Level 3 Technical Level IT

COMUNICATION TECHNOLOGIES

Mark scheme

Unit Number: H/507/6426 and M/506/6109 (2015)
Series: June 2017

Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

MARKING METHODS

In fairness to candidates, all examiners **must** use the same marking methods. The following advice may seem obvious, but all examiners **must** follow it as closely as possible.

1 If you have any doubt about how to allocate marks to an answer, consult your Team Leader.

2 Refer constantly to the mark scheme and standardising scripts throughout the marking period.

3 Use the full range of marks. Don't hesitate to give full marks when the answer merits them.

4 The key to good and fair marking is **consistency**.

INTRODUCTION

The information provided for each question is intended to be a guide to the kind of answers anticipated and is neither exhaustive nor prescriptive.

All appropriate responses should be given credit.

Where literary or linguistic terms appear in the Mark Scheme, they do so generally for the sake of brevity. Knowledge of such terms, other than those given in the specification, is not required. However, when determining the level of response for a particular answer, examiners should take into account any instances where the candidate uses these terms effectively to aid the clarity and precision of the argument.

DESCRIPTIONS OF LEVELS OF RESPONSE

The following procedure must be adopted in marking by levels of response:

- read the answer as a whole
- work up through the descriptors to find the one which best fits
- where there is more than one mark available in a level, determine the mark from the mark range judging whether the answer is nearer to the level above or to the one below.

Since answers will rarely match a descriptor in all respects, examiners must allow good performance in some aspects to compensate for shortcomings in other respects. Consequently, the level is determined by the 'best fit' rather than requiring every element of the descriptor to be matched. Examiners should aim to use the full range of levels and marks, taking into account the standard that can reasonably be expected of candidates.

Section A

1.0 Modulation is the process of using one signal to modify another signal. What name is given to the signal being modified?

B The CARRIER

[AO1a, 1 mark]

2.0 Which **one** of the following is **not** an example of wired transmission media?

D Infrared signals

[AO2a, 1 mark]

3.0 Which **one** of the following best describes the key functions of a SIM card?

A IDENTIFY and AUTHENTICATE

[AO3c, 1 mark]

4.0 Which **one** of the following is a **computer network** most likely to be used in e-commerce for high-speed online processing of large volumes of data?

D Storage Area Network (SAN)

[AO4a, 1 mark]

5.0 Which **layer** of the Open System Interconnection (OSI) model is also known as the **network interface** layer?

D Data link

[AO5b, 1 mark]

6.0 1G, 2G, 3G and 4G development has transformed mobile telecommunications to support the latest generation of smartphones.

Complete the table below, stating **one** key feature of each development.

[AO3c, 2 marks]

Two rows correct: **1 mark**
Three or more rows correct: **2 marks**

Allow:
- 1 feature (across the four) as 'Y faster than X', 'higher data transfer rate' etc
- Other reasonable alternatives.

DNA:
- Smartphone / GPS

1G	First cellular system / voice **calls only** / one country / analogue signal
2G	First data services (eg **text** / messaging / picture / MMS) / digital signal / first use of packet-switched / GPRS / EDGE
3G	increased bandwidth (eg data capacity for mp3 / video calls); common spectrum worldwide; improved security; circuit-switched and packet switched; mobile broadband / internet access / streaming videos
4G	mobile multimedia / mobile broadband / any service anywhere anytime / options: pure data/VOIP/end-to-end IP connection, packet-switched.

7.1 Define what is meant by point-to-point **connection**.

[AO2a, 1 mark]

1 mark (max. **1 mark**) for a definition, eg:
- a connection between two nodes or endpoints
- direct connectivity/dedicated link between two sites
- separate communication channels for each pair of computers
- a connection that only links two computers or circuits (as definition).

