

General Certificate of Education
January 2005
Advanced Subsidiary Examination



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

GSA2

Thursday 13 January 2005 Morning Session

In addition to this paper you will require:

- an objective test answer sheet;
- a data booklet for Questions 1 to 25 (enclosed);
- a black ball-point pen.

You may use a calculator.

Time allowed: 1 hour 15 minutes

Instructions

- Use black ball-point pen.
- Answer **all** questions.
- Answer **both** Section 1 (Questions 1 to 25) **and** Section 2 (Question 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 this 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 (Questions 1 to 25) based on material provided in a separate data booklet.
Section 2 contains 25 objective test questions (Questions 26 to 50) testing mathematical reasoning and its application.
- Each question carries 1 mark. No deductions will be made for wrong answers.
- 2 mm graph paper is available from the Invigilator.

Advice

- Do not spend too long on any question. If you have time at the end, go back and answer any question you missed out.

SECTION 1**Answer Questions 1 to 25**

Each of the 25 questions carries 1 mark.

Read the passage entitled **HEARING AND NOISE INDUCED LOSS** which is printed in the separate data booklet.

Each of questions **1** to **22** consists of a question or an incomplete statement followed by four suggested answers or completions. You are to select the most appropriate answer (**A** to **D**) in each case.

Questions 1 to 22

- 1** The space between the ear-drum and the oval and round windows (Figure 1) is known as the
- A** outer ear.
 - B** auditory canal.
 - C** middle ear.
 - D** inner ear.
- 2** The pinna of the ear (Figure 1) assists hearing because it
- A** focuses sound waves on the eardrum.
 - B** detects the direction from which the sound comes.
 - C** filters out extraneous noise.
 - D** vibrates with the sound waves.
- 3** The Eustachian tube (Figure 1) goes from the ear to the
- A** brain.
 - B** eye.
 - C** throat.
 - D** nose.
- 4** The diameter of the average ear-drum (Figure 1) is approximately
- A** 1 μm
 - B** 1 mm
 - C** 1 cm
 - D** 10 cm

5 If pressure is defined as force per unit area then which of the following is/are correct?

- 1 Increasing force increases pressure.
- 2 Increasing area increases pressure.
- 3 Decreasing area increases pressure.
- 4 Decreasing area decreases pressure.

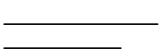
Answer

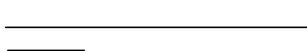
- A if 1 alone is correct.
- B if 1 and 2 only are correct.
- C if 1 and 3 only are correct.
- D if 2 and 4 only are correct.

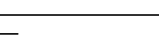
6 A pressure increase is necessary across the middle ear because

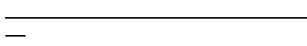
- A air needs greater pressure to transmit vibrations.
- B fluid in the cochlea needs greater pressure than the air.
- C the auditory nerve needs a greater stimulus.
- D hairs in the cochlea are of different lengths.

7 Which diagram best represents the relative lengths of the longest and shortest hairs in the cochlea (paragraph 5 and Figure 2)?

A 

B 

C 

D 

8 Potential difference (paragraph 4) is measured in

- A decibels.
- B pascals.
- C watts.
- D volts.

