Please write clearly in	n block capitals.
Centre number	Candidate number
Surname	
Forename(s)	
Candidate signature	
	I declare this is my own work.

Level 3 Certificate/Extended Certificate APPLIED SCIENCE

Unit 3 Science in the Modern World

Wednesday 18 January 2023 Afternoon

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a clean copy of the pre-release Sources A, B, C and D
- a calculator.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do **not** write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do **not** want to be marked.

Information

- You will be provided with copies of the pre-release Sources A, B, C and D.
- There are two sections in this paper Section A and Section B.
- You should answer all questions in each section. You should spend approximately 1 hour on Section A and 30 minutes on Section B.
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.

Advice

Read each question carefully.



For Examiner's Use				
Question	Mark			
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
TOTAL				

	Section A
	This section is based on Sources A , B , C and D .
	Answer all questions in this section.
1	Source A is an article about nanotechnology from a website aimed at young people.
1.1	The nanometre is the unit used in nanotechnology.
	How many nanometres are there in one metre?
	Tick (✓) one box. [1 mark]
	100 000
	1 000 000
	100 000 000
	1 000 000
1.2	Describe two ways that the author of Source A has made this article suitable for young people. [2 marks]
	1
	2



		Do not write outside the
02	Source A describes examples of products made using nanotechnology.	box
02.1	Why do nanoparticles make good catalysts? [1 mark]	
02.2	The author of Source A refers to chemical pesticides. Chemical pesticides are not examples of products made using nanotechnology.	
	Explain why the author of Source A refers to chemical pesticides. [3 marks]	
		4
	Turn over for the next question	



03.1	The author of Source B makes the point that the ideas behind nanotechnology have been around for a long time. Explain how the author of Source B does this. [2 marks]	Do not write outside the box
03.2	Source B refers to examples of media such as books, video games and films.	
	Suggest two reasons why the author included references to media in this article. [2 marks] 1	
	2	4

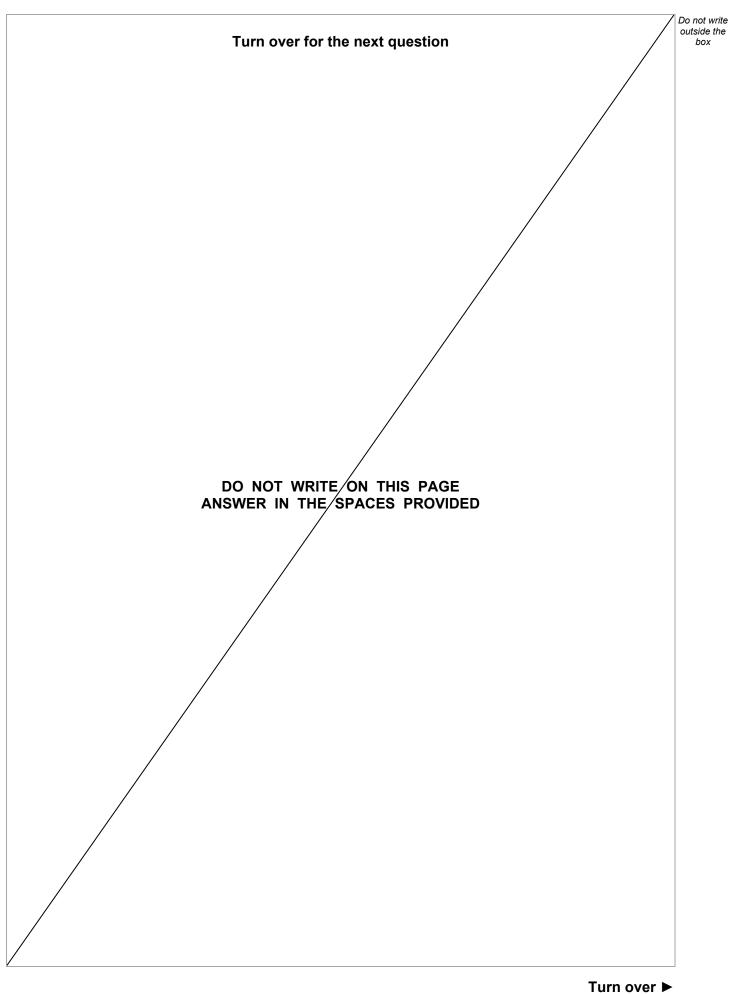


04	Source B compares a nanocar constructed by scientist Ben Feringa to a fictional vehicle in the film <i>Fantastic Voyage</i> .	Do not write outside the box
04.1	The nanocar constructed by scientist Ben Feringa was different to the fictional vehicle.	
	Give two differences between the nanocar and the fictional vehicle. [2 marks]	
	1	
	2	
04.2	Formula 1 cars have a width of 1.80 metres.	
	Calculate the width of the nanocar.	
	Use information from Source B .	
	Give your answer in metres. [2 marks]	
	Width of nanocar = metres	4
	Turn over for the next question	
]



