a proprietary software that can't be altered.	1
If a school was able to launch and control it's own microsatellite with an onboard camera and was able to ensure that it was pointing at the school for most of the day, what subjects in school could use the data available and for what purpose?	The geography students could use the images to track changes in the flora and fauna at the school over the course of the school year (1). They could also use it for a detailed map to add to the school website for parents (1). Other subjects could be for art, to use for collages or for photography to practice modifying the images with digital software. The data could also be used by science to look for environmental changes over the seasons, or maths to collect data about pupil/staff movements to generate statistics.	2
In a recent experiment, seeds were sent to the International Space Station to be grown and others returned to earth for primary school students to plant and monitor. What is the purpose of this type of experiment?	Many people see the exploration and colonisation of space as important for the future of people. If the world becomes too hot or polluted, we need to be able to move on. Growing seeds in space is to see whether or not they will be affected by the forces in space and so see if we can grow what we need to eat (1). Sending seeds back to earth after being in space is to check if that impacts on them, should we need to send material back from space once grown on other planets (1). o.e	2
Give an example of a privacy concern relating to UAV and how it can be minimised.	No real right or wrong here, but candidates need to show an awareness of the issue. They need to say that people can be photographed from great heights without their knowledge (1). They can give a reason for this in that cameras now have very high resolution, even though very small (1). Some idea of a solution, perhaps a law to license people who own these devices and regular police checks of their data collected (1).	3
Most microsatellites are used for GPS. What does this stand for?	Global Positioning System	1
AI is now being used in almost every area of work and is	There is not necessarily a correct answer here as it will depend what each centre has taught	5

Question	Answer	Marks
replacing people at different levels. AI has been proven to be better at driving cars with less accidents, making money for investors, teaching people and even flying planes. Discuss, with some examples, some of the ethical and social concerns you have with this progress of AI.	for this topic. Candidates will be given marks for showing that they understand some ethical issue. For example, if they were planning to train to be an investment manager or even a lawyer, they may well not have a job once they are trained (1-2 marks). They need to show that they appreciate the ethical and social impacts, so society will be getting less "human" (1), if the AI devices can do people's work better, what will people do to live (1). 1 mark can be given for clarity and overall writing if candidates can show a good understanding and can get their argument across clearly. This is an A/A* level question.	
A company in Japan called Softbank manufactures a robot called Pepper that has been programmed to react like a human to emotions. It has a range of human type emotions and will respond by laughing and crying to inputs. Identify and discuss three possible problems with this type of device related to the way it works with human emotions.	This is a question to allow candidates to explore their ideas and there may not be explicitly right and wrong answers and markers will need to use their professional judgement. Some examples of answers that it is hard to make judgements on what an emotion should be (1), someone might laugh at something that others find offensive (1). They could talk about the danger of over attachment (1). If the device is used by people with emotional issues they may become too attached which could cause problems if the device does not act as expected (1). Related to this, they could discuss the wider problem of de-humanisation (1). If people rely on these machines, rather than real people, we could end up with a very poor society where people avoid each other as machines are far better (1)	6
Describe, with an example, one strength and one weakness of using 3D design software for developing a device such as a robot or microsatellite.	candidates should show a strength in terms of their specified program (1 mark) being able to use POV (Point of View) features (1) to be able to see their design from every angle, so something similar (1). A weakness is likely to be that it is over complex as it is designed for professional use and has too many features, so perhaps has a feature to program in complex physical relationships to materials that require A level maths understanding or similar (1). I mark each for naming the feature they are describing.	4
Many microsatellites are built using aluminium panels that employ a honeycomb sandwich structure between the plates. Explain what this is and how it helps the design.	Candidates should be able to explain that this feature comes from the observation of bee hives which gives it the name of "honeycomb" (1). The hexagonal shaped tubes are placed between the two sheets add strength as they are harder to crush (1) but are significantly lighter than having a solid plate of the same thickness (1).	3
Some unmanned aerial vehicles (UAV) have been increasingly used by criminals for various illegal activities. The devices and their use are so new that there is no law currently to deal with them. What kinds of legal actions or practices can be taken to deal with the use of UV in illegal activities?	This question is looking for candidate's ability to synthesize what they know about the laws to come up with answers. The range of possible answers will be quite wide, but should show a clear understanding of the legal aspects. They could recommend something that was used to reduce tagging in cities by checking on who is buying the equipment, forcing shops to register the details. (1). They could suggest that a new law is passed by government just for UV. (1). Other issues might be similar to a neighbourhood watch scheme so that local people police their own skies, or similar answers. (1).	3
What is the difference between data collected by microsatellites and the information that is used as a result?	This is a generic question for all the units based on an understanding of the difference between data and information. The answer should be something along the lines of: data is the raw numbers collected by the device, such as temperatures in space, information is using charts and graphs from those numbers to present a diagram of the changes in temperature so that decisions can be made. (1)	1

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List and describe three key safety checks that should be carried out before launching an explosives based rocket.	The first real check should be that you have notified any local airports due to the potential invasion of airspace. (1) Since there is a danger of explosion, you should also have someone on hand with fire extinguishing equipment or have notified the fire services. (1). Other checks would be to have the appropriate safety equipment or experienced people with this knowledge (1). Other examples might be to check the launcher has their explosives license or to make sure there are no people nearby who are not aware. Any other suitable examples	3
Why is it important to work to a detailed specification when assembling a robot or unmanned vehicle for usage	This is a generic question to test candidate's application of their general knowledge. The key consideration is that the specification should provide details of how and where to use the device which is useful for guidance purposes (1). It should also be a good guideline to the limitations of the device so that people using it will not endanger themselves or others by operating it outside the recommended safety limits. (1) other answers related to working within safe limits would be accepted.	2
Most devices created using advanced manufacturing technology tend to use open source software. What is open source software and how would you describe its main attributes?	Open source software is created using more liberal licenses such as ShareAlike which allow people to use someone else's code to speed up development (1). It is community based which means that it is well supported and problems get seen and fixed quickly. (1). They could also say that it is free	2
Name one open source license that could be used for advanced manufacturing and describe one of its attributes.	They could name a number of licenses such as Copyleft (1) and say that it can be used and modified, but has to then be shared back with the community if any improvements are made (1).	2
According to recent research, the power of AI is such that the devices and machines built using it will not only replace "low level" jobs, such as factory assembly, but also "high level" jobs such as legal advice or analysis. Describe the impact of this type of development on the future workforce, both positively and negatively, giving examples of the impact where appropriate. Draw a conclusion using the possible impact on you personally.	The main danger with this type of future is an over-reliance on machines (1). If machines control our electricity or food, any failure of the device will lead to huge impacts on the world (1). The other main concern is social unrest (1). If these devices take away all of our jobs, what will people do to earn money to pay for the food and other services the A devices are supplying (1). Any example they can give of the impact on themselves, such as loss of career opportunities will earn a 5th mark. Any other reasonably dangers or benefits, plus an example, for the marks.	5

20 = C	30 = B	40 = A	50+ = A*