PSYCHOLOGICAL AND BEHAVIOURAL SCIENCES ADMISSIONS ASSESSMENT

CONTENT SPECIFICATION

2016

Overview

The Psychological and Behavioural Sciences Admissions Assessment consists of two sections:

Section 1: This section consists of three parts. Candidates will be required to answer two of these three parts: they should answer one compulsory part [Part A Thinking Skills] and one further part chosen from two options [Part B Mathematics and Biology, Part C Reading Comprehension].

Each part in Section 1 contains multiple-choice questions.

The time allowed for Section 1 is 80 minutes.

Section 2: This section consists of four written tasks of which candidates should complete one.

The time allowed for Section 2 is 40 minutes.

Candidates should note that calculators and dictionaries are **not** permitted for any part of this assessment.

The purpose of the Psychological and Behavioural Sciences Admissions Assessment is to determine a candidate's potential to achieve in an academically demanding undergraduate degree course. The assessment is designed to be challenging in order to differentiate effectively between able applicants, including those who may have achieved the highest possible grades in school examinations.

Format

Section 1 consists of three parts. **Candidates will be required to answer Part A, and two further parts chosen from Parts B or C.** The three parts are as follows:

      Part A   Thinking Skills

      Part B   Mathematics and Biology

      Part C   Reading Comprehension

Part A Thinking Skills consists of 22 multiple-choice questions; these 22 questions are made up of 11 Critical Thinking questions and 11 Problem Solving questions.

Part B, Mathematics and Biology, consists of 30 multiple-choice questions, of which 15 are Mathematics and 15 are Biology. The questions in Part B draw upon a candidate's ability to use and apply their mathematical and biological knowledge.

Part C, Reading Comprehension, consists of 24 multiple-choice questions, and comprises three tasks.

The time allowed to complete Section 1 is 80 minutes and candidates should be careful to manage their time accordingly. Candidates are advised to spend approximately 40 minutes on Part A, and 40 minutes on their chosen part. Results for each part will be reported separately.

Section 2 requires candidates to discuss a quotation. Candidates must discuss **one** from a choice of four. This section assesses each candidate's ability to think analytically and produce a coherent argument. The time allowed to complete Section 2 is 40 minutes.

Content

Section 1:

The questions in Section 1 will draw upon the knowledge and topics set out in the appropriate part of Appendix 1.

In Section 1, Part A will have both Critical Thinking and Problem Solving multiple-choice questions.

Part B of Section 1 will assume knowledge of the mathematical and biological content of Part B (Mathematics and Biology).

Part C will include three tasks, each based around text excerpts. The questions will not require any specialist or background knowledge beyond the information contained in the texts.

Section 2:

The questions in Section 2 require candidates to discuss one quotation from a choice of four. Further details of what is expected of candidates in Section 2 can be found in Appendix 2.

Example questions

Example questions are set out in the corresponding Appendices.

Scoring

In Section 1, each correct answer will score 1 mark. No marks will be deducted for incorrect answers. Results for each part will be reported separately.

In Section 2, candidates' answers will be assessed taking into account how well they have:

- thought analytically and produced a coherent argument, using relevant evidence;
- written with clarity and precision under time pressure.

Appendix 1: Knowledge and skills assumed in Section 1

Part A of this appendix gives an overview of the main skills tested by the Thinking Skills part of Section 1. In addition to explanations of the Critical Thinking and Problem Solving skills that will be assessed, an example of each type of question has been included, together with an explanation of the correct answer.

Part B of this appendix outlines the mathematical and biological knowledge that the questions in Part B can draw upon. Some example questions for Part B are given at the end of this appendix.

Throughout this specification it should be assumed that, where mention is made of a particular quantity, knowledge of the SI unit of that quantity is also expected (including the relationship of the unit to other SI units through the equations linking their quantities). Candidates will be expected to be familiar with the SI prefixes (for the range 10^{-9} (nano) to 10^{9} (giga)) when used in connection with any SI unit.

Part A Thinking Skills

Part A will have both Critical Thinking and Problem Solving multiple-choice questions. In each case a stimulus is presented, followed by the question and five options. One of the options is the correct answer and the remaining four options are incorrect.

The skill of Critical Thinking is essential to any academic study and often involves considering an argument put forward to promote or defend a particular point of view. It is important in higher education to understand the arguments presented by others and to be able to assess whether the arguments establish their claims.

The skill of Problem Solving is important as many problems encountered in academic and professional work are novel and no ready 'off the peg' solution is available. The task is to find or create a solution using the information available.

In the case of the Critical Thinking questions, the stimulus is a passage of text, often one which puts forward an argument to promote or defend a particular point of view. In Problem Solving questions, the stimulus may include a diagram, a table of information or a graph. The multiple-choice options may also be graphs or diagrams.

Critical Thinking

Critical Thinking involves reasoning using everyday written language. Questions focus on the skills involved in understanding and evaluating arguments. These include: summarising conclusions, identifying assumptions, assessing the impact of additional evidence, detecting reasoning errors and applying principles. On the pages that follow, you will find one example of each of the five Critical Thinking question types in the assessment.

Example 1: Summarising the Main Conclusion

In this type of question you have to judge which one of the statements A to E best expresses the main conclusion of the argument. So the important first step is to read the passage carefully and pick out the sentence which is the conclusion. Remember that the conclusion can appear anywhere within an argument, not necessarily at the end. Remember also that what you are looking for is the statement which follows from or is supported by the rest of the passage.

Vegetarian food can be healthier than a traditional diet. Research has shown that vegetarians are less likely to suffer from heart disease and obesity than meat eaters. Concern has been expressed that vegetarians do not get enough protein in their diet but it has been demonstrated that, by selecting foods carefully, vegetarians are able to amply meet their needs in this respect.

Which one of the following best expresses the main conclusion of the above argument?

A   A vegetarian diet can be better for health than a traditional diet.

B   Adequate protein is available from a vegetarian diet.

C   A traditional diet is very high in protein.

D   A balanced diet is more important for health than any particular food.

E   Vegetarians are unlikely to suffer from heart disease and obesity.

A passage may have an intermediate conclusion which is just one of the steps in the reasoning towards the main conclusion. Be careful to check this. If a sentence appears to be a conclusion, but is used as a reason to support some other statement in the passage, then it will not be the main conclusion. Do not worry about whether the information in the passage is true. Just ask yourself: 'If these reasons were true, would they give me good reason to accept the sentence I have identified as the main conclusion?'