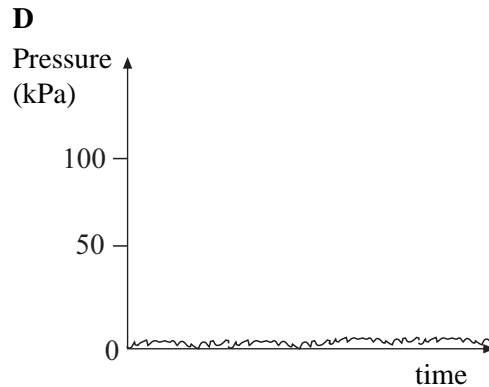
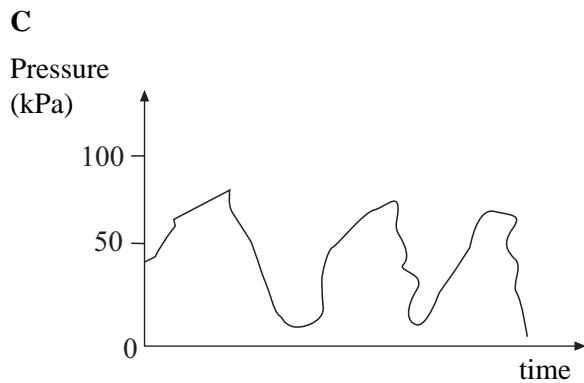
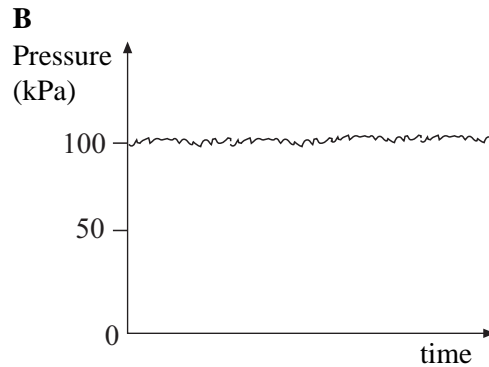
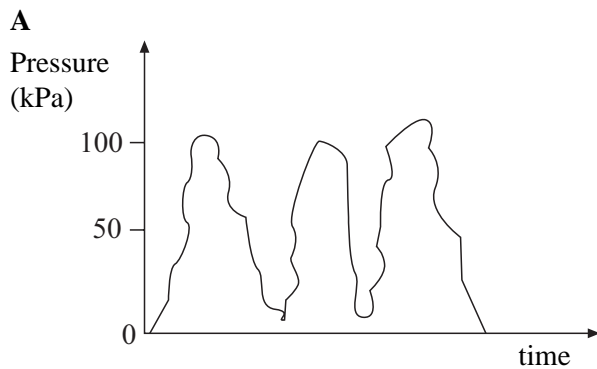
9 The output of the piezoelectric effect (paragraph 4) is a potential difference. The input energy is

- A chemical.
- B magnetic.
- C light.
- D mechanical.

Turn over ►

- 10** Look at Figure 2 and paragraph 5.
The length of ‘hair’ which vibrates at the most sensitive frequency appears to be
- A** 0.05 mm
 - B** 0.15 mm
 - C** 0.25 mm
 - D** 0.35 mm
- 11** The ear will hear (paragraph 5) which of the following frequencies most easily?
- A** 2.5 Hz
 - B** 25 Hz
 - C** 250 Hz
 - D** 2500 Hz
- 12** A sound with an intensity of 60 dB could be detected by someone with average hearing at which of the following frequencies (Figure 3)?
- A** 20 Hz
 - B** 120 Hz
 - C** 40 kHz
 - D** 140 kHz
- 13** A cochlea implant (paragraph 7) sends electrical signals to the auditory nerve. A device which changes sound into electricity is a
- A** dynamo.
 - B** loudspeaker.
 - C** microphone.
 - D** photocell.

- 14 Which graph best shows the fluctuations in pressure of a sound wave in the Earth's atmosphere?



- 15 In the past a deaf person would use an ear trumpet. The principal reason why this worked was because it

- A reminded people to speak loudly.
- B amplified the sound.
- C transmitted high-pitched sounds.
- D focused sound on the ear-drum.

- 16 Which of the following explains why some people suffer from NIHL (paragraph 6) more easily than others?

- 1 microwave radiation from mobile phones
- 2 some people inherit the tendency to suffer NIHL easily
- 3 repeated use of a personal stereo on high volume
- 4 increasing age

Answer

- A if 1 alone is correct.
- B if 2 and 3 only are correct.
- C if 1 and 4 only are correct.
- D if all are correct.

Turn over ►

- 17 If there is little absorption of energy between the source of sound and the listener, the intensity, I , is inversely proportional to the square of the distance, x , between the source and the listener

(i.e. $I \propto \frac{1}{x^2}$).

So if you double the distance you are from the loudspeaker, the volume would go down by a factor of

- A 2
 - B 3
 - C 4
 - D 8
- 18 A sound with a frequency of about 3 500 Hz and intensity level of 40 dB could be heard by which of the following people (Figures 4a, b & c)?
- 1 someone with normal hearing
 - 2 someone suffering from noise induced hearing loss
 - 3 someone with age related hearing loss

Answer

- A if 1 alone is correct.
 - B if 1 and 2 only are correct.
 - C if 1 and 3 only are correct.
 - D if all are correct.
- 19 A person who had both age related and noise induced hearing loss (Figures 4b & 4c) would not be able to hear **any** sound unless it was at least
- A 10 dB
 - B 20 dB
 - C 30 dB
 - D 40 dB
- 20 For normal age related hearing loss the cochlea hairs which first lose their elasticity (paragraph 3 and Figure 4c) are
- A the short ones.
 - B the middle ones.
 - C the long ones.
 - D spread along the length of the cochlea.

