General Certificate of Education
January 2007
Advanced Level Examination

GENERAL STUDIES (SPECIFICATION A) **GSA5**
Unit 5 Science, Mathematics and Technology

Thursday 25 January 2007 1.30 pm to 3.00 pm

For this paper you must have:
- an objective test answer sheet
- an 8-page answer book
- a black ball-point pen.

You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use a black ball-point pen for recording your answers to Questions 1.1 to 1.20 on your objective test answer sheet.
- Use blue or black ink or ball-point pen for answering **one** question from Questions 2.1 to 2.6.
- Write the information required on the front of your answer book for Question 2. The *Examining Body* for this paper is AQA. The *Paper Reference* is GSA5.
- Answer **all** of Question 1 (1.1 to 1.20) using the answer sheet provided **and one** question from Questions 2.1 to 2.6 in a separate answer book.
- For each item in Question 1 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.
- Do all rough work in your answer book, **not** on your answer sheet.

Information
- The maximum mark for this paper is 45.
- This paper consists of **two** questions.
  Question 1 contains 20 objective test questions based on a variety of exercises in spatial and mechanical relations. Each question carries 1 mark. You will not lose marks for wrong answers.
  Question 2 consists of six alternative essay questions (2.1 to 2.6). 25 marks are available for your essay.

QUESTION 1

Answer Questions 1.1 to 1.20.

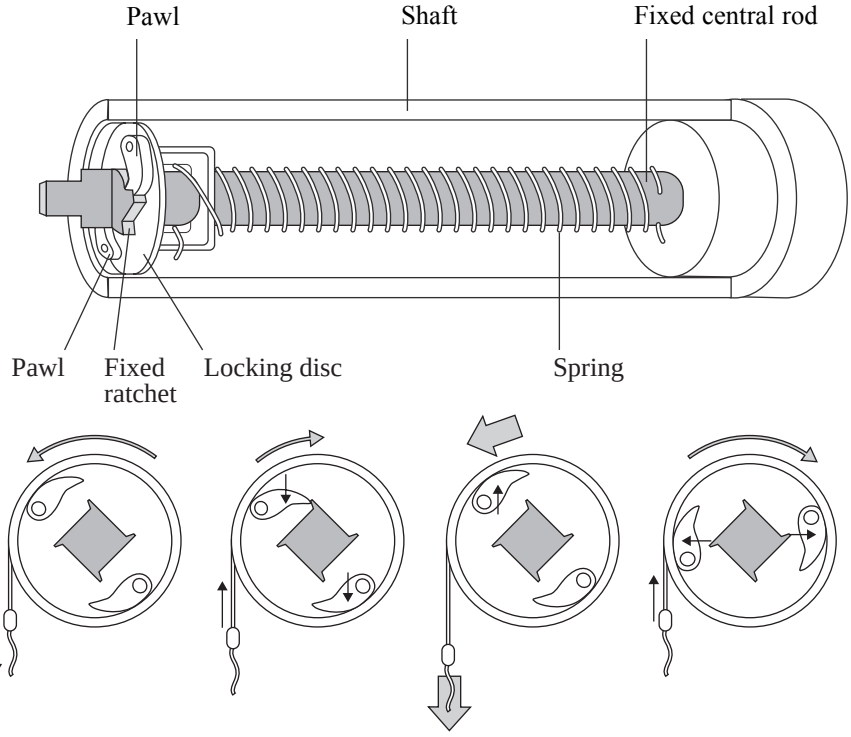
Answer **Questions 1.1** to **1.20** by choosing the answer represented by the letter **A**, **B**, **C** or **D** that you think best.

Questions 1.1 to 1.5

Roller Blind

A roller blind is lowered simply by pulling it down; the blind unrolls and remains in any position. To raise the blind, all that is needed is a sharp tug and the whole blind will roll up. But how can the blind tell a gentle pull from a sharp tug?

The shaft on which the blind is rolled contains a powerful spring, which is wound up as the blind is lowered. A locking mechanism – a simple ratchet – prevents the spring unwinding if it is released gently. But when the blind is pulled suddenly, the ratchet no longer holds the blind in position.



