General Certificate of Education
June 2008
Advanced Subsidiary Examination

GENERAL STUDIES (SPECIFICATION A) **GSA2**
Unit 2   Science, Mathematics and Technology

Thursday 15 May 2008   1.30 pm to 2.45 pm

For this paper you must have:
• an objective test answer sheet
• a Data Booklet for Questions 1 to 25 (enclosed)
You may use a calculator.

Time allowed: 1 hour 15 minutes

Instructions
- Use a black ball-point pen.
- Answer **all** questions.
- Answer **both** Section 1 (Questions 1 to 25) **and** Section 2 (Questions 26 to 50) using the answer sheet provided.
- For each question there are several alternative responses. When you have selected the response which you think is the best answer to a question, mark this response on your answer sheet.
- Mark all responses as instructed on your answer sheet. If you wish to change your answer to a question, follow the instructions on your answer sheet.
- Do all rough work in your answer book, **not** on your answer sheet.

Information
- The maximum mark for this paper is 50.
- This paper consists of two sections.
  Section 1 contains 25 objective test questions based on material provided in a separate Data Booklet.
  Section 2 contains 25 objective test questions testing mathematical reasoning and its application.
- Each question carries 1 mark. You will not lose marks for wrong answers.
- 2 mm graph paper is available from the Invigilator.

GSA2

SECTION 1

Answer **Questions 1** to **25**.

Each of the 25 questions carries 1 mark.

Read the passage entitled **Our Changing Body Shape and Image** which is printed in the separate Data Booklet and answer **Questions 1** to **25** by choosing the answer represented by the letter **A**, **B**, **C** or **D** that you think best.

Questions 1 to 21

1 Which of the following statements are true?

The 'Size UK' project involved measuring

1 people of different ethnicity.
2 both rich and poor.
3 young children.
4 only women.

Answer

A if **4** alone is true.
B if **1** and **2** only are true.
C if **1**, **3** and **4** only are true.
D if all are true.

2 Which of the following statements is/are true about how the measurements were obtained for the 'Size UK' survey?

1 Digital cameras were used.
2 Lasers were used.
3 X-rays were used.

Answer

A if **1** alone is true.
B if **2** alone is true.
C if **3** alone is true.
D if **2** and **3** only are true.

3 When an individual was measured for the 'Size UK' survey, the number of photos taken at one instant was

A 2
B 4
C 6
D 8

4 Measurements are made very rapidly by the projector-camera pairs. Which of the following is the best description of the approximate rate at which measurements are made?

A   1 000 points per second
B   13 000 points per second
C   130 000 points per second
D   5 000 000 points per second

5 A digital 'skin' (paragraph 2) may be described as

A   a skin made from artificial material.
B   a photographic image made from an electronic picture.
C   a picture of the skin made of horizontal stripes of light.
D   an image made from electronic data.

6 The new measurements reveal that the increase in the average waist measurement is greater than the increase for three other measurements (paragraph 3). The number of times greater is approximately

A   1.5
B   2
C   4
D   5

7 Which of the following statements can be deduced from the data in paragraph 3?

1   More women have increased their height by 1.5 inches than by any other amount.
2   Half the female population now have a waist 6.5 inches greater than the average woman's waist in 1951.

Answer

A   if both can be deduced.
B   if **1** alone can be deduced.
C   if **2** alone can be deduced.
D   if neither can be deduced.

8 The new information (paragraph 4) will help each of the following **except**

A   the ergonometric design of chairs.
B   judgement of the value of an aerobics course.
C   a supplier of climbing gear.
D   a supplier of custom-made shoes.

Turn over ▶

9 In 1965, the gap in average height between men and women in Holland (paragraph 5) was

    A   6 cm
    B   7 cm
    C   12 cm
    D   13 cm

10 Between 1960 and 1990 the average height of a Spaniard (paragraph 5) increased overall by about

    A   3 cm
    B   5 cm
    C   7 cm
    D   10 cm

11 According to the passage, which of the following are likely reasons for the increased average height of women in the last 50 years (paragraph 6)?

    1   They have a better diet.
    2   They have fewer childhood illnesses.
    3   They do more exercise.

Answer

    A   if **1** and **2** only are correct.
    B   if **1** and **3** only are correct.
    C   if **2** and **3** only are correct.
    D   if all are correct.

12 The table shows the height and mass of three individuals, X, Y and Z.

	Height (m)	**Mass (kg)**
X	1.95	97
Y	1.8	65
Z	1.75	82

How many are of normal weight according to their BMI values (paragraph 7 and **Table 1**)?

    A   none of them
    B   1
    C   2
    D   3

13 It is generally believed that the UK is approximately 10 years behind the USA in terms of obesity. Using **Table 2**, what was the approximate percentage of obese people in the UK in 2007?

