PROVE UFFICIALI DEGLI ANNI PASSATI

IMAT

2014

A B ✓ D E

SVOLTA CON SOLUZIONI COMMENTATE

Il perché di ogni risposta

WHAT'S IN THIS DOCUMENT

Prova di ammissione IMAT 2014, 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 with the answers in random order
- Under each question the correct answer and why every other answer is wrong

General Knowledge and Logical Reasoning	26 questions
Biology	13 questions
Chemistry	8 questions
Physics and Mathematics	8 questions
Total	**55 questions**

This version has **55 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 **Research reveals that, in a given period of the 20th century, top footballers (defined as those who had played for their country's team) lived, on average, almost 5 years longer than middle ranking footballers. We can conclude therefore that for the top footballers, success had a beneficial effect on their lifespan.**

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

- **A** **It assumes that the longer lifespan could not be explained by other factors.**
- **B** The study was limited to footballers in a given period of time.
- **C** Living longer is not necessarily a good thing.
- **D** Playing football regularly may have health benefits which contribute to longer lifespan.
- **E** Life expectancy increased generally in the 20th century.

Correct answer: A

The argument notes that top footballers lived longer but incorrectly infers that **career success** caused this outcome. It overlooks **alternative factors** that could explain the gap, such as innate **health advantages** or superior baseline **fitness levels** that enabled elite performance. Without ruling out these variables, a direct **causal connection** remains unproven.

Why the other answers are wrong

- **B) The study was limited to footballers in a given period of time.**: Limiting the data to one era constrains statistical generalizability but misses the fundamental error of mistaking correlation for cause.
- **C) Living longer is not necessarily a good thing.**: Evaluating the worth of longevity distracts from the logical core, which only tests whether professional achievement actually extended lifespan.
- **D) Playing football regularly may have health benefits which contribute to longer lifespan.**: Both tiers participated in regular football training, so shared athletic activity cannot account for the divergence in their lifespans.
- **E) Life expectancy increased generally in the 20th century.**: Nationwide gains in life expectancy would lift all cohorts equally and fail to isolate why high achievers survived longer than their peers.

2 **One of the foolish but persisting fantasies of the Olympic movement is that the Games are, or were, or will be, or even ought to be, completely free of politics. It is difficult to understand how this foolish belief continues, but the facts are these: the nations lining up to host the games are motivated not by unattainable ideals but by a legitimate desire to promote the excellence of their citizens; and the nations who have boycotted the games in the past have done so to make genuine political points.**

Which one of the following is a conclusion which can be drawn from the above passage?

A Just because the Olympic games have been politicised, it doesn't mean that they should be.

B National interests are ruining the Olympics.

C **If some countries use the Olympic movement to further their own ends, they are guilty only of exposing a myth.**

D We should do everything possible to ensure that the Olympics do not become further politicised.

E Although everyone knows the Olympics are caught up in politics, no one is brave enough to admit it.

Correct answer: C

The author defines the expectation of **politics-free games** as a foolish fantasy. Nations host or boycott the events to **promote national interests** or make political points. These actions simply reveal the persistent myth rather than violate an accepted ideal. Therefore, using the Olympics for personal goals only exposes a false expectation.

Why the other answers are wrong

- **A) Just because the Olympic games have been politicised, it doesn't mean that they should be.**: The text directly dismisses the normative view that the event ought to remain apolitical, grouping it with other unrealistic expectations.
- **B) National interests are ruining the Olympics.**: The text explicitly describes the motivation to highlight citizen excellence as legitimate, contradicting any claim of structural ruin.
- **D) We should do everything possible to ensure that the Olympics do not become further politicised.**: The author analyzes current diplomatic motives without prescribing future actions or advocating for stricter neutrality policies.
- **E) Although everyone knows the Olympics are caught up in politics, no one is brave enough to admit it.**: The passage notes the fantasy persists among observers, but it never claims individuals know the truth or lack courage to state it.