7.2 Give **one** example of point-to-point **communication**.

[AO2a, 1 mark]

1 mark (max. **1 mark**) for an example, eg:
- a telephone call / one (landline) telephone connected to the other / what is said by one caller can only be heard by the other caller
- leased-lines / data line / private line
- microwave relay links
- two-way radio
- connect two routers directly
- DSL Internet service connection
- a connection that only links two computers or circuits (as example).
- secure file sharing
- VOIP / video-conferencing

Allow:

- correct example given as part of definition in 7.1 (only if candidate has left 7.2 unanswered – **DNA** if wrong answer given for 7.2)
- consider whether 7.1 and 7.2 judged together is worth **2 marks** overall for 7.0.

8.0 Megabits per second (Mbps) is the ISP industry-standard unit for measuring your broadband connection speed.

Give **two** other examples of an appropriate unit for measuring broadband connection speed.

[AO1b, 2 marks]

1 mark (max. **2 marks**) for each example, eg:

- bits per second (bits/s or baud)
- kilobits per second (kbps)
- kilobytes per second (kB/s)
- megabytes per second (MB/s)
- gigabits per second (Gbps)
- gigabytes per second (GB/s).

Allow:

- other variants, eg gibibits per second/minute.

DNA:

- bytes (data storage)
- megabits per second (in stem).

9.0 **Communications data** (sometimes referred to as traffic data or metadata) is different from the content of the message.

Give **two** examples of metadata.

[AO2a, 2 marks]

1 mark (max. **2 marks**) for each example, eg:

- Origin / sending address / source / host
- Destination / receiving address
- Route
- Time / length / bits in message
- Date
- Size
- Duration
- Type
- Phone number
- Credit card transactions (or dates, locations, amounts)
- Location, eg GPS
- (TCP) Port / checksum / sequence number / TCP header
- IMEI / mobile phone / nearest cell tower
- IP address / MAC address / Provider

(**1 mark** each).

Allow:
other reasonable alternatives.

10.0 Explain, using examples, why **network bandwidth consumption** and **network bandwidth capacity** are both important when calculating network bandwidth requirements.

[AO1d, 4 marks]

Example answers:

- We need to see the size and impact of traffic **(1 mark)** on the network but if you don't take capacity into account a consumption measure could be affected by lack of capacity. **(1 mark)**
- A consumption measure might show a user with 2Mbps of bandwidth consumption but if you don't take capacity into account you won't realise the issues of trying to pass 100 such users over a 100Mbps link**. (2 marks)**

11.0 Provide a **technical** description of a **touch screen** for a mobile device.

[AO3a, 3 marks]

1 mark (max. **3 marks**) for each point, eg:

- LCD
- Resistive touch screen / "transparent keyboard"
- Upper layer conducting polyester plastic / lower layer conducting glass / separated by insulated membrane
- Chip configures coordinates of point touched (resistive)
- Can use plastic stylus (resistive)
- Capacitive / multiple layers of glass / all layers conductive
- Can touch screen in more than one place (capacitive)
- Cannot use plastic stylus (capacitive) as plastic stylus insulated
- Tapping (stylus or finger) / touch / equivalent to left button mouse
- Refresh rate (eg 100ps)
- input & output device

12.0 Explain why the use of **licensing** helps to ensure that mobile network operators' transmissions do **not** interfere with each other.

[AO3d, 3 marks]

1 mark (max. **3 marks**) for each point, eg:

- **frequency** bands = licensed bands / different bands
- licensing fee = **exclusive** right to transmit / **assigned channels** / frequency
- within that band in each **geographical** area
- with licensing, usually the only place where interference occurs is at the edge of the assigned coverage area

DNA

- 'minimises / avoids interference' alone / without explanation

13.0 Where might a network manager find a list of devices which are (or have been) connected to the local area network?

[AO3b, 3 marks]

1 mark (max. **3 marks**) for each location, eg:

