Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3445UB0-1

S18-3445UB0-1

APPLIED SCIENCE (Double Award)
UNIT 2: Space, Health and Life

HIGHER TIER

MONDAY, 11 JUNE 2018 – MORNING

1 hour 30 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1.(a)(b)(c)**	**19**	
	1.(d)	**6**	
Section B	**2.**	**16**	
	3.	**12**	
	4.	**12**	
	5.	**10**	
	Total	**75**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will require a separate Resource Folder, calculator, pencil and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **3***(a)* is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A periodic table is printed on page 16.

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Section A

Answer **all** *questions in the spaces provided.*

Use the information in the separate Resource Folder to answer the following questions.

1. *(a)* Use the information in **Table 1** to answer the following questions.

(i) Europa is an asteroid. Estimate its temperature and orbital period. [2]

Temperature = ... °C

Orbital period = ... days

(ii) Pluto is no longer classed as a planet. State **one** reason why. [1]

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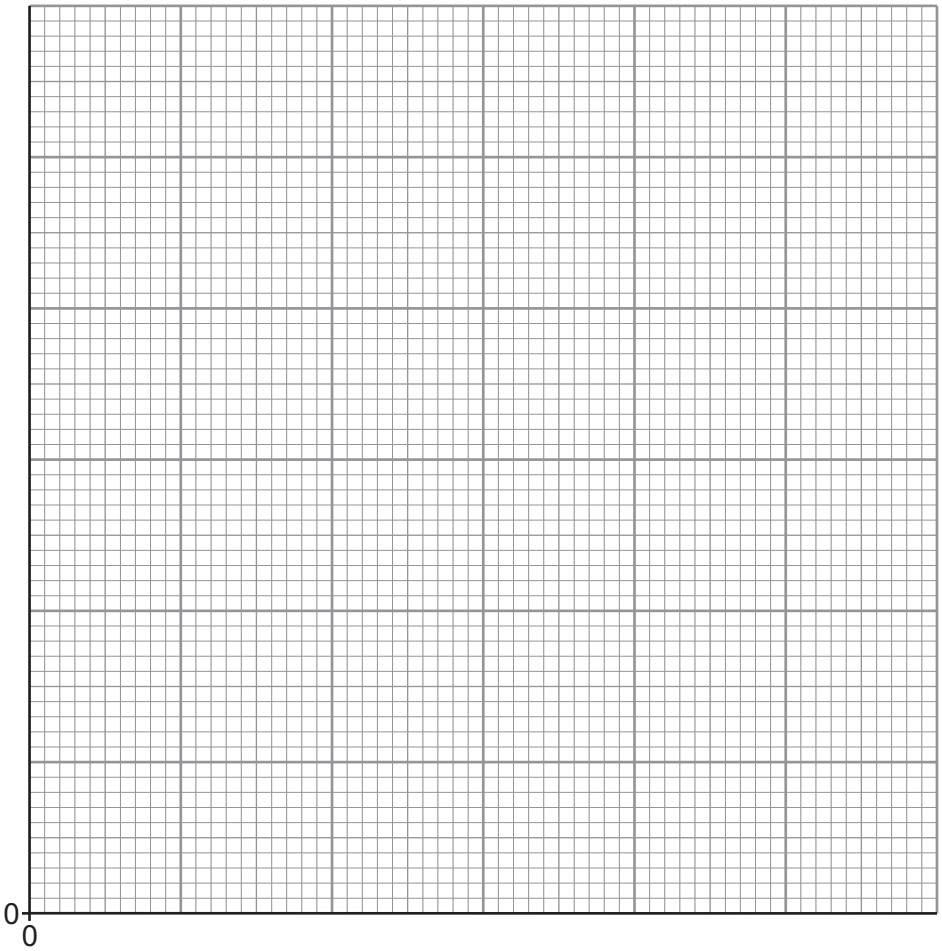
(iii) Plot the points on the grid below to show how the orbital velocity of the five planets Mercury, Venus, Earth, Mars and Jupiter depends on distance from the Sun. Draw a suitable line. [4]

Orbital Velocity (km/s)



Distance from Sun (AU)

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(iv) Orbital velocity is not proportional to the distance from the Sun. Explain how your graph shows this to be true. [2]

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(b) Use your knowledge and the information on **pages 4 and 5** to answer the following questions.