3 **There is concern at the moment about the way in which football referees are treated by players during games. The Football Association and the Referees' Association feel that there is too much verbal (and physical) abuse directed at referees. Various solutions have been suggested such as only allowing the captain of each team to approach and talk to the referee. The major difficulty is how such new rules should be introduced. The preferred suggestion seems to be that the rules should be changed first in the amateur game, the aim being to improve discipline in the game from the bottom upwards, until the whole game is improved.**

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

A **Not many professional players start out in the amateur leagues.**

B Amateur players are more likely to abuse referees than are professionals.

C Referees in the amateur game are less proficient than those in the professional games.

D Referees should use their existing powers to control abusive players.

E By introducing it first to amateur players, it reaches those who spend the least time playing football.

Correct answer: A

The proposal assumes that improving discipline in amateur football will naturally influence professional football through **shared development pathways**. If most professional players do not begin their careers in amateur leagues, the intended **upward influence** cannot function. This breaks the **logical link** between the two tiers and directly undermines the plan.

Why the other answers are wrong

- **B) Amateur players are more likely to abuse referees than are professionals.**: Stating that amateur players abuse referees more frequently actually provides a reason to address abuse in that league first. It supports the strategy rather than weakening it.
- **C) Referees in the amateur game are less proficient than those in the professional games.**: Observing that amateur referees are less proficient might affect enforcement during local matches. It does not establish that improved discipline at the bottom would ultimately fail to spread to higher levels.
- **D) Referees should use their existing powers to control abusive players.**: Suggesting referees use existing powers presents an alternative response. It does not directly challenge the specific claim that an amateur-first approach would successfully improve the entire sport.
- **E) By introducing it first to amateur players, it reaches those who spend the least time playing football.**: Noting that the policy reaches those who spend the least time playing raises a concern about its overall reach. However, it still does not undermine the proposed route from amateur to professional levels as directly as option A.

4 **The purpose of an election is to decide what policies are supported by the people. However, in elections the concept of 'tactical voting' is becoming increasingly common.**

The argument is a simple one: Party X will never be beaten by party Y but party Z could win with a few extra votes. Therefore, you should transfer your vote from party Y to party Z to make sure that party X is beaten.

This reasoning is perfectly sound if your main objective is to vote a party out. Unfortunately, if you support party Y then there is no guarantee that party Z will support the same principles.

Which one of the following is the conclusion that could best be drawn from the above passage?

A **Tactical voting will not achieve the purpose of an election.**

B Party X policies are not popular.

C Tactical voting is an important part of the electoral process.

D Elections are often thought of in terms of voting for or against the party in office, rather than as voting for your preferred party.

E It is important that party X does not win the election.

Correct answer: A

The passage explains that the primary **electoral purpose** is to identify publicly supported policies. **Strategic vote switching** occurs when voters abandon their favorite candidate to block a stronger rival. This maneuver risks **policy misalignment** because the resulting government may hold opposing principles. Consequently, tactical strategies can distort genuine **voter intentions**.

Why the other answers are wrong

- **B) Party X policies are not popular.**: The passage offers no information on public approval, making any claim about Party X's popularity completely unsupported.
- **C) Tactical voting is an important part of the electoral process.**: The text only notes that tactical voting is increasing in frequency, never asserting it carries inherent importance or merit.
- **D) Elections are often thought of in terms of voting for or against the party in office, rather than as voting for your preferred party.**: The passage never states that Party X holds office, so it cannot frame voting as purely opposition to the incumbent.
- **E) It is important that party X does not win the election.**: Preventing Party X from winning reflects the tactical voter's private aim, not a stance validated by the author.

5 **Despite much opposition to the idea, modern musical trends such as hip hop have a place in the world of opera. Traditional opera is a powerful musical experience. However, modern musicians should not necessarily stick with the traditional form. Modern musical forms which fuse staged drama, singing and contemporary or ethnic trends in music are also powerful musical experiences. Glydebourne's youth operas 'Misper' and 'Zoe', and its Mozart hiphopera, 'School 4 Lovers', enjoyed critical and box office success and attracted hip hop audiences. Moving away from the snobbery of tradition gives a much wider audience access to transformative musical experience.**

Which one of the following best expresses the main conclusion of the passage?

A Musicians are entitled to fuse new forms and old to create exciting musical experiences.

B Creating new operatic performances allows more people to access this exciting art form.