    A   15%
    B   20%
    C   25%
    D   30%

14 Using the definition of abdominal obesity in paragraph 8, which of the following would be classed as obese?

    1   a man with a waist measuring 100 cm
    2   a woman with a waist measuring 95 cm
    3   a man with a waist measuring 90 cm
    4   a woman with a waist measuring 85 cm

Answer

    A   if **1** alone is correct.
    B   if **2** alone is correct.
    C   if **1** and **2** only are correct.
    D   if **2** and **4** only are correct.

15 In 1960–62, the most common waist measurement for men (**Figure 3**) was about

    A   72 cm
    B   82 cm
    C   92 cm
    D   102 cm

16 If a teaspoon holds about 6 g of sugar (**Figure 4**), approximately how many cans need to be drunk to consume 1 kg of sugar through fizzy drinks?

    A   15
    B   50
    C   85
    D   170

17 What is the relevance of **Figure 4** in an article on changing body shape?

    A   Fizzy drinks fill your stomach up with gas.
    B   All fizzy drinks contain a lot of carbohydrates.
    C   It shows that drinking milk keeps people slim.
    D   It is evidence that diets are changing.

Turn over ▶

18   The body shape in cold climates is likely to be

    A   tall and thin.
    B   short and stocky.
    C   tall and broad.
    D   short and thin.

19   There is an anomalous relationship between the actual BMI and the 'ideal' BMI of the male population (paragraph 11) because

    A   actual BMI is decreasing and 'ideal' BMI is increasing.
    B   actual BMI is increasing and 'ideal' BMI is increasing.
    C   actual BMI is decreasing and 'ideal' BMI is decreasing.
    D   actual BMI is increasing and 'ideal' BMI is decreasing.

20   In which of the following ways has the GI Joe doll changed between 1964 and 1994?

    1   larger biceps measurement
    2   larger chest measurement
    3   smaller waist measurement

Answer

    A   if **1** and **2** only are correct.
    B   if **1** and **3** only are correct.
    C   if **2** and **3** only are correct.
    D   if all are correct.

21   Which of the following are facts rather than opinions?

    1   A girl must be slim to be popular.
    2   Most fizzy drinks are fattening.
    3   Body fat is necessary for a woman to be fertile.

Answer

    A   if **3** alone is a fact.
    B   if **1** and **2** only are facts.
    C   if **2** and **3** only are facts.
    D   if all are facts.

Assertion / Reason questions

For each of **Questions 22** to **25** you are given an assertion followed by a reason. Consider the assertion and decide whether, on its own, it is a true statement. If it is, consider the reason and decide if it is a true statement. If, and only if, you decide that *both* the assertion and the reason are true, consider whether the reason is a valid or true explanation of the assertion. Choose your answer (**A** to **D**) as follows and indicate your choice on the answer sheet.

	Assertion	Reason	Argument
A	True	True	Reason is **a correct** explanation of assertion
B	True	True	Reason is **not a correct** explanation of assertion
C	True	False	Not applicable
D	False	–	Not applicable

	ASSERTION		**REASON**
22	The gap between the average height of men and women is increasing	because	women are growing more quickly than men.
23	A reduction in the level of consumption of convenience foods should reduce levels of obesity	because	convenience foods are generally high in fat and sugar.
24	Since 1960, abdominal obesity in the USA has increased	because	less milk is now being drunk.
25	Dissatisfaction with body shape for young people is rising	because	the difference between the 'ideal' and actual BMI is increasing.

Turn over for SECTION 2

Turn over ▶

SECTION 2

Answer **Questions 26** to **50**.

For each of **Questions 26** to **50** choose the answer represented by the letter **A**, **B**, **C** or **D** that you think best. Graph paper is available from the Invigilator.
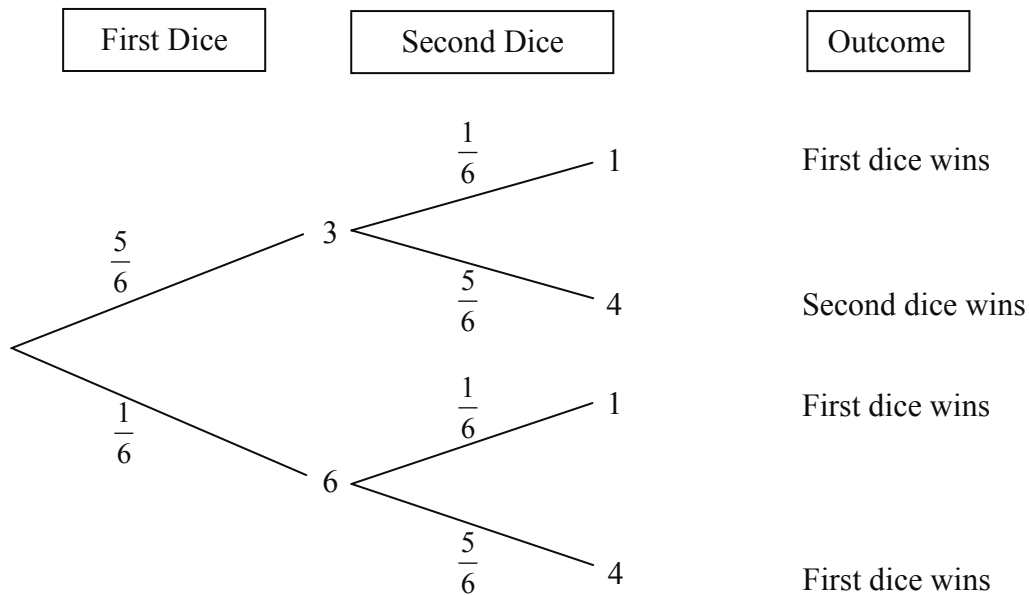
Questions 26 and 27