0 5	Source B describes ways that food manufacturers are using nanotechnology.	Do not write outside the box
	In one example, nanocapsules are used to add Omega-3 oil to foods to improve the nutritional value.	
0 5.1	Explain the advantage of using nanocapsules rather than adding the Omega-3 directly to the food. [2 marks]	
0 5.2	Give the name of the type of scientist employed by food manufacturers to develop ways to change the taste and texture of foods. [1 mark]	
		3







0 6	Source C describes the development of a new technique to deliver drugs into the body.	Do not writ outside the box
	The technique involves magnetic nanoparticles and liposomes.	
06.1	What is a liposome? [1 mark]	
06.2	What is the liposome used for in this technique? [1 mark]	
06.3	Describe how placing the nanoparticles in a magnetic field allows the drug to be released. [2 marks]	
06.4	Suggest one role of a pharmacologist when this technique is used with patients. [1 mark]	







0 7	Source D refers to animals like chameleons that can change the colour of their skin.	Do not write outside the box
0 7.1	Suggest one reason why chameleons change the colour of their skin. [1 mark]	
0 7.2	Chromatophores in the chameleon allow the colour change to take place. Describe what happens to the pigments in the chromatophore that causes the colour change.	
	[3 marks]	
0 7.3	The artificial chromatophores have nanoparticles instead of pigments.	
	What are these nanoparticles made from?	
	Tick (✓) one box. [1 mark]	
	Algae	
	Gold	
	Polymer	
	Water	



Suggest what Sean Cormier means by the term 'biomimicry'.

[1 mark]