Lowering the blind
As the shaft rotates, it turns the locking disc which winds up the spring. The pawls are hinged and move over the ratchet, which is fixed to the central rod and does not move.

Securing the blind
When the shaft stops, the spring pulls the locking disc back slightly. One of the pawls falls to engage the ratchet, securing the locking disc. The other pawl drops, with gravity, to rest freely on the inside of the shaft.

Freeing the blind
A tug on the blind rotates the shaft sharply, making the locking pawl move up and back and disengage from the ratchet. The locking disc is now free to move.

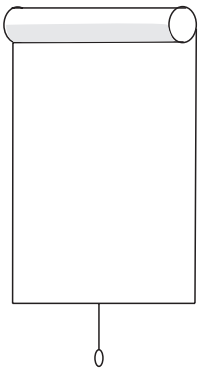
Raising the blind
The spring unwinds, rotating the shaft and locking disc rapidly.

1.1 The energy stored in the blind before it is freed and raised is essentially

A light energy.
B potential energy.
C kinetic energy.
D sound energy.

1.2 Which of the roller blinds shown below is likely to have the most energy stored before being freed?

A



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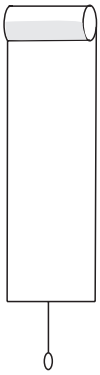
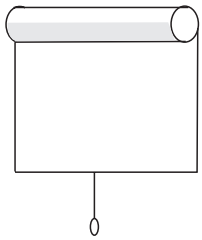
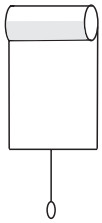


C



D



1.3 The same locking principle could be used in each of the following **except**

A reels of electrical extension cable.
B metal tape measures.
C shop window canopies.
D car safety belts.

1.4 The number of times a metre long blind fitted to a three centimetre diameter shaft will be looped around the shaft is approximately

A 5
B 11
C 17
D 33

1.5 The work needed to raise the blind is provided by the

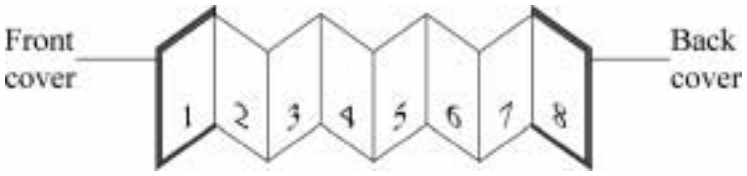
A spring.
B operator.
C ratchet.
D pawls.

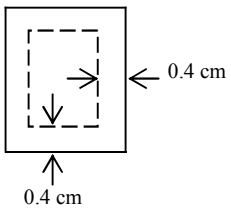
Folded Books

Simple handmade books can be made by folding paper in various ways.

Questions 1.6 to 1.7

One design is an accordion book. A rectangular strip of paper is folded forwards and backwards alternately to form the pages. To finish the book, card covers are glued to the backs of the first and last pages.

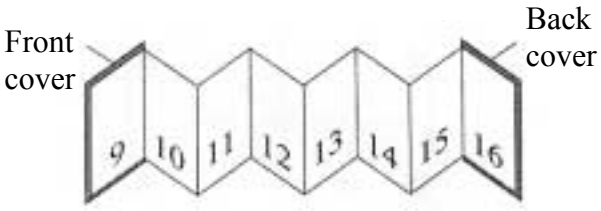




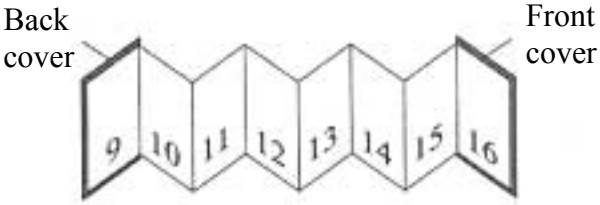
This book is folded from a strip of paper 50 cm long and 8 cm high. The front and back covers have a border 0.4 cm bigger than the pages to which they are attached.

