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**BEATTY SECONDARY SCHOOL
END OF YEAR EXAMINATION 2021**

SUBJECT : SCIENCE (PHYSICS - CHEMISTRY) **LEVEL : Sec 3 E / 3N SBB**

PAPER : 5076 / 1 **DURATION : 1 hour**

SETTER : Mrs Seah & Ms Jamie **DATE : 11 October 2021**

CLASS :	NAME :	REG NO :
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READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, register number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** or **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will **not** be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 17.

The use of an approved scientific calculator is expected, where appropriate.

This paper consists of **17** printed pages.

[Turn over

- 1 A micro-organism's length is 20 nm. What is its length in metres in standard form?

A 2.0×10^{-9} m B 2.0×10^{-8} m C 20×10^{-9} m D 2.0×10^{-10} m

- 2 Which row correctly shows a scalar and a vector quantity?

	scalar	vector
A	acceleration	velocity
B	displacement	speed
C	mass	density
D	time	force

- 3 Two objects X and Y are identical in size and shape but X has 3 times the mass of Y. They are both released simultaneously from a point 100 m above the ground.

Below are some statements regarding the motion of X and Y.

- 1 The rate of change of velocity is the same for X and Y as soon as they are released.
- 2 Both X and Y will reach the same terminal velocity.
- 3 X will reach the ground before Y.

Assuming no air resistance, which statement(s) is/are true?

A 1 only B 1 and 3 only C 2 and 3 only D 1, 2 and 3

- 4 An Eskimo is pulling a sledge across level snow. The sledge has a mass of 25 kg. The Eskimo pulls with a horizontal force of 60 N and the constant force of friction is 20 N.

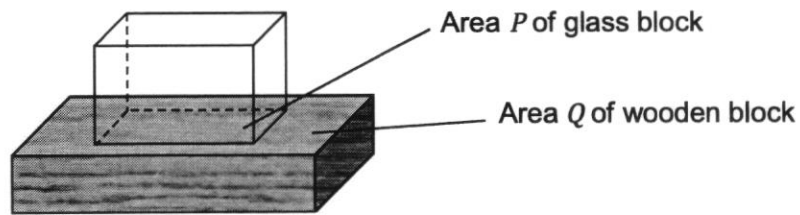
What is the acceleration of the sledge?

A 0.080 m/s^2 B 0.625 m/s^2 C 1.60 m/s^2 D 1.80 m/s^2

- 5 Which person has the greatest inertia?

A 50 kg girl sprinting at 10 m/s
 B 70 kg marathon runner running at 2 m/s
 C 90 kg National Serviceman jogging at 5 m/s
 D 110 kg boxer resting on a bench

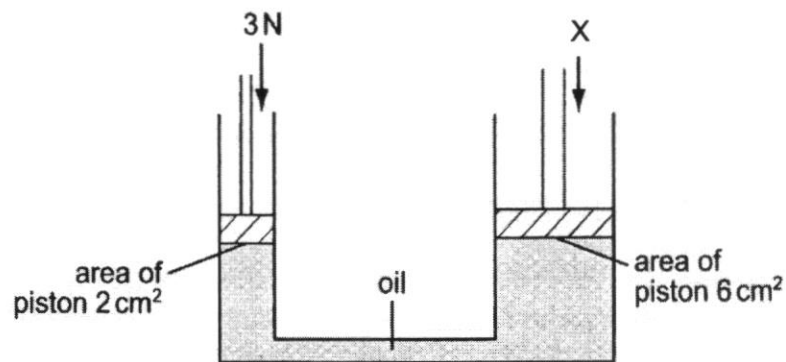
- 6 The diagram shows a glass block resting on a wooden block.



The area of the glass block in contact with the wooden block is P and the area of the top of the wooden block is Q . The weight of the glass block is W and the weight of the wooden block is X .

Which expression gives the pressure exerted on the glass block by the wooden block?

- A $W \div P$ B $W \div Q$ C $X \div P$ D $X \div Q$
- 7 Two closely-fitting smooth pistons are connected as shown below. What is the force X necessary to balance the system?



- A 1.5 N B 3.0 N C 6.0 N D 9.0 N
- 8 Which description suits the animal that is less likely to live in muddy terrain?
- A big feet and has big volume
 B big feet and has small mass
 C small feet and has large mass
 D small feet and has small mass

- 9 When the Brownian motion of smoke particles in air is observed with a microscope, moving points of light are seen.

Which description about these points of light is correct?

- A air particles moving randomly B air particles vibrating
C smoke particles moving randomly D smoke particles vibrating

- 10 A fixed mass of gas is expanding while kept at constant temperature.

How do the properties of the molecules of the gas change at the same time?

	average speed	frequency of collision with walls	average distance apart
A	increases	decreases	increases
B	increases	increases	decreases
C	unchanged	decreases	increases
D	unchanged	increases	decreases

- 11 Which statement about the kinetic model of matter is true?

- A All matter are made up of tiny particles that are closely packed and vibrate about their fixed position.
B All molecules in solid, liquid and gas move at the same speed.
C At higher temperature, gas molecules move faster and change direction more frequently.
D Solid particles are constantly moving around at high speed.

- 12 During a barbecue, why do we always cook food on top of the charcoal?

- A To increase the rate of heat transfer by conduction.
B To increase the rate of heat transfer by convection.
C To increase the rate of heat transfer by radiation.
D To increase the rate of heat transfer by radiation and convection.

- 13 What property of the particles decreases when a solid becomes a liquid at its melting point?

- A attractive forces between molecules
B average kinetic energy of the molecules
C molecular mass
D molecular spacing

- 14 Electromagnetic waves of wavelength λ and frequency f travel at speed c in a vacuum.

Which pair of values describes the wavelength and speed if the electromagnetic waves frequency is now $0.5f$?

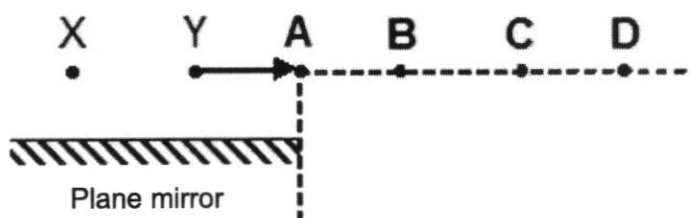
	wavelength	speed in vacuum
A	0.5λ	$0.5c$
B	0.5λ	c
C	2λ	c
D	2λ	$0.5c$

- 15 Which statement best describes the common property of visible light, X-rays and radio waves?

- A** They can be used in telecommunications.
- B** Their frequencies are lower than that of microwaves.
- C** Their wavelengths are shorter than that of microwaves.
- D** They travel with the same speed in vacuum.

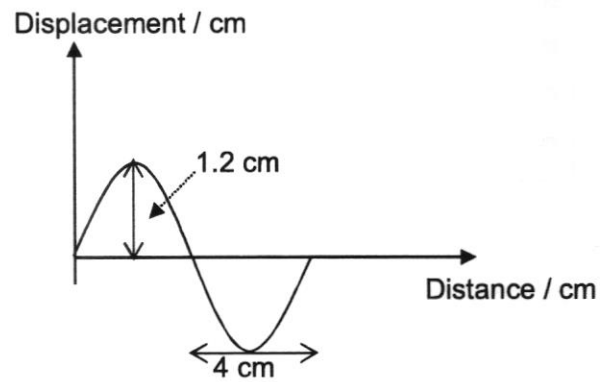
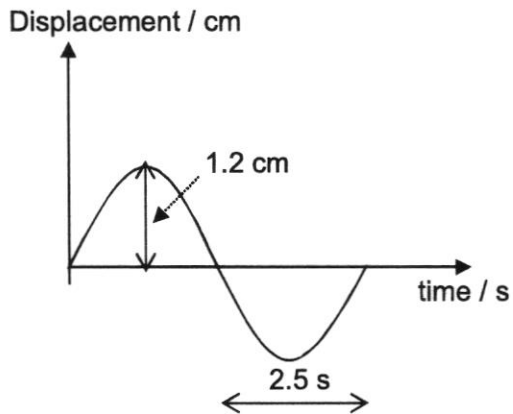
- 16 Two people are standing at points X and Y in front of a plane mirror as shown in the diagram below. They see each other through reflection in the mirror.

If the person at Y walks away from X in the direction of the arrow shown, which of the points is the furthest position he can walk so that the two people will still be able see each other by reflection in the mirror?



- 17 The displacement-time graph and displacement-distance graph of a wave are shown in the diagrams below.

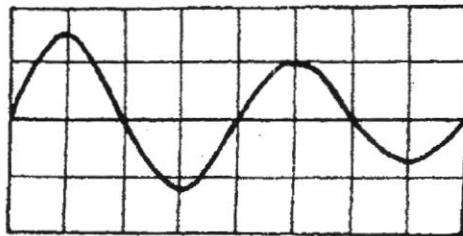
What is the speed of the wave particle?