6

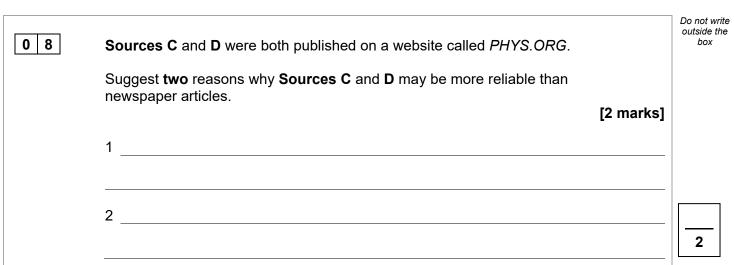
Do not write outside the

box

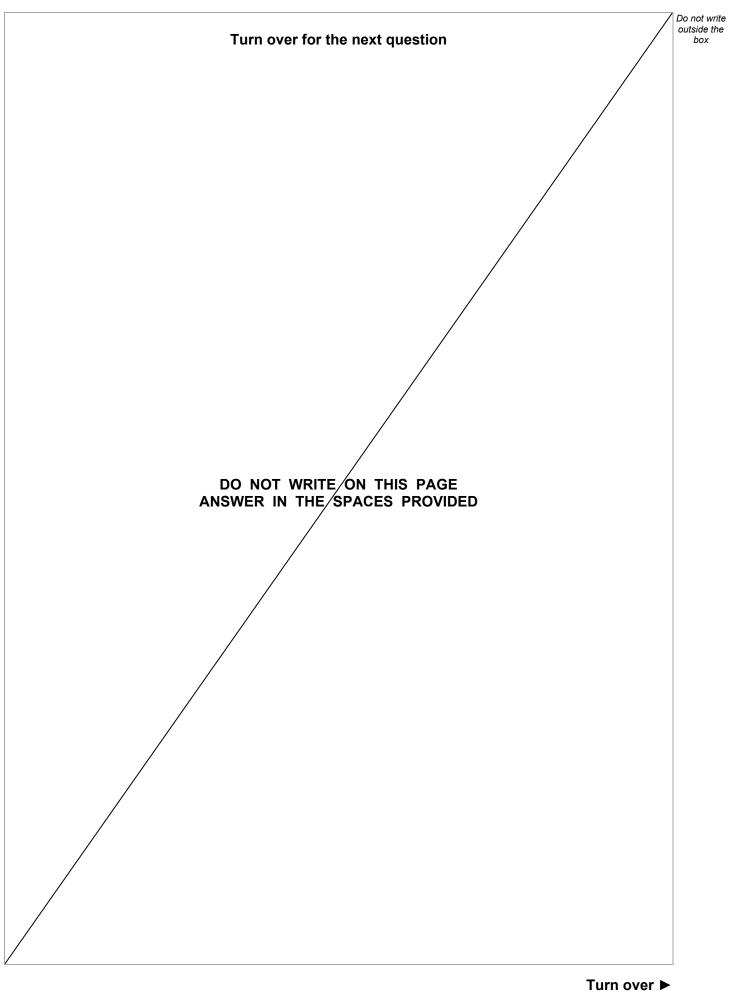
Turn over for the next question



0 7 . 4









09	Describe the adventages and disadventages of the use of repotesticity	Do not write outside the box
0 3	Describe the advantages and disadvantages of the use of nanotechnologies described in Sources A , B , C and D .	~~~
	[9 marks]	

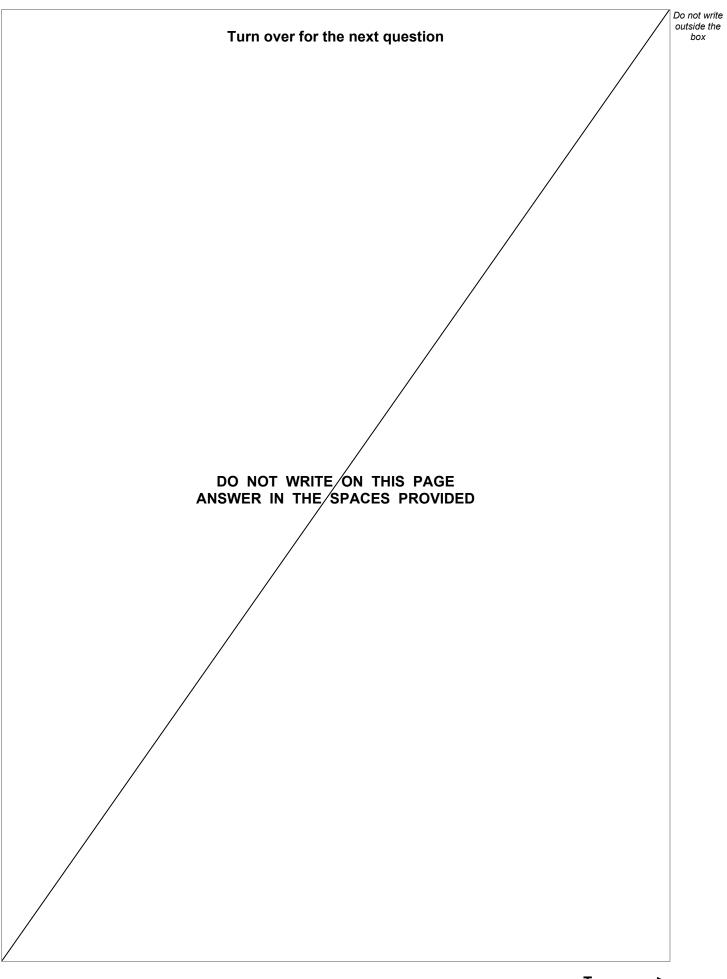


Extra space			



					Do not write outside the	
		Section B	section		box	
	Answer all questions in this section.					
1 0	Table 1	shows a selection of objects and their	sizes measured in n	anometres (nm).		
	Use Tab	ole 1 to answer Question 10.				
		Table 1				
		Object	Size / nm			
		Length of bacterial cell	200			
		Diameter of human hair	80 000			
		Thickness of one piece of paper	100 000			
10.1	Calculat	e how many bacteria would fit end to e	end across the diame	ter of a		
	human h	nair.		[1 mark]		
			Number of bacteria =	=		
10.2	A 1.5 me	etre tall person is 1 500 000 000 nm ta	all.			
		ific journal is 1.5 cm thick.				
		e how many pages the scientific journ	al has.			
				[3 marks]		
					[]	
					4	
			Number of pages =	=	4	







1 1	Graphene is a nanotechnology material made from a single layer of carbon.				
	When graphene material in the		2004, scientists cla	imed it was the stronge	st
	Table 2 shows	data for three differ	ent materials.		
	Use Table 2 to	answer Question 1	1.		
		Та	able 2		
	Material	Strength / arbitrary units	Mass of 1 cm ³ / g	Ability to stretch / % of original length	
	Graphene	130 000 000 000	0.64	20	
	Structural steel		7.85	0.002	
	Kevlar	375 700 000	1.44	2	
11.1	Compare the st	25 times stronger that trength of structural on to justify your and	steel with Kevlar.	[2 marks]
11.2	2 Give the name strength and at		tist who would test	graphene for properties	such as [1 mark]