- DHCP server
- Router, eg
  - Table/list of MAC addresses
  - Table of IP addresses
- ARP table / ARP cache
- Enterprise authentication, eg
  - Radius logs
- User ID logs
- Host's Wi-Fi network
- Device Manager / Device Server
- Windows Network Devices tab
- Network log / Network connections
- Wi-fi Manager / Wireless Network watcher / BSSID

Example answer:

- A router **(1 mark)** acts as a DHCP server **(1 mark)** and the router keeps a table of the IP addresses issued **(1 mark).**

DNA

- 'server' alone
- hub / switch

14.1 Give **one** advantage of using **serial transmission** and **one** advantage of using **parallel transmission.**

[AO2a, 2 marks]

Serial transmission: 1 mark (max. **1 mark**) for an advantage, eg:

- longer distances
- cheaper / only single channel between sender and receiver required
- lack of crosstalk/interference between channels
- higher bitrates without suffering the effects of noise / better SNR
- don't have to synchronise/stabilise all the channels
- the bandwidth of serial wires is much higher than parallel
- faster in some circumstances, eg: SATA > PATA, PCI-e > PCI (example required for mark).

Parallel transmission: 1 mark (max. **1 mark**), for an advantage, eg:

- (usually) faster than serial (**1 mark**), eg: given the same signal frequency
- capable of sending data signals simultaneously over several channels
- multiple bits are transmitted simultaneously with a single clock pulse
- clock frequency can be kept low without affecting speed of operation.

-

14.2 State where parallel data transmission would be used.

[AO2a, 1 mark]

1 mark (max. **1 mark**) for an example, eg:

- pathways between CPU and memory
- in memory devices, such as RAM
- internal connections in a computer, eg (peripheral) buses / computer systems bus / internal bus
- an integrated circuit / IC / microchip / chip
- time critical uses, eg video streaming

15.1 List **three** ways in which an analogue signal can be modulated.

[AO1a, 1 mark]

1 mark (max. **1 mark**) for three ways/types, ie:

- Amplitude, Frequency, Phase / **Accept:** AM, FM, PM.

Allow:

- subgroups of these techniques, eg DSB, SSB, VSB, QSM, TM
- angle modulation
- pseudo-analogue modulation (TM)
- technical descriptions, graphs or diagrams of modulation.

DNA

- 'carrier wave' at 15.1

15.2 Explain how a **modem** enables a computer to transmit data using a telephone line.

[AO1a, 2 marks]

1 mark (max. **2 marks**) for each point, eg:

- Computer (largely) digital / telephone (partly) analogue / modem converts
- Combination of 19th century technology with 20th century technology
- Modem modulates AND demodulates / encodes AND decodes
- Modulates to send (like a voice), demodulates to receive (as a number)
- Different modems for dial-up, broadband, mobile broadband (HSDPA)
- Dial-up = circuit switching, broadband = packet switching
- Carrier wave

16.0 Explain the key features of **simplex**, (full) **duplex**, and **half-duplex** data transmission.

[AO2a, 4 marks]

1 mark (max. **4 marks**) for each point, eg:

Only 2 transmission modes attempted: Max. **3 marks**.
Only 1 transmission mode attempted: Max. **2 marks**.

Simplex (max. **2 marks**), **1 mark** for each point, eg:

- only transmits / one direction only
- listeners can only listen, not respond.

Half-duplex (max. **2 marks**), **1 mark** for each point, eg:

- messages can flow in both directions / be reversed
- **not** at same time / listener must listen and only then respond.

(Full) **duplex** (max. **2 marks**), **1 mark** for each point, eg:

- message in both directions
- two simplex channels / forward & reverse channel / at the same time

Example answers:

- Simplex communication only transmits **(1 mark)** whereas full duplex is in both directions **(1 mark)**. Half-duplex is in either direction **(1 mark)** but not at the same time **(1 mark)**.
- Simplex communication only transmits **(1 mark)** meaning you can only listen not respond **(1 mark)** whereas full duplex is a forward and reverse channel **(1 mark)**. Half-duplex is in either direction **(1 mark)**.