1.6 The accordion book would appear from the back as

A



B



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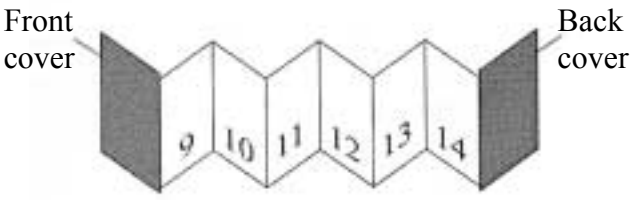

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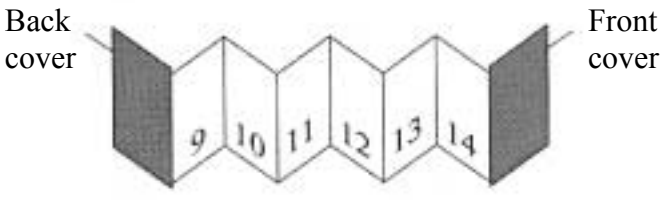


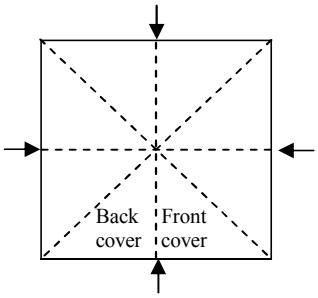
1.7 The length of paper needed to make an accordion book with pages measuring 9 cm wide by 12 cm high and numbered 1 - 18 is

A 81 cm
B 90 cm
C 120 cm
D 160 cm

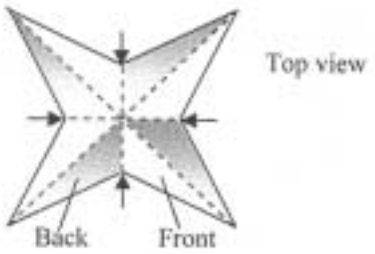
Question 1.8

Another type of folded book is one with triangular pages.

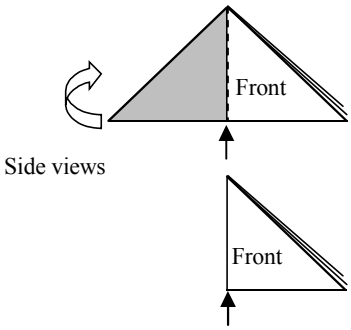
Fold a square of paper along all of its lines of symmetry



Push the folded square in the direction of the arrows to bring the points at the heads of the arrows together at the base of the spine of the book and form the double layer triangular pages.

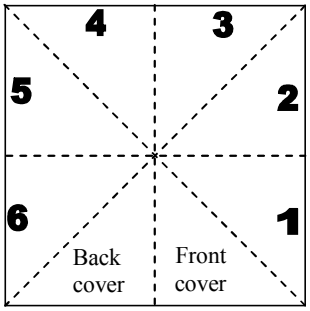


Finally fold the back cover round so that the front and back covers encase the book.



1.8 The page numbers are written at the bottom of each page. Which diagram shows the correct numbering?

A



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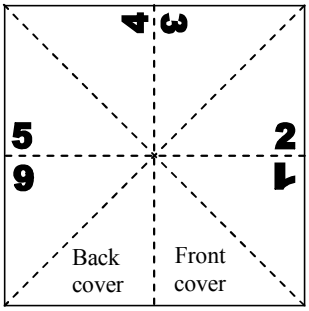

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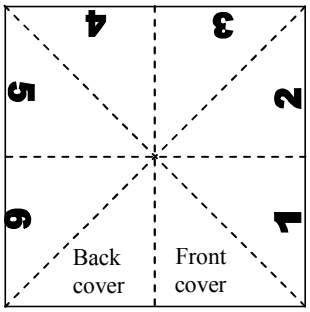
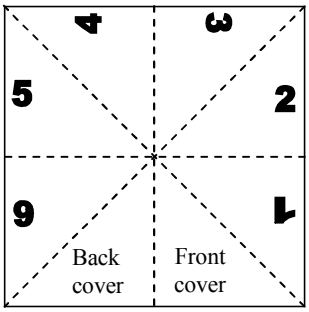


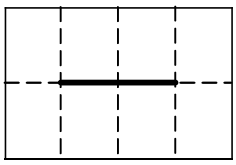
D



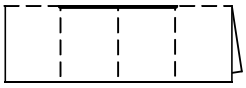
Questions 1.9 to 1.10

Another type of folded book also has double-layered pages. It is a rectangular version of the book with triangular pages.

