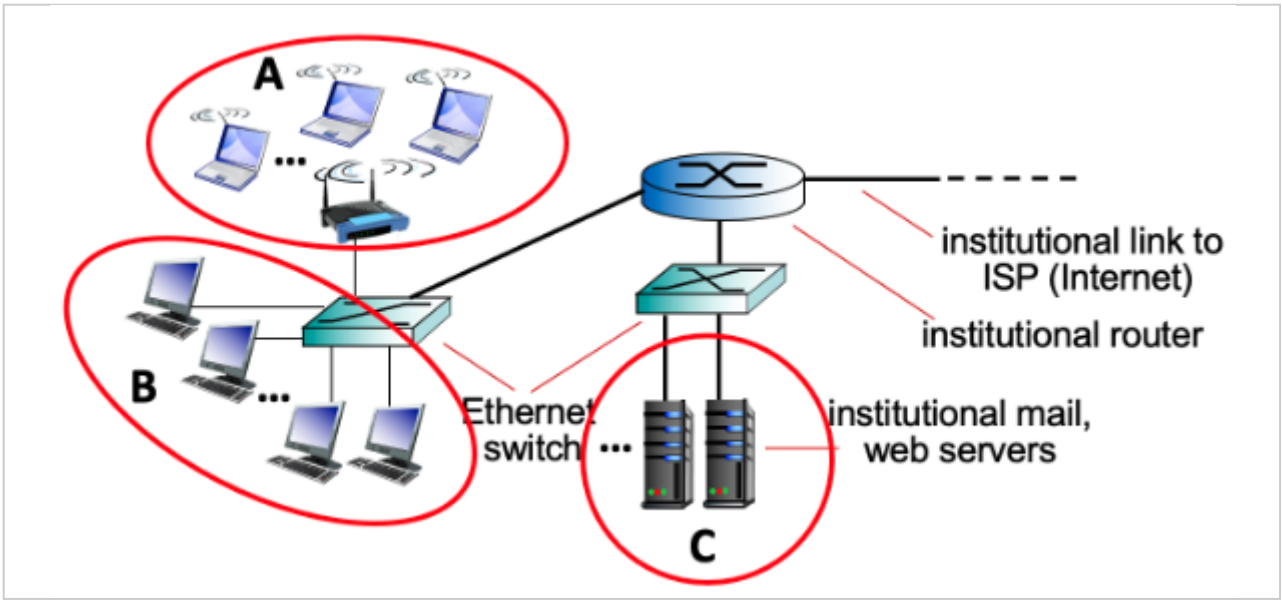
COMP3331/COMP9331 – Computer Networks & Applications

Mid-Term Exam – Term 3 2023

INSTRUCTIONS:

1. Time allowed: 1 hours and 15 minutes.
2. Total number of questions to be answered : 24
3. Total marks available: 20 marks (each question is worth 1 mark), worth 20% of the total marks for the course.
4. Students are advised to read all of the examination questions before attempting to answer the questions.
5. This exam cannot be copied, forwarded, or shared in any way.
7. Students are reminded of the UNSW rules regarding Academic Integrity and Plagiarism.
8. Your work will be saved periodically throughout the exam and will be automatically submitted when the test ends provided you are connected to the internet.
9. You must upload all of your work within the exam time. There is no extra time to upload. No late submissions will be accepted.

1



Consider the a small university network shown in the figure above comprised of 3 types of hosts. Suppose that the institutional link has a connection to the Internet that supports **250 Mbps** downstream transmission rate and **200Mbps** upstream transmission rate. Suppose that the Ethernet networks (**B and C)** can support a transmission rate of **1Gbps** (both upstream and downstream) and the WiFi network (**A**) can support a transmission rate of **150Mbps** (both upstream and downstream). Assume that the rest of the Internet (not shown in the figure) and the backbone connections between Ethernet switch and router have ample capacity, which can support any transmission rate (both upstream and downstream). Hosts in Networks B and C are connected through Ethernet while Hosts in Network A are connected through WiFi. **There are 10 hosts in Network A, 15 hosts in Network B and 5 hosts/servers in Network C.**

Answer the following three questions (1 mark for each)

1) Assumes that all host in Network B are idle. If all hosts in Network A and all servers in Network C and are downloading large files from the Internet simultaneously and each host gets an equal share of the available bandwidth, what is the maximum throughput that any host/servers in the university network can experience?