17.0 Describe the terms **crosstalk** and **interference**, giving an example of each.

[AO1c, 6 marks]

Crosstalk (2 marks for description, **1 mark** for example):

- disturbance caused by the electric or magnetic fields / one signal affecting another signal / in an adjacent circuit (max. **2 marks**)
- can result in hearing part of another conversation / example of type, eg alien crosstalk. (max. **1 mark**)

Interference (2 marks for description, **1 mark** for example):

- anything which modifies or disrupts a signal / as it travels along a channel / from source to receiver (max. **2 marks**)
- addition of unwanted signals to useful signal / crosstalk is a type of interference / coupling devices / humming from a power line / Wi-Fi or Bluetooth interference. (max. **1 mark**)

Allow:

- other reasonable alternatives.

18.0 The real-world usage of the terms **mobile hotspot** and **tethering** has become almost interchangeable.

Explain your understanding of the terms and provide an example of how or where each might be used.

[AO3e, 4 marks]

Mobile hotspot:

- allows user (Internet) connection using adaptor or device / may be LAN or a wireless network
- a separate device that can share a mobile data connection / router / broadband access point

Tethering:

- connecting one device to another device / could tether a device with no Wi-Fi capability to another device with Wi-Fi capability through cabling or a wireless connection.

Examples of real-world usage:

Android, Samsung call tethering 'mobile hotspot'
iOS calls tethering 'personal hotspot'.

Example answer:

- Tethering is to connect my laptop via my mobile phone **(1 mark)** whereas a mobile hotspot is a separate device that can share a mobile data connection **(1 mark)** but this is confusing because Samsung call tethering 'mobile hotspot' **(1 mark)** and Apple call it 'personal hotspot' **(1 mark)**.

DNA

- PAN

19.0 Rather than using wired technology, a business decides to use mostly **wireless technology** when replacing its communication network.

Give **two** advantages and **two** disadvantages for the business making the decision to use **wireless technology**.

[AO2b, 4 marks]

1 mark (max. **2 marks**) for an advantage, eg:

- Ease of installation / quick, no trenching, no expensive installation, cheaper
- Long range, tested, low risk
- Affordable: wired options often costed by the foot / wireless in miles
- Flexible, upgradeable / inexpensive compared with cost of replacing a buried cable
- (no) Copper theft
- (no) unsightly cabling
- BYOD benefits
- Caters for modern/mobile devices that don't have wired Ethernet

1 mark (max. **2 marks**) for a disadvantage, eg:

- Reliability and speed of physical connections
- Security / keeping unauthorised visitors out of network
- Lack of control over signal range
- Prone to downtime, interference
- (no) additional security costs related to BYOD

Section B

20.0 **Network topology** is the arrangement of the various elements (links, nodes, etc) of a computer network.

20.1 Choose **three** of the following network topologies and identify a strength and a weakness for each:

- Bus
- Ring
- Star
- Tree
- Mesh

[AO4b, 6 marks]

More than three topologies: mark first three only. Less than three topologies: max. **2 marks** for each topology.		
	1 mark for each strength (max. **3 marks**)	**1 mark** for each weakness (max. **3 marks**)
BUS	**bus** = central cable / main wire / backbone inexpensive / easy to install uses less cable than STAR	cable break = total shutdown
RING	All nodes connected in closed loop able to span larger distances each node able to generate messages	Slower as data passes through every computer One workstation or port fails, whole network fails
STAR	All devices are connected to a central computer or hub / failure by one node does not affect rest of network	Central computer / central hub breakdown = total shutdown
TREE	*Hybrid* of linear (bus) and star topologies good for large computer networks divides whole network into parts / more easily manageable	Dependent upon a central hub / central hub breakdown = total shutdown
MESH	In **full mesh**, every node has a connection to every other node; if one fails, network traffic can be directed to another *Hybrid* **partial mesh** connected to full mesh backbone, less expensive	Full mesh expensive Partial mesh only offers one or two nodes if failure

20.2 You are a network manager undertaking a review of the network topology for a setting of your choice.

State your chosen setting _____

Select the most appropriate topology for your setting. Justify your choice.

