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**INFORMATION TECHNOLOGY**

**9626/32**

Paper 3 Advanced Theory

**May/June 2019**

MARK SCHEME

Maximum Mark: 90

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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This document consists of **12** printed pages.

**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

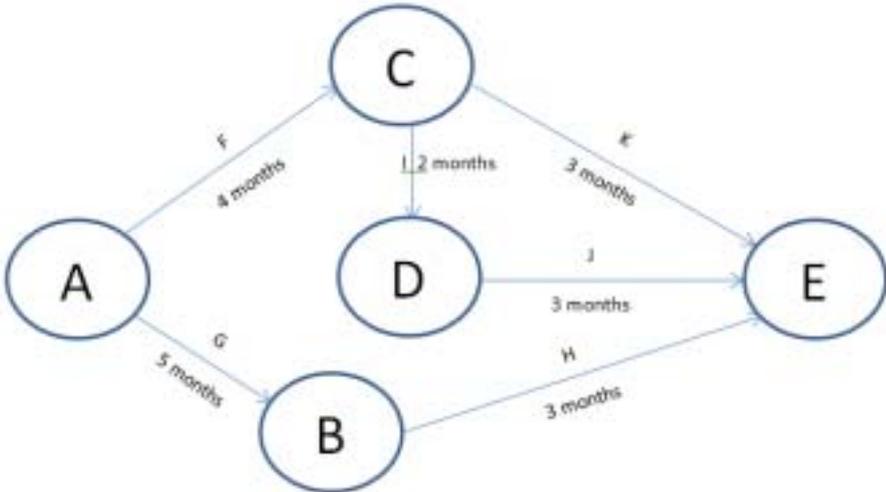
Question	Answer	Marks
1(a)	<p><b>Four from:</b></p> <p>Download speeds are typically 2 to 5 times that of 3G            Provides bandwidths of up to 100Mbps (typically 15 to 20) c.f. 3G's 6 to 10Mbps            Uses OFDM (orthogonal frequency division multiplexing) / same technology as WiFi and digital TV which reduces latency as data is split and sent in parallel 'chunks' to increase capacity            Uses MIMO (multiple input and multiple output) with multiple antenna arrays at transmitter and receiver to increase performance            Common configuration is 2×2 MIMO for smartphones            Reduces power requirements            Reduces the need for additional bandwidth            Does not require extra data allowance to be used            Can revert seamlessly to 3G if 4G is not available            Provides smoother online streaming than 3G            Is an IP-based network.</p>	<b>4</b>
1(b)	<p><b>Two from:</b></p> <p>Continuous coverage in urban areas / better coverage of urban and rural areas by providing a dense network            Lower costs of data transfer / download            Allows higher number of simultaneously connected devices / mobiles            More available spectrum            Fewer dropouts / poor signal issues / more reliable connections            Lower power requirements by phones so longer battery life / smaller batteries            Provides greater download speeds for data than 4G            Has low latency which improves gaming / streaming experience.</p>	<b>2</b>

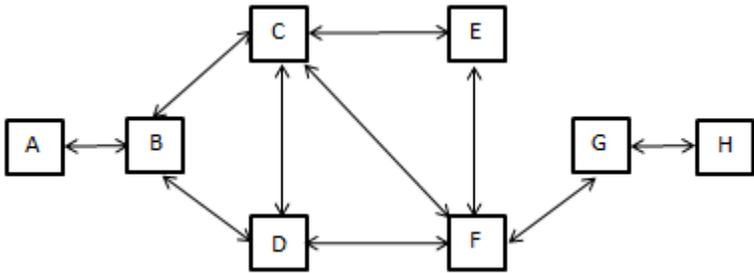
Question	Answer	Marks
2(a)	<p><b>Two from e.g.:</b></p> <p>Between spacecraft (in orbit through vacuum)            To connect sites across roads / other barriers not owned by sender / receiver            Provide (temporary) network connection in e.g. disaster areas where cabling is not possible.</p>	<b>2</b>
2(b)	<p><b>One from:</b></p> <p>Short range only in atmosphere due to dispersion of (light) beam by particles in atmosphere            Accurate aiming of (light) beam is more / may be more difficult            Difficulty in connection is increased if sender / receiver are moving            Blocked by objects / weather in path of (light) beam / line of sight.</p>	<b>1</b>