- 21 Which sequence best represents the order of the energy changes which take place inside the ear (paragraphs 1, 2 and 4)?
- A electrical to mechanical to sound
 B mechanical to electrical to sound
 C sound to mechanical to electrical
 D sound to electrical to mechanical
- 22 The principal cause of hearing loss identified in the passage is
- A glue ear.
 B damage to the ear-drum.
 C damage to the cochlea.
 D damage to the chain of bones.

Assertion/reason questions

In Questions 23 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, then 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

- | | | | |
|----|--|---------|--|
| 23 | Your hearing could not be permanently damaged by a 'banger' firework | because | one loud noise alone would do no harm. |
| 24 | High notes have higher frequencies than low notes | because | the 'hairs' nearest the oval window vibrate most with low notes. |
| 25 | Human speech is particularly difficult to interpret if you have noise induced hearing loss | because | the hairs that respond to frequencies in the region 3-6 kHz are the worst affected by noise. |

TURN OVER FOR SECTION 2

Turn over ►

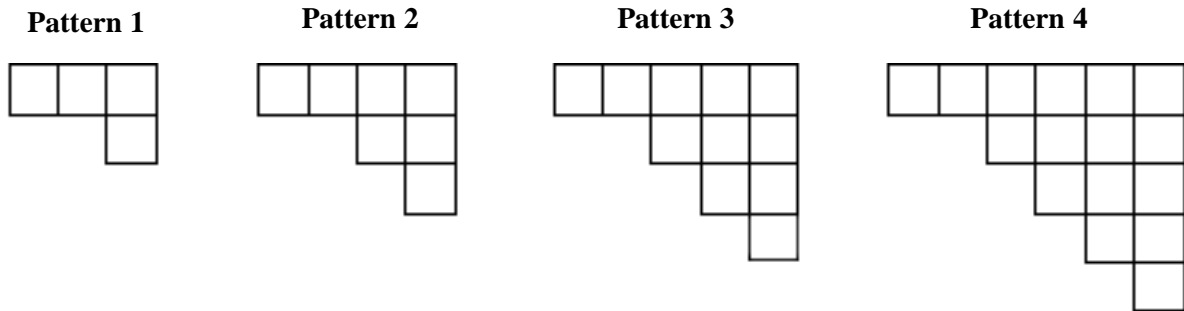
SECTION 2

Answer Questions 26 to 50

Each of the 25 questions carries 1 mark.

For each of Questions 26 to 50 choose the answer you consider the best of the alternatives offered in A, B, C and D. You are reminded that graph paper is available on request from the Invigilator.

- 26 In the diagram, each pattern is made by adding more squares onto the previous pattern.



Pattern Number	1	2	3	4
Number of Squares	4	7	11	16

The number of squares in the n^{th} pattern is given by the formula

- A $n^2 + 3$
- B $4n - 1$
- C $\frac{1}{2}(n^2 + 3n + 4)$
- D $\frac{1}{2}(n^2 - n + 2)$
- 27 The average life span in Britain is now about 75 years. Which of the following is the best approximation for this life span in seconds?
- A 3.9×10^7
- B 9.9×10^7
- C 2.2×10^9
- D 2.4×10^9

Questions 28 and 29

Ten people complete a challenge.

The times, in minutes, taken by eight of them are

8, 6, 5, 12, 4, 10, 12 and 6.

The remaining two people take longer than 15 minutes to complete the challenge.

28 The median time for the whole group to complete the challenge is

- A 6 minutes
- B 7 minutes
- C 8 minutes
- D 9 minutes

29 One person is chosen at random from the whole group.
What is the probability that this person did not complete the challenge within 11 minutes?

