Q1 (a)
Highlight the difficulties of using traditional Internet model in providing multimedia services on the Internet. Give an account of the current research in Internet and multimedia technologies to resolve the difficulties you mentioned.

(25 marks)

See p.7 to p.16 of your notes - Intro.
Q1 (b)
The following SMIL program is received from the server. By using a timing diagram, show
how audio.ra, image1.gif and image2.gif are presented synchronously when playing. (If you
use other kind of timing diagram different from that in the notes, clear explanation of the
diagram is mandatory.)

(25 marks)

```xml
<smil>
  <head>
    <layout>: ::
  </layout>
</head>
<body>
  <par>
    <audio src="audio.ra" begin="6s" clip-begin="15s"
    clip-end="50s"/>
    <img src="image1.gif" begin="6s" dur="30s"
    region="im1"/>
    <seq>
      <img src="image2.gif" begin="10s" dur="12s"
      region="im2"/>
      <img src="image2.gif" begin="7s" dur="12s"
      region="im2"/>
    </seq>
  </par>
</body>
</smil>

Play button
press here

Start play
here

6s

15s 35s

audio.ra

image1.gif

30s

10s 12s 7s 12s

image2.gif
Q2 (a)
Comment, in detail, on various resource constraints when designing an on-demand multimedia streaming server. 

(25 marks)

See p.10-p.13 of your notes - Buffering.
Q2 (b) 
An on-demand multimedia server is equipped with a single hard disk and a large buffer space for the storage of streaming data. The buffer space can be further divided into a number of smaller buffers for the storage of the streaming data required by each admitted client. Each buffer has its turn to be read or filled. A server is said to complete a round of service when it refills all buffers. The following is the specification of the system:

- Total buffer space \((M)\) = 64M Bytes
- Average track seeking time for a stream \((t_s)\) = 8.5ms
- Average rotational latency \((t_r)\) of disk = 4ms
- Disk sector size \((s)\) = 512 bytes (the minimum unit of each disk access)
- Data transfer rate \((r_d)\) of disk = 160M Bytes per second
- Network consumption rate \((r_c)\) = 320k bit per second

(Note: 1k = 1000 and 1M = 1kx1k)

Note that the consumption rate of the network \((r_c)\) is constant across time and is the same for all clients in the system.

(i) Assumed the Buffer Conservation Algorithm is used for buffer control of the system, show that

\[
N \left\{ \frac{2r_cN(t_s + t_r)}{1 - \frac{r_cN}{r_d}} + s - 1 \right\} < M
\]

where \(N\) is the number of admitted clients. 

(ii) Based on the specification as shown above, determine the maximum number of clients that can be admitted to the system such that the amount of total buffer memory required will not exceed the limit. State any assumptions you made in deriving the solution. (Note: \(N\) must be a positive integer.)

Since

\[
N \left\{ \frac{2r_cN(t_s + t_r)}{1 - \frac{r_cN}{r_d}} + s - 1 \right\} < M
\]

By substituting the parameters as shown in the question into this equation, we have

\[N^2 + 16.511N - 64k < 0\]

Hence

\[N < 255\]. That is, the maximum number of \(N\) is 244.