Question	Answer	Marks																		
3	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="316 297 804 398">Line number of error and explanation of error</th> <th data-bbox="804 297 1292 398">Explanation of suggested correction</th> </tr> </thead> <tbody> <tr> <td data-bbox="316 398 804 528">Line 6/9 and the function is spelt incorrectly / differently, so will not run on button click</td> <td data-bbox="804 398 1292 528">Should be same as function/ CheckAgeFunction/ CheckAgFunction</td> </tr> <tr> <td data-bbox="316 528 804 629">Line 8 script is not opened so web browser cannot interpret it</td> <td data-bbox="804 528 1292 629">Add &lt;script&gt; to open the script</td> </tr> <tr> <td data-bbox="316 629 804 730">Line 9 missing {/open curly bracket so line is not terminated correctly</td> <td data-bbox="804 629 1292 730">Add {/open curly bracket</td> </tr> <tr> <td data-bbox="316 730 804 860">Line 10 the variable CanApply is not declared so cannot be used in function</td> <td data-bbox="804 730 1292 860">Add , to separate variables / add new line with var / add CanApply to declare the variable</td> </tr> <tr> <td data-bbox="316 860 804 990">Line 15 age is wrongly shown as 15 so age check is incorrectly compared</td> <td data-bbox="804 860 1292 990">Should be 16 as per intended age check/stem/line 3</td> </tr> <tr> <td data-bbox="316 990 804 1120">Line 15 incorrect logic comparison so age messages are reversed when displayed</td> <td data-bbox="804 990 1292 1120">Change to &lt; for correct comparison/reverse the messages to match comparison</td> </tr> <tr> <td data-bbox="316 1120 804 1288">Line 17 " is missing from ("AgeCheck " so AgeCheck is not interpreted as p id so its value is not returned</td> <td data-bbox="804 1120 1292 1288">Add "</td> </tr> <tr> <td data-bbox="316 1288 804 1386">Line 19 script is not closed so web browser cannot interpret it</td> <td data-bbox="804 1288 1292 1386">Add &lt;/script&gt; to close the script</td> </tr> </tbody> </table> <p data-bbox="316 1420 991 1456">1 mark for error and 1 mark for <u>matching</u> correction.</p>	Line number of error and explanation of error	Explanation of suggested correction	Line 6/9 and the function is spelt incorrectly / differently, so will not run on button click	Should be same as function/ CheckAgeFunction/ CheckAgFunction	Line 8 script is not opened so web browser cannot interpret it	Add <script> to open the script	Line 9 missing {/open curly bracket so line is not terminated correctly	Add {/open curly bracket	Line 10 the variable CanApply is not declared so cannot be used in function	Add , to separate variables / add new line with var / add CanApply to declare the variable	Line 15 age is wrongly shown as 15 so age check is incorrectly compared	Should be 16 as per intended age check/stem/line 3	Line 15 incorrect logic comparison so age messages are reversed when displayed	Change to < for correct comparison/reverse the messages to match comparison	Line 17 " is missing from ("AgeCheck " so AgeCheck is not interpreted as p id so its value is not returned	Add "	Line 19 script is not closed so web browser cannot interpret it	Add </script> to close the script	8
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3	<p><i>The errors are shown here:</i></p> <pre> 1 &lt;html&gt; 2 &lt;body&gt; 3 &lt;p&gt;You can apply for a licence to drive when you are 16 years old.&lt;/p&gt; 4 &lt;p&gt;To check if you are old enough to drive, input your age and click the button:&lt;/p&gt; 5 &lt;input id="AgeNow" value="16" /&gt; 6 &lt;button onclick="CheckAgeFunction()"&gt;Check now&lt;/button&gt; 7 &lt;p id="AgeCheck"&gt;&lt;/p&gt; 8 9     function CheckAgeFunction() 10 var AgeNow; 11     AgeNow = number(document.getElementById("AgeNow").value); 12     if (isNaN(AgeNow)) { 13         CanApply = "Please enter your age in numbers."; 14     } else { 15         CanApply = (AgeNow &lt; 16) ? "You are too young to apply for a licence.": "You are old enough to apply for a licence."; 16     } 17     document.getElementById("AgeCheck").innerHTML = CanApply; 18 } 19 20 &lt;/body&gt;&lt;/html&gt; 21 </pre>	

Question	Answer	Marks
4	<p><b>Eight from e.g.:</b></p> <p>Focus group is an interview with a small number of respondents conducted by a trained interviewer / moderator</p> <p>Members often have similar backgrounds / expertise in order to pool ideas / views</p> <p>Representatives of the organiser / stake holders may be present to gather views / suggest ideas</p> <p>Informal so that respondents can interact in a natural manner and freely give their views</p> <p>Interviewer / moderator may have a guide / agenda to lead the discussion to a conclusion as the session progresses</p> <p>Can provide accurate information in a short time</p> <p>Can be less expensive than other methods of gathering information</p> <p>Can be more expensive if carried out over e.g. national areas to gather information from wide range of people</p> <p>Results / views can be affected by presence of observers / representatives of interested parties</p> <p>Validity of outcomes can be questionable as participants may not be independent / be affected by presence of stake holders</p> <p>Outcomes may not be kept confidential as participants are often from external sources.</p>	8