What does this argument seem to be trying to get you to accept? It seems to be trying to persuade you that vegetarian food can be healthier than a traditional diet (the first sentence). If you think this is the main conclusion, you should then check whether the rest of the passage gives you reason to believe this. Two reasons are given:

(i)   Vegetarians are less likely to suffer from heart disease and obesity than meat eaters.
(ii)   A vegetarian diet can contain sufficient protein.

You may not know whether these reasons are true but, if they were true, they would indicate that vegetarian food is healthier in one respect than a diet which includes meat, and that a vegetarian diet does not necessarily have the disadvantage to health (providing insufficient protein) which some may think. So it seems clear that the first sentence of the passage is being offered as a conclusion. **A** is the correct answer.

Example 2: Identifying an Assumption

Questions of this type ask you to identify an assumption in an argument. An assumption is something which is not stated in the argument but which is taken for granted in order to draw the conclusion. So you need first to identify the conclusion of the argument. Then look for the reasoning it gives to support this conclusion, and think about any important point which is not actually stated in the reasoning.

People who write books revealing the inner workings of the secret service have usually been dismissed from the service or have retired with a sense of grievance against it. The result is that only the seedy side of the secret service is exposed. This is partly because those who would paint a more favourable picture are unwilling to flout the legal restrictions placed on all who have been employed in the secret service, and partly because the records of the organisations are not available to outsiders.

Which one of the following is an underlying assumption of the above argument?

A   The records of the secret service are readily available to its former employees.

B   The work of the secret service is undervalued as a result of publication of distorted accounts of its working.

C   The seedy side of the secret service is of minor significance compared with the important work it carries out.

D   Legal restrictions against revealing the inner workings of the secret service do not apply to those who have been dismissed.

E   Those who have a grievance against the secret service are either unable or unwilling to give a balanced account of its workings.

The answer to this question is **E**. The conclusion is that only the seedy side of the secret service is exposed. The reasons given for this are that:

(i)   the records of the secret service are not generally available;
(ii)   there are legal restrictions on employees of the secret service which forbid them from writing about it;
(iii)   the only employees or ex-employees who would ignore this restriction are those with a sense of grievance against the secret service.

From these reasons, it would not follow that only the seedy side of the secret service was exposed if those with a grievance were able and willing to give a balanced account. So it must be assumed that either they are not able or they are not willing to do so.

A is not assumed. The passage says that the records are not available to outsiders. But ex-employees may or may not have access to records. We do not need to assume that they do have access in order to conclude that, when they write about the secret service, they reveal only its seedy side.

B is not assumed, because it goes further than the passage. It considers the effects of publications about the secret service. But what we are looking for as an assumption is something which helps to support the conclusion of the passage.

C is not assumed, because the passage says nothing about the importance of the work carried out by the secret service. It does suggest that there is another side to the secret service, besides the seedy side, but no assumptions can be made about which is more important.

D is not assumed, because the passage says that the legal restrictions apply to 'all who have been employed', and this must include those who have been dismissed.

Example 3: Assessing the Impact of Additional Evidence

This type of question will typically ask you to consider what would weaken or strengthen an argument. You need first to be clear about what the argument is trying to establish. Work out what the conclusion is, and then consider what effect each of the possible answers would have on the conclusion.

Polar bears in captivity frequently engage in obsessive patterns of behaviour, pacing back and forth on the same spot, swinging their heads from side to side, and showing other signs of stress. They do this even when their living areas are quite spacious. What this shows is that conditions of captivity are not a satisfactory substitute for the natural environment of the polar bear species.

Which one of the following, if true, would most weaken the above argument?

A   Polar bears are especially ill-suited to a life in captivity.

B   Many polar bears in the wild engage in obsessive patterns of behaviour.

C   Polar bears in captivity are much better fed than those living in the wild.

D   Polar bears in the wild cover many miles a day when they are hunting for food.

E   Polar bears which have been reared in captivity are incapable of surviving in the wild.

The answer is **B**. The conclusion of the argument is that the obsessive behaviour of polar bears in zoos shows that conditions of captivity are not a satisfactory substitute for the polar bear's natural environment. But if **B** is true, that is, if polar bears in the wild behave in the same way as those in captivity, then the behaviour of those in captivity cannot be taken as good evidence that the conditions of captivity are unsatisfactory.

A does not weaken the argument. If polar bears are ill-suited to a life in captivity, it follows that captivity is not a satisfactory substitute for their natural environment. So **A** strengthens the argument.

C does not weaken the argument, even though it suggests that polar bears might be better off in one respect in captivity (that is, better fed). Captivity might nevertheless lead to stress which is not suffered by polar bears in the wild.

D does not weaken the argument, because, even if polar bears cover many miles per day in the wild, pacing around in captivity may not be a satisfactory substitute for this freedom to roam.

E does not weaken the argument, because the conclusion is about the best environment for the polar bear species. Information about the best environment for those polar bears which have been reared in captivity cannot weaken this general conclusion about the species as a whole.

Example 4: Detecting Reasoning Errors

This type of question asks you to identify the flaw in the argument, which means that you must identify why the conclusion does not follow from the reasons that are given. So you need to be clear about what the conclusion is and what reasons are meant to support it.

Some recent films have been very expensive to make, but have not been the big box-office hits that would have justified the expense. At the same time, there have been films made very cheaply which have been received with both huge critical and popular acclaim. Indeed, some directors who have made successful low-budget films have gone on to make unsuccessful but expensive films. It is obvious then that if directors want to make popular films they should stick to low budgets.

Which one of the following is the best statement of the flaw in the argument above?

A Critics are often wrong in their predictions about the popularity of films.

B The cost of making a film is normally greater than its original budget.

C The cost of a film need not be the factor that determines its popularity.

D The popularity of a film would justify a high level of expense in making it.

E The public does not necessarily know whether a film has been expensive or cheap to make.

The answer is **C**. The argument draws the conclusion that if directors want to make popular films they should stick to low budgets. The reasoning offered in support of this is that:

 (i) some recent films have been very expensive to make, but have not been successful enough to justify the expense;
 (ii) there have been films made very cheaply that have been very popular; and
 (iii) some directors who have made successful low-budget films have gone on to make unsuccessful but expensive films.

But the conclusion does not follow, because the argument fails to establish a causal link between the cost of making a film and its popularity: it fails to consider high-budget films that have been popular and low-budget films that have been unpopular. **C** is the statement which best explains this.

A does not describe the flaw, because it simply states something that may be true but is of little relevance to the argument.

B does not describe the flaw, because the argument does not depend upon a comparison of original and final budgets.

D does not describe the flaw, because it states something that may be true but, if anything, contradicts the conclusion of the argument.

E does not describe the flaw, because it simply states something that may be true but is not relied upon by the argument when reaching the conclusion.