Two dice have their six faces marked as follows:

First dice: 3, 3, 3, 3, 3, 6
Second dice: 1, 4, 4, 4, 4, 4

The two dice are thrown together and the dice showing the higher number wins.

The tree diagram below shows the possible outcomes.

First Dice		Second Dice				Outcome

$\frac{1}{6}$ ⟋ 1   First dice wins

$\frac{5}{6}$ ⟋ 3

$\frac{5}{6}$ ⟍ 4   Second dice wins

$\frac{1}{6}$ ⟍ 6

$\frac{1}{6}$ ⟋ 1   First dice wins

$\frac{5}{6}$ ⟍ 4   First dice wins

26 The probability of getting a 6 on the first dice and a 4 on the second dice is

A $\dfrac{1}{36}$

B $\dfrac{5}{36}$

C $\dfrac{1}{2}$

D $\dfrac{5}{6}$

27 A player throws the first dice and gets a 6.

What is the probability that she gets a 4 when she throws the second dice?

A $\dfrac{5}{36}$

B $\dfrac{1}{6}$

C $\dfrac{1}{2}$

D $\dfrac{5}{6}$

28 The diagram shows the graph of a cubic function.
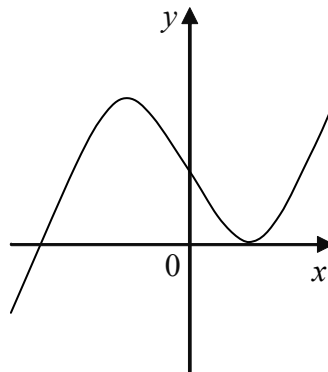
The number of different values of x for which $y = -1$ for this function is

A 0
B 1
C 2
D 3

Turn over ▶

Questions 29 and 30
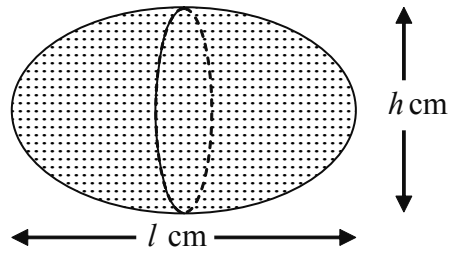
The volume, $V \text{cm}^3$, of the solid shown above is given by $V = \dfrac{\pi}{6} lh^2$.

29 What is the value of V, to the nearest whole number, when $l = 40$ and $h = 15$?

    A   628
    B   4 712
    C   98 696
    D   188 496

30 What is the formula for h in terms of l and V?

    A $h = \sqrt{\dfrac{6V}{\pi l}}$

    B $h = \sqrt{\dfrac{\pi V}{6l}}$

    C $h = \sqrt{\dfrac{6V}{\pi l}} \div l$

    D $h = \dfrac{6\sqrt{V}}{\pi l}$

31 The diagram below shows the graphs of lines $y = x + 4$, $x + y = 4$, $2y = x + 4$ and $2x + y = 8$.

Which point represents the solution of the simultaneous equations $2x + y = 8$ and $y = x + 4$?
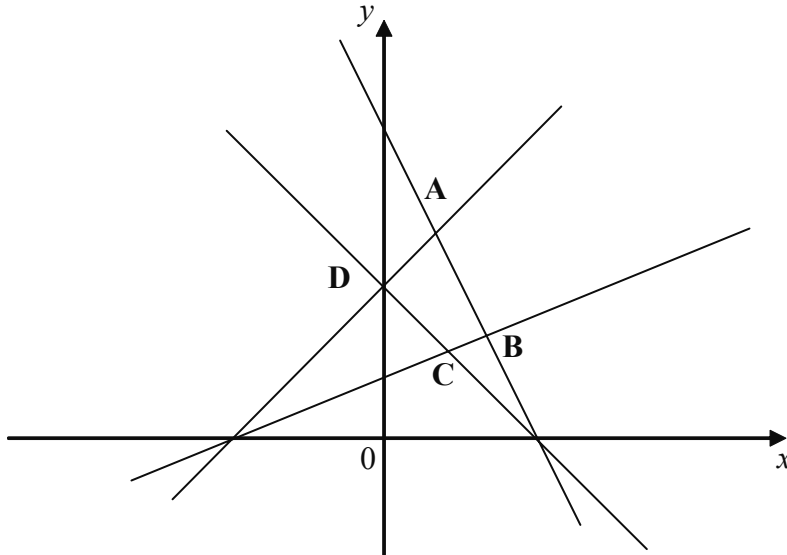
Questions 32 and 33

A person uses a metre rule to measure a length of string and finds that the string is 89 cm long.