- A $\frac{1}{4}$
- B $\frac{2}{5}$
- C $\frac{3}{5}$
- D $\frac{3}{4}$

30 A fir tree can be modelled as a cone. The volume of a cone is given by the formula $V = \frac{1}{3} \pi r^2 h$.

A particular tree has a base radius of 3 metres and a height of 10 metres. If a cubic metre of this tree contains on average 10 000 needles, which of the following is the best approximation for the total number of needles for this particular tree?

- A 100 000
- B 500 000
- C 1 000 000
- D 5 000 000

31 The value of y is inversely proportional to the value of x . If the value of x is doubled, the corresponding value of y is

- A divided by 4.
- B divided by 2.
- C multiplied by 2.
- D multiplied by 4.

Questions 32 to 34

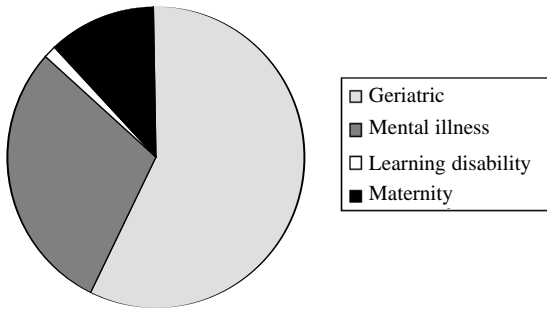
The table below shows the number of outpatients attending hospital for their first visit during the ten year period from April 1991 to April 2001.

Year	Cases				
	Acute	Geriatric	Mental illness	Learning disability	Maternity
1991-92	7 965 550	70 409	218 465	3 048	684 054
1992-93	8 411 632	76 739	237 763	3 884	612 262
1993-94	8 748 127	83 390	243 373	5 230	600 473
1994-95	9 419 243	93 674	257 179	4 661	588 120
1995-96	10 026 261	101 485	271 227	5 496	584 865
1996-97	10 304 790	110 329	284 850	5 634	588 466
1997-98	10 536 182	106 905	290 019	6 273	590 053
1998-99	10 810 904	107 619	287 411	6 493	565 353
1999-00	11 180 486	113 024	281 578	6 990	554 327
2000-01	11 523 764	113 551	284 884	7 497	536 537

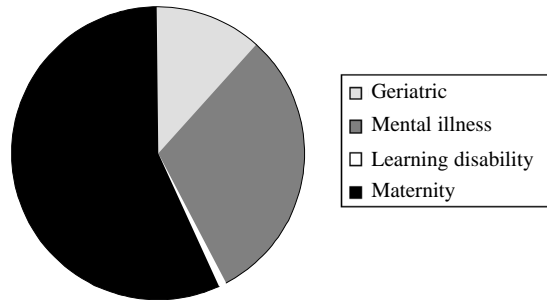
- 32 The overall percentage increase in the number of acute cases from 1991-92 to 2000-01 is
- A 31
 - B 39
 - C 45
 - D 69
- 33 From 1991-92 to 1992-93 the number of maternity cases decreased by approximately 10.5%. If this percentage decrease had continued each year, the number of maternity cases, to the nearest thousand, seen in 1995-96 would have been
- A 397 000
 - B 439 000
 - C 459 000
 - D 490 000

34 For the year 2000-01, the chart which best shows the distribution of the number of outpatients attending for non-acute visits is