- A 0.48 cm/s B 0.96 cm/s C 1.20 cm/s D 1.60 cm/s

- 18 The waveform of a note from a piano is shown below.

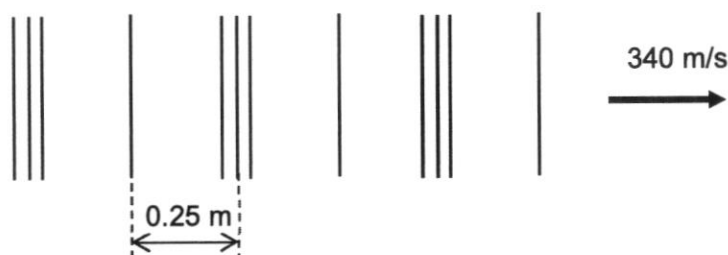
Which row of descriptions about the loudness and the pitch of the note is correct?



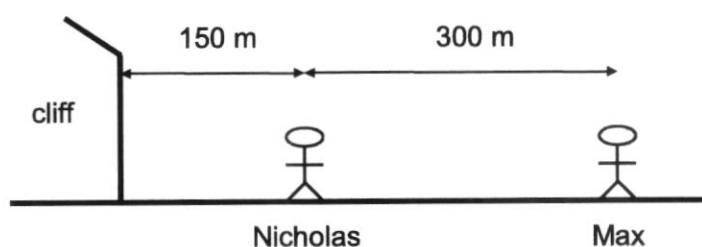
	loudness	pitch
A	decreases	decreases
B	decreases	remains unchanged
C	remains unchanged	decreases
D	remains unchanged	remains unchanged

- 19 As a sound wave propagates at 340 m/s, regions of compressions and rarefactions appear. One typical waveform is drawn below.

What is the frequency of the sound wave?



- A 85 Hz B 170 Hz C 680 Hz D 1360 Hz
- 20 Nicholas fired a gun 150 m towards a cliff. Max who was standing another 300 m further away from Nicholas heard the gunshot 1.0 s after he saw the flash.

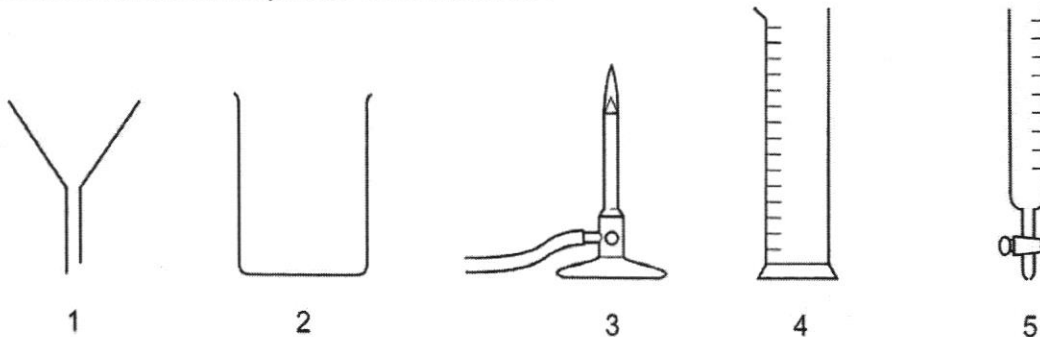


When will Max hear the echo?

- A 1.0 s after seeing the flash. B 2.0 s after hearing the gunshot.
C 2.0 s after seeing the flash. D 3.0 s after hearing the gunshot.

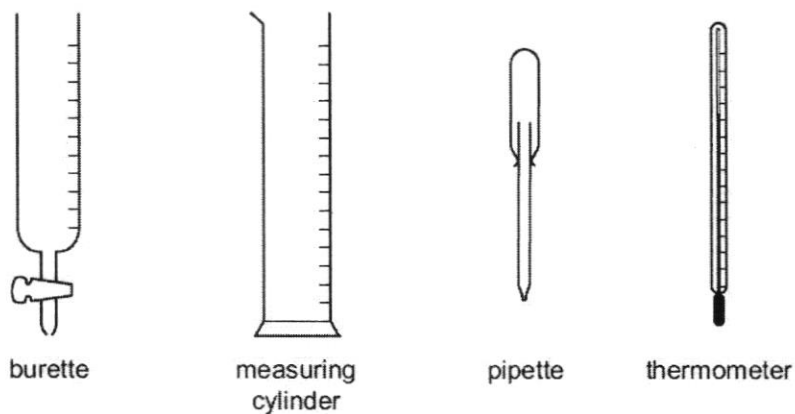
- 21 Strontium sulfate is an insoluble salt. A student, Alexis, attempts to make strontium sulfate by adding approximately 21.0 cm^3 of aqueous strontium nitrate to aqueous sodium sulfate.

Which pieces of apparatus are needed by Alexis to obtain solid strontium sulfate from aqueous strontium nitrate and aqueous sodium sulfate?



- A 1, 2 and 3
- B 1, 2 and 4
- C 2, 3 and 4
- D 2, 3 and 5

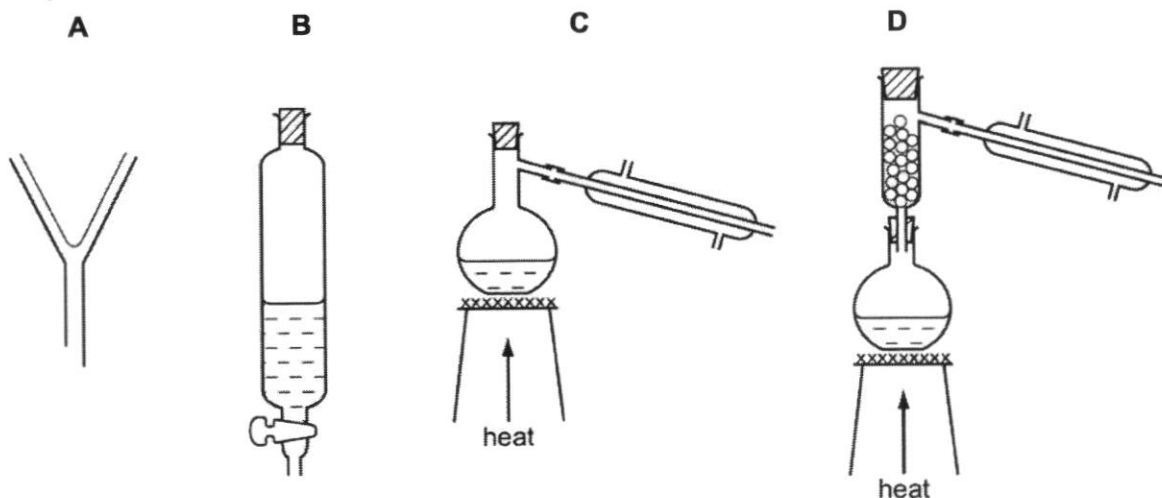
- 22 The four pieces of apparatus shown below are used in chemical experiments.



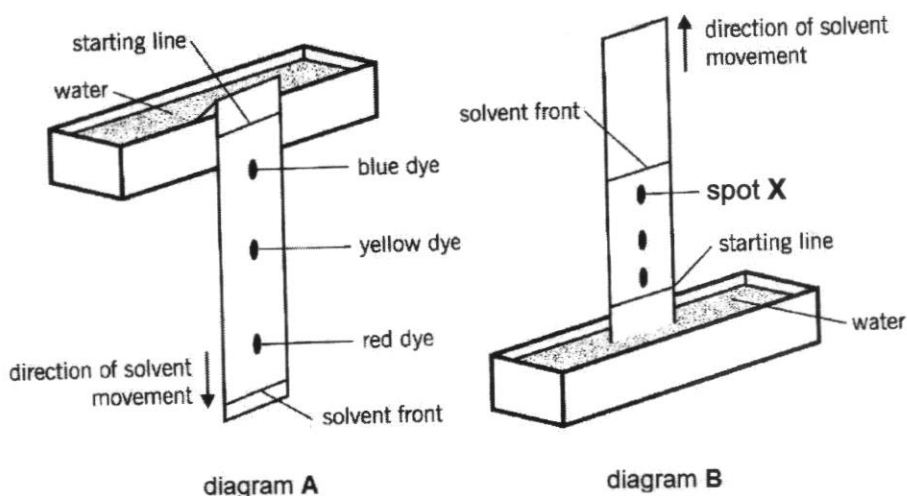
Which statement about the apparatus is correct?

- A The burette can be used to measure 17.30 cm^3 of solution to a flask.
- B The measuring cylinder measures the mass of a substance used in an experiment.
- C The pipette can be used to add 25.10 cm^3 of liquid to a beaker.
- D The thermometer collects and measures the temperature of a water-soluble gas.