Example 5: Applying Principles

In this type of question you are asked which statement illustrates the principle underlying the passage. A principle is a general recommendation, which in the passage will be applied to just one particular case, but which could also be applied to other cases. In order to answer this type of question, you must first identify this principle and then consider each of the options to see which one follows from that principle.

Smokers who suffer from heart disease which is caused by their smoking should not be allowed to get free health treatment. That is because this is an example of self-inflicted illness. Those whose actions have caused illness or injury to themselves should make a financial contribution to their treatment.

Which one of the following best illustrates the principle underlying the argument above?

A   Children should get free dental treatment, even if they eat sweets which cause dental decay.

B   Heart disease sufferers who can afford to pay for health treatment should not receive free treatment.

C   Smokers who cannot afford to pay for healthcare should be allowed free treatment when they are ill.

D   People who are injured in car accidents should receive free treatment regardless of whether they were wearing a seat belt.

E   Motor cyclists whose head injuries are caused by not wearing a crash helmet should make a financial contribution to their treatment.

When you are asked which statement illustrates the principle underlying the passage, you must first identify this principle. For example, someone might use the principle 'Killing is wrong' in order to argue for pacifism, that is, for refusing to go to war. If we are to accept the principle that killing is wrong, then it also follows that capital punishment is wrong and even that killing in self-defence is wrong.

In order to answer this type of question, you first need to understand the argument, so look for the conclusion and for the reasons in the usual way. This should enable you to see what principle the argument relies on in order to draw its conclusion. You then need to consider each possible answer to see which one follows from the principle.

The conclusion of this argument is that smokers who get heart disease as a result of smoking should not get free health treatment. The reason given for this is that their illness is self-inflicted. This reasoning relies on the general principle that if your actions have caused your illness or injury, you should make a financial contribution to your treatment.

The correct answer is **E**, which applies the principle to motor cyclists whose failure to wear a crash helmet has caused their head injuries.

A is not an application of the principle, because it suggests that even if a child's actions (eating sweets) have caused a health problem (dental decay) the child should nevertheless have free treatment.

B is not an application of the principle, because it makes a recommendation based on people's ability to pay for treatment rather than on whether their actions have caused their illness.

C is not an application of the principle, because, like **B**, it makes its recommendation solely on the ability to pay.

D is not an application of the principle, because it recommends free treatment regardless of whether people's actions have contributed to their injuries.

Problem Solving

Problem Solving involves reasoning using numerical and spatial skills. The Problem Solving questions in the assessment are of three kinds, each assessing a key aspect of insight into unfamiliar problems. The three kinds of question are Relevant Selection, Finding Procedures, and Identifying Similarity. Although most questions fall into one category, some questions fit into more than one of the categories.

The examples on the following pages show the three kinds of Problem Solving question in the assessment.

Example 1: Relevant Selection

Very often a real world problem will be overloaded with information, much of which is unimportant. The first step in solving the problem is to decide which bits of the information available are important. It may be that the question has presented you with information which is not important, perhaps redundant, and possibly distracting. This kind of question demands Relevant Selection, in which the task is to select only that information which is necessary and helpful in finding a solution.

The following table gives figures for the percentage growth per year of labour productivity per person per year in various countries during three periods.

	Period 1	Period 2	Period 3
Japan	8.5	3.0	3.2
France	5.4	3.0	2.6
United Kingdom	3.6	1.5	2.4
Belgium	3.3	2.8	2.3
Sweden	4.1	1.5	1.8
Denmark	4.3	2.6	1.7
Italy	6.3	3.0	1.6
Netherlands	4.8	2.7	1.6
Germany	4.5	3.1	1.6
United States	2.2	0.0	0.8

Which country's percentage growth per year was greater than half of its Period 1 level in both Period 2 and Period 3?

A   Belgium

B   Denmark

C   France

D   Germany

E   United Kingdom

For this question, you need first to be clear what you need to do to find the answer: you must identify which row of the table contains numbers in the 'Period 2' and 'Period 3' columns that are more than half the number in the 'Period 1' column.

By quickly comparing the 'Period 1' and 'Period 2' columns, you can eliminate all but France, Belgium, Denmark, Netherlands and Germany. By comparing 'Period 1' and 'Period 3' you can eliminate all but Belgium. So the correct answer is **A**.

Example 2: Finding Procedures

Sometimes you will find that even if you have selected all the relevant information, no solution presents itself. Questions of this type often provide you with very little information, all of which may be needed in order to solve the problem. You then have to find a method or procedure which you can use to generate a solution. Typically you will have three or four numbers which have to be operated on. This aspect of Problem Solving is called Finding Procedures.

The 400 seats in a parliament are divided amongst five political parties. No two parties have the same number of seats, and each has at least 20.

What is the largest number of seats that the third largest party can have?

    A   22

    B   118

    C   119

    D   120

    E   121

Five parties share 400 seats. For the third largest party to have the maximum number of seats, the other parties must have the minimum number, whilst still meeting the other conditions set out in the question. So the fourth and fifth largest parties will have 21 and 20 seats respectively. This leaves 359 seats to be divided between the three largest parties.

For the third largest party to have as many seats as possible, the other two must have only slightly more seats. If we divide the remaining 359 seats as nearly as possible into thirds, we get: 1st = 120; 2nd = 120; 3rd = 119. However, this violates the condition that no two parties have the same number of seats. To avoid this, one of the seats of the third largest party must be transferred to the largest party.

This gives: 1st = 121; 2nd = 120; 3rd = 118; 4th = 21; 5th = 20. The answer is **B**.

Example 3: Identifying Similarity

These questions are about being able to recognise data in a different form to that presented. The data is often presented in two different forms such as a table and then some graphs. It may also include spatial reasoning.

The graph below shows a person's bank balance at the end of each month in a year.
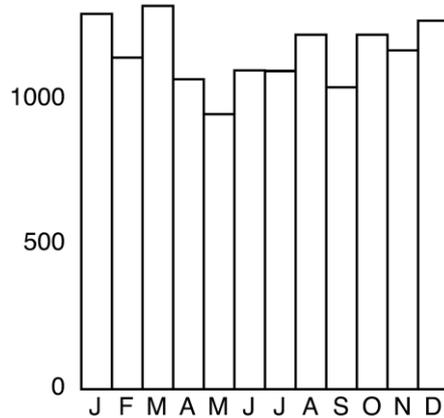
Which one of the following graphs could show the actual change in the bank balance each month?