Your answer should include:

- cost
- size/scope
- setting and alternative topologies or options
- shortcomings of topology, eg: potential for failure, options to minimise failure.

[AO4b/c, 9 marks]

NO marks if no reference to one of: cost, size or scope, setting or alternative topologies.		
1 mark (max. **3 marks**)	**+1 mark** (max. **3 marks**)	**+1 mark** (max. **3 marks**)
Reference to **COST**	Cost **EXPLAINED / EXPANDED**	Compromise / limitations identified **OR** additions / advantages justified
Reference to **SIZE / SCOPE**	Size / Scope **EXPLAINED / EXPANDED**	(limiting) consequences of FAILURE **OR** potential for FAILURE clearly identified
Choice **JUSTIFIED** by reference to Setting **OR** alternatives	Choice **JUSTIFIED** by reference to Setting **AND** alternative topologies / options	Shortcomings of topology of choice identified **AND / OR** options to minimise FAILURE identified

21.1 Draw a diagram that shows both the **OSI** and **TCP/IP** network models.

[AO5b, 3 marks)

Max. **3 marks** for the following diagram or similar:

1 mark for TCP/IP application layer = OSI application, presentation, sessions layers
1 mark for TCIP/IP network access layer = OSI datalink, physical layers
1 mark for either:

- ALL FOUR TCP/IP layers AND in correct order as shown
- ALL SEVEN OSI layers AND in correct order as shown
  (for correct order: see table on next page)

APPLICATION	**APPLICATION**
PRESENTATION	
SESSION	
TRANSPORT	**TRANSPORT or TCP (host-to-host)**
NETWORK	**INTERNET or INTERNETWORK**
DATA LINK	**NETWORK ACCESS or HOST-TO-NETWORK or NETWORK INTERFACE or LINK LAYER or SUBNET (LINK and PHYSICAL)**
PHYSICAL	

21.2 Compare and contrast the **OSI** and **TCP/IP** network models.

In doing so, you should summarise:

- the functions of each model
- the relationships between each model
- the purposes of each layer.

[AO5b/c, 12 marks]

For reference, the table in 21.1 shows the two network models.

Mark using levels of response grid on the next page.

LEVELS OF RESPONSE GRID: allow **1 mark** from each cell and EITHER: max. **3 marks** each row (4 x 3) OR 3 marks on two rows + 2 marks + 4 marks (3+3+2+4).		
NO marks if no creditworthy content.		
COMPARE +1 mark	**EXPAND +1 mark**	**CONTRAST +1 mark**
Top 3 layers of OSI model **not distinguished separately** in TCP/IP model; presentation layer and session layer missing in TCP/IP model; TCP/IP model only has application layer above transport layer / **fewer and less rigidly defined layers.**	Layers at the top closer to **user application** / layers at the bottom closer to **physical transmission;** encapsulation (into layers) of **abstraction** of protocols and services (eg FTP, HTTP, SMTP, etc); application layer provides communication functions (eg DNS, IMAP, POP) / verifies **availability**; presentation layer used to check **compatibility** between data formats / (eg **formatting**, conversion, **compression**, **encryption**, translation); session layer handles **authentication/authorisation** / (eg verify, establish, maintain, terminate).	**No fixed** layer / **architecture** in TCP/IP above transport layer; TCP/IP not concerned with strict layering / predates OSI; confusion as different authors advocate (7) different TCP/IP models equating to OSI model / **may not fit cleanly into OSI model**; TCP/IP **not intended to be OSI compliant.**
Transport layer supports source and host / **host to host in both /** determines **level of service** / status of connection used / segmenting, sequencing and combination	Functionality of OSI session layer (HTTP, SMTP) similar to **TCP** transport layer / **port numbering** of TCP, UDP; provides quality of service (QoS) functions / ensures completely delivery of data.	UDP unreliable v **TCP more reliable;** no retransmission v **retransmitting** until received; no sequencing / data recovery by providing sequence number with each packet / reliably and without errors
Network layer (OSI) and **Internet** layer (TCP/IP) define and establish Internet / uniform **networking interface** / Internet access, connects independent networking / logical topology / end to end / point to point / / CRC	MAC Addressing, **packet** routing / router switching / exchanging datagrams / moving them nearer final destination, **IP** datagrams, packet switching / routing / (eg IP, ICMP, ARP, DCHP) / frames	**IP defines** IP addresses; (original TCP /IP) **end to end principle** (speed & simplicity) changed by real world need for firewalls, cache, etc./ translate to MAC