(i) Explain why sunspots appear darker than the surrounding area of the Sun. [2]

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(ii) State **two** ways in which human activities may be affected by solar flares. [2]

1. .....

2. .....

(iii) Explain why the effect of solar flares on the Earth is not the same for each sunspot cycle. [2]

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(c) Use the information in **Diagram 1** to describe the differences between Aristotle's model of the Solar System and the 2006 model. [4]

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(d) Use the information in **Diagram 3** to answer the following questions.

(i) Explain what you can deduce about the motion of the three galaxies. [3]

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(ii) Explain what you can deduce about the chemical composition of the three galaxies. [3]

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Section B

2. Velothon Wales is a weekend of road cycling events. The Bloodwise cycling team raises funds to help beat blood cancer.

(a) Three cyclists are monitored before the Velothon. They have blood samples taken.

The results of their blood tests are shown in the table below. Normal ranges are also given.

Name of cyclist	Red blood cell count (10^6/cm^3)	White blood cell count (10^3/cm^3)	Platelet count (10^3/cm^3)
Normal range	*4.4 - 5.8*	*3.9 - 10.8*	*130 - 400*
Brian	5.5	35.1	240
Gareth	2.2	6.6	115
Jonathan	4.7	8.8	320

(i) Suggest which cyclist needs treatment for an infection. [2]

Cyclist .....

Reason .....

.....

(ii) Suggest which cyclist needs treatment to raise their haemoglobin level. [2]

Cyclist .....

Reason .....

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(iii) Suggest which cyclist will experience a problem if he has a fall and cuts himself. [2]

Cyclist .....

Reason .....

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(b) Explain how the structure of veins and capillaries are related to their function. [4]

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(c) (i) During a training ride, Jonathan accelerated from rest over a distance of 10 m in 2.5 s then travelled another 96 m at a constant speed in 6 s.
Use the equations:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

and

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

to calculate the acceleration of the cyclist. [4]

Acceleration = ... m/s^2

(ii) Jonathan has a height of 1.9 m. He is advised his maximum BMI should be 22.
Use the equation:

$$\text{BMI} = \frac{\text{mass}}{\text{height}^2}$$

to calculate his maximum mass. [2]

Mass= ..... Kg

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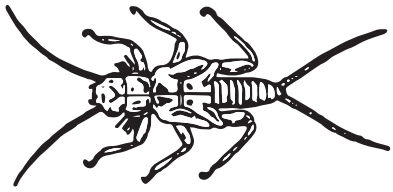
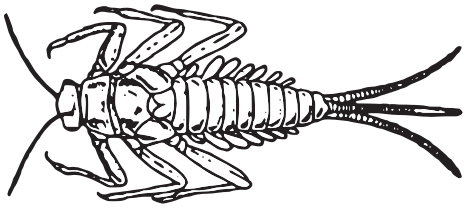
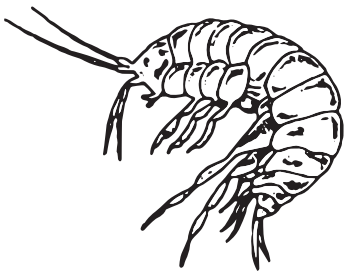
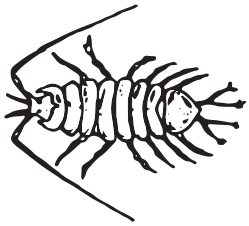
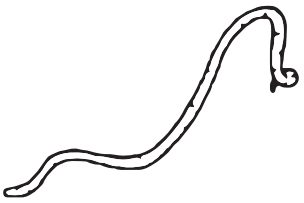
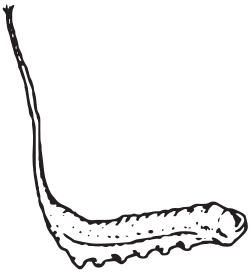
3. Water pollution can be monitored using invertebrates as indicators. Some indicator species are shown below.