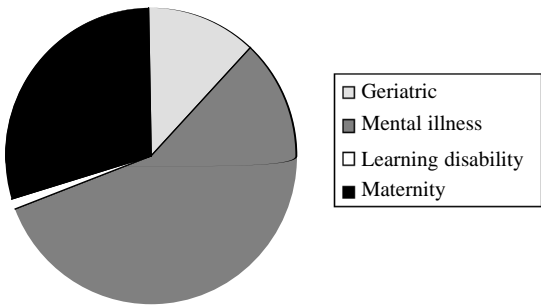
A



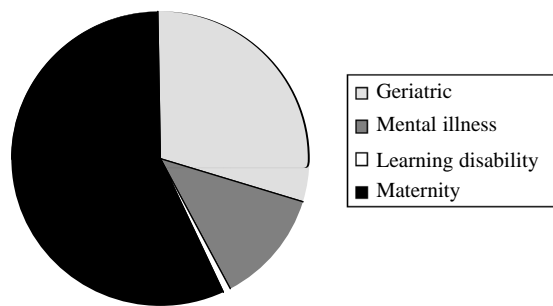
B



C



D



TURN OVER FOR THE NEXT QUESTION

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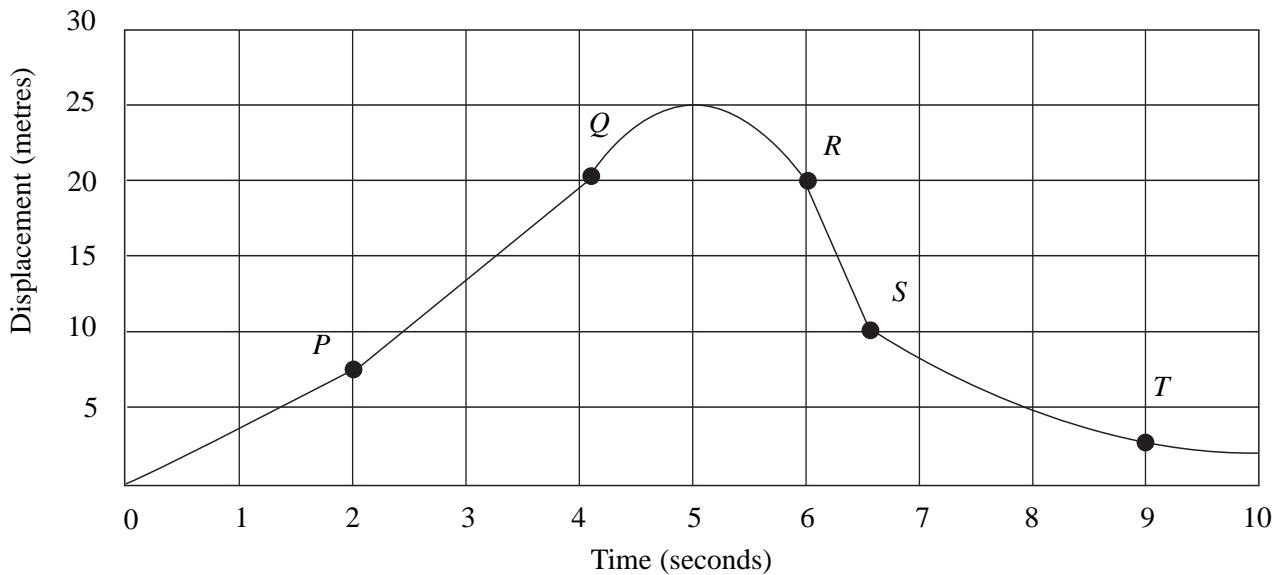
35 One third of 6×10^9 is equal to

- A 2×10^3
- B 6×10^3
- C 6×10^6
- D 2×10^9

36 A complete factorisation of the expression $3x^2 + 9x^2y^2$ is

- A $3(x^2 + 3x^2y^2)$
- B $x(3x + 9xy^2)$
- C $3x(x + 3xy^2)$
- D $3x^2(1 + 3y^2)$