Question	Answer	Marks
5(a)(i)	<p>A suitable diagram could be:</p>  <p><i>Mark allocation:</i></p> <p>3 marks for all milestones linked correctly                  2 marks for 4 milestones linked correctly                  1 mark for 3 milestones linked correctly</p> <p>1 mark for all correct timings                  1 mark for all correct tasks.</p>	<b>5</b>
5(a)(ii)	<p>The critical path is F + I + J  <math>4 + 2 + 3 = (9 \text{ months})</math></p>	<p>1 mark                  1 mark  <b>2</b></p>

Question	Answer	Marks
6(a)	<p>A suitable diagram could be:</p>  <p><b>Three from:</b></p> <p>All correct labelled boxes for routers C, D, E, F, G                  All correct connecting lines between boxes / routers                  All connecting lines shown as double-ended arrows.</p>	<b>3</b>

Question	Answer	Marks
6(b)(i)	(A, B), C/D, F, G, (H).	1
6(b)(ii)	<b>Two from:</b> shortest route is 5 hops so: $5 \times 6 = 30$ (time units) $\times 2$ for return, $30 \times 2 = 60$ (time units).	2
6(c)(i)	<b>Two from:</b> longest route takes 7 hops so: $7 \times 6 = 42$ (time units) $\times 2$ for return = 84 (time units).	2
6(c)(ii)	<b>One mark for all correct:</b> (A, B), D, C, E, F, G (H).	1
6(d)(i)	Between B and G.	1
6(d)(ii)	<b>Two from:</b> $4 \text{ hops} \times 6 = 24$ $\times 2 = 48$ (time units).	2

Question	Answer	Marks
7(a)	<p><b>Four from:</b></p> <p>Provides access (for protocols) to physical / wireless transmission medium            Creates the protocol stack (using its electrical components)            Allows communications between LANs / WANs (using the protocols it has created)            Provides low level addressing at MAC level            Works at physical and data level of OSI model / OSI layer 1 and 2.</p>	4
7(b)	<p><b>Seven from:</b></p> <p>Accepts data from CPU via internal buses            Converts parallel data stream to linear / serial data stream and vice versa for transmission / after reception to / from transmission medium            Data is sent / received in frames</p> <p><i>When sending:</i>            NIC is notified that frame has been created by OS in a buffer            NIC accesses / reads buffer / memory directly by DMA            NIC determines address and creates data frame            NIC transmits completed frame to transmission medium            NIC notifies OS that frame has been sent</p> <p><i>When receiving:</i>            NIC monitors transmission medium for frames            NIC reads frame from transmission medium into buffer using DMA            NIC checks frame contents and calculates checksum to verify integrity of data            NIC interrupts host OS to indicate that a frame has arrived</p> <p><i>Max. 6 if all sending or all receiving.</i></p>	7

Question	Answer	Marks
8	<p><b>Two from:</b></p> <p>Perspective / transformation tool has been used (to correct perspective) by 'stretching' the image across the top to align the sides of the stores / shops / buildings            Rotate right tool used to correct the image to an upright store / shop / building front            Curtains (in left windows) have been inserted by copy / paste / clone pixel tools using those in right-hand set of windows as source            Image has been cropped to remove some of the building            Image has been resized to improve aspect ratio.</p>	2

Question	Answer	Marks
9(a)	<b>Two from:</b>  Opacity from completely opaque to totally transparent Fade (actual) colour from one colour into another colour / white across the colour palette.	<b>2</b>
9(b)	<b>Four from e.g.</b>  Linear fills evenly across the image Radial fills with single line paths where the fill starts at centre and fills outwards along all radii ...fills evenly along all radii Elliptical fills with two line paths where fill starts at centre and fills outwards along two directions away from the centre ...can be skewed along one line or the other Conical fills create the illusion that the image is a cone shape Square fills can produce a star-like view in the colour Three colour fills merge from one colour into two others across the image Four colour fills merge from one colour into three others across the image.	<b>4</b>