Select one alternative:

- 25Mbps
- 1Gbps
- 16.66Mbps ✔
- 50Mbps
- 250Mbps

Solution: There are 15 clients in total downloading files from the Internet, so the bottleneck would be the institutional link. **250Mbps / 15 = 16.66Mbps**

2) What is the maximum throughput that any host in Network A can experience when downloading a large file from the Internet??

Select one alternative:

- 66.66Mbps
- 250Mbps
- 25Mbps
- 1Gbps
- 150Mbps ✔

Solution: The WiFi network is the bottleneck comparing to the institutional link. So the maximum throughput that any host in Network A can experience would be **150Mbps**.

3) What is the maximum throughput that any host in Network B can experience when downloading a large file from any server in Network C?

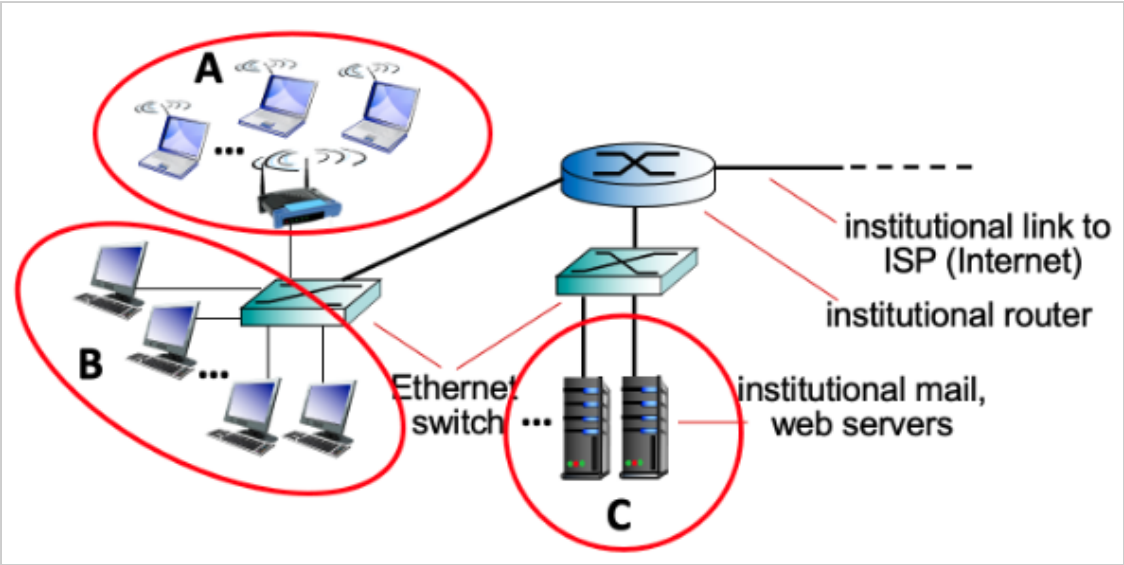
Select one alternative:

- 15Mbps
- 150Mbps
- 250Mbps
- 100Mbps
- 1Gbps ✔

Maximum marks: 3

Solution: When a host in Network B is downloading files from Network C, the Ethernet network would be the bottleneck and the maximum throughput would be **1Gbps**.

Throughput 2023 T3-2



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Answer the following three questions (1 mark for each)

1) What is the maximum throughput that any host in this university network can experience when downloading a large file from the Internet?

Select one alternative:

- 250Mbps ✔
- 200Mbps
- 150Mbps
- 6.25Mbps
- 1Gbps

Solution: When downloading a large file from the Internet, the bottleneck would be institutional link and the max speed would be 250Mbps.

2) What is the maximum throughput that any host in Networks A and B can experience when downloading a large file from any server in Network C?

Select one alternative:

- 40Mbps
- 200Mbps
- 150Mbps
- 250Mbps
- 1Gbps ✔

Solution: When downloading a large file from any server in Network C, the bottleneck would be the Ethernet network and the max speed would be 1Gbps.