- 23 Butane and hexane are two liquids that can mix together. How can a mixture of these two liquids be separated?



- 24 Diagram A shows a descending paper chromatography and diagram B shows an ascending paper chromatography.



Both experiments are used to separate the same sample of ink for two minutes. The distance between the starting line and the solvent front in Diagrams A and B is 5 cm and 3 cm respectively after two minutes.

Which statement about these experiments is **not** correct?

- A Blue is the least soluble in water in descending paper chromatography.
- B The ink sample is made up of three different substances.
- C The substances move faster in descending paper chromatography because they are more soluble in this setup.
- D The spot X is the red dye.

- 25** Annabel accidentally dropped some very tiny diamonds into copper(II) oxide powder.

Copper(II) oxide powder dissolves in acid but not in water while diamonds do not dissolve in either.

What steps should be used by Annabel to recover the tiny diamonds from the mixture?

	step 1	step 2	step 3
A	shake with water	filter	evaporate the filtrate and crystallise
B	shake with water	filter	evaporate the filtrate to dryness
C	shake with dilute sulfuric acid	filter	collect the residue and wash it with water
D	shake with dilute sulfuric acid	filter	collect the filtrate and wash it with water

- 26** A mixture of manganese(IV) oxide powder and sulfur powder may be separated by the procedure below.

Step 1 : The mixture is added into carbon disulfide and stirred.

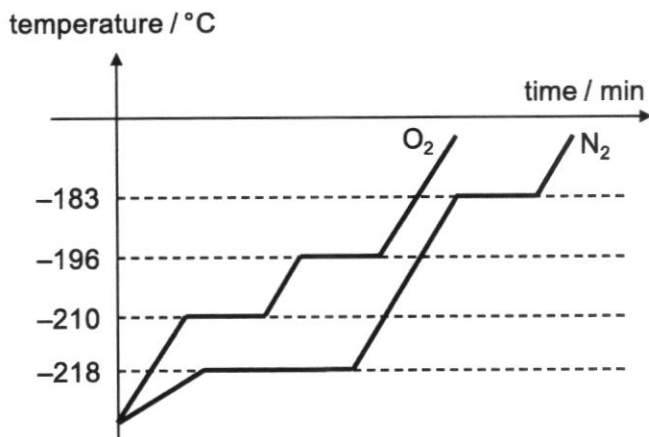
Step 2: The resulting mixture is filtered.

Step 3: The filtrate is distilled to recover the sulfur. The distillate is condensed using tap water.

Which statement cannot be deduced from the above procedure?

- A** Carbon disulfide has a low boiling point.
 - B** Manganese(IV) oxide does not react with carbon disulfide.
 - C** Sulfur is stable to heating.
 - D** Sulfur is soluble in carbon disulfide.
- 27** Some brown powder is placed in a test tube. Water is added and the tube is shaken. The contents are filtered. A black solid is left as the residue. After evaporating the filtrate, some orange crystals are seen. The experiment suggests
- A** the black solid is an element.
 - B** the brown powder is a compound.
 - C** the brown powder is a mixture.
 - D** the orange crystals are a compound.

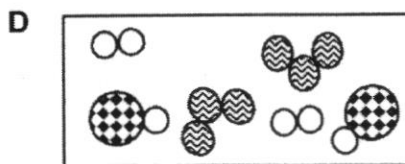
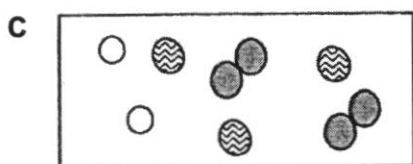
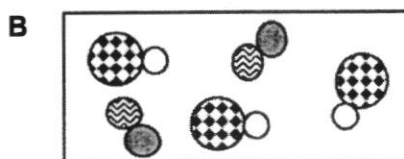
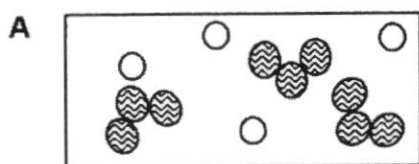
- 28** The graphs (*not drawn to scale*) show the heating curves of oxygen and nitrogen over a period of time when a mixture of oxygen and nitrogen is heated.



At what temperature will oxygen be in a **different** state of matter as compared to nitrogen at the same time?

- A** -180 °C **B** -215 °C
C -200 °C **D** -220 °C

- 29** Which diagram represents a mixture of element(s) and compound(s)?



- 30** Buckminsterfullerene was discovered in 1985 by a group of scientists. The formula of buckminsterfullerene was found to be C_{60} .
From this information alone, we can deduce that buckminsterfullerene

- A** contains only one element.
- B** is a mixture of 60 atoms.
- C** is a mixture of 60 elements.
- D** is a compound made up of 60 atoms.

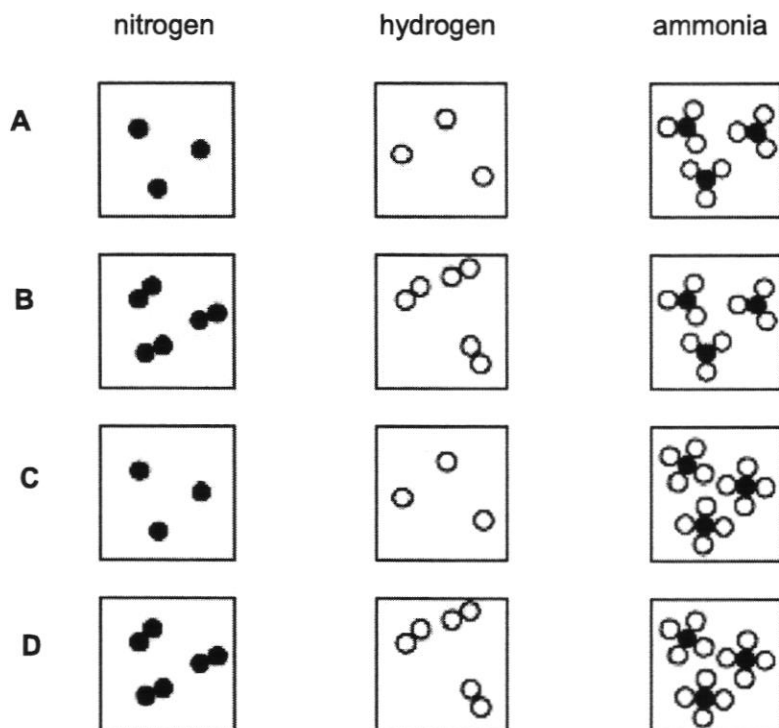
- 31 The table below contains details of four different particles. The letters are not chemical symbols.

	K	L	M	N
nucleon number	3	14	19	23
proton number	2	7	10	11
total number of electrons	2	7	10	11

Which of the particles K, L, M and N will form an ionic compound with chlorine?

- A Particle K
- B Particle L
- C Particle M
- D Particle N

- 32 In the Haber process, nitrogen and hydrogen react to form ammonia. Which set of diagrams represents the molecules of nitrogen, hydrogen and ammonia?



- 33 Uranium has two stable isotopes X and Y.

Which row of the table correctly compares the relative masses, atomic numbers and densities of X and Y?

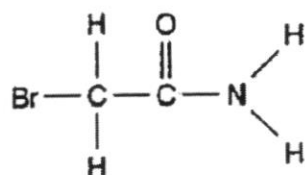
	relative masses of X and Y	atomic numbers of X and Y	densities of X and Y
A	different	same	different
B	different	same	same
C	same	same	different
D	same	same	same

- 34 The table below shows some of the physical properties of two unknown substances, P and Q.

unknown substance	melting point / °C	boiling point / °C	electrical conductivity of		solubility in water
			solid state	molten state	
P	122	550	poor	poor	insoluble
Q	690	1790	poor	good	soluble

Which statement about the two substances is correct?

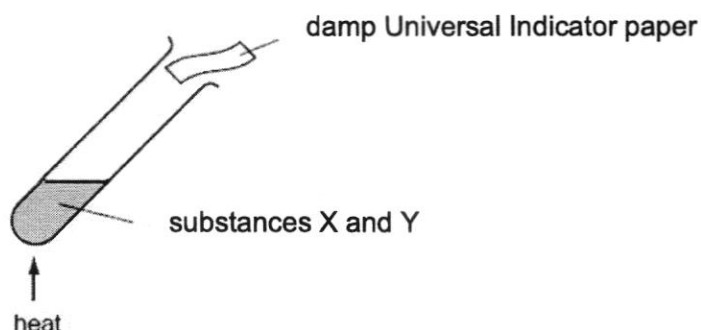
- A Substance P is a simple molecular compound with weak ionic bonds.
 B Substance P is a covalent compound made up of a metal and non-metal.
 C Substance Q is an ionic compound with mobile electrons in the molten state.
 D Substance Q is an ionic compound that is held together by strong forces of attraction.
- 35 The structure of a molecule is shown below.