32 When written to 1 significant figure this length is

    A   9 cm
    B   89.0 cm
    C   90.0 cm
    D   90 cm

33 The length of the string should not be written in centimetres to 3 decimal places because

    A   it is only 89 cm anyway.
    B   it would need too many zeroes after the decimal point.
    C   lengths should only be given to 1 significant figure.
    D   lengths cannot be measured that accurately with a metre rule.

Turn over ▶

34 Consider the three statements:

> Ostriches are birds.
> All birds are animals.
> Some birds cannot fly.

Which of the following conclusions can be logically deduced from the three statements?

1 Ostriches cannot fly.
2 Ostriches are animals.
3 Some animals cannot fly.

Answer

A if **1** and **2** only can be deduced.
B if **1** and **3** only can be deduced.
C if **2** and **3** only can be deduced.
D if all can be deduced.

35 A sequence consists of adding the previous three terms together to form the next term. The first three terms of the sequence are 1, 2, 3.

What is the sixth term in the sequence?

A   6
B   11
C   13
D   20

36 Which of the following is equivalent to $x^2 - 8x - 2$?

A $(x - 4)^2 - 18$

B $(x - 4)^2 - 10$

C $(x - 4)^2 + 6$
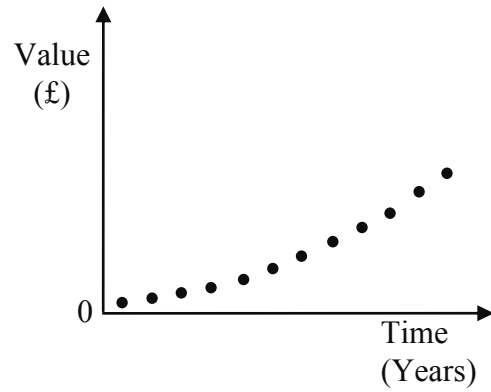
D $(x - 4)^2 + 14$

37 Sam invested £5000 at a compound interest rate of 4% per annum. Interest was added to the investment at the end of each year.

Which graph best shows the value of the investment over a number of years?
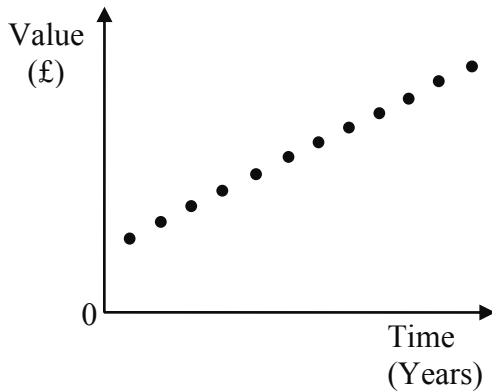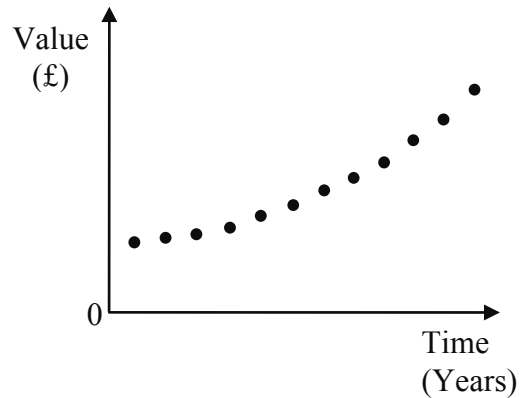
A
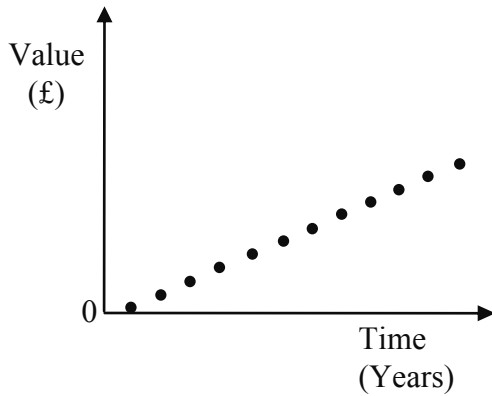
B

C

D

38 Water is entering a storage tank of capacity 1000 litres at a rate of 5 litres per second, whilst at the same time water is flowing out at a rate of 1 litre per second. If the tank is initially half full then after 1.5 minutes it will be

A   36% full.
B   72% full.
C   86% full.
D   overflowing.