C Contemporary music has a place in the musical world in addition to traditional operatic performances.

D **Contemporary music forms have a place in performances of opera.**

E Hip hop is as powerful and dramatic as opera.

Correct answer: D

The passage argues that **modern musical trends** such as hip hop have a valid **place in opera**. Successful productions and broader audience reach serve as direct evidence for this claim. The author uses these details to demonstrate how combining staged drama with contemporary styles generates powerful experiences.

Why the other answers are wrong

- **A) Musicians are entitled to fuse new forms and old to create exciting musical experiences.**: The author maintains that these hybrid shows belong within the operatic spectrum. The discussion centers on artistic placement rather than asserting any creative entitlement for performers.
- **B) Creating new operatic performances allows more people to access this exciting art form.**: Expanded audience access functions strictly as a supporting premise. It clarifies why abandoning traditional snobbery benefits the art form instead of serving as the primary claim.
- **C) Contemporary music has a place in the musical world in addition to traditional operatic performances.**: The central argument focuses on actively integrating current styles directly into operatic staging. It extends past the simple observation that classical and contemporary genres might exist side by side.
- **E) Hip hop is as powerful and dramatic as opera.**: The text confirms that blended performance formats can deliver intense experiences. It never claims that hip hop and traditional opera possess equal dramatic strength.

6 **Over 30 years ago, the smallpox virus was eradicated (removed) from the natural environment, but examples of it are still preserved in two laboratories. It is planned, however, to destroy these remaining viruses. Given that this will be the first example of a deliberate destruction of an entire species, we should think again before destroying these viruses. Years ago we thought we had the right to kill as many creatures as we liked, but now we realise we have no such right. Furthermore, we cannot know the future; we cannot justify destroying something that could be of enormous value to us one day, valuable in ways we cannot even think of now. And anyway, what possible harm can captive viruses do to us?**

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

A We do not have the right to destroy the smallpox virus.

B Captive smallpox viruses are not going to harm us.

C **The planned destruction of the smallpox virus should be given more thought.**

D We cannot justify destroying something which may one day be valuable to us.

E The deliberate destruction of an entire species should never be allowed.

Correct answer: C

The main conclusion is that the planned destruction should be **reconsidered**. The concerns about destroying an entire species, its possible future value, and the harm captive viruses might cause support this conclusion.

Why the other answers are wrong

- **A) We do not have the right to destroy the smallpox virus.**: The passage questions whether destroying the viruses is justified, but it does not conclude that doing so is **absolutely forbidden**.
- **B) Captive smallpox viruses are not going to harm us.**: The passage raises the possibility that captive viruses will not harm us as a **rhetorical question**. It does not establish this as its conclusion.
- **D) We cannot justify destroying something which may one day be valuable to us.**: This is a **supporting reason**: the viruses might be valuable in the future. It supports reconsidering their destruction, but it is not the main conclusion about the plan.
- **E) The deliberate destruction of an entire species should never be allowed.**: The claim that destruction should **never** be allowed is stronger than the passage's call to think again before destroying these viruses.

7 **When driving, if the car in front of you brakes suddenly, you need to be able to stop without crashing into it. The easiest rule of thumb is the two second rule. You choose a reference point that the vehicle in front of you is passing then say aloud: 'Only a fool breaks the two second rule'. If you reach the reference point before you have finished the saying you need to pull back. This works at all speeds. However, when there are adverse road conditions or the road is narrow you need to double your braking distance. These practices will enable you to avoid such crashes.**

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

A Most crashes are caused by cars running into the car in front.

B **It will not take less than two seconds to repeat the saying.**

C Those who do not use the rule do not value road safety.

D Adopting the 'two second rule' will avoid all accidents.

E Some drivers brake more suddenly than others.

Correct answer: B

The rule uses the saying as a measure of a **two-second gap**. If it took less than two seconds to say, a driver could finish it while following too closely and mistakenly think the gap was safe.

Why the other answers are wrong

- **A) Most crashes are caused by cars running into the car in front.**: The argument does not depend on how common this type of crash is.
- **C) Those who do not use the rule do not value road safety.**: The argument makes no claim about the attitudes of drivers who do not use the rule.
- **D) Adopting the 'two second rule' will avoid all accidents.**: The claim concerns crashes into a braking car ahead, not every kind of accident.
- **E) Some drivers brake more suddenly than others.**: Differences between drivers' braking habits are not needed for the rule to work.