How many outer shell electrons of the atoms are **not** involved in covalent bonding?

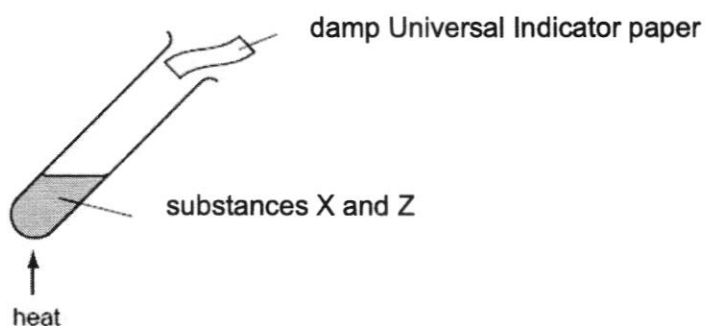
- A 6
 B 10
 C 8
 D 12

- 36 The diagram shows two substances, X and Y, being heated together.



The Universal Indicator paper turns blue during the experiment.

The next diagram shows two substances, X and Z, also being heated together.



The Universal Indicator paper turns yellow during the experiment.

What are substances X, Y and Z?

	X	Y	Z
A	ammonium carbonate	hydrochloric acid	sodium hydroxide
B	ammonium carbonate	sodium hydroxide	hydrochloric acid
C	sodium carbonate	hydrochloric acid	sodium hydroxide
D	sodium carbonate	sodium hydroxide	hydrochloric acid

- 37 Sodium hydroxide is commercially made into a soap known as lye. 2.00 g of the lye required 60.0 cm³ of 0.500 mol/dm³ of HCl to neutralize it. What is the percentage of sodium hydroxide in lye?

- A 20.0%
- B 40.0%
- C 60.0%
- D 80.0%

- 38 The following statements were made by some students about acids, bases and oxides.

student	statement
Caitlin	All metals can react with acids to form a salt and hydrogen gas.
Freya	All carbonates react with acids to form a salt, water and carbon monoxide gas.
Sarah	Alkalis are insoluble bases.
Si Jia	Amphoteric oxides react with acids to form salt and water but do not react with bases.
Tanisha	All acid-base reactions form the ionic equation: $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
Wei Wen	An example of a neutral oxide is nitrogen dioxide.

Which student(s) is/are correct?

- A Caitlin, Freya and Tanisha
- B Caitlin, Sarah and Si Jia
- C Freya, Tanisha and Wei Wen
- D None of the above

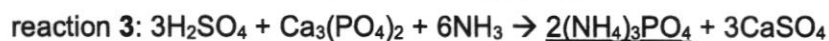
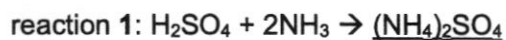
- 39 The following chart shows the range of colours across pH 1 to pH 14 for the indicator Thymol blue.

pH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
bright pink		orange		yellow					cyan blue		dark purple		

Which statement is correct?

- A Distilled water has the same colour when Thymol blue is added to it and when Universal indicator is added to it separately.
- B Dilute sodium hydroxide and sodium chloride solution will show the same colour when Thymol blue is added to these samples separately.
- C Dilute potassium hydroxide has the same colour when Thymol blue is added to it and when Universal indicator is added to it separately.
- D When a few drops of Thymol blue is added to a sample of nitric acid, the colour of the indicator will be orange.

40 Below are the overall equations for the manufacture of three fertilizers (*underlined*).



Mr of H_2SO_4 : 98;

Mr of $(\text{NH}_4)_2\text{SO}_4$: 132;

Mr of $\text{Ca}(\text{H}_2\text{PO}_4)_2$: 234;

Mr of $(\text{NH}_4)_3\text{PO}_4$: 149

In each reaction, 98 tonnes of sulfuric acid was used. Which reaction gave the greatest, and which the least, mass of fertilizer?

	greatest mass	least mass
A	reaction 1	reaction 2
B	reaction 1	reaction 3
C	reaction 2	reaction 1
D	reaction 3	reaction 2