Turn over ▶

Questions 39 and 40

	Mean distance from the Sun (miles)	Time for one orbit
Earth	9.3×10^7	365 days
Jupiter	4.8×10^8	4333 days

39 What is the difference between the mean distance from the Sun (in miles) for Earth and Jupiter?

A 4.5×10^1

B 4.5×10^7

C 3.87×10^8

D 4.5×10^8

40 Assuming that the Earth moves in a circular orbit around the Sun, approximately how fast (in miles per hour) is the Earth moving through space?

A   33 000
B   67 000
C   1 600 000
D   24 000 000

41 A person standing on the surface of the Earth is rotating about the Earth's axis at an angular speed, in degrees per second, of
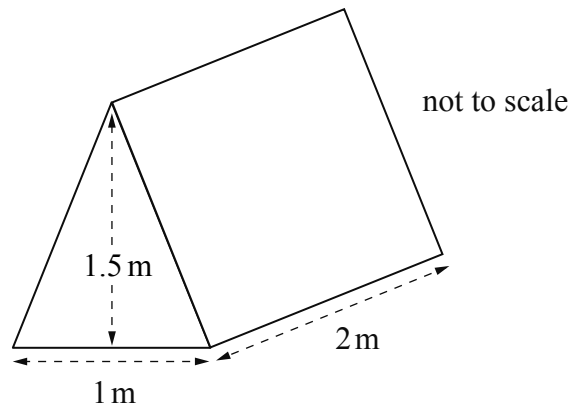
A   0.0042
B   0.25
C   15
D   900

42   If *p* and *w* are negative integers, which of the following must be positive?

    A $\dfrac{p-w}{3}$

    B $\dfrac{pw}{3}$

    C $\dfrac{p}{w} - 3$

    D $(p + w)^3$

Questions 43 and 44

A play tent is made in the shape of a triangular prism.

The tent is 2 m long, 1 m wide and 1.5 m tall at its ridge, as shown.

not to scale

43   The length of one sloping edge at the end of the tent, to the nearest 0.1 m, is

    A   1.6 m
    B   1.8 m
    C   2.0 m
    D   2.5 m

44   The angle the side of the tent makes with the horizontal is

    A   48°
    B   53°
    C   56°
    D   72°

Turn over ▶

Questions 45 and 46

In a group of people there are 13 men and 19 women. The mean weight of the men is 91 kg and the mean weight of the women is 63 kg.

45 Which, if any, of the following statements can be deduced from this information?

1 In general, men weigh more than women.
2 Every man in the group weighs more than every woman in the group.
3 The total weight of the men in the group is more than the total weight of the women in the group.

Answer

A if all can be deduced.
B if **2** and **3** only can be deduced.
C if **3** alone can be deduced.
D if none can be deduced.

46 The mean weight of the whole group is

A under 70 kg.
B between 70 kg and 75 kg.
C between 75 kg and 80 kg.
D over 80 kg.

47 A plank of wood is 1.8 m long, 12 cm wide and 15 mm thick.

Its volume, in m^3, is

A 0.00324
B 0.324
C 0.45
D 1.935

48 The value of a car is predicted to fall by 20% each year. If the car costs £14 300 when new, what is its predicted value (to the nearest £100) when it is 3 years old?

A £5 700
B £7 300
C £8 600
D £9 200

49   Each of the following is true **except**

   A $\dfrac{n}{n} = n^0$

   B $\dfrac{n^4}{n^5} = n^{-1}$

   C $\dfrac{n^6}{n^3} = n^2$

   D $n^7 \times n = n^8$

50   For two positive numbers, x and y, $x^2 + y^2 = 17$ and $x^2 - y^2 = 15$.

   What is the value of $x - y$?

   A   1
   B   2
   C   3
   D   4

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GENERAL STUDIES (SPECIFICATION A)　　　　　　**GSA2**
**Unit 2   Science, Mathematics and Technology**

AQA

Data Booklet

Data Booklet for use with **Section 1 Questions 1** to **25**

GSA2

PASSAGE FOR QUESTIONS 1 TO 25

Our Changing Body Shape and Image

(1) A project, published in 2005 called 'Size UK', has measured 11 000 people of both sexes between 16 and 95 years old with a representative spread of ethnic and socio-economic groups. The last survey of average body shape in the UK was in 1951, involved only women and was carried out using tape measures.

(2) This new study has been made easier by the development of 3D optical body scanning. Measurements of individuals are made within a private booth, with privacy being achieved by using recorded instructions. White light is projected through a horizontal grid producing stripes on the body in front of it (see **Figure 1**). A charge coupled device (CCD) camera, at a fixed baseline distance below a projector, receives the distorted image of the stripes. Computers then calculate the position of the surface of the body using triangulation. There are six projector-camera units inside each booth. Two views at 60° to each other are taken of both the body's upper front and lower front, and a straight ahead view of each of the upper and lower rear, are collected. 800 000 points are measured in 6 seconds and a digital 'skin' constructed from this 'cloud' of data. Each individual is measured sitting and standing.