A

B

C

D

E
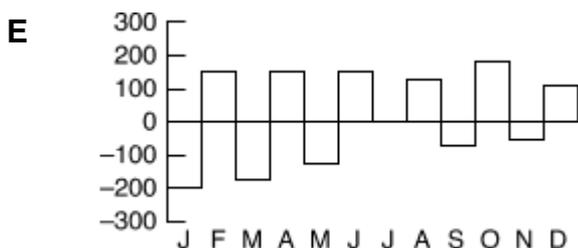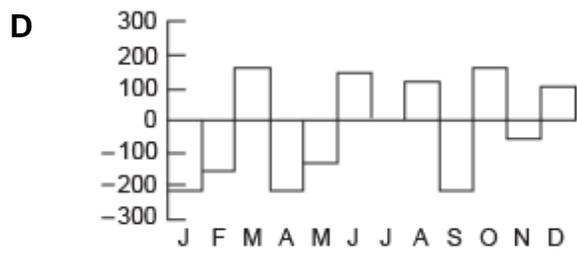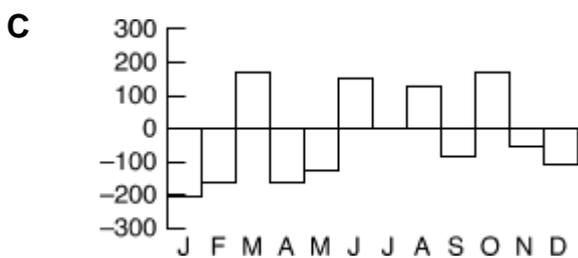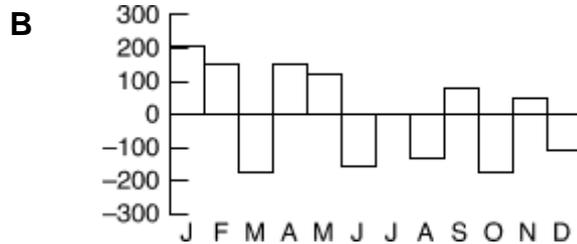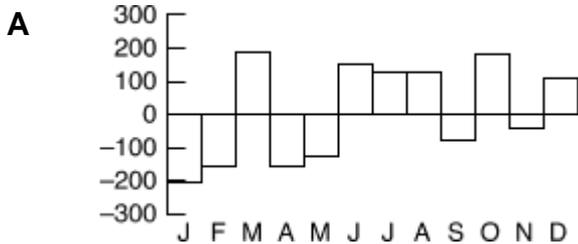
To solve this problem, you must first be clear about how the two types of graph represent the same information. The main graph shows the balance at the end of each month; the graphs in the options show us the *change* in the balance during each month. So, for example, the bar for February in the options represents the difference between the bars for January and February in the main graph.

In the main graph, the balance goes down between the end of January and the end of February, so the bar for February in the options should be negative. A comparison of the options shows that this is true only for options A, C and D, so options B and E can be excluded. By comparing the values for each month in this way, you should find that the correct option is **D**.

Part B Mathematics and Biology

Mathematics

M1. Number

M1.1 Order, add, subtract, multiply and divide whole numbers, integers, fractions, decimals and numbers in index form.

M1.2 Use the concepts and vocabulary of factor, multiple, common factor, highest common factor (hcf), least common multiple (lcm), composite (i.e. not prime), prime number, and prime factor decomposition.

M1.3 Use the terms 'square', 'positive square root' and 'negative square root', 'cube' and 'cube root'.

M1.4 Use index laws to simplify, multiply, and divide integer, fractional, and negative powers.

M1.5 Interpret, order and calculate with numbers written in standard index form.

M1.6 Understand equivalent fractions.

M1.7 Convert between fractions, decimals and percentages.

M1.8 Understand and use percentage, including repeated proportional change and calculating the original amount after a percentage change.

M1.9 Understand and use direct and indirect proportion.

M1.10 Use ratio notation including dividing a quantity in a given ratio, and solve related problems (using the unitary method).

M1.11 Understand and use number operations, including inverse operations and the hierarchy of operations.

M1.12 Use surds and in exact calculations, simplify expressions that contain surds, including rationalising the denominator.

M1.13 Calculate upper and lower bounds in contextual problems.

M1.14 Approximate to a specified and appropriate degree of accuracy, including rounding to a given number of decimal places or significant figures.

M1.15 Know and use approximation methods to produce estimations of calculations.

M2. Algebra

M2.1 Distinguish between the different roles played by letter symbols.

M2.2 Manipulate algebraic expressions by collecting like terms; by multiplying a single term over a bracket; by expanding the product of two linear expressions.

M2.3 Use index laws in algebra for multiplication and division of integer, fractional, and negative powers.

M2.4 Set up and solve linear equations, including simultaneous equations in two unknowns.

M2.5 Factorise quadratics, including the difference of two squares. Simplify rational expressions by cancelling or factorising.

M2.6 Set up quadratic equations and solve them by factorising.

M2.7 Set up and use equations to solve problems involving direct and indirect proportion.

M2.8 Derive a formula, substitute into a formula.

M2.9 Change the subject of a formula.

M2.10 Solve linear inequalities in one or two variables.

M2.11 Generate terms of a sequence using 'term-to-term' and 'position-to-term' definitions.

M2.12 Use linear expressions to describe the nth term of a sequence.

M2.13 Use Cartesian coordinates in all 4 quadrants.

M2.14 Recognise the equations of straight lines; understand and the gradients of parallel lines.

M2.15 Understand that the intersection of graphs can be interpreted as giving the solutions to simultaneous equations.

M2.16 Solve simultaneous equations, where one is linear and one is quadratic.

M2.17 Recognise and interpret graphs of quadratic functions, simple cubic functions, the reciprocal function, trigonometric functions, and the exponential function for simple positive values of .

M2.18 Construct linear functions from real-life problems; interpret graphs modelling real situations.

M3. Geometry

M3.1 Recall and use properties of angles at a point, on a straight line, perpendicular lines and opposite angles at a vertex.

M3.2 Understand and use the angle properties of parallel lines, intersecting lines, triangles and quadrilaterals.

M3.3 Calculate and use the sums of the interior and exterior angles of polygons.

M3.4 Recall the properties and definitions of special types of quadrilateral.

M3.5 Recognise and use reflectional and rotational symmetry of 2-dimensional shapes.

M3.6 Understand congruence and similarity.

M3.7 Use Pythagoras' theorem in 2-dimensions and 3-dimensions.

M3.8 Understand and construct geometrical proofs, including using circle theorems:

    a. the perpendicular from the centre to a chord bisects the chord

    b. the tangent at any point on a circle is perpendicular to the radius at that point

    c. the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference

    d. the angle in a semicircle is a right angle

    e. angles in the same segment are equal

    f. the opposite angles in a cyclic quadrilateral add to 180°

    g. the angle between the tangent and chord at the point of contact is equal to the angle in the alternate segment.

