PROVE UFFICIALI DEGLI ANNI PASSATI

IMAT

2015

A B C D E

FAC-SIMILE DA SVOLGERE

Risposte in ordine casuale e foglio delle risposte

WHAT'S IN THIS DOCUMENT

Prova di ammissione IMAT 2015, pubblicata dal Ministero dell'Università e della Ricerca (accessoprogrammato.mur.gov.it). Versioni, soluzioni e commenti di TestBuddy, che non è collegata al Ministero.

- The questions laid out by TestBuddy, with the answers in random order
- The answer sheet
- The answer key

General Knowledge and Logical Reasoning	22 questions
Biology	16 questions
Chemistry	10 questions
Physics and Mathematics	8 questions
Total	**56 questions**

This version has **56 of the 60 questions** of the paper, the ones with our explained solution; the full paper is in the «official paper» file.

HOW TO USE IT

1 · TIMED

Give yourself about a minute and a half per question, no notes, as in the exam.

2 · CHECK

Mark the wrong answers and read why each one is wrong, not only the right one.

3 · REVIEW

Go back to the topics where you made most mistakes and redo the questions in the app.

GENERAL KNOWLEDGE AND LOGICAL REASONING

1 **Studies are taking place to assess the benefits to dental health of adding fluoride to drinking water, a process known as mass medication. The Health Minister has urged consideration of fluoridation, particularly in deprived areas where dental care is poor. Fluoride can occur naturally in the water because of fluoride containing minerals. Fluoride, if in the water, improves dental health by up to 50 percent. Even so, fluoridation should not take place. A campaign leader opposed to fluoridation has spoken of her experiences of living in a fluoridated area of the USA. She experienced feelings of apathy and depression; her 2 years old son showed autistic tendencies and had white flecks on his teeth. These symptoms disappeared when they returned home from the USA.**

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

- A The reported health symptoms were caused by fluoride in the water.
- B Fluoridation is only necessary in deprived areas.
- C Fluoridation is cheaper than improving dental facilities.
- D Mass medication is always wrong.
- E Fluoridation of water is a person's only source of fluoride.

2 **Climate scientists in Greenland studying patterns of plant growth have suggested that the early arrival of spring in the Arctic threatens to drive down populations of migrating animals such as caribou. However, comparable studies elsewhere show that their fears are unfounded. A recent study of great tits in Oxfordshire showed the birds are capable of adapting to climate change better than many scientists expected. Over the past half century, the birds have brought forward the date they lay their eggs by two weeks, so that young are born when plant eating grubs are most plentiful.**

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

- A Birds are more adaptable than large mammals such as caribou.
- B Migrating animals in the Arctic can adapt to climate change as successfully as great tits in Oxfordshire.
- C Climate change in Greenland and climate change in Oxfordshire are of the same scale.
- D The scientists working in Oxfordshire have greater expertise than those working in Greenland.
- E Unless animals like the caribou produce their young earlier in the year, their population will fall.

3 **Now, it might be thought an amazing coincidence if Earth were the only planet in the galaxy on which intelligent life evolved. If it happened here, the one planet we have studied closely, surely one would expect it to have happened on a lot of other planets in the galaxy – planets we have not yet had the chance to examine. This objection, however, rests on a fallacy: it overlooks what is known as an 'observation selection effect', so it wouldn't be such a coincidence. Whether intelligent life is common or rare, every observer is guaranteed to originate from a place where intelligent life did, in fact, arise. Since only the successes give rise to observers who can wonder about their existence, it would be a mistake to regard our planet as a randomly selected sample from all planets.**

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

- (A) Our planet is not a randomly selected sample from all planets.
- (B) It would be an amazing coincidence if Earth were the only planet in the galaxy on which intelligent life evolved.
- (C) However common intelligent life is, every observer will certainly originate from a place where intelligent life did, in fact, arise.
- (D) There would be no amazing coincidence if we discovered that Earth were the only planet in the galaxy on which intelligent life evolved.
- (E) If life had evolved here on Earth, it would probably have happened on a lot of other planets in the galaxy.

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4 **Although it is sometimes suggested that the congestion caused by the bunching of cars on motorways could be eased by increasing the speed limit to 150 km/hr, such an increase would not be a good thing. An estimated 35 per cent of drivers exceed the speed limit by 20 km/hr and would continue to do so if the limit were raised. Since bunching is caused by speeding drivers trying to pass those who observe the speed limit, raising the limit to 150 km/hr would result in the same amount of congestion, but at an increased speed. Moreover, a higher speed limit would encourage all drivers to drive faster, and thus would increase the existing danger from those who drive too close to the car in front.**

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

- (A) Raising the speed limit to 150 km/hr would not reduce congestion on motorways.
- (B) An increase in the speed limit would increase the existing danger from those drivers who drive too close.
- (C) It would not be a good thing to increase the speed limit to 150 km/hr.
- (D) A higher speed limit on motorways would encourage all drivers to drive faster.
- (E) Congestion on motorways is caused by speeding drivers trying to pass those who observe the speed limit.