Figure 1: Camera images – fine and coarse gratings

Figure 2: Triangulation between projector, camera and target subject
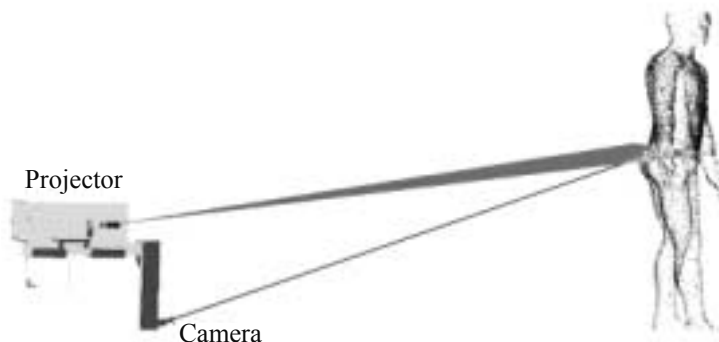
(3) From these measurements a national anthropometric database has been constructed which will be a valuable scientific resource for the future. It was found that the average height, bust and hip measurements of women over 16 have all gone up by 1.5 inches since 1951, and the average waist circumference has gone up by 6.5 inches.

(4)   The main aims of the survey were to produce better fitting clothing and to help in the development of safer seatbelts and better designed seating in the home, cars, trains and planes. The extra detail available is also interesting the medical profession. This may lead to closer correlations between body shape and health, and the effect of different exercise programmes may now be judged more accurately.

Increases in height

(5)   It is generally well known that on average we are taller than our ancestors; this is true of people in various places around the world and not just in the United Kingdom.

The people of the Netherlands, now the world's tallest, have been on an upward trend since 1851, though the rate of growth accelerated after the second world war. In 1965, the average Dutchman was 1.78 m tall. By 1997, he was 6 cm taller. The average Dutchwoman grew from 1.66 m to 1.71 m.

CLAIRE AINSWORTH, 'In Your Dreams', *New Scientist*, 2004

The Spanish grew 2.4 cm per decade between 1960 and 1990. In Western Europe this growth has now slowed to about 1 cm per decade but Eastern Europe and Japan are increasing by up to 3 cm per decade. However, on average, women are increasing in height more slowly than men so the gap in height between the sexes is widening.

(6)   It has been found that it is the first two years of life which are the most important for height, when the leg bones are growing rapidly. Not only increased food supply but also general health improvement brought about by antibiotics and vaccinations have had an effect. Your final height, however, is still dependent on the height of your parents and grandparents.

Increases in weight

(7)   You would expect taller adults to weigh more, so to take this into account the Body Mass Index (BMI) was devised.

BMI for adults = mass in kg / (height in m)^2

The United States is the worst affected by obesity by this definition but some other countries are not far behind. This measure is not applicable to children and adolescents because necessary fat is accumulated at different stages in growth. It is normal, for example, for girls at puberty to double their body fat and this is needed for fertility. Such 'puppy fat' soon disappears with adulthood.

Table 1: Descriptions of adults according to their BMI values

	Underweight	Normal	Overweight	Obese
BMI	less than 18.5	18.6 to 24.9	25.0 to 29.9	above 30

**Table 2: Proportions of obese men and women in the USA population from 1960**

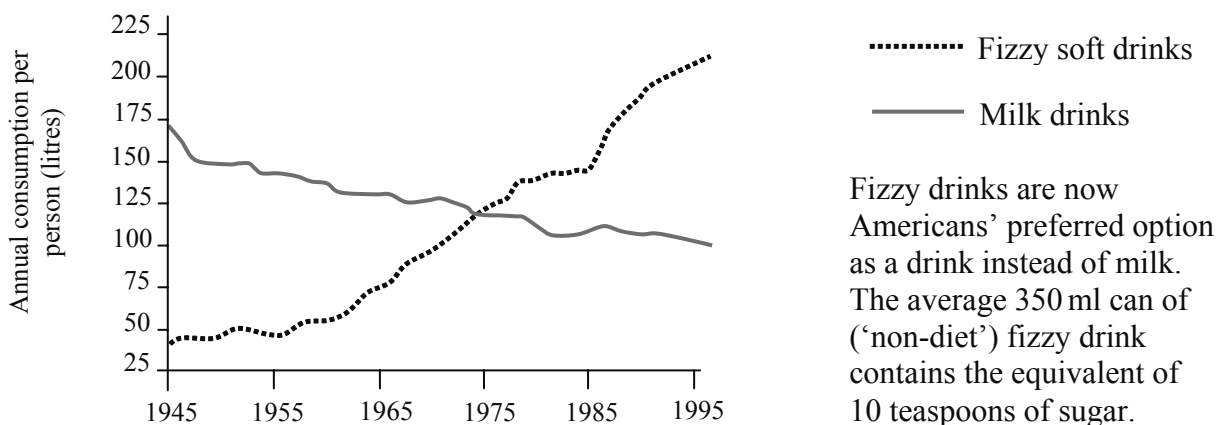|	1960 to 1980	1991	2007
Obese men USA	13%	21%	28%
Obese women USA	17%	26%	34%