M3.9 Use 2-dimensional representations of 3-dimensional shapes.

M3.10 Describe and transform 2-dimensional shapes using single or combined rotations, reflections, translations, or enlargements, including the use of vector notation.

M4. Measures

M4.1 Calculate perimeters and areas of shapes made from triangles, rectangles and other shapes.

M4.2 Find circumferences and areas of circles, including arcs, segments and sectors.

M4.3 Calculate the volumes and surface areas of right prisms, pyramids, spheres, cylinders, cones, and solids made from cubes and cuboids (formulae will be given for the sphere and cone).

M4.4 Use vectors, including the sum of two vectors, algebraically and graphically.

M4.5 Use and interpret maps and scale drawings.

M4.6 Understand and use the effect of enlargement for perimeter, area, and volume of shapes and solids.

M4.7 Convert measurements from one unit to another, including between imperial and metric (conversion factors will be given for imperial/metric conversions).

M4.8 Know the SI prefixes for the range 10^{-9} (nano) to 10^{9} (giga) when used in connection with any SI unit.

M4.9 Recognise the inaccuracy of measurement.

M4.10 Understand and use three-figure bearings.

M4.11 Understand and use compound measures.

M5. Statistics

M5.1 Identify possible sources of bias.

M5.2 Identify flaws in data collection sheets and questionnaires in a survey or experiment.

M5.3 Group, and understand, discrete and continuous data.

M5.4 Extract data from lists and tables.

M5.5 Design and use two-way tables.

M5.6 Interpret bar charts, pie charts, grouped frequency diagrams, line graphs, and frequency polygons.

M5.7 Interpret cumulative frequency tables, graphs, and histograms (including unequal class width).

M5.8 Calculate and interpret mean, median, mode, modal class, range, and inter-quartile range, including the estimated mean of grouped data.

M5.9 Calculate average rates when combining samples or events, including solving problems involving average rate calculations (e.g. average survival rates in different wards of different sizes; average speed of a car over a journey where it has travelled at different speeds).

M5.10 Interpret scatter diagrams and recognise correlation; using lines of best fit.

M5.11 Compare sets of data by using statistical measures or by interpreting graphical representations of their distributions.

M6. Probability

M6.1 Understand and use the vocabulary of probability and the probability scale.

M6.2 Understand and use estimates or measures of probability, including relative frequency and theoretical models.

M6.3 List all the outcomes for single and combined events.

M6.4 Identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1.

M6.5 Construct and use Venn diagrams to solve union and intersection categorisation problems and determine probabilities when required. Familiarity with the meaning and use of the terms 'union', 'intersection', and 'complement' is required.

M6.6 Know when to add or multiply two probabilities.

M6.7 Understand the use of tree diagrams to represent outcomes of combined events:
    a. when the probabilities are independent of the previous outcome
    b. when the probabilities are dependent on the previous outcome.

M6.8 Compare experimental and theoretical probabilities.

M6.9 Understand that if an experiment is repeated, the outcome may be different.

Biology

B1. Cells

B1.1 Describe the structure and function of animal cells to include:

    a. cell membrane

    b. cytoplasm

    c. nucleus

    d. mitochondrion.

B1.2 Describe the structure and function of plant cells to include:

    a. cell membrane

    b. cytoplasm

    c. nucleus

    d. cell wall

    e. chloroplast

    f. mitochondrion

    g. vacuole.

B1.3 Describe the structure and function of a bacterial cell to include:

    a. cell membrane

    b. cytoplasm

    c. cell wall

    d. chromosomal DNA/no 'true' nucleus.

B1.4 Know the levels of organisation as: cells to tissues to organs.

B2. Movement across membranes

B2.1 Know the definition of and examples of diffusion, osmosis and active transport.

B3. Cell division and sex determination

B3.1 Mitosis:

    a. define as cell division that produces two daughter cells that have the same number of chromosomes as the mother cell, so are genetically identical

    b. describe the role of mitosis in growth and repair of tissues, plus replacement of cells.

B3.2 Meiosis:

    a. define as cell division that produces four daughter cells, known as gametes, which have a single set of chromosomes (are haploid), each with different combinations of parent cells' DNA

      b. describe the role of meiosis in reducing the chromosome number so that full chromosome complement, two sets of chromosomes (diploid), is restored at fertilisation.

B3.3 Asexual and sexual reproduction:

      a. understand that asexual reproduction involves one parent and offspring are genetically identical

      b. understand that asexual reproduction produces clones

      c. understand that sexual reproduction involves two parents and offspring are genetically different, leading to (increased) variation

      d. understand that bacteria reproduce asexually by dividing into two by binary fission.

B3.4 Sex determination:

      a. recall that, in most mammals, females are XX and males are XY

      b. know that one of the pairs of chromosomes, XX or XY, carries the genes which determine sex.

B4. Inheritance

B4.1 Know the nucleus as a site of genetic material/chromosomes/genes in plant and animal cells.

B4.2 Describe and understand the following genetic terms:

      a. genes

      b. alleles

      c. dominant

      d. recessive

      e. heterozygous

      f. homozygous

      g. phenotype

      h. genotype.

B4.3 Monohybrid crosses:

      a. use and interpret genetic diagrams to depict monohybrid crosses

      b. use family pedigrees/family trees

      c. express outcome as ratio, numbers or percentage

      d. understand the concept of inherited disease and the use of screening to identify it, e.g. cystic fibrosis.

B5. DNA

B5.1 Understand that chromosomes contain DNA.

B5.2 Describe the structure of DNA:

    a. know that one molecule of DNA is made up of two long chains (strands) of alternating sugar and phosphate molecules connected by bases and that this structure is twisted to form a double helix

    b. know that each of the two DNA strands is made up of many small groups of nucleotides containing four bases: adenine (A), thymine (T), cytosine (C) and guanine (G)

    c. know that A pairs with T, and C pairs with G, and that it is the order of these bases which forms a code.

B5.3 Protein synthesis:

    a. understand that genes carry the code for proteins

    b. understand that the genetic code is 'read' as triplets and each triplet codes for an amino acid

    c. understand that protein synthesis involves the production of proteins from amino acids.

B5.4 Gene mutations:

    a. appreciate that a change in the gene/DNA is a gene mutation and that mutations occur at random

    b. understand that most mutations have no effect but some may be beneficial or harmful.

B6. Gene technologies

B6.1 Genetic modification/genetic engineering:

    a. know that genes from the chromosomes of humans and other organisms can be 'cut out' using enzymes and transferred to cells of other organisms

    b. recall examples of genetic modification in different cell types.