~ End of Paper 1 ~

The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
Key																	
3 Li lithium 7		4 Be beryllium 9		proton (atomic) number atomic symbol name relative atomic mass													
11 Na sodium 23	12 Mg magnesium 24	5 B boron 11															
13 Al aluminum 27		14 Si silicon 28		15 P phosphorus 31		16 S sulfur 32		17 Cl chlorine 35.5		18 Ar argon 40		19 K potassium 39		20 Ca calcium 40		21 Sc scandium 45	
22 Ti titanium 48		23 V vanadium 51		24 Cr chromium 52		25 Mn manganese 55		26 Fe iron 56		27 Co cobalt 59		28 Ni nickel 59		29 Cu copper 64		30 Zn zinc 65	
31 Ga gallium 70		32 Ge germanium 73		33 As arsenic 75		34 Se selenium 79		35 Br bromine 80		36 Kr krypton 84		37 Rb rubidium 85		38 Sr strontium 88		39 Y yttrium 89	
40 Zr zirconium 91		41 Nb niobium 93		42 Mo molybdenum 96		43 Tc technetium -		44 Ru ruthenium 101		45 Rh rhodium 103		46 Pd palladium 106		47 Ag silver 108		48 Cd cadmium 112	
49 In indium 115		50 Sn tin 119		51 Sb antimony 122		52 Te tellurium 128		53 I iodine 127		54 Xe xenon 131		55 Cs caesium 133		56 Ba barium 137		57-71 lanthanoids	
72 Hf hafnium 178		73 Ta tantalum 181		74 W tungsten 184		75 Re rhenium 186		76 Os osmium 190		77 Ir iridium 192		78 Pt platinum 195		79 Au gold 197		80 Hg mercury 201	
104 Rf Rutherfordium		105 Db dubnium		106 Sg seaborgium		107 Bh bohrium		108 Hs hassium		109 Mt meitnerium		110 Ds darmstadtium		111 Rg roentgenium		112 Cn copernicium	
116 Lv livermorium		117 Ts tennessine		118 Og oganesson		119 Nh nihonium		120 Fl flerovium		121 Mc moscovium		122 Lv livermorium		123 Nh nihonium		124 Ts tennessine	
126 Lr lawrencium		127 Nh nihonium		128 Og oganesson		129 Jl jllene		130 Uu ununium		131 Uuh ununium		132 Uub ununium		133 Uut ununium		134 Uuq ununium	
136 Nh nihonium		137 Og oganesson		138 Jl jllene		139 Uu ununium		140 Uuh ununium		141 Uub ununium		142 Uut ununium		143 Uuq ununium		144 Uur ununium	
146 Nh nihonium		147 Og oganesson		148 Jl jllene		149 Uu ununium		150 Uuh ununium		151 Uub ununium		152 Uut ununium		153 Uuq ununium		154 Uur ununium	
156 Nh nihonium		157 Og oganesson		158 Jl jllene		159 Uu ununium		160 Uuh ununium		161 Uub ununium		162 Uut ununium		163 Uuq ununium		164 Uur ununium	
166 Nh nihonium		167 Og oganesson		168 Jl jllene		169 Uu ununium		170 Uuh ununium		171 Uub ununium		172 Uut ununium		173 Uuq ununium		174 Uur ununium	
176 Nh nihonium		177 Og oganesson		178 Jl jllene		179 Uu ununium		180 Uuh ununium		181 Uub ununium		182 Uut ununium		183 Uuq ununium		184 Uur ununium	
186 Nh nihonium		187 Og oganesson		188 Jl jllene		189 Uu ununium		190 Uuh ununium		191 Uub ununium		192 Uut ununium		193 Uuq ununium		194 Uur ununium	
196 Nh nihonium		197 Og oganesson		198 Jl jllene		199 Uu ununium		200 Uuh ununium		201 Uub ununium		202 Uut ununium		203 Uuq ununium		204 Uur ununium	
206 Nh nihonium		207 Og oganesson		208 Jl jllene		209 Uu ununium		210 Uuh ununium		211 Uub ununium		212 Uut ununium		213 Uuq ununium		214 Uur ununium	
216 Nh nihonium		217 Og oganesson		218 Jl jllene		219 Uu ununium		220 Uuh ununium		221 Uub ununium		222 Uut ununium		223 Uuq ununium		224 Uur ununium	
226 Nh nihonium		227 Og oganesson		228 Jl jllene		229 Uu ununium		230 Uuh ununium		231 Uub ununium		232 Uut ununium		233 Uuq ununium		234 Uur ununium	
236 Nh nihonium		237 Og oganesson		238 Jl jllene		239 Uu ununium		240 Uuh ununium		241 Uub ununium		242 Uut ununium		243 Uuq ununium		244 Uur ununium	
246 Nh nihonium		247 Og oganesson		248 Jl jllene		249 Uu ununium		250 Uuh ununium		251 Uub ununium		252 Uut ununium		253 Uuq ununium		254 Uur ununium	
256 Nh nihonium		257 Og oganesson		258 Jl jllene		259 Uu ununium		260 Uuh ununium		261 Uub ununium		262 Uut ununium		263 Uuq ununium		264 Uur ununium	
266 Nh nihonium		267 Og oganesson		268 Jl jllene		269 Uu ununium		270 Uuh ununium		271 Uub ununium		272 Uut ununium		273 Uuq ununium		274 Uur ununium	
276 Nh nihonium		277 Og oganesson		278 Jl jllene		279 Uu ununium		280 Uuh ununium		281 Uub ununium		282 Uut ununium		283 Uuq ununium		284 Uur ununium	
286 Nh nihonium		287 Og oganesson		288 Jl jllene		289 Uu ununium		290 Uuh ununium		291 Uub ununium		292 Uut ununium		293 Uuq ununium		294 Uur ununium	
296 Nh nihonium		297 Og oganesson		298 Jl jllene		299 Uu ununium		300 Uuh ununium		301 Uub ununium		302 Uut ununium		303 Uuq ununium		304 Uur ununium	
306 Nh nihonium		307 Og oganesson		308 Jl jllene		309 Uu ununium		310 Uuh ununium		311 Uub ununium		312 Uut ununium		313 Uuq ununium		314 Uur ununium	
316 Nh nihonium		317 Og oganesson		318 Jl jllene		319 Uu ununium		320 Uuh ununium		321 Uub ununium		322 Uut ununium		323 Uuq ununium		324 Uur ununium	
326 Nh nihonium		327 Og oganesson		328 Jl jllene		329 Uu ununium		330 Uuh ununium		331 Uub ununium		332 Uut ununium		333 Uuq ununium		334 Uur ununium	
336 Nh nihonium		337 Og oganesson		338 Jl jllene		339 Uu ununium		340 Uuh ununium		341 Uub ununium		342 Uut ununium		343 Uuq ununium		344 Uur ununium	
346 Nh nihonium		347 Og oganesson		348 Jl jllene		349 Uu ununium		350 Uuh ununium		351 Uub ununium		352 Uut ununium		353 Uuq ununium		354 Uur ununium	
356 Nh nihonium		357 Og oganesson		358 Jl jllene		359 Uu ununium		360 Uuh ununium		361 Uub ununium		362 Uut ununium		363 Uuq ununium		364 Uur ununium	
366 Nh nihonium		367 Og oganesson		368 Jl jllene		369 Uu ununium		370 Uuh ununium		371 Uub ununium		372 Uut ununium		373 Uuq ununium		374 Uur ununium	
376 Nh nihonium		377 Og oganesson		378 Jl jllene		379 Uu ununium		380 Uuh ununium		381 Uub ununium		382 Uut ununium		383 Uuq ununium		384 Uur ununium	
386 Nh nihonium		387 Og oganesson		388 Jl jllene		389 Uu ununium		390 Uuh ununium		391 Uub ununium		392 Uut ununium		393 Uuq ununium		394 Uur ununium	
396 Nh nihonium		397 Og oganesson		398 Jl jllene		399 Uu ununium		400 Uuh ununium		401 Uub ununium		402 Uut ununium		403 Uuq ununium		404 Uur ununium	
406 Nh nihonium		407 Og oganesson		408 Jl jllene		409 Uu ununium		410 Uuh ununium		411 Uub ununium		412 Uut ununium		413 Uuq ununium		414 Uur ununium	
416 Nh nihonium		417 Og oganesson		418 Jl jllene		419 Uu ununium		420 Uuh ununium		421 Uub ununium		422 Uut ununium		423 Uuq ununium		424 Uur ununium	
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456 Nh nihonium		457 Og oganesson		458 Jl jllene		459 Uu ununium		460 Uuh ununium		461 Uub ununium		462 Uut ununium		463 Uuq ununium		464 Uur ununium	
466 Nh nihonium		467 Og oganesson		468 Jl jllene		469 Uu ununium		470 Uuh ununium		471 Uub ununium		472 Uut ununium		473 Uuq ununium		474 Uur ununium	
476 Nh nihonium		477 Og oganesson		478 Jl jllene		479 Uu ununium		480 Uuh ununium		481 Uub ununium		482 Uut ununium		483 Uuq ununium		484 Uur ununium	
486 Nh nihonium		487 Og oganesson		488 Jl jllene		489 Uu ununium		490 Uuh ununium		491 Uub ununium		492 Uut ununium		493 Uuq ununium		494 Uur ununium	
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506 Nh nihonium		507 Og oganesson		508 Jl jllene		509 Uu ununium		510 Uuh ununium		511 Uub ununium		512 Uut ununium		513 Uuq ununium		514 Uur ununium	
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526 Nh nihonium		527 Og oganesson		528 Jl jllene		529 Uu ununium		530 Uuh ununium		531 Uub ununium		532 Uut ununium		533 Uuq ununium		534 Uur ununium	
536 Nh nihonium		537 Og oganesson		538 Jl jllene		539 Uu ununium		540 Uuh ununium		541 Uub ununium		542 Uut ununium		543 Uuq ununium		544 Uur ununium	
546 Nh nihonium		547 Og oganesson		548 Jl jllene		549 Uu ununium		550 Uuh ununium		551 Uub ununium		552 Uut ununium		553 Uuq ununium		554 Uur ununium	
556 Nh nihonium		557 Og oganesson		558 Jl jllene		559 Uu ununium		560 Uuh ununium		561 Uub ununium		562 Uut ununium		563 Uuq ununium		564 Uur ununium	
566 Nh nihonium		567 Og oganesson		568 Jl jllene		569 Uu ununium		570 Uuh ununium		571 Uub ununium		572 Uut ununium		573 Uuq ununium		574 Uur ununium	
576 Nh nihonium		577 Og oganesson		578 Jl jllene		579 Uu ununium		580 Uuh ununium		581 Uub ununium		582 Uut ununium		583 Uuq ununium		584 Uur ununium	
586 Nh nihonium		587 Og oganesson		588 Jl jllene		589 Uu ununium		590 Uuh ununium		591 Uub ununium		592 Uut ununium		593 Uuq ununium		594 Uur ununium	
596 Nh nihonium		597 Og oganesson		598 Jl jllene		599 Uu ununium		600 Uuh ununium		601 Uub ununium		602 Uut ununium		603 Uuq ununium		604 Uur ununium	
606 Nh nihonium		607 Og oganesson		608 Jl jllene		609 Uu ununium		610 Uuh ununium		611 Uub ununium		612 Uut ununium		613 Uuq ununium		614 Uur ununium	
616 Nh nihonium		617 Og oganesson		618 Jl jllene		619 Uu ununium		620 Uuh ununium		621 Uub ununium		622 Uut ununium		623 Uuq ununium		624 Uur ununium	
626 Nh nihonium		627 Og oganesson		628 Jl jllene		629 Uu ununium		630 Uuh ununium		631 Uub ununium		632 Uut ununium		633 Uuq ununium		634 Uur ununium	
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686 Nh nihonium		687 Og oganesson		688 Jl jllene		689 Uu ununium		690 Uuh ununium		691 Uub ununium		692 Uut ununium		693 Uuq ununium		694 Uur ununium	
696 Nh nihonium		697 Og oganesson		698 Jl jllene		699 Uu ununium		700 Uuh ununium		701 Uub ununium		702 Uut ununium		703 Uuq ununium		704 Uur ununium	
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716 Nh nihonium		717 Og oganesson		718 Jl jllene		719 Uu ununium		720 Uuh ununium		721 Uub ununium		722 Uut ununium		723 Uuq ununium		724 Uur ununium	
726 Nh nihonium		72															

lanthanoids

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



**BEATTY SECONDARY SCHOOL
END OF YEAR EXAMINATION 2021**

SUBJECT : SCIENCE (PHYSICS)

LEVEL : Sec 3E / 3N SBB

PAPER : 5076 / 2

DURATION : 1 hour 15 minutes

SETTER : Mrs Seah

DATE : 6 Oct 2021

CLASS :	NAME :	REG NO :
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.....

READ THESE INSTRUCTIONS FIRST

Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B

Answer **both** questions.
Write your answers in the spaces provided on the Question Paper.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part-question.

For Examiner's Use	
Section A	/45
Section B	/20
TOTAL	/65

This paper consists of **14** printed pages (including this cover page)

[Turn over

Section A (45 marks)

Answer **all** the questions in this section.

- 1 In Fig.1.1, the bob of a simple pendulum is swinging between X and Y. It took 1.5 s to go from X to Y.