37 The displacement - time graph shows the first ten seconds of the motion of a model train.



The train was travelling fastest between

- A *P* and *Q*
- B *Q* and *R*
- C *R* and *S*
- D *S* and *T*

Questions 38 and 39

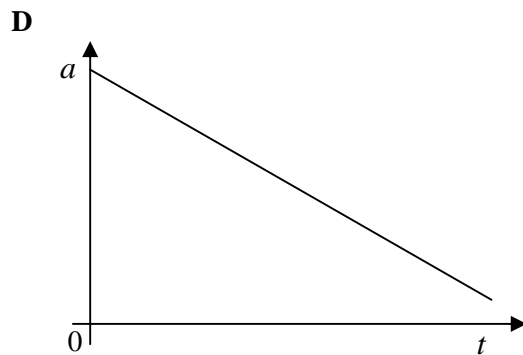
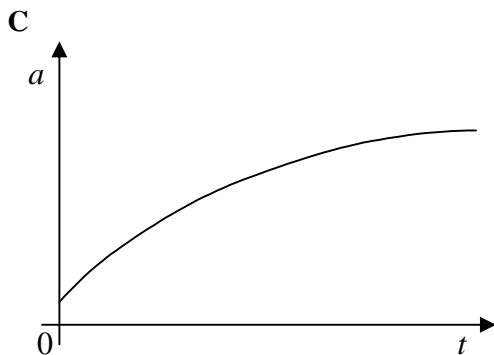
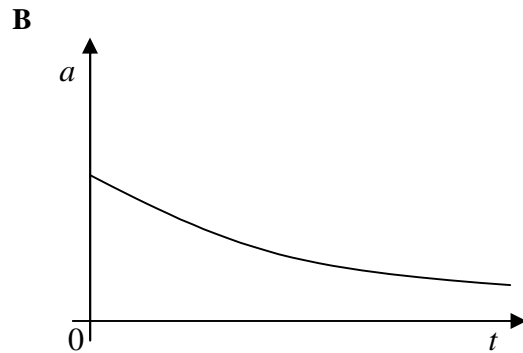
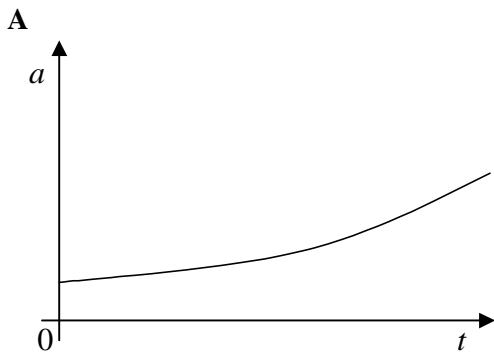
Carbon dating is used to estimate the ages of certain objects. The rate of decay of Carbon-14 in an object is recorded in 'counts per minute' on a Geiger counter.

The formula $a = 15.3 \times 0.886^t$ is used to connect the rate of decay, a counts per minute, with the age of the object, t thousand years.

38 What is the approximate rate of decay of Carbon-14 in a wooden spear from 1500 BC?

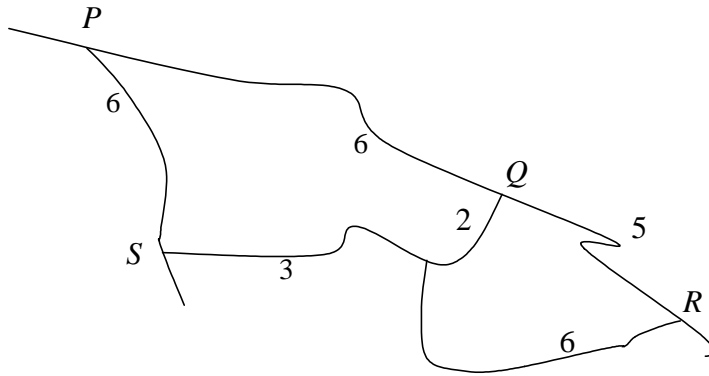
- A** 0 counts per minute
- B** 10 counts per minute
- C** 47 counts per minute
- D** 9200 counts per minute

39 Which diagram best shows the graph of a against t ?

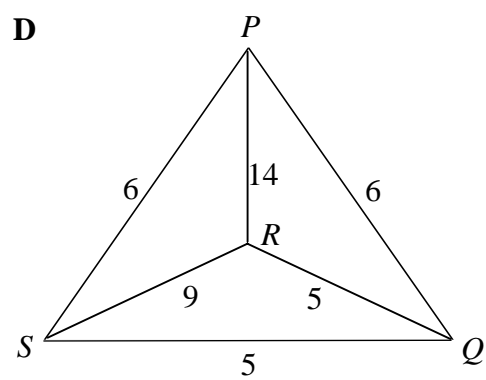
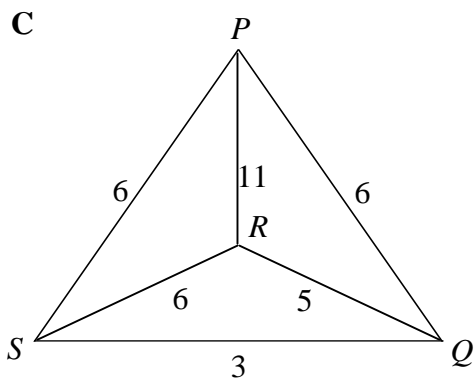
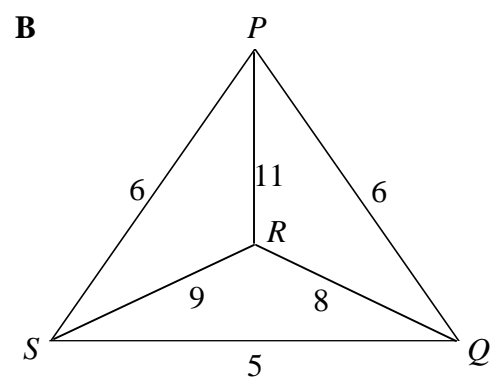
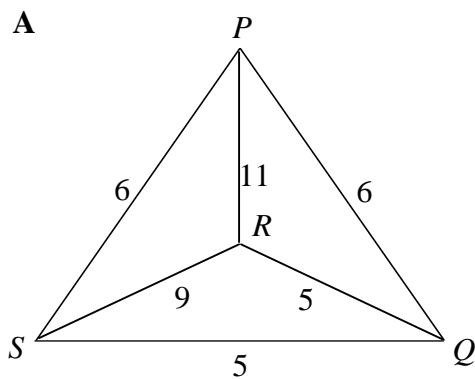