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5 **Food producers are resisting pressure to reduce still further the levels of salt in food. Although it is proven that salt intake must be reduced by those with hypertension, there is no evidence that reducing salt intake prevents hypertension. So why should we all be deprived of the pleasures of salt in food? We certainly need to identify those with hypertension and give them advice on their salt intake, but why should everyone else be deprived of salt? Food producers are right to resist the pressure.**

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

A Retailers cannot sell alcohol to people under 18 years, but providing more general advice on alcohol in schools would be better, as it would encourage young people to be self limiting in their consumption of alcohol.

B Advice to wear sun block to protect the skin from harmful rays is ignored by some people. Those people should be charged for medical treatment for skin cancer.

C Adding fluoride to drinking water has reduced tooth decay, but fluoride is unwelcome to some people. Instead, dentists should advise patients with tooth problems on better tooth care.

D Passive smoking is still a problem for people who share a home with a smoker. The law should be extended to make smoking illegal even in the home.

E The requirement to wear seatbelts has reduced deaths in car accidents but was unpopular when first introduced. People eventually accepted such changes even if it has not benefited them personally.

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6 **Sports are played either as a means of getting exercise or as a competition with an opponent. Some sports, such as football, involve a large amount of running and some people are more motivated to run when it is part of a game. Other sports, such as pool, do not involve much physical activity and so it is unlikely that they would be played for the exercise.**

Which one of the following conclusions is best supported by the passage above?

A People who play pool are more likely to be interested in the competition than those who play football.

B It is easier to exercise when it is as part of another activity, such as playing sport.

C Football is a better sporting activity than pool.

D There is no point in running as a hobby, since football is more fun.

E Since the main reason for playing sports is to get exercise, pool should not be classified as a sport.

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7 **Concern about the effects of chemicals upon the environment has led to calls for more research. But we should not wait for further research before we ban some of the chemicals used by industry. If anyone has a good reason to think something is harmful, it should not be used until, or unless, the risk is found to be zero. We know enough about past mistakes to be forewarned. Much of the harm to wildlife and humans is long term, and the disturbing results we see today reflect the chemical environment 40 years ago. Thousands more chemicals have been released into the environment since then.**

Which one of the following most closely matches the reasoning above?

A A suspected terrorist should be arrested at once. Waiting for conclusive evidence in the past has resulted in atrocities that could have been avoided by acting on suspicion, and the threat of terrorism has grown.

B Some homes for the elderly have been found to give dangerously substandard care. Therefore they should be closed down and the residents found acceptable alternatives.

C Cyclists should not place too much confidence in the benefits of helmets, because there is no conclusive evidence as yet that helmets prevent serious injuries.

D Some cars that have passed the annual roadworthiness test would not pass 6 months later. Cars should be tested more than once a year once they pass a certain age.

E People should not be able to adopt children until proper checks have been carried out. Serious consequences may follow if adoptive parents are unsuitable.

8 **Children are being encouraged to take up gardening through special events at shows and activities in schools. It is hoped that an interest in gardening, and particularly growing one's own food, will make children more interested in learning about their food and they will therefore be deterred from eating junk food. The initiative should be supported and spread to more schools as quickly as possible.**

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

A It tends to be older people who are interested in gardening and growing their own food.

B Most children have enjoyed the events provided, but have not gained an interest in gardening itself.

C The events to encourage children to garden also included stands where junk food was for sale.

D The practical experience of gardening is not a traditional academic subject.

E Some schools do not have a garden.

9 **Although the Earth supports life, it has a mysterious carbon deficit. Compared with other bodies in the solar system the Earth has far less carbon than would be expected for a planet that supports life. Originally it was thought that in the inner region of the dust disc where the Earth formed, temperatures soared high enough for the carbon to boil away. However, observations of developing solar systems have now suggested that the temperature would not have been high enough. It is more likely that fire is to blame. Hot oxygen atoms would have readily combined with carbon, burning to produce carbon dioxide. There would have been fewer of these oxygen atoms further away from the Sun.**

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

A There are other solar systems with Earth like planets that have an abundance of carbon on them.
B There is no theoretical reason why life has to be carbon based.
C The abundance of carbon in the asteroid belt surrounding the inner planets increases the further away you get from the Sun.
D At temperatures that are high enough for carbon to boil away, oxygen would also have boiled away.
E The carbon that is present on the Earth could have arrived at a later date from an asteroid.