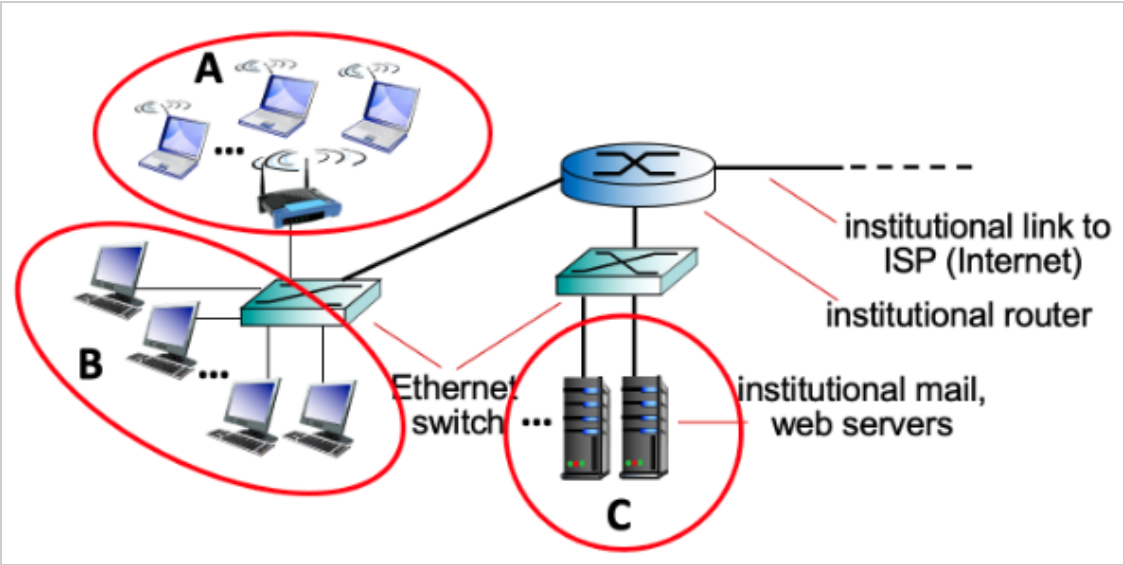
3) Assumes that all servers in Network C are idle. If all hosts in Networks A and B are downloading large files from the Internet simultaneously and each host gets an equal share of the available bandwidth, what is the maximum throughput that any host in the university network can experience?

Select one alternative:

- 15Mbps
- 10Mbps ✔
- 33.33Mbps
- 8Mbps
- 40Mbps

Solution: There are 25 clients in total downloading files from the Internet, so the bottleneck would be the institutional link. **250Mbps / 25 = 10Mbps.**

Throughput 2023 T3 - 3



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Answer the following three questions (1 mark for each)

1) Assumes that all servers in Network C and all host in Network B are idle. If all hosts in Network A are downloading large files from the Internet simultaneously and each host gets an equal share of the available bandwidth, what is the maximum throughput that any host in the university network can experience?

Select one alternative:

- 250Mbps
- 150Mbps
- 15Mbps ✔
- 25Mbps
- 10Mbps

Solution: When downloading a large file from the Internet, the bottleneck would be WiFi network and since there are 10 hosts in Network A, the max speed for each host would be 15Mbps.

2) What is the maximum throughput that any host in Network B can experience when downloading a large file from the Internet?

Select one alternative:

- 66.66Mbps
- 1Gbps
- 40Mbps
- 33.33Mbps
- 250Mbps ✔

Solution: When downloading a large file from the Internet, the bottleneck would be the institutional link and the max speed would be **250Mbps** when only **one host in Network B is downloading**.

3) What is the maximum throughput that any host in Network A can experience when downloading a large file from any server in Network C?

Select one alternative:

- 250Mbps
- 15Mbps
- 1Gbps
- 150Mbps ✔
- 100Mbps

Solution: When downloading a large file from any server in Network C, the bottleneck would be the WiFi network and the max speed would be **150Mbps**.

Suppose that a webpage has seven referenced objects all residing on the same server. **Assume that TCP 3-way hand-shake costs 1.5 RTTs, the client combines the HTTP Get with the last ACK in the TCP 3-way hand-shake, and ignore TCP connection tear-down time.**

Based on the information above, please provide answers to the questions on the **right**-hand side.