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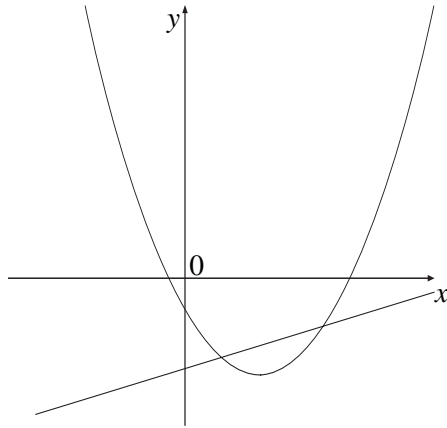
- 40 The diagram shows the roads connecting villages P , Q , R and S . The distances in miles along each length of road are given.



A corresponding network of shortest distances between each pair of villages is



Questions 41 and 42

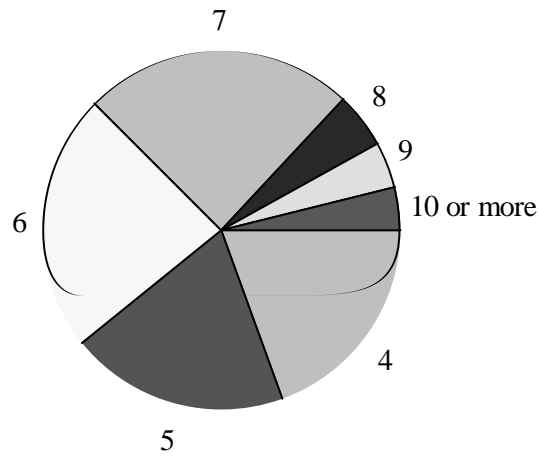


The graphs of the curve $y = x^2 - 3x - 1$ and the straight line $y = \frac{1}{2}x - 3$ are shown above.

- 41** What is the y -coordinate of the point on the curve where $x = -2$?
- A** -3
 - B** 1
 - C** 8
 - D** 9
- 42** Which of the following statements can be deduced from the diagram shown above?
- A** The graphs $y = x^2 - 3x - 1$ and $y = \frac{1}{2}x$ will not intersect.
 - B** The graphs $y = x^2 - 3x - 1$ and $y = \frac{1}{2}x$ will intersect at exactly one point.
 - C** The graphs $y = x^2 - 3x - 1$ and $y = \frac{1}{2}x$ will intersect at exactly two points.
 - D** Further information is required to establish the number of points of intersection for $y = x^2 - 3x - 1$ and $y = \frac{1}{2}x$.

- 43 A survey is carried out to investigate the number of rooms in the houses of a town. The results of the survey are shown in the pie chart below.