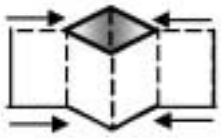
Make folds (shown by dotted lines) in the paper to divide it into eighths. Cut along the solid line.



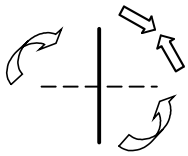
Fold paper in half lengthwise then push ends together to form the double layer pages.



Side views



Finally fold the pages round to make the book.



Top view

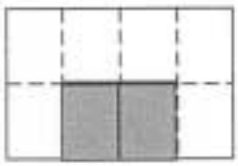
1.9 The shape of the paper used to make this book

A may be any sized rectangle.
B must be a rectangle that is not a square.
C must be a rectangle that is longer than it is high.
D must be a rectangle whose measurements are even numbers of centimetres.

1.10 Which of these diagrams show possible positions for the front and back covers of the folded book?

1

2



3

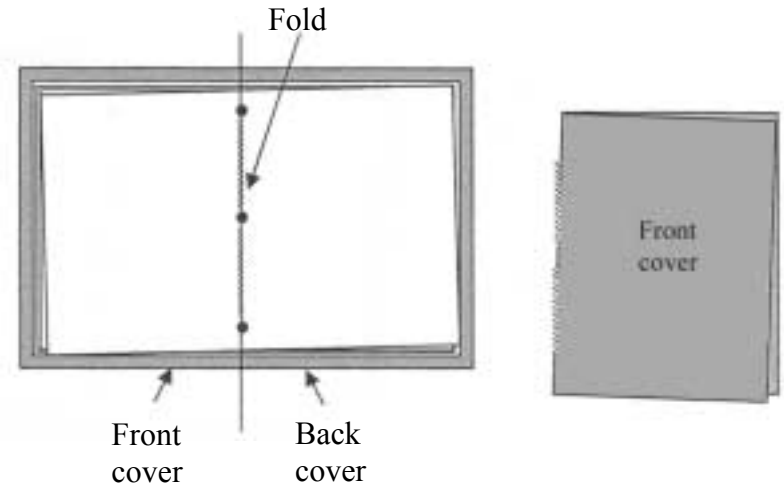
4

Answer

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

Questions 1.11 to 1.13

A more conventional type of handmade book can be made simply by placing a number of single sheets of paper on top of one another on top of a sheet of card for the cover, stitching them through the middle, and folding the result in half.



1.11 How many sheets of paper (apart from the cover) are needed to make a book like this where the final page is numbered 48?

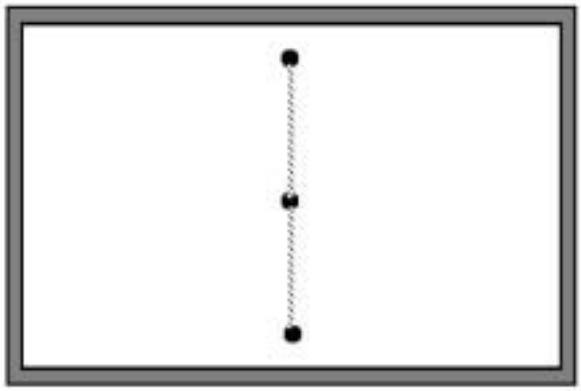
A 6
B 12
C 24
D 48

1.12 A book like this is made using 5 sheets of paper (not including the cover). One sheet of paper is numbered 6 on its left-hand side. What number is on the right-hand side of the sheet?

A 7
B 10
C 12
D 15

Turn over for the next question

1.13



A book has a cover made from a sheet measuring 30 cm by 20 cm. The book is stitched together with thread through 3 holes in the spine of the book, one in the centre of the spine and the others 2.5 cm from the top and bottom of the spine.