10 **Undercover police investigators sometimes commit 'crimes' in order to convince the 'real criminals' that they are on the same side as them. Some of these activities have victims, although in the main these are other criminals – rival gang members for example. In committing what are technically offences the officers are preventing many more serious crimes by helping to convict and imprison dangerous criminals who might otherwise remain at liberty. But that is not really the point. A breach of the law is a breach of the law, whoever commits it and for whatever reason. Preventing a crime does not make it right to commit another crime.**

Which one of the following is the general principle underlying the above argument?

A The police have a duty to protect law abiding citizens from violence.
B There is no such thing as a victimless crime.
C Serious crime must be prevented by any reasonable means.
D An act is criminal only if it is committed for criminal reasons.
E The end does not justify the means.

11 **Looking in his rear view mirror, Graham sensed that there was something wrong with the number plate of the car behind him. When the car overtook him and he saw its rear plate he realised that the front plate had been upside down.**

What had Graham seen in his rear view mirror?



A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F1ex2121m12j21u2727.png?alt=media&token=a99121c3-b434-4624-9bd8-4a78b3ed9ad3<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx2e18e1281x8281dkdkkdfkdd.png?alt=media&token=23d3fe58-3f09-47c7-b140-3f00bf163437<i>

C <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx8w8wi1ixi1w82626hcncnc.png?alt=media&token=4644f636-50bf-4760-97df-d149ae3ba42f<i>

D <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx21ee2i12i8s7f77ffhhg.png?alt=media&token=cab0d8c1-b058-4c23-a6b8-e735f3e7f7d5<i>

E <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx1di21iiwdi333n444.png?alt=media&token=7fceb880-d86a-40d9-a1d3-7423290954ea<i>

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12 **A local museum wishes to exhibit a collection of butterflies which is mounted in nine narrow (only 0.2 m wide) display cases, each 1.5 m long. The museum wants to arrange four tables, each 2 m long and 1 m wide, in such a way that all the display cases can be placed around the edges. The room for the exhibition is 6 m by 6 m and there must be at least 1 m of clear floor space around the outside of the tables.**

Which one of the five arrangements shown would be satisfactory?

A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F128ex12ixk27367363y43.png?alt=media&token=35b6c7de-b53d-47cf-be03-b8964555fc22<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F1x2ei12ie2ie282xnmmc.png?alt=media&token=df07d8bb-2aa9-448e-9c49-afeb61b060eb<i>

C <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fe12i2eie21i1e2ixxxxxxx2.png?alt=media&token=baa57858-44a9-46f6-9a84-325a5ca5f1e3<i>

D <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fdwuddjdjddjjdj2j2.png?alt=media&token=db308e9e-3fe4-43ac-8af9-d512aa162441<i>

E <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fxode2o1ox1o1x2o2122.png?alt=media&token=525fce21-9ed6-49e1-91ca-7933ad3d0508<i>

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13 **Alberto has decided to paint his dining room. Paint comes in 1 litre cans. The paint in one can will cover an area of approximately 24 square metres. The dining room is 4 m x 6 m x 3.5 m high. There is just one window which is in one of the long walls and is 1.5 m x 2 m.**

All of the walls, door and ceiling are to be painted with the same type of paint.

Approximately 20% of the wall area to be painted is wood which will need a second coat of paint.

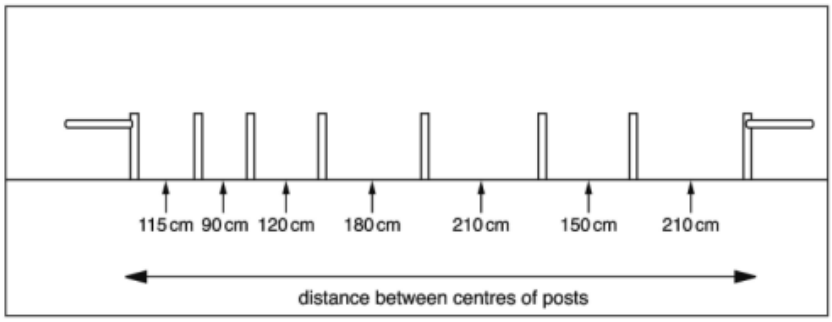
What is the minimum number of cans of paint that Alberto should buy to have sufficient to complete the room?

- A 6 cans
- B 2 cans
- C 3 cans
- D 4 cans
- E 5 cans

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14 **A farmer wishes to fix fencing rails to posts which are already in place. The posts are shown in the diagram. The farmer has a supply of rails, each one 2.4 m long. One rail or part of a rail is to be fixed between each pair of posts. (He can cut the rails into smaller lengths.)**

What is the smallest number of rails that he could use?



- A 7
- B 6
- C 5
- D 3
- E 4

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15 **Tom is having a celebration and needs to send out 50 invitation cards. The cards must be at least 6 cm wide and at least 8 cm high and Tom wants to put a photo on the card. Each type of card has a standard version and a deluxe version. The prices (per card) that have been quoted to Tom are shown in the table below:**

Tom wants to buy the cheapest type of card possible but is willing to pay for the deluxe version instead of the standard.

What is the total extra that Tom would have to pay to buy the deluxe cards?

Width (cm)	*Height (cm)*	*Photo?*	*Personalised greeting?*	*Price (standard)*	*Price (deluxe)*
6	6	Y	N	€0.90	€1.65
6	10	N	Y	€1.00	€1.60
6	10	Y	Y	€1.75	€2.15
7	7	Y	N	€1.40	€1.90
7	10	Y	N	€1.50	€1.95
7	10	Y	Y	€1.60	€2.15
10	10	Y	N	€2.25	€2.95

A € 27.50
B € 22.50
C € 25.00
D € 30.00
E € 20.00

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16 **The table below shows the average mass of the cerebellum, which is a part of the brain, and total body mass, for a number of animal species. The cerebellum of a cat has an average mass of 5.3 g, while a cat's average body mass is 3.5 kg**

For which of the species shown is the ratio of cerebellum to total body mass closest to that of the cat?

Species	Cerebellum mass(g)	Body mass (g)
Mouse	0.09	58
Pigeon	0.4	500
Squirrel	1.5	350
Rabbit	1.9	1800
Dog	6.0	3500

A Rabbit
B Dog
C Pigeon
D Mouse
E Squirrel

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17 **There are two services between Sandpoint and Genville: a fast hovercraft service which takes 50 minutes and a slow ferry which takes 1 hour 40 minutes. They both stop in port for 20 minutes at each end before starting the return journey. They start out from Sandpoint together at the same time each morning.**

For how long has the slow ferry been sailing before it meets the hovercraft coming back? (Answer to the nearest minute if necessary.)

A 1 hour and 30 minutes
B 1 hour and 10 minutes
C 1 hour and 7 minutes
D 1 hour and 25 minutes
E 1 hour and 20 minutes

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18 **Deanna keeps a record of the petrol she puts into her car and the current distance it has covered so she can estimate her fuel consumption. When she puts petrol in, sometimes the tank is filled completely and she marks 'FULL' beside the entry if this is so, otherwise the tank is only partly filled.**

Her data for the last month is as follows:

Which one of the following is the best estimate of her fuel consumption?

Date	Total km	Fuel added	FULL?
2 June	23,508	5 litres	
6 June	23,805	37 litres	FULL
12 June	24,350	25 litres	
17 June	24,743	21 litres	
23 June	24,989	34 litres	FULL
27 June	25,454	18 litres	

A 7.7 litres / 100 km
B 1.7 litres / 100 km
C 9.9 litres / 100 km
D 6.8 litres / 100 km
E 8.0 litres / 100 km

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19 **Leroy cycles to work each morning. The first half of his journey is up hill and he can manage only a steady 5 kilometres per hour. The second half, however, is downhill and he covers this at 15 kilometres per hour.**

Which one of these graphs could show Leroy's journey?

A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fsd81811c81cchhsjhs.png?alt=media&token=942e32cc-1ada-4577-95b0-094e0c00078a<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fd1i1ii1d1.png?alt=media&token=04a15ff6-dff0-41d1-b6f2-618f71703847<i>

C <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F1xe2128wisaksk.png?alt=media&token=8a0930dc-315e-4a5d-a8ef-a7278df2d787<i>

D <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F1ex12w8wudjsdjdjd2.png?alt=media&token=2a74ddc8-00d0-4ff5-9e30-37469a5df970<i>

E <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fxwq1iwei1ikdkdsmmss.png?alt=media&token=bbcb5e17-a651-48b0-9c56-7b606b41ccae<i>

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20 **When I made a hotel reservation online yesterday I was given an 8 digit booking reference which contained no zeros. It did, however, consist of three 2 digit odd numbers followed by the sum of these three numbers, and all eight digits were different.**

The first digit of the booking reference was 4. What was the last digit?

A 5

B 9

C 7

D 1

E 3

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21 **Which one of the following pairs of scholar/field of study is NOT correct?**

A Doris Lessing - Literature

B Ludwig - Wittgenstein Philosophy

C Amartya - Sen Economics

D Konrad Lorenz - Ethology

E Max Weber - Pedagogy

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22 **Which one of the following public figures was NOT awarded the Nobel Peace Prize?**

A Mahatma Gandhi

B Martin Luther King

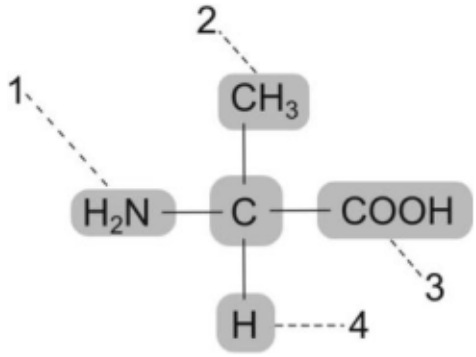
C Willy Brandt

D Nelson Mandela

E Aung San Suu Kyi

BIOLOGY

23 **The diagram below shows an amino acid.**
Which option correctly identifies both the variable group (R group) and the acidic group?



A variable group = 2; acidic group = 3
B variable group = 2; acidic group = 4
C variable group = 3; acidic group = 1
D variable group = 1; acidic group = 2
E variable group = 4; acidic group = 3

24 **In a prokaryote, transcription can occur in which of the following?**

1. cytoplasm
2. mitochondria
3. ribosomes

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

25 **Which of the following are directly produced during photolysis of water?**

1. oxygen
2. carbon dioxide
3. protons

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

26 **The table shows some events of the normal eukaryotic cell cycle.**

Which row shows the correct sequence of events (left to right) as they occur during part of this cell cycle?

row 1	nuclear envelope disappears	DNA starts to condense	chromosomes line up at the equator	cytoplasm divides
row 2	chromosomes line up at the equator	spindle fibres shorten	DNA starts to condense	nuclear envelope reappears
row 3	chromosomes line up at the equator	spindle fibres shorten	nuclear envelope reappears	cytoplasm divides
row 4	DNA starts to condense	nuclear envelope disappears	spindle fibres shorten	chromosomes line up at the equator
row 5	nuclear envelope disappears	spindle fibres shorten	chromosomes line up at the equator	nuclear envelope reapears

A row 5
B row 4
C row 2
D row 3
E row 1

28 **The genotype QqRr produces a certain phenotype.**
If two individuals with a genotype of QqRr reproduce, how many different possible phenotypes could be created, assuming all allele combinations are equally viable and the phenotypes are the result of complete dominance?

A 8
B 4
C 9
D 16
E 5

30 **Which of the following could be the outcome of evolution?**

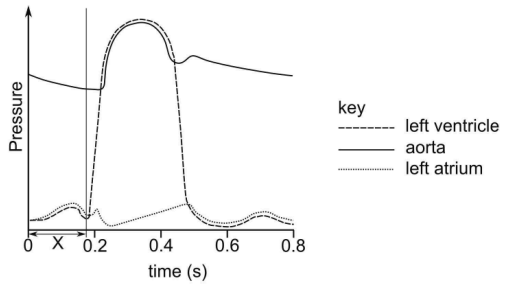
1. speciation
2. a change in allele frequency
3. increased biodiversity

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

31 **Where in a shoulder joint are osteocytes found?**

A cartilage
B ligament
C bone tissue
D skin
E muscle tissue

32 **The diagram shows how the pressure changes in the left atrium, left ventricle and the aorta during one heartbeat in a healthy human.**
Which row shows the correct events during time period X?



Which row shows the correct events during time period X?

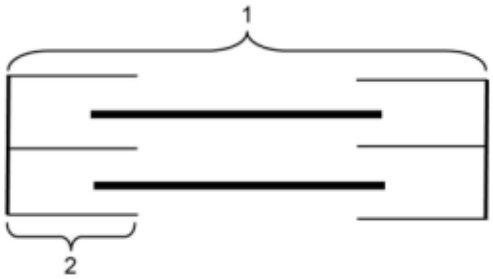
row	*volume of blood in left atrium*	*semi-lunar valve in aorta*	*muscles of left ventricle wall*
1	decreases	closed	relax
2	decreases	open	relax
3	increases	closed	contract
4	decreases	open	contract
5	increases	closed	relax

A row 1
B row 4
C row 2
D row 3
E row 5

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33 **The diagram shows a single sarcomere in a relaxed state.**

Which answer describes the changes when the sarcomere contracts?