Question	Answer	Marks
10	<b>Five from:</b>  Cable ensures an uninterrupted connection to the TV Cable does not suffer from dynamic range limitations as does Bluetooth transmission so (action) movies do not have same impact Cable does not suffer from limited frequency ranges as does Bluetooth transmission so movie experience can be spoiled Cable does not need power in the headphones so can be used without preparation when watching movies / unlimited by battery going flat Bluetooth can suffer from interference from other wireless devices which can spoil the sound (effects) from movie Bluetooth takes time to process so video and audio are out of sync / lip sync issues spoil the movie experience Bluetooth headphones can be larger / uncomfortable / heavy due to battery requirements to movie watchers who get tired of using them before end of movie Bluetooth headphones do not work if battery is flat / needs charging, so cannot listen to sound of movie.	<b>5</b>

Question	Answer	Marks
11	<p>This question to be marked as a Level of Response.</p> <p><b>Level 3 (7–8 marks)</b> Candidates will evaluate, giving both advantages and disadvantages, of the use of anti-virus software in combatting IT crime. The information will be relevant, clear, organised and presented in a structured and coherent format. There will be a reasoned conclusion / opinion. Subject specific terminology will be used accurately and appropriately.</p> <p><b>Level 2 (4–6 marks)</b> Candidates will explain both advantages and disadvantages, of the use of anti-virus software in combatting IT crime. For the most part, the information will be relevant and presented in a structured and coherent format. There may be a reasoned conclusion / opinion. Subject specific terminology will be used appropriately and for the most part correctly.</p> <p><b>Level 1 (1–3 marks)</b> Candidates will describe the use of anti-virus software in combatting IT crime Candidates will explain advantages / disadvantages of the use of anti-virus software in combatting IT crime Answers may be in the form of a list. There will be little or no use of specialist terms.</p> <p><b>Level 0 (0 marks):</b> Response with no valid content.</p> <p><i>Answers may make reference to e.g.:</i></p> <p><b>Advantages</b> Removes virus / malicious software that could delete / edit / destroy data Protect against spyware to prevent theft of confidential / personal information thus preventing unauthorised access to bank accounts leading to financial loss Can help / may protect against spam / phishing emails thus preventing the divulgence of confidential / personal information Protect against identity theft that may be a result of stolen confidential / personal information Protect against redirection of automatic payments ('stealware' or 'chargeware / affiliate fraud') to help prevent 'click fraud' Can help protect / stop unwanted / unauthorised use of computer for crypto-currency mining</p>	8

Question	Answer	Marks
11	<p><b>Disadvantages</b></p> <p>Anti-virus software must be kept up to date in order to combat the most recent viruses / malicious software</p> <p>Anti-virus software must be running all the time so places a performance ‘overhead’ on a computer system that may make the system slow / sluggish / unresponsive</p> <p>Anti-virus software will not detect all / every instance / type of malicious software so perpetrators can find ways around it</p> <p>...infected websites use malicious code which is often not picked up by anti-virus software.</p>	

Question	Answer	Marks
12	<p><b>Six from:</b></p> <p>Perpetrators are the attackers and include e.g. script kiddies, crackers, hackers, terrorists, business competitors, (foreign) governments who carry out the crimes / intrusions</p> <p>Each type of perpetrator has different skills / aims that can be identified by an analysis</p> <p>.. the higher the skill, the higher the risk of crime being perpetrated</p> <p>Analysis of their actions is carried out by the company / victim agents / representatives who design / implement the plan for disaster recovery</p> <p>Allocation of resources to disaster recovery from cyber threats depends on likelihood of perpetrators succeeding / wishing to / probability of attack on the company</p> <p>Analysis will define / determine the type of resource allocated e.g. firewalls / antivirus / antispymware software</p> <p>Intrusion detection systems can be deployed to combat the type of perpetrator identified by the analysis</p> <p>Resources can be targeted at the type of intruder / risk identified by the analysis of who / what is likely to be of concern.</p>	6

Question	Answer	Marks
13	<p><b>Eight from e.g.:</b></p> <p><i>Data protection laws are needed to address these concerns e.g.:</i></p> <p>Personal data is stored on computer systems / in databases which may not be secure  Databases are easily edited / searched / accessed (remotely) so data can be seen / manipulated  Data can be easily / quickly cross-referenced / correlated by computer systems  Computer systems can be networked so data can be accessed from many different locations / shared more easily between users  Control over shared data is more difficult to maintain  Accuracy of the information may be compromised / difficult to maintain when shared  Data can be easily copied to other media / stolen without any trace of the action  Data about individuals can be stored without their knowledge so infringing their privacy  Keeping records of who / what / when data is accessed are difficult to maintain unless enforced by law.</p>	8