Turn over ▶

Effect on Health

(8)   Where fat is deposited around the body affects health. Fat around the midriff and upper body produces a higher risk of developing diabetes, heart attack or stroke and unhealthy levels of fats in the blood. Waist circumference is a simple measure used at present. Medical experts think that the more detailed analyses becoming available will lead to finer discrimination between body types and health risks. In the USA since 1960 men's waists have increased on average by 9.9 cm and women's by 23.2 cm. **Abdominal obesity** is defined as a waist greater than 88 cm (35 inches) for women, and 102 cm (40 inches) for men. 40% men and 60% women in the USA satisfy this criterion, a much higher figure than that produced using the BMI.

Figure 3: Distribution of waist circumference in US adults
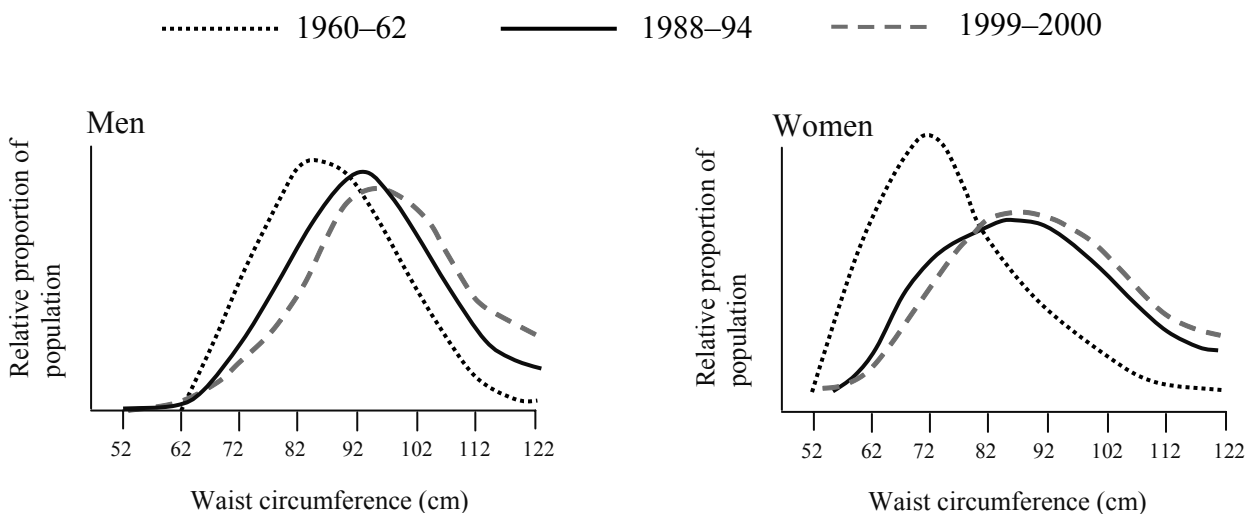
(9)   Even worse than added fat, it has been found that some overweight people are losing lean tissue or muscle. This is particularly worrying as it has now been detected as occurring in young children. Boys lost 3.2% of muscle from the mid 1970s to the 1990s and girls lost 3.6%. Some believe this could be blamed on a more sedentary lifestyle. About one half of girls and one quarter of boys now take no regular exercise, even in the playground, and a quarter of US children watch TV for more than 4 hours a day. Properly developed muscles are needed for strong bones. A typical Western diet has also changed significantly as the quantity of food eaten has gone up during this time, but the quality has gone down. Convenience foods are generally high in fat and sugar but low in nutrition.

Figure 4: Average consumption of milk and fizzy drinks in the USA

Fizzy drinks are now Americans' preferred option as a drink instead of milk. The average 350 ml can of ('non-diet') fizzy drink contains the equivalent of 10 teaspoons of sugar.
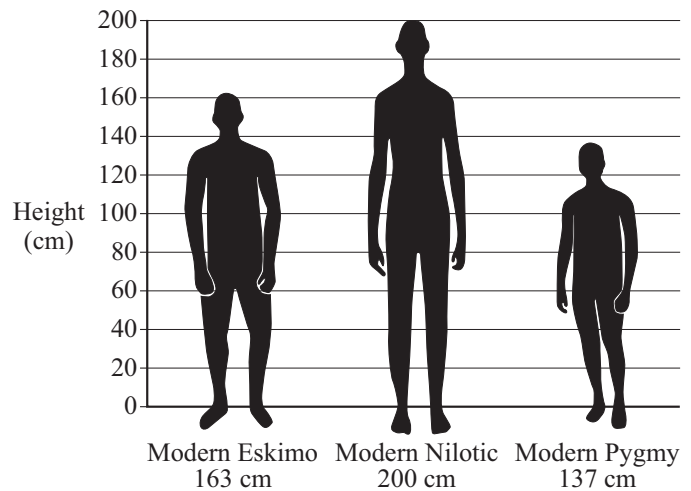
Other factors

(10) The origin of different peoples around the globe also has an effect on body shape. In order to lose or conserve body heat, the ratio of surface area to body mass alters. At low latitudes people may be tall and thin like the Nilotics who live in equatorial Africa, whereas the Eskimos living in the Arctic are shorter and bulkier. Where it is very humid a small size is advantageous, as exemplified by the Pygmies who live in tropical rain forests.