Physical layer v link layer / OSI layers 1 & 2 / both move packets / transmit bits / both transmit over physical medium / pack/unpack frames / binary transfer / 1s 0s / switches & hub / cables & connections	VPN, local network / Ethernet, collision detection, CSMA / CD Access Method / network card / (eg XDSL, PPP – EAP, token ring, GSM).	TCP network access layer (above) handles (OSI) Internet layer datagrams.

Question	Assessment Outcomes (2015)					Total
	1	2	3	4	5	
SECTION A						
1	1a (1)					1
2		2b (1)				1
3			3b (1)			1
4				4a (1)		1
5					5b (1)	1
6			3c (2)			2
7.1		2a (1)				1
7.2		2a (1)				1
8	1b (2)					2
9		2a (2)				2
10	1d (4)					4
11			3a (3)			3
12			3d (3)			3
13			3b (3)			3
14.1		2a (2)				2
14.2		2a (1)				1
15.1	1a (1)					1
15.2	1a (2)					2
16		2a (4)				4
17	1c (6)					6
18			3e (4)			4
19		2b (4)				4
Total A	16	16	16	1	1	**50**
SECTION B						
20.1				4b (6)		
20.2				4b/c (9)		
21.1					5b (3)	
21.2					5b/c (12)	
Total B	0	0	0	15	15	**30**
Total A+B	16	16	16	16	16	**80**

Question	Assessment Outcomes (2016)					Total
	1	2	3	4	5	
SECTION A						
1	1a (1)					1
2		2b (1)				1
3			3b (1)			1
4				4a (1)		1
5					5b (1)	1
6			3c (2)			2
7.1		2a (1)				1
7.2		2a (1)				1
8	1b (2)					2
9		2a (2)				2
10	1d (4)					4
11			3a (3)			3
12			3d (3)			3
13			3b (3)			3
14.1		2a (2)				2
14.2		2a (1)				1
15.1	1a (1)					1
15.2	1a (2)					2
16		2a (4)				4
17	1c (6)					6
18			3e (4)			4
19		2b (4)				4
Total A	16	16	16	1	1	**50**
SECTION B						
20.1				4b (6)		
20.2				4b/c (9)		
21.1					5b (3)	
21.2					5b/c (12)	
Total B	0	0	0	15	15	**30**
Total A+B	16	16	16	16	16	**80**

Assessment Outcomes	Marks available in Section A	Marks available in Section B	Total mark
AO1: Understand the fundamentals of data communication	8 – 1**2 marks** 10 – 15%	2 x 15 37.5%	16
AO2: Analyse data communication methods	5 – 10 marks 6 – 13%		16
AO3: Analyse basic mobile technology communication	8 – 1**2 marks** 10 – 15%		16
AO4: Understand the fundamentals of computer networks	5 – 10 marks 6 – 13%		16
AO5: Understand network conceptual models, protocols and devices	8 – 1**2 marks** 10 – 15%		16
Total	**50 marks**	**30 marks**	**80**