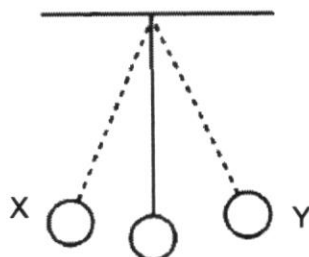


Fig. 1.1

- (a) Calculate the period.

period = s [1]

- (b) In another experiment, a pupil obtains the five different values for 20 oscillations of a pendulum as shown in Fig. 1.2.

time for 20 oscillations / s	12.60	12.70	12.50	12.60	12.70
-------------------------------------	-------	-------	-------	-------	-------

Fig. 1.2

Determine the period of the pendulum.

period = s [3]

- (c) State one way to increase the period of the pendulum.

.....
 [1]

- 2 A box of weight 400 N is at rest on a frictionless, horizontal surface. It is then being pulled to the left by a force of 200 N and it moves horizontally.

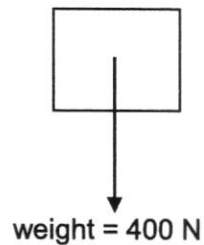


Fig. 2

- (a) Fig. 2 shows a partially completed free body diagram of the box. One of the forces has been drawn for you. Complete the diagram with arrows indicating the direction of each force. State also the magnitudes and labels of all the forces acting on the box. [2]
- (b) Calculate the mass of the box.

mass = kg [1]

- (c) Calculate the acceleration of the box.

acceleration = m/s^2 [2]

- 3 Alfred checks the purity of a small, uniform bar of gold by measuring its density. He measures the dimensions of the bar and the values are shown in Fig. 3.

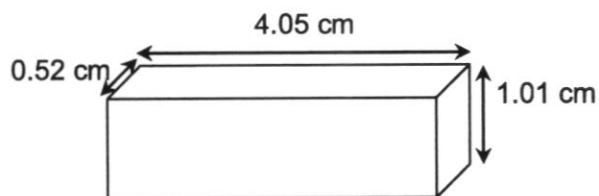


Fig. 3

- (a) Alfred has written down every digit of the readings from the measuring instrument that he used. Suggest the name of the instrument used to measure the length to the stated precision.

..... [1]

- (b) He measures the mass of the bar to be 39.0 g. Calculate the

- (i) volume of the bar,

volume = cm^3 [1]

- (ii) the density of the bar. Give your answer in kg/m^3 .

density = kg/m^3 [3]

- (c) The density of pure gold is 19300 kg/m^3 . State and explain whether the bar is made of pure gold.

.....

 [2]

- 4 (a) Fig. 4.1 shows an instrument used to measure the time that the sun shines during a day. The blackened glass bulb contains mercury and is supported inside an evacuated glass case.

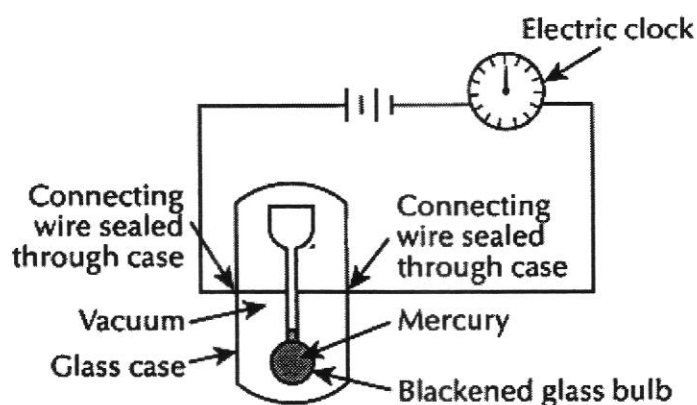


Fig. 4.1

- (i) State the mode of transfer of thermal energy from the sun to reach the mercury. Briefly explain your answer.

.....

 [2]

- (ii) State the reason why blackening the bulb ensures that the mercury level falls rapidly at night when there is no more sun.

.....
 [1]

- (b) Fig. 4.2 show a slab of ice cream that was dipped in dough mixed with bicarbonate of soda and deep fried in hot oil, also know as "fried ice-cream"

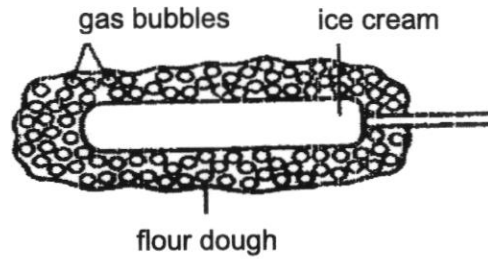


Fig. 4.2

- (i) Explain why the ice cream does not melt in the hot oil.

.....

.....

.....

..... [2]

- (ii) Describe how heat is distributed throughout the hot oil.

.....

.....

.....

..... [2]

- 5 An immersion heater is used to heat the water in a plastic cup until the water boils. The immersion heater is switched off 6.0 minutes later. Fig. 5 shows the temperature-time graph of the water.

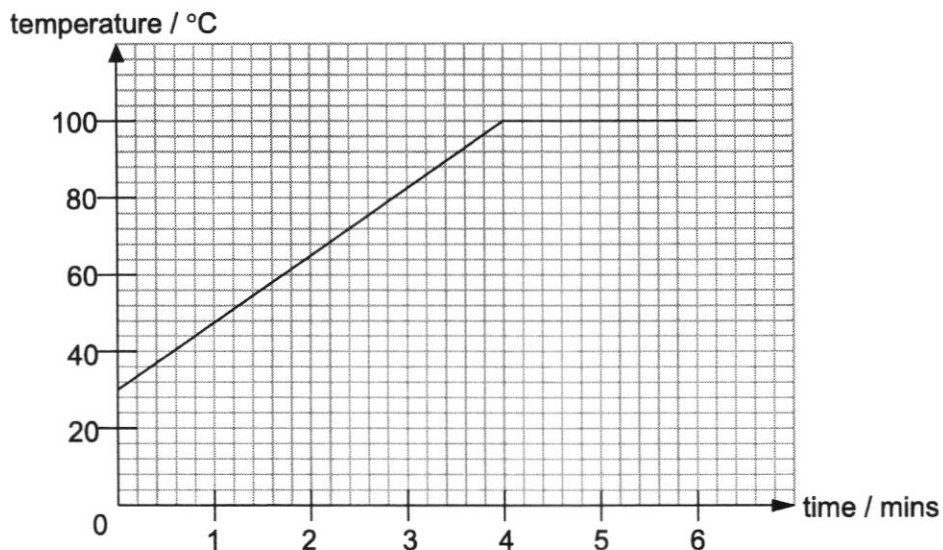


Fig. 5

- (a) State the initial temperature of the water in the cup.

initial temperature = °C [1]

- (b) Use the kinetic model of matter to describe what happens to the internal energy of the water during the first four minutes.

.....

 [2]

- (c) After 4.0 minutes, the temperature remains the same, even though the immersion heater is constantly supplying thermal energy.

- (i) State the process that is taking place at this constant temperature.

..... [1]

- (ii) Instead of increasing the temperature, briefly explain what happens to the thermal energy supplied by the heater.

.....

 [2]

- 6 Fig. 6.1 shows how a wave is caused to travel along a spring by moving end X while Fig. 6.2 shows the displacement-time graph of the same wave.

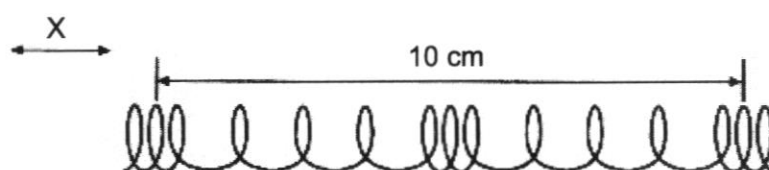


Fig. 6.1

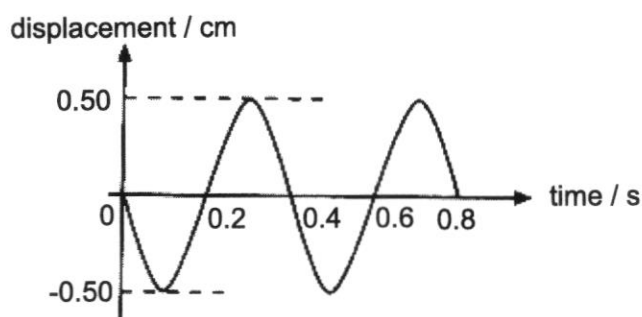


Fig. 6.2

- (a) Determine the amplitude and wavelength of this wave from Fig. 6.1 and Fig. 6.2.

amplitude = cm [1]

wavelength = cm [1]

- (b) State and explain whether this wave is transverse or longitudinal.

.....