B6.2 Stem cells:

    a. understand that embryonic stem cells can give rise to any cell type

    b. understand cells lose this ability as an animal matures

    c. recall that there are embryonic and adult stem cells.

B7. Variation

B7.1 Natural selection and evolution:

    a. understand the sequence as (1) variation (2) leads to differential survival (3) as those best adapted survive; (4) these can reproduce (5) and pass on

genes/alleles/characteristics to the next generation

b. recall antibiotic-resistance/MRSA as an example of evolution through natural selection.

B7.2 Sources of variation:

a. understand that variation can be genetic/inherited

b. understand that variation can be environmental.

B7.3 Extinction:

a. understand that extinction can occur if organisms cannot adapt quickly enough.

B8. Enzymes

B8.1 Enzyme function:

a. know that chemical reactions in cells are controlled by enzymes and that enzymes are proteins made by living things

b. know that enzymes speed up/catalyse the rate of chemical reactions.

B8.2 Understand the mechanism of enzyme action in terms of the 'lock and key' hypothesis:

a. understand that the specific shape of an enzyme enables it to function.

B8.3 Understand how the following factors affect the rate of enzyme action:

a. temperature

b. pH

c. substrate concentration.

B8.4 Digestive enzymes:

a. know the role of amylase (breaks down starch into maltose), protease (breaks down proteins into amino acids) and lipase (breaks down lipids into fatty acids and glycerol) in digestion.

B9. Animal physiology

B9.1 Respiration:

a. define respiration

b. describe aerobic respiration

c. recall the word equation for aerobic respiration

d. describe anaerobic respiration in animals

e. recall the word equation for anaerobic respiration in animals

f. compare aerobic respiration with anaerobic respiration in animals

g. describe the effect on the cells of changing energy requirements, including changes to exchange of oxygen and carbon dioxide.

B9.2 Central Nervous System (CNS):

    a. know that sense organs are groups of receptor cells which respond to stimuli (light, sound, touch, temperature, chemicals) and then relay this information as electrical impulses along neurons to the CNS

    b. understand the specific effects of alcohol and drugs on the nervous system (including reaction times).

B10. Plant physiology

B10.1 Photosynthesis:

    a. recall how and why factors affect the rate of photosynthesis, including temperature, carbon dioxide and light intensity and understand these as being limiting factors

    b. understand the importance of photosynthesis in plants and the role of chlorophyll

    c. recall the chemical reactions of photosynthesis in a cell are controlled by enzymes

    d. recall the word equation for photosynthesis

    e. understand that relative rates of respiration and photosynthesis affect the exchange of carbon dioxide and oxygen in plants.

B10.2 Response:

    a. interpret data on the positive response of plant shoots to light (phototropism)

    b. explain how phototropism is due to a plant hormone.

B11. Environment

B11.1 Food chains:

    a. understand the flow of energy in a food chain including:

        i. light energy from the sun

        ii. chemical energy in organisms used in repair and maintenance and growth of cells

        iii. transfer (loss) of the chemical energy to the environment in waste materials and as heat from respiration.

B11.2 Population size:

    a. appreciate that a population can change in size

        i. increasing when resources (including food, light, minerals, water) are available and not limited

ii. decreasing if resources are in short supply or become limiting as a result of competition between species (interspecific) or within a population (intraspecific).

B11.3 Cycles:

a. understand that nutrients are released in decay and that nutrients are then taken up by other organisms resulting in nutrient cycles

b. recall the carbon cycle to include the following processes:

i. photosynthesis

ii. respiration

iii. combustion

iv. decomposition.

B11.4 Pollution:

a. understand that living organisms can be used as indicator species for levels of pollution in:

i. air (sulfur dioxide concentration) – lichens

ii. polluted water (low oxygen concentration) – invertebrates e.g. bloodworm

iii. clean water (high oxygen concentration) – invertebrates e.g. stonefly.

B11.5 Variety of life:

a. understand that living organisms show a range of sizes, features and complexity and explain that the similarities are used to group organisms

b. list the main features used to group organisms:

i. plants into non-flowering (e.g. ferns) and flowering plants

ii. animals into invertebrates and vertebrates

iii. microorganisms into fungi, bacteria and algae.

c. explain that classification is based on morphology, anatomy and DNA.

B11.6 Biodiversity:

a. understand how quadrats are used to investigate the distribution of species

b. calculate the density of a species by counting the number of individual plants of a particular species in each quadrat, and calculating the mean number of individuals per unit area

c. calculate the frequency of occurrence using the equation:

$$\text{frequency of occurrence} \quad \frac{\text{number of quadrats the species occurs in}}{\text{total number of quadrats}}$$

Example questions for Part B

The following sets out some example questions for part B. Examples questions for Part A form part of the content specification for Part A. Example questions for Part C are included in the next section of this Appendix.
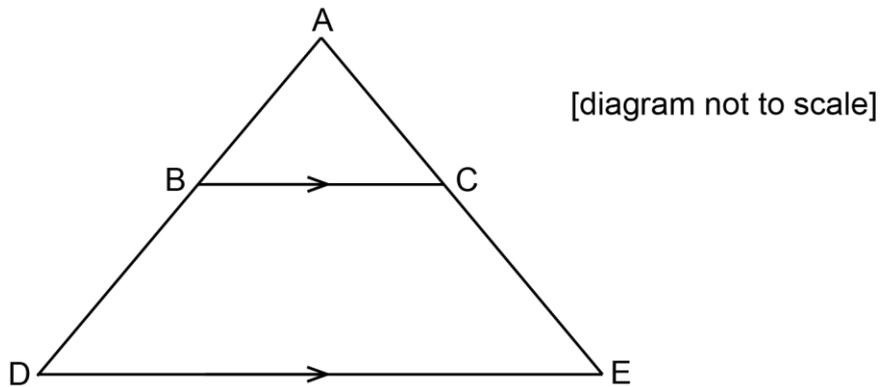
In the following questions, the correct answer has been underlined.

Mathematics

1   A shape is formed by drawing a triangle ABC inside the triangle ADE.

BC is parallel to DE.