A 1 gets smaller and 2 does not change
B 1 gets smaller and 2 gets smaller
C 1 does not change and 2 gets wider
D 1 gets longer and 2 gets smaller
E 1 gets longer and 2 gets wider

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34 **Some local anaesthetics affect nervous impulse transmission by making it more difficult for voltage gated sodium channels to open. In a human patient treated with these anaesthetics which of the following statements would be true?**

A The sodium/potassium pump may need to work faster to maintain the resting potential
B The axon membrane would become more difficult to repolarise
C The threshold potential required to generate an action potential would be lowered
D The membrane potential of the neuron at rest would decrease below –90 mV
E It would become harder to depolarise the neuron

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35 **The changes in concentration of hormones in a healthy woman's blood were monitored during several menstrual cycles.**

During which stage of the menstrual cycle was the concentration of oestrogen falling, the concentration of luteinising hormone (LH) and follicle stimulating hormone (FSH) maximal and the progesterone concentration rising?

A at the end of menstruation
B between the end of menstruation and four days before ovulation
C at the start of menstruation
D after ovulation but before the start of menstruation
E four days before ovulation and the time of ovulation

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36 **The following events occur during a reflex response to a person placing a hand on a hot object.**

1. Myosin binding sites on actin filaments uncovered
2. ADP and phosphate ion released from myosin head
3. Sodium voltage gated channels open
4. Myosin head detaches from binding site on actin
5. Calcium ions released by sarcoplasmic reticulum

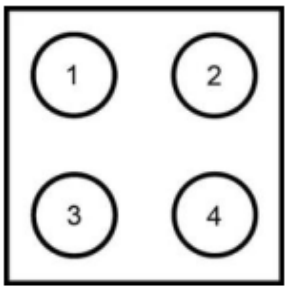
Which of the following options places four of these events in the correct order (from left to right)?

A 5, 2, 1, 4
B 5, 1, 2, 4
C 3, 1, 4, 2
D 3, 5, 4, 2
E 1, 2, 4, 3

---

37 **The picture below shows a DNA microarray.**
Each spot (labelled 1–4) contains a different DNA probe. A sample of fluorescently labelled human DNA, with the sequence TGGTCAAGATTAT, is washed over the array.

Which of the spots would show a positive signal because it fluoresces?



spot	DNA probe
1	GATTAT
2	CTAATA
3	ACCAGT
4	TGGTCA

A 1, 2, 3 and 4
B 1 and 4 only
C 2 and 4 only
D 1 and 3 only
E 2 and 3 only

---

38 **In the nerve cells of a person, one gene has two alleles, 'A' and 'a', present. For this person, which row correctly shows the alleles present in all three different situations given in the table?**

row	*Situation*		
	Stem cell starting to specialise into a liver cell	Cell at the start of mitosis	Cell at the start of meiosis I
1	Aa	AAaa	AAaa
2	AAaa	Aa	AAaa
3	AAaa	AAaa	Aa
4	Aa	Aa	A or a
5	A or a	A or a	Aa

A row 5
B row 3
C row 4
D row 2
E row 1

---

39 **Place the following structures in a human sperm cell in descending order of size (left to right):**

1. mitochondria
2. nucleus
3. ribosome

A 3, 1, 2
B 1, 2, 3
C 2, 3, 1
D 1, 3, 2
E 2, 1, 3

40 **Which one of the following is NOT a carbohydrate?**

A glucagon
B ribose
C amylose
D amylopectin
E maltose

CHEMISTRY

41 **What is the correct formula of propanal?**

A $CH_3CH_2CO_2H$
B $CH_3CH_2OCH_3$
C CH_3COCH_3
D CH_3CH_2CHO
E $CH_3CH_2CH_2OH$

42 **Which two of the following oxides would NOT give acidic solutions in water?**

CO, CO_2, SO_2, NO

A NO and SO_2
B CO and NO
C CO and SO_2
D CO and CO_2
E NO and CO_2

43 **Assume that the oxidation numbers are as shown below:**

N = –3 ; H = +1 ; Cr = +6 ; O = –2

Which compound formula given below is correct?

A $(NH_4)_3\,CrO_4$
B $NH_4Cr_2O_7$
C $(NH_4)_2\,CrO_4$
D $[(NH_4)_3\,CrO_4]^-$
E $[(NH_4)_2\,CrO_4]^+$

44 **0.75 g of a hydrocarbon compound contains 0.60 g of carbon.**
(A_r : C = 12.0; H = 1.0)

Which one of the following could be the molecular formula of the hydrocarbon compound?