 [2]

- (c) Calculate the

- (i) frequency,

frequency = Hz [1]

- (ii) and speed of this wave.

speed = cm/s [2]

- 7 Fig. 7 shows an object and its virtual image as viewed from a converging lens.

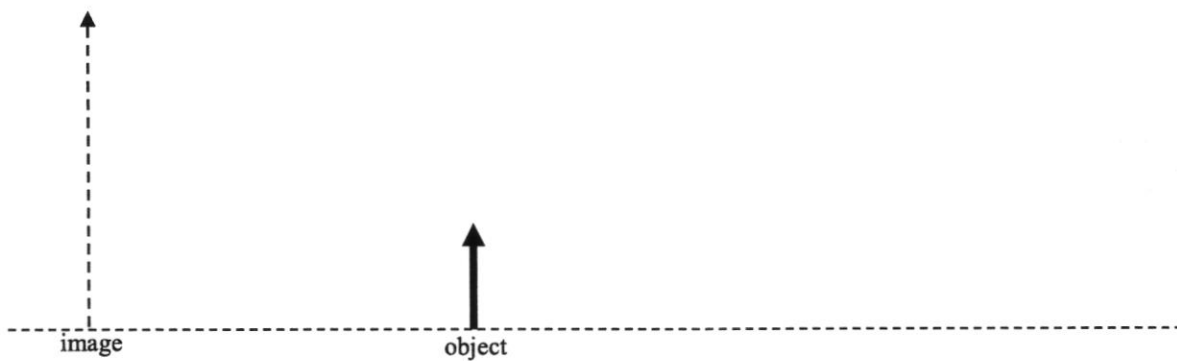


Fig. 7

- (a) Complete the ray diagram in Fig. 7 to locate the position of the lens. Draw a double-headed arrow to represent the lens and label it as L. [3]

- (b) Measure and write down the focal length of the lens used in Fig. 7.

focal length = cm [1]

- (c) Give two other characteristics of the image observed.

..... [1]

- 8 Fig. 8 shows a fishing boat using a sound echo to determine the depth of a shoal of fish below the boat. The echo sounder is a system, which uses high frequency sound waves.

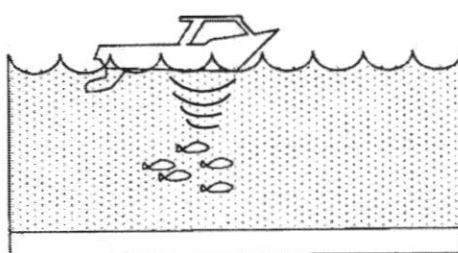


Fig. 8

- (a) If the time taken for the return of the wave is 0.067 s, calculate the depth of the shoal of fish below the boat if the speed of sound in water is 1 500 m/s.

depth of fish = m [2]

- (b) Using kinetic theory of matter, briefly explain why the speed of sound is greater in water than that in air.

.....

..... [1]

Section B (20 marks)

Answer **both** questions from this section.

- 9 A car accelerates constantly from rest and reaches a speed of 12 m/s at $t = 6$ s. For the next 6 s, the car stops accelerating and moves at a constant speed.

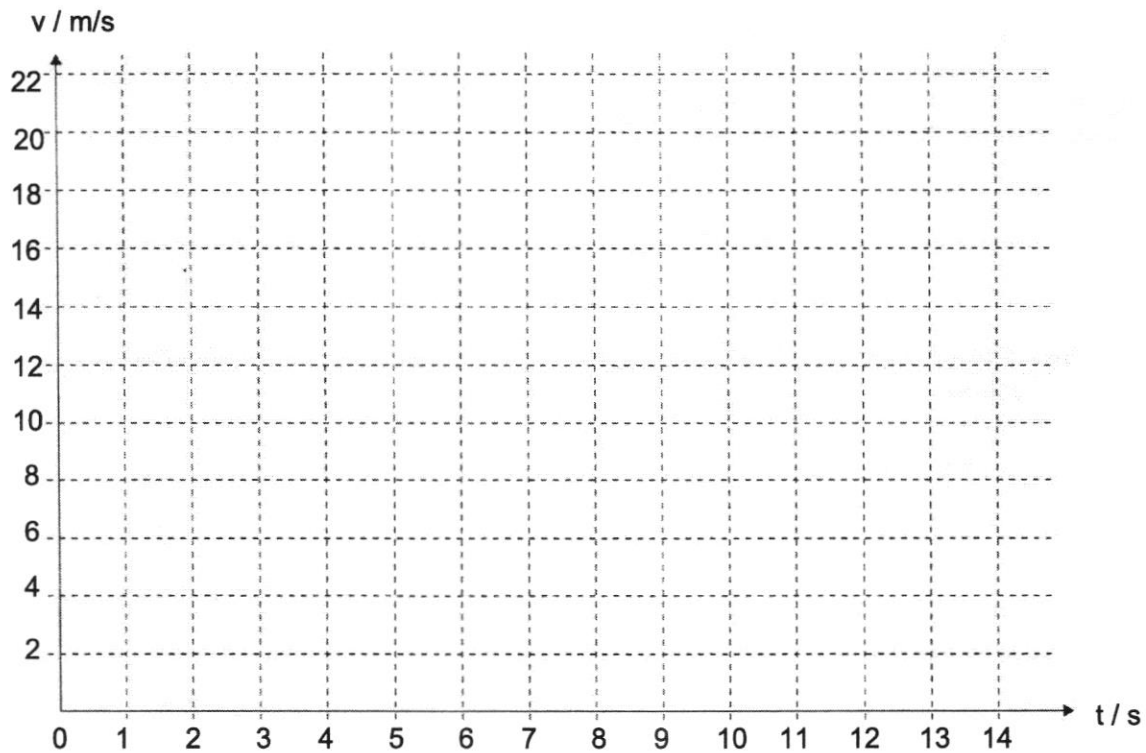


Fig. 9

- (a) On Fig. 9, sketch the speed-time graph of the scenario as described. [2]
- (b) Calculate the distance travelled by the car by the 12th second.

distance = m [2]

- (c) A motorbike accelerates constantly from rest at the same time as the car and reaches a speed of 18 m/s at the 12th second. On Fig. 9, sketch the speed-time graph of the motorbike from 0 s to 12 s. Label this graph as B.

[1]

- (d) Calculate the acceleration of the motorbike.

acceleration = m/s^2 [2]

- (e) Briefly explain with the aid of calculations, if the motorbike will overtake the car at the 12th second.

.....
.....
..... [3]

- 10 Light enters an optical fibre with refractive index of 1.38 as shown in Fig.10.

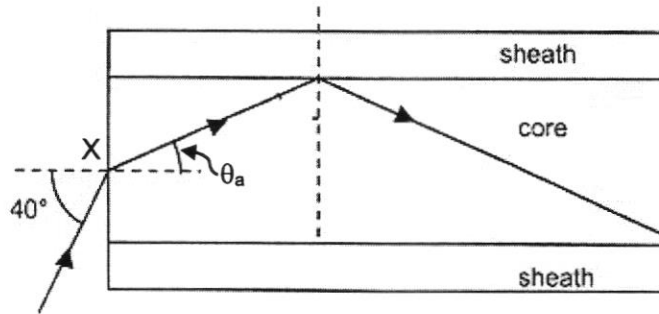


Fig. 10

- (a) Calculate the angle θ_a when the light enters the fibre at an angle of 40° to the normal.

angle $\theta_a = \dots\dots\dots^\circ$ [2]

- (b) Calculate the critical angle of the core of the optical fibre.

critical angle = $\dots\dots\dots^\circ$ [2]

- (c) Define *critical angle*.

.....

[1]

- (d) Calculate the largest possible angle (to the nearest angle) for entry at point X from air for total internal reflection to take place in the core.

largest possible angle = $\dots\dots\dots^\circ$ [2]

- (e) State and explain if the intensity of the light at the furthest end of the fibre increase or decrease when the fibre is made with a smaller refractive index.

.....

.....

.....

.....

.....