Do not write outside the box

		Do not write
	Kevlar is a man-made fibre that is described as 'bulletproof'.	outside the box
	Graphene may be used instead of Kevlar to make helmets and body armour in the future.	
1 1.3	Give two reasons why graphene may be better than Kevlar for making helmets and body armour.	
	Suggest an explanation for each of your reasons.	
	Use data from Table 2. [4 marks]	
	Reason 1	
	Explanation	
	Reason 2	
	Explanation	
11.4	Give the name of the type of scientist who would design helmets and body armour	
	made from graphene. [1 mark]	
		8
	Turn over for the next question	
]



Computers process information using transistors on microchips.

The processing power of computers has increased over time.

Table 3 shows data about transistors from 1971 to 2020.

Use Table 3 to answer Question 12.

Table 3

Year	Size of a transistor / nm	Number of transistors / thousands per microchip
1971	10 000	2.5
1977	3000	29
1984	1000	275
1990	600	1180
1996	250	7500
2001	130	42 000
2014	14	6 000 000
2020	5	

1 2 . 1

One trend shown in **Table 3** is that the size of a transistor has decreased from the year 1971 to 2020.

Calculate the percentage decrease in the size of a transistor from the year 1971 to 2020.

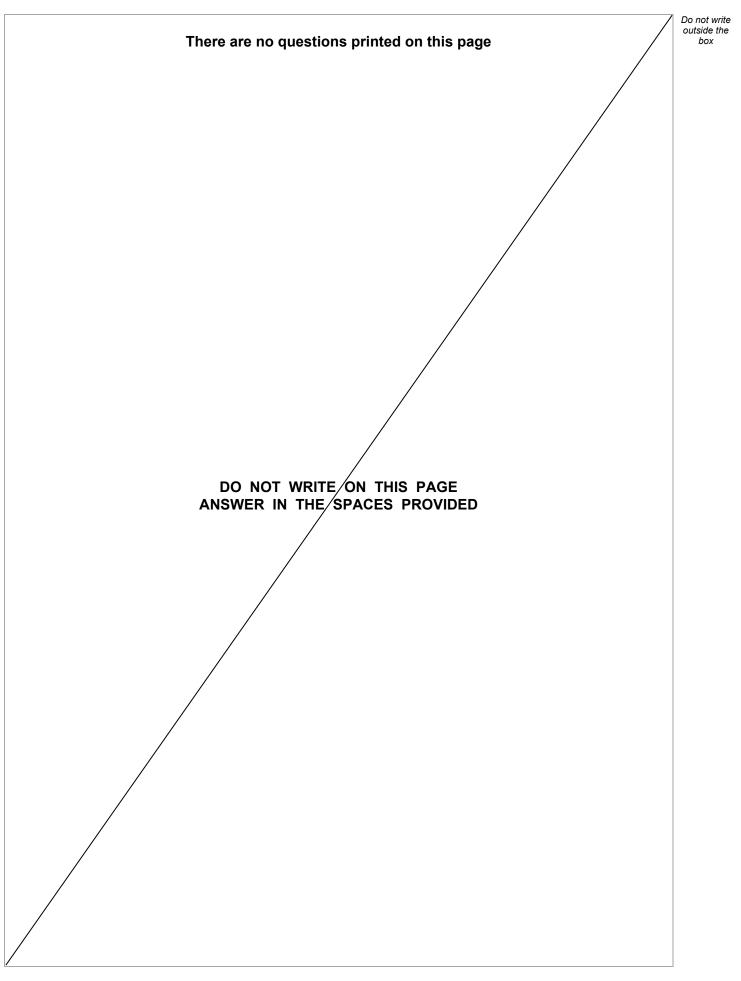
[2 marks]

Percentage decrease = %



12.2	Describe two other trends shown in Table 3 . [2 marks]	Do not write outside the box
	1	
	2	
12.3	An American engineer, Gordon Moore, predicted that the number of transistors per microchip would double every 2 years.	
	This is known as Moore's Law.	
	Calculate how many transistors there were on a microchip in 2020.	
	Assume that the number of transistors continues to increase according to Moore's Law after 2014 .	
	Use data from Table 3. [3 marks]	
		7
	Number of transistors =	
	END OF QUESTIONS	







Question number	Additional page, if required. Write the question numbers in the left-hand margin.	



Question number	Additional page, if required. Write the question numbers in the left-hand margin.	
	Copyright information	
	For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from www.aqa.org.uk.	
	Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.	
	Copyright © 2023 AQA and its licensors. All rights reserved.	