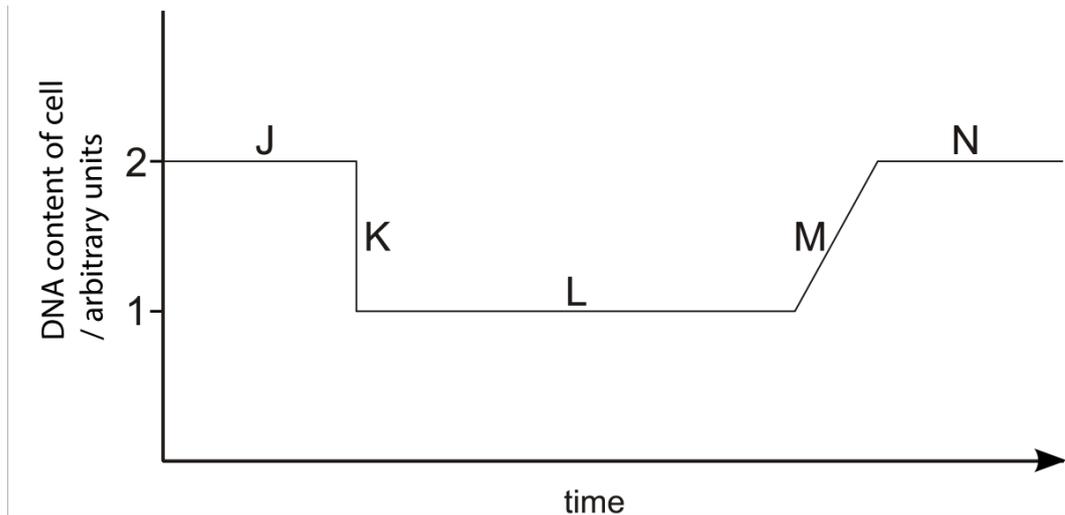AB = 4 cm   BC = cm   DE =   cm   DB =   cm

A
[diagram not to scale]
B ——→ C
D ——→ E

Calculate the length of DE.

A   5 cm

B   7 cm

<u>C</u>
       9 cm

D $\sqrt{}$ cm

E $\sqrt{}$ cm

Biology

1 Before a cell can divide by mitosis, DNA synthesis has to take place. Following DNA synthesis, the DNA is separated into each half of the cell and then the cell divides.

The graph below shows the DNA content per cell over a period of time.

Which of the letters on the graph represent the sequence of the three events described above?

	cell divides	*DNA synthesis*	*DNA separates*
A	J	K	L
B	J	L	M
C	K	L	M
D	K	M	N
E	L	M	N
F	L	M	J
G	M	N	J
H	M	N	K

Part C Reading Comprehension

Part C of the PBS Admissions Assessment assesses the ability to understand and draw meaning from texts in a multiple-choice format. This part of the assessment is not subject-specific, and texts included will be on a variety of topics and may be drawn from a range of sources. Candidates will have 40 minutes to complete this element of the assessment.

All academic subjects require the ability to critically read a variety of sometimes challenging texts for meaning. Specifically, the tasks in Section 1, Part C focus on identifying the way in which the texts are structured, the main ideas being presented, and the way in which these are supported and developed.

The reading comprehension consists of three tasks, each based around text excerpts. Each task will have a set of multiple-choice questions with four options. Questions will not require specialist knowledge or any information beyond what is contained within the texts.

Content

Each task will use recently written texts, from authentic sources, in English. Sources may include works of non-fiction (at a relatively high level conceptually and linguistically but which do not assume specialist subject knowledge), newspapers, general interest magazines, book reviews, abstracts written for research papers or journal articles, and professional websites. Texts will not depend on the understanding of specific aspects of British culture.

Questions will require candidates to:

- look at the main ideas and focus of a text;

- analyse the detail, distinguish opinions and attitudes presented in the text;

- determine the writer's purpose in writing the text, including consideration of intended audience;

- extract implications and implicitly stated elements of the text;

- draw comparisons and contrasts within a text or between different texts.

For all tasks, the emphasis is on identification of opinion, attitude, purpose and inferred meaning rather than the retrieval of directly stated factual details. Questions may also focus on elements of text organisation that support meaning, such as the use of exemplification and comparison.

Format

Part C consists of three tasks. **Candidates will be required to answer all questions in all of the tasks.** Each task will consist of one or more text excerpts and a set of four-option multiple-choice questions. There will be no overlap between tasks. Answers to questions will not depend on other questions.

Task 1: Understanding short texts

Questions in this task are on two short abstracts or reviews on a common topic. Texts will be no more than 200 words each. The task assesses candidates' ability to identify, compare and contrast features of two different texts. The candidate's understanding of the two texts is tested through discrete questions aiming to cover a wide range of focuses with the emphasis on identification of opinion, attitude, purpose and inferred meaning rather than the retrieval of directly stated factual details. Questions may also focus on elements of text organisation which support meaning, such as the use of exemplification, comparison and reference.

Task 2: Multiple-Matching

Questions in this task are on four short extracts, either from four different writers on the same theme or four extracts from the same source. Extracts will be no more than 200 words each. This task requires candidates to locate a text where a particular idea is expressed, discounting ideas in other texts which may appear similar but do not reflect the whole of the question accurately. Each question requires the candidate to scan the four texts to locate the area of text which appears to contain the answer, and then to read this carefully to check that it is the correct answer.

Task 3: **Understanding Extended Text**

Questions in this task are on one extended text (of no more than 1000 words). The task assesses the understanding of a longer stretch of academic text that may include argument, supported claims, and reference to previous work and ideas in a particular field.

Scoring

All questions are worth 1 mark. Marks are not deducted for incorrect answers, so candidates are advised to answer all questions.

Example questions for Part C

Task 1

Read the two abstracts below, which give summaries of two academic articles relating to cities and urban development. For questions, 1 – 6, choose the option (A, B, C or D) which you think fits best according to the texts.

ABSTRACT ONE

Retrofitting cities: Local governance in Sydney, Australia
Robyn Dowling, Pauline McGuirk, Harriet Bulkeley

Transforming cities to a lower carbon future is a key challenge of contemporary urban governance. Retrofitting the city – or modifying existing urban infrastructures, buildings and daily life to suit different energy sources and expectations of energy consumption – is essential to this transformation. In urban studies, little focus has been applied to the shape and character of urban governance frameworks and mechanisms required to successfully retrofit cities. In this paper we address this lacuna by exploring the logics, practices and dynamics of retrofitting governance in the Australian city. Using a governmentality perspective, the paper identifies the involvements of different scales of government in retrofitting policies and mechanisms and connections between them. Based on our survey of carbon reduction initiatives involving government, business and community actors across Australia's cities, we outline the types of retrofitting solutions being proposed and enacted. Focussing on initiatives from Sydney, Australia's largest city, the paper documents four key techniques through which retrofitting is being governed – self-governing, holistic, facilitative and educative. The findings indicate that governance gaps remain in attending to the daily life of technologies and the materiality of daily life.