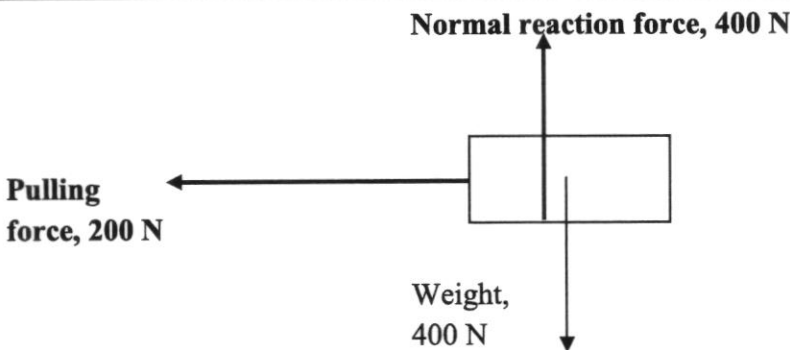
.....[3]

- End of the paper -

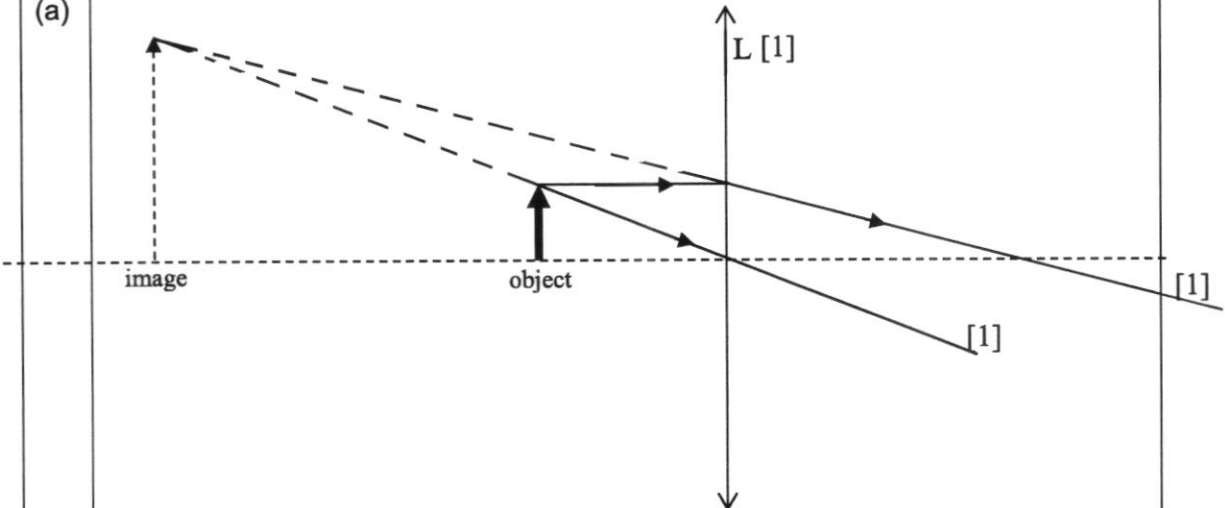
**Beatty Sec 3E Science Physics (5076) Paper 1 and Paper 2
End-Of-Year Examination 2021**

MARKING SCHEME

Paper 1 [20 marks]									
1	B	2	D	3	A	4	C	5	D
6	A	7	D	8	C	9	C	10	C
11	C	12	B	13	A	14	C	15	D
16	C	17	D	18	B	19	C	20	C

Paper 2 Section A [45 marks]			
Qn no.	Answer		Marks
	<u>-1 overall for giving answer in fractions 2 or not 3sf except for the exact figure.</u>		
1.	(a)	$1.5 \times 2 = \underline{3.0 \text{ s}}$	1
	(b)	Average = $(12.6 + 12.7 + 12.5 + 12.6 + 12.7) / 5$ = 12.62 s Period = $12.62 / 20$ = $\underline{0.631 \text{ s (3 s.f.)}}$	1 1 1
	(c)	<u>Increase the length</u> of the pendulum.	1
2.	(a)		1 mark per labelled force with magnitude
	(b)	$W = mg$ $m = w/g = 400/10 = 40 \text{ kg}$	1
		$F = ma$ $a = F/m = 200/40$ $= 5 \text{ ms}^{-2}$	1 1
3.	(a)	Vernier calipers	1
	(b)	(i) volume of the bar = $0.52 \times 4.05 \times 1.01$ = $\underline{2.13 \text{ cm}^3 \text{ (3 s.f.)}}$	1
		(ii) Density of the bar = $39.0 / 2.13$ = 18.3 g/cm^3 = $\underline{18\,300 \text{ kg/m}^3 \text{ (3 s.f.)}}$ (correct conversion)	1 1 1
	(c)	The bar is <u>not made of pure gold.</u> If the bar is pure gold, then the <u>density of the bar should be the same as gold.</u> OR The density of the bar is <u>lower than the density of pure gold.</u>	1 1

4.	(a)	(i)	Heat from the sun reaches the mercury by <u>radiation</u> . Heat can be transmitted <u>through a vacuum only by radiation in the form of infrared radiation</u> .	1 1
		(ii)	<u>Black surface is a better emitter of heat</u> , thus causing the temperature to fall rapidly.	1
	(b)	(i)	<u>Gas bubbles in the flour dough are poor conductors of thermal energy</u> , thus they <u>reduce heat transfer by conduction</u> .	1 1
		(ii)	Oil at the bottom of the frying pan is <u>heated and expands</u> . Its <u>density decreases / becomes less dense</u> . Hot oil <u>rises</u> and <u>cold, denser oil on top sinks</u> . [B1] when this movement is repeated, <u>convection currents are set up</u> . Heat in the hot oil is transferred <u>by convection</u> .	1 1
5.	(a)		30 °C	1
	(b)		<u>As the temperature increases, the water molecules moves faster</u> . Since temperature is directly related to internal kinetic energy, <u>there is an increase in the internal kinetic energy</u> . Since there is <u>no change in state</u> during the first four minutes, there is <u>very small or no change in internal potential energy</u> . Thus there is <u>an overall increase</u> in the internal energy.	1 1
	(c)	(i)	Boiling	1
		(ii)	The thermal energy supplied is used to <u>overcome / break the intermolecular bonds between water molecules</u> and also to <u>overcome the atmospheric pressure</u> as the water molecules tried to escape into the atmosphere as <u>vapour</u> .	1 1
6.	(a)		amplitude = <u>0.50 cm</u> wavelength = $10 \text{ cm} \div 2$ = <u>5 cm</u>	1 1
	(b)		This wave is a <u>longitudinal wave</u> as the <u>direction of vibrations is parallel to the direction of wave travel</u> .	1 1
	(c)	(i)	frequency = $\frac{1}{0.4 \text{ s}}$ = <u>2.5 Hz</u>	1
		(ii)	speed = $\frac{5 \text{ cm}}{0.4 \text{ s}}$ = <u>12.5 cm/s</u>	1 1

7.	(a)	 Note that each ray is credited only with correct solid and straight lines with arrows from object and extended with dotted lines to the image. The lens should be drawn with double-headed arrow as stated in question.	
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7	(b)	focal length of lens = 3.5 cm	1
	(c)	The image is upright and magnified .	1
8.	(a)	speed of sound = $2 \times \text{depth} / \text{time}$ $\text{depth} = (1\,500 \times 0.067) / 2$ $= 50.3 \text{ m}$	1 1
	(b)	The water molecules are closer than air molecules, hence it takes shorter time for the passing of vibrations through water and thus the speed of sound is greater in water.	1

Paper 2 Section B [20 marks]			
Qn no.	Answer		Marks
9.	(a) (c)	$v / \text{m/s}$ For (c) • 1 mark for correct graph and for labelling B For (a) with label, A: • 1 mark for correct slanted and • 1 mark for horizontal line at 12 m/s t / s	note that the graphs "A" and "B" will be given full credit if the lines are drawn with the correct gradient and at correct value.
	(b)	$\text{Distance travelled} = \frac{1}{2} \times (6 + 12) \times 12$ $= 108 \text{ m}$	1 1
	(d)	$a = \frac{18-0}{12}$ $= 1.5 \text{ m/s}^2$	1 1
	(e)	Distance travelled by the motorbike at 12th second = area under graph B $= \frac{1}{2} \times 12 \times 18$ $= 108 \text{ m}$ The motor bike has only travelled the same distance as the car at 12th second as shown in part (b) above. The motor bike has just caught up / met up with the car at 12th second.	1 1 1
10.	(a)	$1.38 = \sin 40^\circ / \sin \theta_a$ $\theta_a = 27.8^\circ$	1 1
	(b)	$\eta = 1/\sin c$ $1.38 = 1/\sin c$ $c = 46.4^\circ$	1 1

(c)	Critical angle is <u>the angle of incidence in the optically denser medium</u> such that the <u>angle of refraction is 90° in the optically less dense medium.</u>	1
(d)	For TIR to happen, angle of refraction is at least 46.5°, thus the angle of refraction at X will be $(90 - 46.5 = 43.5^\circ)$ $\sin i / \sin 43.5 = 1.38$ $\angle i = 71.8^\circ$ largest angle = <u>72°</u> (nearest angle)	1 1
(e)	The intensity of the light will <u>decrease</u> . With a fibre of a smaller refractive index, will have a <u>larger critical angle</u> , thus <u>more rays will undergo refraction</u> at the sheath-core boundary and hence <u>the rays will travel out of the sheath along the length of the fibre by refraction.</u> Therefore, there is lower intensity of light at the furthest end of the fibre.	1 1 1