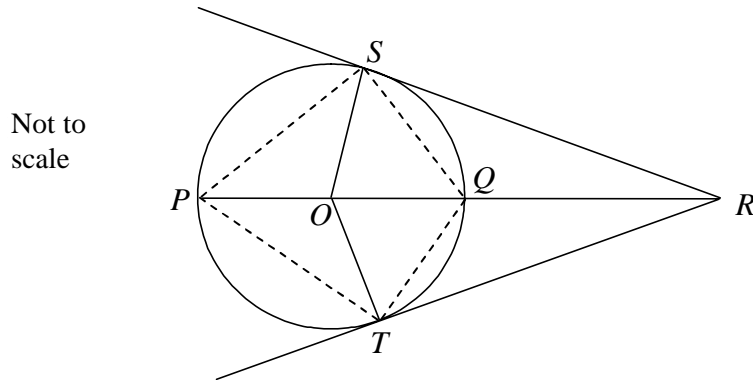
Number of Rooms per House



Which of the following statements is correct for the houses in this survey?

- A The range of the number of rooms is 6.
- B The range of the number of rooms is 10.
- C The range cannot be found because the number of houses surveyed is unknown.
- D The range cannot be found because the exact number of rooms in the larger houses is unknown.

- 44 The diagram shows a circle with centre O passing through the points P , S , Q and T . PQR is a straight line through O . RS and RT are tangents to the circle.



Which of the following is/are true?

- 1 angle $PSQ = 90^\circ$
- 2 angle $OSR = 90^\circ$
- 3 angle $PTQ = \text{angle } PSQ$
- 4 angle $OTR = \text{angle } OSR$

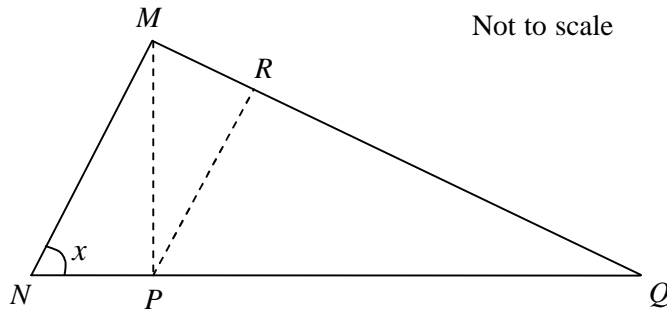
Answer

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

TURN OVER FOR THE NEXT QUESTION

Turn over ►

Questions 45 to 47



In triangle MNQ , $\angle M = 90^\circ$, $\angle N = x$ and $NQ = 3.2$ m.

P is the point on NQ such that MP is perpendicular to NQ .

R is the point on MQ such that PR is perpendicular to MQ .

45 Which of the following statements is correct?

- A Triangles PNM and RMP are similar to MNQ , but triangle RPQ is not.
- B Triangles RMP and RPQ are similar to MNQ , but triangle PNM is not.
- C Triangles RPQ and PNM are similar to MNQ , but triangle RMP is not.
- D Each of the triangles PNM , RMP and RPQ is similar to MNQ .

46 The area of triangle MNQ is 2.9 m^2 .

What is the length of MP , correct to 2 significant figures?

- A 0.45 m
- B 0.91 m
- C 1.1 m
- D 1.8 m

47 Which expression gives the length of MN ?

- A $3.2 \cos x$
- B $3.2 \sin x$
- C $\frac{3.2}{\cos x}$
- D $\frac{3.2}{\sin x}$

48 An examination question was

“Solve $12x^2 + 11x - 15 = 0$ ”.

A student’s solution was

$$12x^2 + 11x - 15 = 0$$

$$\therefore (4x - 3)(3x + 5) = 0 \quad \text{Line 1}$$

$$\therefore 4x - 3 = 0 \text{ or } 3x + 5 = 0 \quad \text{Line 2}$$

$$\therefore x = \frac{3}{4} \text{ or } \frac{-3}{5} \quad \text{Line 3}$$

The student’s solution is

- A incorrect, because there is an error in Line 1.
- B incorrect, because there is an error in Line 2.
- C incorrect, because there is an error in Line 3.
- D correct.

49 A fair coin is to be tossed repeatedly until the first head occurs. What is the probability that it will need to be tossed exactly 4 times?

- A $\frac{1}{4}$
- B $\frac{1}{8}$
- C $\frac{1}{16}$
- D $\frac{1}{32}$

50 Given that P and Q are numbers such that $P^2 = Q^2$, which one of the following is **impossible**?

- A $P \neq Q$
- B $P > 0$ and $Q < 0$
- C $P > Q$ and $Q > 0$
- D $P > Q$ and $Q < 0$

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE