



General Certificate of Education
Advanced Subsidiary Examination
January 2011

General Studies (Specification A)

GENA2

Unit 2 AS Science and Society

Source Booklet

Source for use with **Questions 1.1 to 1.30.**

Section A

Source for **Questions 1.1 to 1.30**

If people start having trouble, it won't show up until it is a really big effect

- (1) If we came expecting reassurance from this bearded grandfather, the Emeritus Professor of Physics who heads the government's mobile phone safety research, we are about to be a little shaken. We begin by asking whether we haven't all got into an unnecessary lather about the dangers of mobiles and wireless technology. There are all these vague concerns. "There should be," Lawrie Challis immediately cuts in. Oh. This is more disconcerting because Professor Challis is one of the world's most eminent experts on mobile phone radiation.
- (2) He has some good news: the first batch of research they have done confirms that mobile phones are very safe in the short term, under ten years. But there is less good news. "It's encouraging because they found nothing for people who've used phones for less than ten years," he says, "but there is a hint of something for people using them more."
- (3) Now Professor Challis is keen to emphasise that this "hint" remains just that. A massive European study found a slight association between the risk of brain tumours and using a mobile for more than ten years. But the problem is that the number of people involved over a decade ago was so small.

Table 1: Number of mobile phone subscriptions in the United Kingdom (per 100 inhabitants)

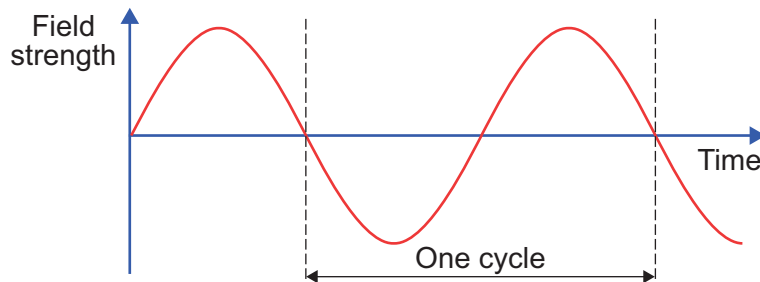
1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
10	12	15	25	41	68	76	84	91	100	109	115

- (4) But Professor Challis is worried. His knowledge of the major breakthroughs in what causes cancers – smoking, sunlight, asbestos, nuclear radiation – tells him that effects often take a long time to show up, at least ten years and usually more.
- (5) The groundbreaking study proving the link between lung cancer and smoking showed a similar delay, he says. "You find absolutely nothing for ten years and then, after that, it starts to grow dramatically. It goes up ten times. You look at what happened after the atomic bomb. Nagasaki. Hiroshima. The same for asbestos disease."
- (6) As we both quietly turn off our phones, Professor Challis announced that he is in the final stages of negotiating £3.1 million from government and industry to follow 200 000 volunteers, long-term mobile users among them, for five years. He would like the research to go on for ten years "because there is a hint and because professional epidemiologists feel they can't rule out the possibility of getting cancer".
- (7) The number of mobiles in Britain has doubled since 2000, and the number of children between the ages of five and nine using mobiles has increased fivefold. No research has yet been conducted on them, for ethical reasons.
- (8) "We all know that if you're exposed to sunlight as a kid you're much more likely to get skin cancer than if you're exposed as an adult. We know that children react differently to ionising radiation, to radioactivity and gamma rays. We know they are more sensitive to pollutants. But we have absolutely no idea whether they're different in reaction to this sort of radio frequency."

- (9) Two quantities used to describe simple radio signals are the frequency and the field strength.
- Radio receivers tune in to signals according to their frequency.
 - Signals must have sufficient field strength for them to be received.

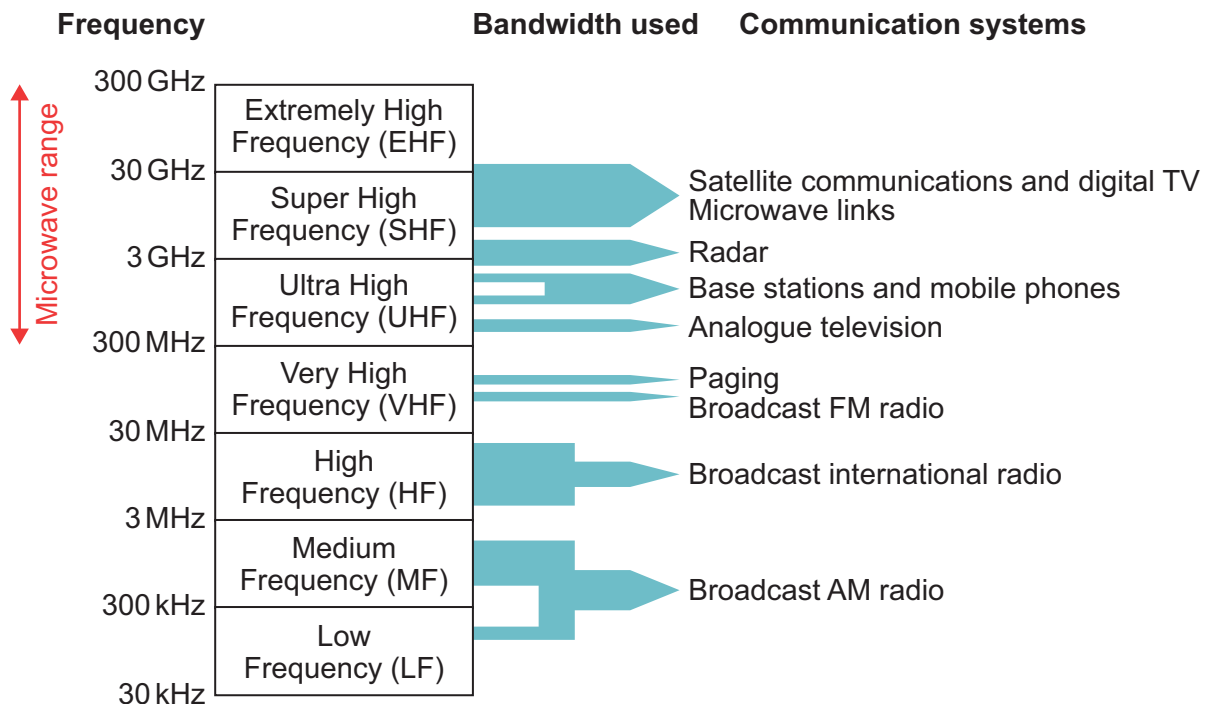
The field strength of radio waves oscillates in time as shown in **Figure 1**; the frequency is the number of cycles in field strength that occur every second.

Figure 1: Graph showing field strength against time



- (10) The use of different frequencies for different radio signals ensures they do not interfere with each other. The mobile phone networks in the UK use frequencies close to 900 MHz, 1800 MHz and 2000 MHz. Typical frequencies used for radio communications are shown in **Figure 2**.

Figure 2: Uses of radio communication frequencies in 2006



- (11) Could mobile phones turn out to be the cigarettes of the 21st century? We put it to Professor Challis that we have lived with radio waves from TV transmitters, radios and radar installations. But this is the first time in our lives that many people have stuck a transmitter right near their ear. And the exposure you get from mobile phones is thousands – ten of thousands sometimes – of times more than you get from a television broadcast or from a mobile-phone mast. “About 40% of the radio energy of that phone is absorbed into your head.”

Turn over ►

(12) It is inevitable that a proportion of the radio waves from using a mobile phone will be directed towards the user's body because mobile phones are designed to transmit radio waves in all directions, as the nearest mobile phone mast (or base station) could be in any direction.

(13) The radio waves that are directed towards the head of the phone user penetrate into the body tissues for a few centimetres. Calculations have shown that the maximum temperature rise produced in the head due to absorption of energy in the radio waves from a mobile phone is around 0.1 °C. The body is able to accommodate some extra energy being absorbed in its tissues, but beyond this point, temperature rises or thermoregulatory responses can occur.

(14) There have also been fears about the transmissions from base stations, particularly when these have been located (or planned) close to housing and schools. However, if as a society we are to have complete coverage across any region, then we need a certain density of phone masts.