2 How many RTTs the client will have to wait to see all objects on the page if it uses **non-persistent HTTP**?

Select one alternative:

- 12
- 18
- 16 ✔
- 14

Maximum marks: 1

Solution: Since the client combines the HTTP Get with the last ACK in the TCP 3-way hand-shake, the connection establishment and HTTP Get will cost 2 RTTs in total. For non-persistent, two RTTs are needed (connection establishment and HTTP Get) for each requested object. Since there are 7 + 1= 8 objects in total, we must wait 2 * 8 = 16 RTTs.

3 How many RTTs the client will have to wait to see all objects on the page if it uses **persistent HTTP with pipelining**?

Select one alternative:

- 6
- 2
- 3 ✔
- 8

Maximum marks: 1

Solution: For persistent HTTP with pipelining, we only need to establish TCP connection one time and we can request multiple objects back to back. The total time would be **2RTTs(handshake and first HTTP Get for the webpage) + 1RTT(HTTP Get for those 7 objects) = 3 RTTs.**

4 How many RTTs the client will have to wait to see all objects on the page if it uses **persistent HTTP without pipelining**?

Select one alternative:

- 3
- 2
- 9 ✔
- 8

Maximum marks: 1

Solution: For persistent HTTP without pipelining, we only need to initiate the TCP connection for the first object once. The total time would be **2RTTs(handshake and first HTTP Get for the webpage) + 7RTTs(HTTP Get for the remaining 7 objects) = 9RTTs**

5 Suppose four packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet has a length of 300 bytes and the link has a transmission rate of 1.5Mbps.

What is the average queuing delay for the four packets? Please provide a concise explanation of how you arrived at this result in two to three sentences.

Fill in your answer here

Format

Solution: transmission time for each packet = 300*8/(1.5*10^6) = 1.6 ms
If four packets arrive simultaneously to the link, each packet will have equal possibility to wait 0, 1, 2, 3 packets to be transmitted.
Total transmission delay = 1.6 * (0+1+2+3) = 9.6 ms
Average queuing delay = 9.6 / 4 = 2.4 ms

0.5 mark for correct solution and 0.5 mark for reasoning

Words: 0

Maximum marks: 1

6 To speed up file transfers, a Go-back-N implementation uses a window size of 15. The sequence number field in the packet header must have at least

Select one alternative:

- None of these
- 3 bits
- 4 bits ✔
- 6 bits
- 5 bits

Maximum marks: 1

Solution: Window size <= Sequence number space - 1. 2^3 - 1 <= 15 <= 2^4 - 1

7 A DNS resource record has “sydney.edu.au” for the *name* field and “dns-2.sydney.edu.au” for the *value* field. The *type* field is likely to contain which of the following texts?

Select one alternative:

- MX
- NS ✔
- CNAME
- A

Maximum marks: 1

Solution: Since the value field contains keyword "dns", **type NS** is the most likely.

8 Two hosts located at two ends of a continent are trying to transfer data using a window-based (for pipelining purposes) reliable transport protocol. Suppose that the one-way propagation delay between the hosts is 25 millisec. If the hosts are using packets of length 1,500 bytes over a 1 Gbps transmission link, how big the window size has to be for the channel utilization to be greater than 98%?

Select one alternative:

- Approximately 2,050 packets
- Approximately 4,100 packets ✔
- Approximately 41,000 packets
- Approximately 20,500 packets

Maximum marks: 1

Solution: RTT = 2*25 = 50 ms
0.98=X (L/R)/(RTT+L/R)
0.98=X ((1500*8)/10^9))/(50*10^-3 + (1500*8)/10^9)
X=4100 packets

9 An enterprise LAN that is connected to the Internet using a gateway. The average request rate from the enterprise browsers to the Internet origin servers is 20/sec and the average object size is 150 kilobyte. If the gateway has a 150 Mbps access link, what is the traffic intensity at the access link?

Select one alternative:

- 16% ✔
- 10%
- 15%
- 20%

Solution: Downloading speed = 20*150*8 = 24000 Kbps = 24Mbps
Traffic intensity = 24/150 = 16%

Maximum marks: 1

10 For a 7-bit sequence number field in the packet header, the maximum window size for Selective Repeat is

Select one alternative:

- 16
- 64 ✔
- None of these
- 32
- 128

Maximum marks: 1

Solution: Sender window size <= ½ of Sequence number space.
(1/2)*(2^7) = 64

11 Consider a UDP segment with source port number 1,025 and destination port number 1,026. Now assume that during the transmission of this UDP segment, the least significant bit (i.e., the rightmost bit) of both the source port number and the destination port number are flipped (i.e. 0 becomes 1, and 1 becomes 0) while all the other bits in the UDP segment are transmitted correctly.