The stitching is done as follows:

Go through the centre hole from the outside first. Next, go through one of the other holes followed by the last hole and back through the first one from the inside.

An extra 30 cm of thread is needed for ties and decoration. How much thread is needed to stitch and tie this book? (Ignore the thickness of the book.)

A 15 cm
B 30 cm
C 45 cm
D 60 cm

Turn over for the next question

Questions 1.14 to 1.20

Pianos

The piano is a large and versatile stringed musical instrument. The full name is 'pianoforte' meaning 'soft-loud'. The concert grand piano has a keyboard with 88 keys, each of which, when depressed, sets a mechanism in motion, resulting in a felt-covered hammer hitting strings and causing them to vibrate. The pianist has control over whether notes are sounded loudly or softly depending on how hard he or she presses the keys.

Figure 1: A simplified version of a grand piano without the black keys shown viewed from above

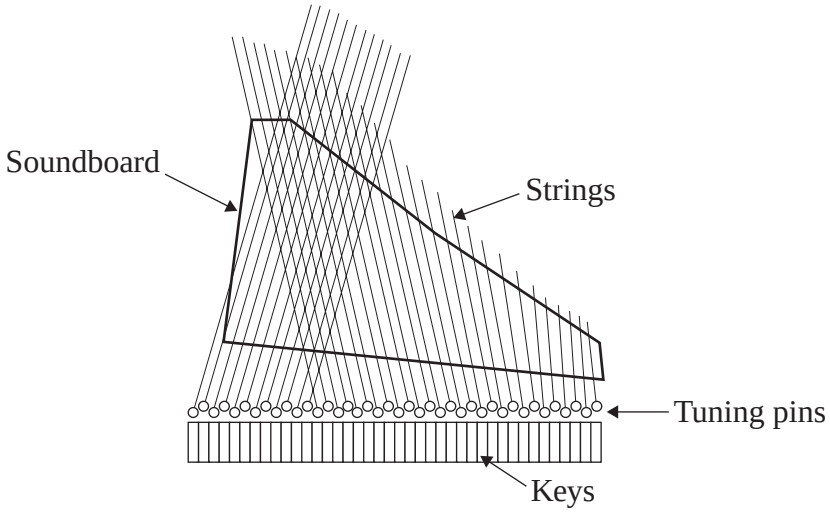
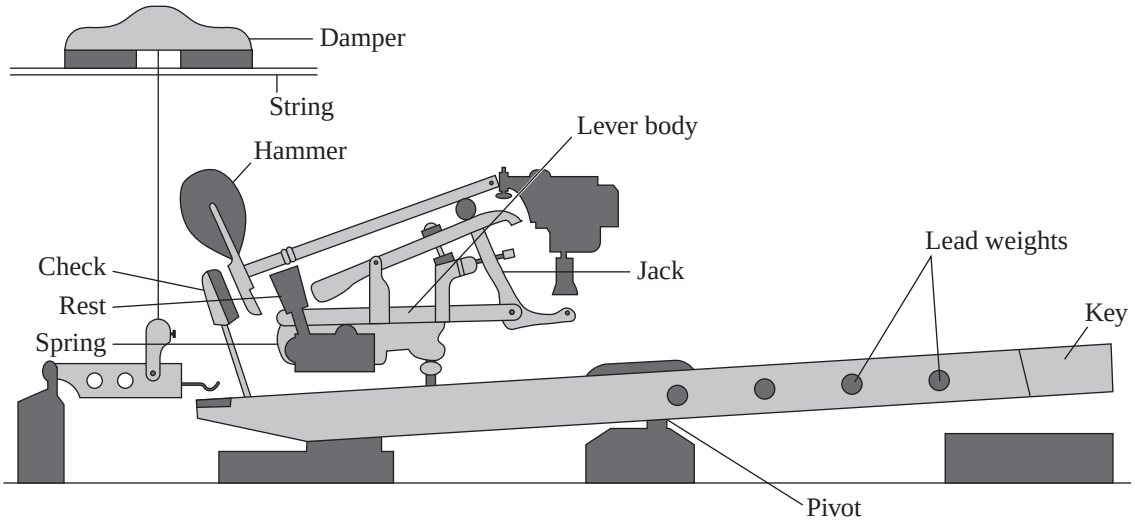


Figure 2: The piano key mechanism, with the key shown in its resting position



When the key is pressed, the lever body lifts and rotates, causing the jack to lift the hammer. When the jack hits the regulating rail (not shown), it rotates relative to the lever body and the hammer continues upwards without being pushed, hitting the string whilst moving freely.