Each base station handles all of the mobile phone calls taking place in a region around it known as a cell. Cells are sometimes thought of as regular hexagons making up a 'honeycomb' structure (see **Figure 4**). In practice, the shape of the cells is irregular because

- features of the local terrain, such as trees, hills and buildings, can block or weaken the radio signals
- network operators cannot always put masts where they want to because suitable sites are not available
- smaller cells are needed where there is a greater density of users, e.g. in city centres.

(15) The technology places limits on the maximum coverage area for base stations because the radio signals can only travel so far before they become too weak to be received. Using higher transmitter powers lets the radio signals travel further, but beyond around 35km, the time taken for the signals to travel between the phones and base stations becomes too great.

(16) Base stations also have limited capacity in terms of how many mobile phone calls they can handle at the same time. The number of transmitters installed on a base station determines the capacity and the number of phone users in its cell determines the level of demand.

Figure 3: Exposure from mobile phones

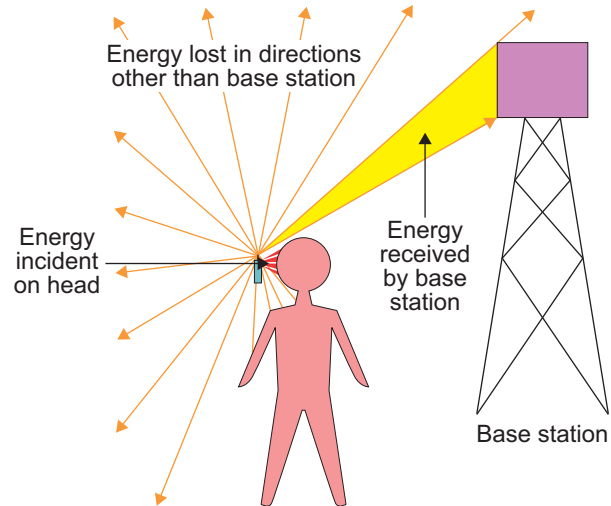
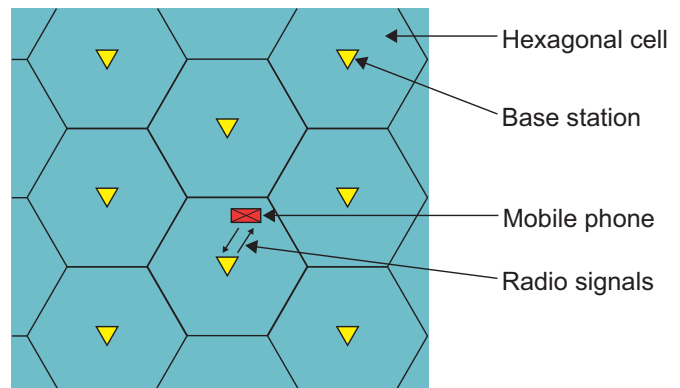


Figure 4: A simplified cell network



- (17) Given the above constraints, cells for base stations are generally 1-10 km in diameter in rural areas and a few hundred metres in diameter in urban areas. When a person using a mobile phone travels across the country, the radio communications are passed from one base station to another allowing continued communication. The radio signals never have to travel more than a few kilometres.
- (18) Professor Challis helps his case by being as sceptical about the dangers of masts, and wi-fi, as he is concerned about possible risks of mobiles. He calmly puts paid to recent panic about wireless broadband in schools. Pinging an email through wi-fi typically exposes you to 200 times less radiation than talking into a mobile phone, he says, and most children do not use their time on school computers sending email.
- (19) We ask Professor Challis if we can call him on his mobile later, on his way home. Difficult, he says – he keeps it switched off. Because of health fears? “No. I don’t like people rabbiting away on trains. It annoys me.” We are about to sigh with relief, and then he adds: “As far as health is concerned, bear in mind that I’m not a young guy. Rather different from being a child or a young person or people of your age.”

Source: Adapted from ALICE MILES and HELEN RUMBELOW,
‘If people start having trouble, it won’t show up until it is a really big effect’,
The Times, 20 January 2007

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