Whether the UDP checksum process at the receiver can effectively detect errors? Please provide a concise explanation of how you arrived at this result in two to three sentences.

Fill in your answer here

Format

Solution:
The receiver can't detect errors.
0b10000000001 + 0b10000000010 = 0b100000000011
0b10000000000 + 0b10000000011 = 0b100000000011

0.5 mark for answering can't detect the errors. 0.5 mark for reasoning.

Words: 0

Maximum marks: 1

Suppose a number of users share a 15 Mbps link. Also, suppose that each user transmits continuously at 3 Mbps when transmitting, but each user transmits only 15% of the time.

Based on the information above, please provide answers to the questions on the **right**-hand side. Simply record the numerical responses in the designated spaces. No explanations are necessary.

12 When circuit switching is used, how many users can be supported? Simply enter the numeric value in the space provided. No explanation is required.

(5) .

Maximum marks: 1

Solution:In circuit switching, the percentage of time a user is active is irrelevant. A circuit needs to be established for each active user. Since each user requires 3Mbps and the link capacity is 15 Mbs, 5 users can be supported.

13 Suppose packet switching is used. If there be no queuing delay, what is the maximum number of users that may transmit at the same time before the link? [ ] (5) .

Maximum marks: 1

Solution: Since each user requires 3 Mbps when transmitting, if five or fewer users transmit simultaneously, a maximum of 15 Mbps will be required. This won't result in queuing delay.

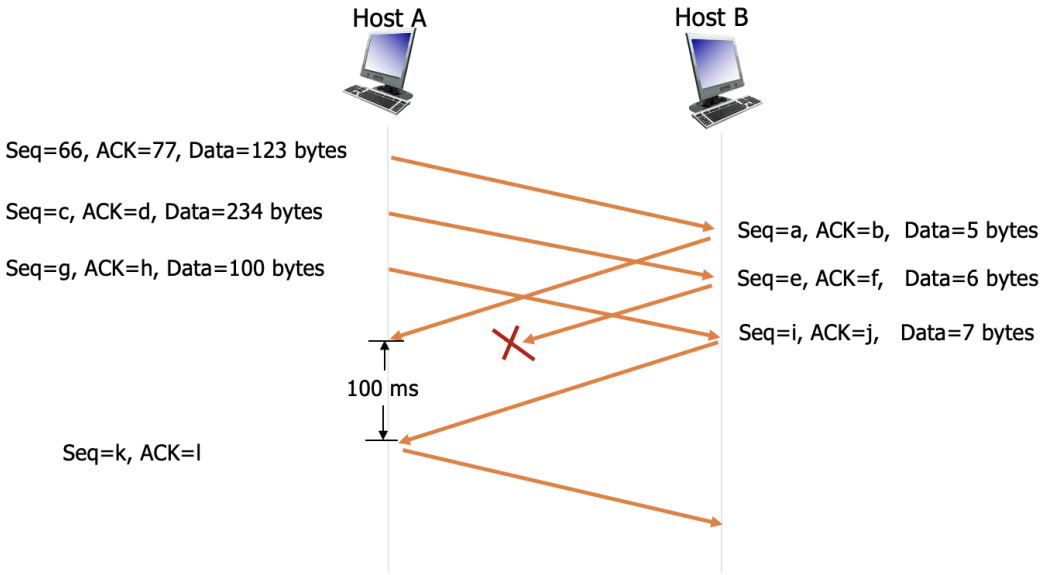
14 Suppose with packet switching, there are five users. Find the probability that at any given time, all five users are transmitting simultaneously. Enter the numeric value.: (0.000075937 - 0.000075938) .

Maximum marks: 1

Solution: The probability that all five users are transmitting simultaneously = **(0.15)^5 0.0000759375**

Consider the exchange of TCP segments between Hosts A and B shown in the figure below. The TCP connection establishment process is not shown. The figure depicts all segments exchanged between the two hosts (i.e. no other segments beyond those shown are exchanged). Host A sends three data segments (with sequence numbers **66, c** and **g**, respectively). Host B responds with an ACK for each segment (with sequence numbers **a, e**, and **i** respectively). The second ACK is lost, the first and third ACKs are received by Host A.