A grand piano has three pedals; the left pedal moves the hammers relative to the strings so that the notes are played more softly; the right pedal lifts the dampers from all the strings; the centre pedal causes any dampers that are already lifted by the player's keystrokes to remain in the up position as long as the pedal is down.

1.14 The contacts between the moving parts of the piano have one or both surfaces coated with felt or leather. This is

A to ensure smooth and silent motion.
B to ensure that the parts rebound from one another.
C because leather and felt are renewable resources.
D because leather and felt are long lasting.

1.15 Each of the piano strings has a damper on it (**Figure 2**), which is lifted when the piano key is played. The purpose of the damper is to

A make the strings vibrate longer.
B change the frequency of the vibrations of the strings.
C stop the strings vibrating.
D prevent damage to the strings.

1.16 The soundboard of the piano is a curved board that goes across the width of the piano under the strings. Its purpose is to

A amplify the sound of the piano.
B stop the vibration of the piano.
C hold the piano in shape.
D provide damping so that the notes do not sound for too long.

1.17 Many modern grand pianos are cross-strung, as shown in **Figure 1**, where one set of strings passes over another. The advantage(s) of this method of stringing over parallel strings is/are that

1 the strings cover a greater area of the soundboard.
2 the strings can vibrate against one another.
3 longer bass strings can be used without increasing the overall size of the piano.

Answer

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

1.18 When the hammer hits the strings, the energy transfer sequence relevant to the sounding of the note is

A potential energy of hammer ⟶ potential energy of string ⟶ sound energy
B kinetic energy of hammer ⟶ potential energy of string ⟶ sound energy
C kinetic energy of hammer ⟶ kinetic energy of string ⟶ sound energy
D potential energy of hammer ⟶ kinetic energy of string ⟶ sound energy

1.19 The strings for high notes compared with strings for low notes are

A longer and thinner.
B shorter and thinner.
C longer and thicker.
D shorter and thicker.

1.20 If a note continues to sound after the key has been released, this could be because the

1 right pedal is depressed.
2 centre pedal is depressed.
3 damper is missing.
4 piano is not correctly tuned.

Answer

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

END OF QUESTION 1

QUESTION 2

Answer **one** of **Questions 2.1** to **2.6** in English.

Each question carries 25 marks.

Answer this question in a **separate** answer book. Label this answer book **GSA5 Question 2**.

Where appropriate include relevant science and use examples to illustrate your answer.

Write your answer in continuous prose as if you are addressing the intelligent general reader. You will be marked on your ability to use good English, to organise information clearly and to use specialist vocabulary where appropriate.

2.1 Some problems which science and technology are trying to address are international in scale, e.g. global warming, flu pandemics, computer crime, national disasters emergency planning.

Discuss the causes and effects of one such problem. To what extent is international scientific and technological co-operation needed to solve this problem? How realistic is such co-operation?

2.2 Explain how canals have been engineered to deal with the practical problems presented by the landscape.

How realistic is the suggestion that our canals and waterways could be used more extensively for freight traffic to relieve pressure on roads and motorways?

2.3 Using suitable examples, explain the contributions to knowledge of classical physics and quantum physics.

2.4 Trips into space for the exceptionally wealthy are now a reality, and holidays in space may become more widely available later in the 21st century.

Explain the scientific principles involved in space travel.

Discuss the attractions and risks involved in recreational space journeys.

2.5 Explain the science of how embryonic stem cell lines are established.

Indicate their potential medical benefits and discuss the ethical concerns about their production and use.

2.6 Discuss, in scientific and technological terms, threats to the human food chain.

END OF QUESTIONS

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