A C_2H_3
B C_3H_8
C CH_4
D C_2H_6
E C_2H_4

46 **When propan 1 ol is burnt in excess oxygen the only products formed are carbon dioxide and water.**

In the balanced equation for this reaction what is the ratio of $CO_2 : H_2O$ molecules formed?

- A 2 : 7
- B 4 : 7
- C 3 : 4
- D 3 : 8
- E 5 : 12

---

47 **2,2 – dimethylpropane, $C(CH_3)_4$, is an isomer of pentane, $CH_3(CH_2)_3CH_3$.**

Pentane has a boiling point of 36 °C whilst the boiling point of 2,2 – dimethylpropane is 10 °C.

Which statement below explains the difference in the boiling points for these two substances?

- A Pentane has permanent dipoles
- B Longer chain, less branched molecules have stronger spontaneous/induced dipoles
- C The molecules have different relative molecular masses
- D Isomers have different chemical properties
- E 2,2 – dimethylpropane has stronger intermolecular forces

---

48 **Potassium nitrate was found to have a solubility of 120 g in 100 g of water at 80 °C and 50 g in 100 g of water at 25 °C.**

50 g of water was heated to 80 °C and solid potassium nitrate added until the solution was just saturated.

The solution was then cooled to 25 °C when solid potassium nitrate separated out to leave a saturated solution.

Using the information provided in this question, what is the minimum mass of water that must now be added to the mixture of the solution and the solid in order to make this solid potassium nitrate redissolve at 25 °C?

- A 140 g
- B 190 g
- C 120 g
- D 20 g
- E 70 g

---

49 **Pure water self ionises. This endothermic reaction is represented by the equation:**

$$\mathrm{H_2O(I) \rightleftharpoons H^+(aq) + OH^-(aq)}$$

Which of the following statements is true for pure water between the temperatures of 0 °C and 100 °C?

1. The concentrations of $\mathrm{H^+(aq)}$ and $\mathrm{OH^-(aq)}$ are equal between 0 °C and 100 °C
2. An increase in temperature causes the pH to fall
3. An increase in temperature causes the electrical conductivity to decrease

- A 1 and 2 only
- B 3 only
- C 1 and 3 only
- D 1 only
- E 2 only

---

51 **Atoms X and Y form an ionic compound with formula XY_2.**

Which option below could give the correct atomic numbers for X and Y?

- A X = 11; Y = 16
- B X = 14; Y = 8
- C X = 12; Y = 9
- D X = 6; Y = 16
- E X = 3; Y = 17

---

52 **In the reaction**

$$\mathrm{C_3H_7Br + KOH \rightarrow C_3H_7OH + KBr}$$

24.6 g of 1 bromopropane reacts with excess potassium hydroxide to produce 8.00 g of propan 1 ol.

$M_\mathrm{r}: \mathrm{C_3H_7Br} = 123$
$A_\mathrm{r}: \mathrm{H} = 1.0; \mathrm{C} = 12.0; \mathrm{O} = 16.0$

What is the percentage yield of this reaction?

- A 0.333
- B 0.5710000000000001
- C 0.325
- D 0.667
- E 0.93

PHYSICS AND MATHEMATICS

53 **The variables x and y satisfy the following two equations:**

x + 3y = 13

2x – y = 5

What is the value of x + y?

A 6
B 7
C 9
D 8
E 10

---

54 **Evaluate:** $(27^2 - 23^2) + (14^2 - 6^2)$

A 80
B 40
C 360
D 840
E 1680

---

55 **Given that** $2\log_{10}(x) - 3 = \log_{10}(y)$
Express y in terms of x.

A $y = x^2 - 3$
B $y = \frac{2x}{1000}$
C $y = \frac{x^2}{3}$
D $y = \frac{x^2}{1000}$
E $y = \frac{2x}{3}$

---

56 **The arithmetic mean of the three numbers a, b, c is 8.**
Find the arithmetic mean of the four numbers: a + 1, b + 2, c + 6, 3.

A 27
B 5
C 9
D 7
E 11

---

57 **An aluminium block of mass 2.5 kg is supplied with 9000 J of thermal energy. This causes its temperature to rise by 4 K.**

Which expression gives the specific heat capacity of this aluminium, from this data?

[Assume that the block remains solid throughout, and that no additional energy is exchanged between the block and the surroundings.]