Water quality	Indicator species	
Clean water	 Stonefly nymph	 Mayfly nymph
Some pollution	 Freshwater shrimp	 Caddisfly larva
Moderate pollution	 Water louse	 Bloodworm
High pollution	 Sludgeworm	 Rat-tailed maggot
Very high pollution	No life	

(Not drawn to scale.)

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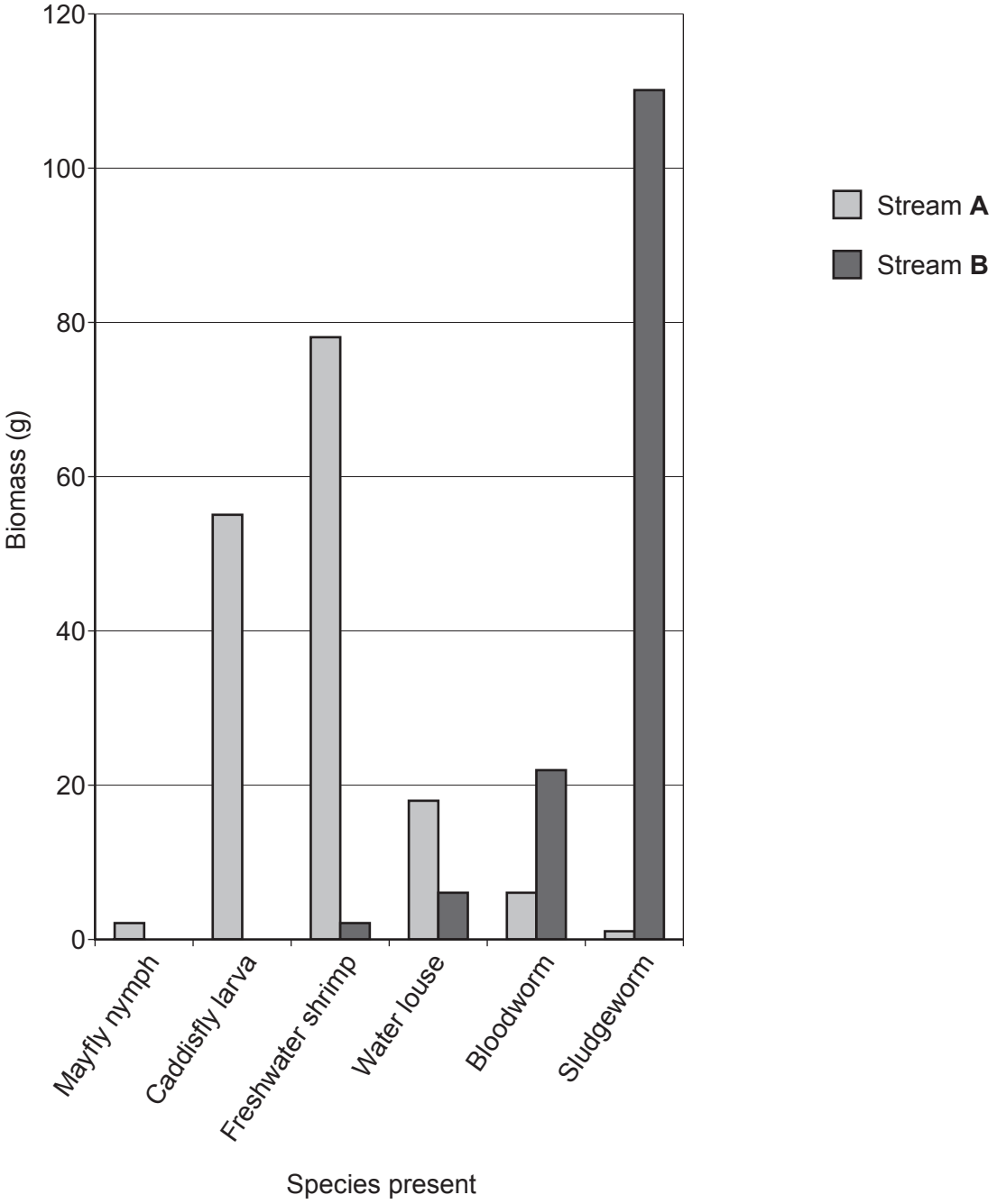
(a) Describe how you would carry out an investigation to determine water quality in a stream using invertebrates as indicator species. [6 QER]