ABSTRACT TWO

Critical research on eco-cities? A walk through the Sino-Singapore Tianjin Eco-City, China
Federico Caprotti

This article uses the narrative tool of a walk through Tianjin Eco-City, China, as an entry point in raising and discussing key questions in contemporary eco-city research. Eco-city projects are becoming increasingly prevalent in policy and political-economic discourses in a variety of locations as new urban spaces where blueprints for low carbon economies can be trialled. In light of this, the article highlights the necessity of, firstly, considering scale when analyzing eco-city 'futures'. Secondly, the article argues for the need to interrogate eco-cities' definitions, as well as their evaluation, performance and monitoring frameworks, as this will aid in critical analyses of the marketing and presentation of actually built eco-city projects. Thirdly, the question of internal social resilience needs to be assessed: this is of crucial importance in light of the exclusive, gated nature of several flagship eco-city projects under construction at present. Lastly, the article argues that research on eco-city projects needs to consider not only high-tech, new urban environments, but also the low-paid workers who form what the article calls the 'new urban poor', forming large, often transient populations on the edges of flagship 'sustainable' urban projects worldwide.

1   According to Abstract One, what is the main aim of the article on retrofitting
       cities?

    A   to defend the idea of retrofitting

    B   to point out weaknesses in retrofitting technology

    C   to describe the technology required for retrofitting

    D   to look at methods of achieving retrofitting

2   Which word from Abstract One describes the theoretical framework used by the
       writers in their analysis of retrofitting in Sydney?

    A   'lacuna'

    B   'governmentality'

    C   'holistic'

    D   'materiality'

3   In Abstract One, the writers claim that one feature of their research is that

    A   they have engaged with an area representing a weakness in the field.

    B   they have proposed a way of integrating key techniques.

    C   they have identified potentially divisive underlying attitudes.

    D   they have employed a controversial methodology.

4   In Abstract Two, the writer says that eco-city projects are important because

    A   they show that low carbon economies are sustainable.

    B   they provide an opportunity for testing economic models.

    C   they offer new opportunities for disadvantaged groups.

    D   they encourage political involvement in environmental issues.

5 In Abstract Two, 'exclusive, gated nature' contrasts with

    A 'internal social resilience'.

    B 'new urban environments'.

    C 'new urban poor'.

    D 'projects under construction'.

6 Which abstract or abstracts refer to the physical experience of a particular city being used as a stylistic device?

    A neither abstract

    B both abstracts

    C Abstract One only

    D Abstract Two only

Key

1 D **2** B **3** A **4** B **5** C **6** D

Appendix 2: Skills assessed in Section 2

Section 2 of the Psychological and Behavioural Sciences Admissions Assessment requires students to write a short essay, discussing a quotation on a topic of general interest. It requires no specialist or background knowledge.

Section 2 is designed to assess candidates' ability to:

- think analytically and produce a coherent argument, using relevant evidence;
- write with clarity and precision under time pressure.

Example questions

Choose **one** of the quotations below and use **the space provided in this question paper** to discuss it.

---

1. *The fact is, you have fallen lately, Cecily, into a bad habit of thinking for yourself. You should give it up. It is not quite womanly... men don't like it.*

Oscar Wilde, *Lady Windermere's Fan* (1893)

2. *Biology gives you a brain. Life turns it into a mind.*

Jeffrey Eugenides, *Middlesex (2002)*

3. *There are some ideas so wrong that only a very intelligent person could believe in them.*

George Orwell (attributed)

4. *Memory itself is an internal rumour.*

George Santayana, *The Life of Reason* (1905)

Example Answers

Question 4

'Memory itself is an internal rumour.' George Satayana, *The Life of Reason* (1905)

The term 'memory' can refer to both the process by which we recall events from the past and store information and also to those recollections themselves. Satayana's statement that memory is an 'internal rumour' implies that memory is both personal and subjective, so to discuss this I will break down these

claims to consider whether memory is indeed an 'internal' phenomenon and, following that, whether the metaphor of a 'rumour' is fitting to the nature of memory itself.

Memory conventionally refers to our individual personal recollections of past events - an 'internal' record of learning based on our previous perceptual experiences of the world in which we live. There are many different types of memory process, varying at an individual and a communal level. Individual memory process can be broadly split into declarative memory, commonly referred to as "knowing what", like remembering facts, and procedural memory, the "knowing how", such as learning to drive a car. Yet I would argue that memory can be inherently social, too. Society surrounds us with evidence of collective cultural processes of memory, like ritual and myth, photo albums and memorial monuments, all of which could be seen from a social anthropological perspective as memory processes at a societal, rather than an 'internal' level. So the term "memory", then, encompasses such a diversity of processes, that when Satavana talks of it as an 'internal' rumour, he may not be crediting the full extent of its external influences and manifestations.

Memory-making is based on an interaction between the internal and the external, as external influences are perceived and internalised to form memories. Thus social factors shape our memories - for instance, we remember things better if we recall them regularly, and social occasions that make us recall these memories are helpful in maintaining them. An example would be your telephone number, which becomes easy to remember when you tell it to others regularly. However, internal psychological factors distinct from social factors also affect memory. Korsakoff's syndrome, for instance, can prevent people from forming new memories, leaving people living in a mental state remnant from many years in the past, like the case of Jimmy G. in Oliver Sacks' 'The Man Who Mistook His Wife For A Hat'. Therefore, I agree to some extent with Satayana's statement about memory existing within and facilitating our 'internal' worlds, but I also think this does not capture the fact that it is also externally influenced, mediated, and maintained by the social world, too.

This would provide support for Satayana's suggestion that memory is a 'rumour', which I agree with to a greater extent. This term implies that memory is, whilst based on some original truth, exaggerated and elaborated in a way that means it comes to resemble more of a nuanced version of the truth than an objective fact. The cross-race-effect has come to prominence in media coverage recently as part of the Black Lives Matter movement. It highlights the alarming fact that eye-witnesses repeatedly misidentify suspects of another race, because people find it more difficult to distinguish faces of people of a different race to their own. One infamous example is the incarceration of the innocent Brenton Butler in 2000, based on misidentification made by a husband who had watched his wife shot at close range by the guilty party, yet still misremembered the face of the killer. This phenomenon has been widely replicated, including in controlled psychology studies and meta-analyses of these. The cross-race effect is evidence for the idea that memory is a 'rumour' in the sense that it cannot always be trusted, and is often inaccurate even when we feel sure it is correct.

In conclusion, I agree with Satayana to a large extent, in the idea that memory is not objective and can be a personal construction of sorts. However, I would argue that it is not necessarily an entirely 'internal' rumour, but may be more externally informed than his statement implies.