A $\frac{2.5\times4}{9000}\ \mathrm{J\ kg^{-1}\ K^{-1}}$

B $9000\times2.5\times4\ \mathrm{J\ kg^{-1}\ K^{-1}}$

C $\frac{9000\times4}{2.5}\ \mathrm{J\ kg^{-1}\ K^{-1}}$

D $\frac{9000}{2.5\times4}\ \mathrm{J\ kg^{-1}\ K^{-1}}$

E $\frac{9000\times2.5}{4}\ \mathrm{J\ kg^{-1}\ K^{-1}}$

---

58 **The diagram shows a car of mass 1000 kg travelling at a constant speed of 30 m/s in the direction shown along a flat, level road which forms a circle of radius 50 m.**

<i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx2188d1818.png?alt=media&token=81270162-3368-49a4-9fe8-e8f9b4c17f94<i>

Which row in the table gives both the magnitude of the resultant force on the car and the direction of the acceleration of the car at the instant shown?

<i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/IMAT%2FIMAT_Quizzes%2F83333f43a5850013b1e7f1dd269dc83201ec952a.png?alt=media&token=423c0441-d4dc-409c-89da-d3c84bfd8f54<i>

A row 2

B row 4

C row 5

D row 3

E row 1

---

59 **Two forces F of equal magnitude act on a beam.**
Which diagram shows a couple acting and states the magnitude of the torque (moment) of the couple about the pivot?

[The pivot is at the centre of the beam]

A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Facd139c9dkack.png?alt=media&token=716aa31a-5450-4dc8-b554-55912f387f41<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fcxjcqucquuc1c.png?alt=media&token=55f5318f-0309-47c5-8234-2b4fe0844a80<i>

C <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F8scccj1ccc.png?alt=media&token=2ddb6b8e-1830-4576-b3d0-5527330c3bc7<i>

D <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F1x2esuudaquduw1d%C3%B9.png?alt=media&token=850c202b-cf3f-4510-8084-40a3dc8f50c0<i>

E <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fdw1w881c8c1.png?alt=media&token=5ee580ed-cfcc-4980-a43f-8cc9217c384b<i>

---

60 **Which one of the following equations is dimensionally consistent (has consistent units)?**

[All the symbols have their usual meanings:

$v =$ velocity; $F =$ force; $m =$ mass; $t =$ time; $V =$ voltage; $Q =$ charge; $R_1, R_2, R_3, R_4 =$ resistance**]**

A temperature change = energy × m × specific heat capacity

B resistance $= R_1 + R_2 + (1/R_3) + (1/R_4)$

C energy $= \left(1/2mv^2\right) + Fv$

D electrical current $= (V/R_1) + (Q/t)$

E acceleration $= \left(1/2vt^2\right) + (F/m)$

ANSWER SHEET

Fill in one box per question, as in the exam. The key is on the next page.

1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E
11	A	B	C	D	E
12	A	B	C	D	E
13	A	B	C	D	E
14	A	B	C	D	E
15	A	B	C	D	E
16	A	B	C	D	E
17	A	B	C	D	E
18	A	B	C	D	E
19	A	B	C	D	E
20	A	B	C	D	E
21	A	B	C	D	E
22	A	B	C	D	E
23	A	B	C	D	E
24	A	B	C	D	E
25	A	B	C	D	E
26	A	B	C	D	E
28	A	B	C	D	E
30	A	B	C	D	E
31	A	B	C	D	E
32	A	B	C	D	E
33	A	B	C	D	E
34	A	B	C	D	E
35	A	B	C	D	E
36	A	B	C	D	E
37	A	B	C	D	E
38	A	B	C	D	E
39	A	B	C	D	E
40	A	B	C	D	E
41	A	B	C	D	E
42	A	B	C	D	E
43	A	B	C	D	E
44	A	B	C	D	E
46	A	B	C	D	E
47	A	B	C	D	E
48	A	B	C	D	E
49	A	B	C	D	E
51	A	B	C	D	E
52	A	B	C	D	E
53	A	B	C	D	E
54	A	B	C	D	E
55	A	B	C	D	E
56	A	B	C	D	E
57	A	B	C	D	E
58	A	B	C	D	E
59	A	B	C	D	E
60	A	B	C	D	E

ANSWER KEY

Valid for this TestBuddy version: the answers are in a different order from the official paper.

1	A	20	C	41	D
2	B	21	E	42	B
3	D	22	A	43	C
4	C	23	A	44	D
5	C	24	A	46	C
6	A	25	C	47	B
7	A	26	D	48	E
8	B	28	B	49	A
9	C	30	E	51	C
10	E	31	C	52	D
11	C	32	A	53	B
12	E	33	A	54	C
13	E	34	E	55	D
14	C	35	E	56	C
15	B	36	B	57	D
16	D	37	E	58	D
17	E	38	E	59	D
18	D	39	E	60	D
19	B	40	A		

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