(b) The results from such an investigation are shown in the chart below.



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(i) Explain what conclusions can be made about the water quality in stream **A** and stream **B**. [4]

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(ii) Explain why it is difficult to obtain repeatable data in this experiment. [2]

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4. *(a)* Green plants capture a small percentage of solar energy during the process of photosynthesis. The table below shows how the absorption of light by a green plant depends on the wavelength of the visible light.

Wavelength of visible light (nm)	Absorption (%)
400	85
450	100
500	2
550	12
600	18
650	35
700	75

(i) Describe how the absorption of light depends on the wavelength of visible light. [3]

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(ii) Electromagnetic waves travel at 3×10^8 m/s in space.

Use the equation:

wave speed = frequency $\times$ wavelength

to calculate the frequency of light which is most strongly absorbed. [3]

(1 nm = 1×10^{-9} m)

Frequency = ... Hz

Examiner only

(b) The table shows what happens to the energy taken in each day by organisms in the food chain below.

grass ⟶ grasshopper ⟶ shrew ⟶ fox

Organisms	Energy per day (MJ)		
	As waste	Released during respiration	Used for growth
grass	6	10	8
grasshopper	14	22	3
shrew		26	4
fox	24	32	4

(i) The shrew releases 60% of its energy during respiration and for growth. Calculate how much energy is released by the shrew as waste. [2]

Energy as waste = ... MJ

(ii) Explain why the amount of energy released during respiration by each organism increases through the food chain. [2]

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(iii) Sometimes plant seeds will stick to the coat of a fox. Explain how this benefits the plant. [2]

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5. Nuclear medicine involves the use of radioactive substances in the diagnosis and treatment of disease. Nuclear medicine records radiation emitted from within the body rather than radiation that is generated by external sources like X-rays. Nuclear medicine scans differ from radiology as the emphasis is not on imaging but on organ function.

Information about some isotopes that emit gamma (γ) rays is given in the table.

Radioisotope	Half-life	Energy of γ rays
caesium-137	30.17 years	0.662 MeV
cobalt-60	5.26 years	1.17 MeV
iodine-125	59.6 days	31.4 keV
thallium-201	73.0 hours	71.0 keV
palladium-103	17.0 days	21.0 keV

(a) (i) Describe the nature of a gamma (γ) ray. [2]

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(ii) Explain why radioisotopes that emit gamma rays are suitable for examining organ function when injected into the body. [2]

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(iii) Explain which is the most suitable radioisotope from the table to inject into the human body as part of a gamma camera investigation. [2]

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Examiner only

(b) In order to treat prostate cancer, palladium-103 pellets are placed directly into the prostate gland. They remain permanently in place. The gamma emissions from the pellets are almost undetectable when their activity drops to 1/32 of its original value.
Calculate the time taken for this reduction to occur. [4]

Time = ... days

10

END OF PAPER

THE PERIODIC TABLE

1	2	Group										3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

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