Figure 5: Typical body heights for people from different climatic regions

(11) If you compare modern film and pop 'stars' with those of the past there have been great changes in the looks we admire. Studies based on analysing Playboy and Playgirl centrefolds over the last twenty years concluded that the 'ideal' for women has become more androgynous (bust and hips reduced, waist increased) and the 'ideal' for men has become more 'masculine' showing muscles like a body builder. It is suggested that the cause of this change in the 'ideal' male form may be the result of women having invaded other areas such as traditional male employment, but only men can develop muscle to this extent. In practice then as the actual BMI is rising, the 'ideal' BMI is falling. This leads to dissatisfaction with body shape and may lead young people to unsuitable dieting or muscle building exercise in order to be popular.

(12) The change in body shape has even affected our toys. For a real average woman to look like Barbie she would be 50 cm taller, her bust 13 cm larger and waist 15 cm smaller. In 1978 the Star Wars figures resembled their actors but by 1997 artistic licence had been used to alter the proportions. A similar change occurred with GI Joe dolls.
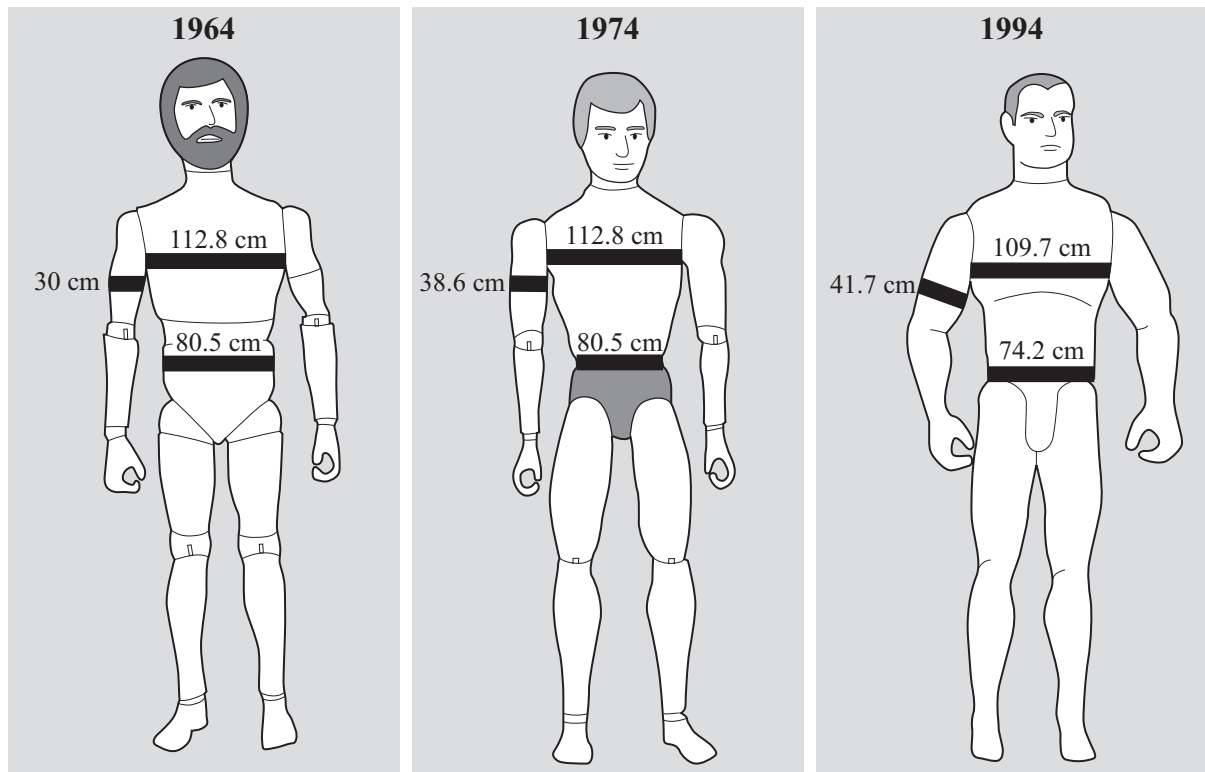
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Figure 6: How GI Joe dolls would measure up if scaled up to a height of 178 cm

(13) We all know what we must do to become less obese – eat healthy and unprocessed foods, especially fruit and vegetables, and take regular exercise – but how to alter the image of the bodyshape we would like to have is a much more complex process.

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