After receiving the ACK with the Seq = i from Host B, Host A transmits a fourth segment (with sequence number **k**). You will need to figure out whether this segment is a retransmission of one of the three previously transmitted data segments or a fresh segment containing new data.

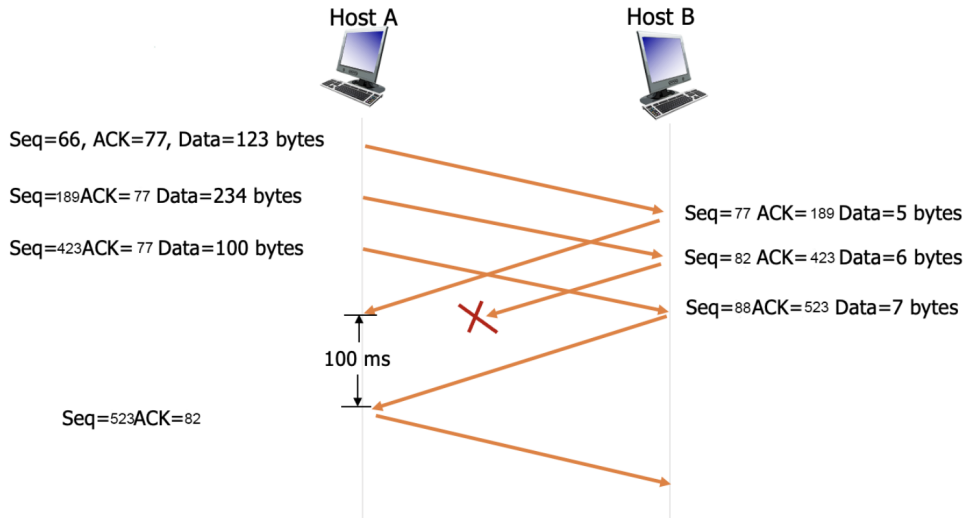


Based on the information above, please provide answers to the questions on the **right**-hand side. Simply record the numerical responses in the designated spaces. No explanations are necessary.

15 What is g? (423) .

Maximum marks: 0.5

Solution:



16 What is a? (77) .

Maximum marks: 0.5

17 What is e? (82) .

Maximum marks: 0.5

18 What is c? (189) .

Maximum marks: 0.5

19 What is h? (77) .

Maximum marks: 0.5

20 What is k? (523) .

Maximum marks: 0.5

21 What is j? (523) .

Maximum marks: 0.5

22 What is i? (88) .

Maximum marks: 0.5

Document 1
Attached

Network issues - In-term Assessments

Stay calm

Do not panic. Your answers are saved in the browser cache you are using.

STEP 1

Keep working

Keep doing your Test. Any changes or additions to your answers will be saved in your browser and will be uploaded to Inspera when your internet reconnects.

STEP 2

What else

- Don't close your browser Don't clear your browser cache.
- Don't switch laptops/computers.

STEP 3

The most recent answers are auto-submitted at the end of the test.

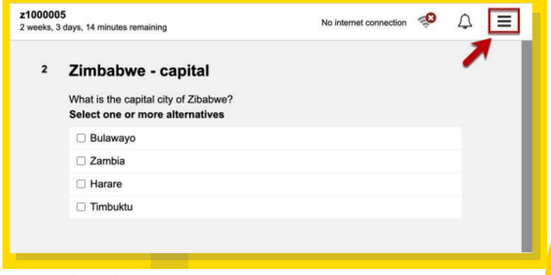
End of Test

If your internet didn't reconnect, save your submission as a file.

STEP 4

a) Saving your file

You can do this by clicking the hamburger icon on the top right corner of your test page.



- Click on save submission as a file
- Click save submission and it will look like this. Do not change the name of the file.

Cand_z1000006-Test_61384634.ia

STEP 5

b) Email your file

Submit your submission file as soon as you can <u>after the end of your test</u>. Please only download and email your file, if you are still offline at the completion of your Test.

Email to your Convenor the .ia file, your zID, course name, location and contact number as soon as possible.

c) Support

Contact your Convenor.

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For more information, refer to the Frequently Asked Questions and Answers at www.student.unsw.edu.au/exams/inspera