8 **If for a number of hours each day you're having experiences on the computer where there are no consequences, that may have an implication for antisocial behaviour. In real life you can't undo something; you can't bring someone back to life once you've stabbed them. On a computer you can play the game again. It may be that for people who spend most of their time playing computer games involving killing others, real bleeding to death has no meaning. Studies of brain activity show that there is less pre frontal cortex activity in the brains of screen obsessed teenagers than in the brains of those who spend little time on computer games. The pre frontal cortex area of the brain is where we process ideas of sequence, consequences and empathy.**

Which one of the following can be drawn as a conclusion of the passage above?

A People who spend a lot of time playing computer games are the main culprits in knife crime.

B Young people cannot distinguish the difference between fantasy and reality.

C Brain structure is altered by environmental factors.

D **There may be a link between use of computer games and violence.**

E Computer games should not be available for children under 18 years of age.

Correct answer: D

The passage suggests that repeated exposure to virtual violence without real-world outcomes may affect how players process actual harm. Brain scans show lower activity in the **prefrontal cortex** of heavy gamers, an area responsible for tracking **consequences** and **empathy**. These observations point to a potential correlation rather than established causation.

Why the other answers are wrong

- **A) People who spend a lot of time playing computer games are the main culprits in knife crime.**: The passage contains no statistical evidence linking gamers to being the primary perpetrators of knife crime.
- **B) Young people cannot distinguish the difference between fantasy and reality.**: The text highlights specific impacts on emotional regulation, rather than claiming a general cognitive inability to differentiate fantasy from reality.
- **C) Brain structure is altered by environmental factors.**: The cited research tracks temporary fluctuations in neural activation during gameplay, explicitly distinguishing these findings from permanent modifications to physical brain architecture.
- **E) Computer games should not be available for children under 18 years of age.**: The argument outlines observed psychological and neurological patterns; it never introduces policy proposals or age restrictions for purchasing games.

9 **We constantly split our attention between the people we are with and what's happening on our mobile phone screens. On screen multi tasking makes us less efficient as well as less emotionally engaged with others. It takes 64 seconds to recover our train of thought after interruption by a message (that's 8.5 hours a week wasted if we check our screens every five minutes) and when we've sent an email or SMS text message, the brain goes through a series of semi conscious calculations as we wonder when and how the recipient will reply. The result is that we're not 'present' for several minutes afterwards. In order to function effectively in the workplace, we need to switch off our communication hardware.**

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

A It may only be the younger workers who use mobile phone technology to excess.

B In many work environments you may not be allowed to use personal mobile phones.

C **Without the means to send and receive information instantly, our effectiveness may be compromised.**

D We may need to have some 'down time' in order to recharge our mental batteries.

E People may be unwilling to make less use of their mobile phones.

Correct answer: C

The passage argues that switching off communication devices improves workplace effectiveness, but it overlooks that **instant communication** may be **essential** for modern tasks. This assumption creates a logical **flaw** by ignoring how **professional workflows** often depend on these very tools.

Why the other answers are wrong

- **A) It may only be the younger workers who use mobile phone technology to excess.**: Restricting the issue to younger workers limits who is affected but does not address the proposed solution.
- **B) In many work environments you may not be allowed to use personal mobile phones.**: Workplace phone restrictions concern company policies rather than whether disconnecting aids work performance.
- **D) We may need to have some 'down time' in order to recharge our mental batteries.**: The need for mental breaks does not challenge the claim about switching off communication hardware.
- **E) People may be unwilling to make less use of their mobile phones.**: Unwillingness to change habits does not show that switching off devices would be ineffective.

10 **If the media give publicity to certain types of crime, it may encourage criminals to carry out 'copy cat' offences. If, however, they were forbidden to divulge details of crimes, this would amount to censorship. The freedom of speech of the media is too important to sacrifice, so the media should be free to report crime even if this means some crimes are committed which would not otherwise be committed.**

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

A Publicity about crimes can encourage others to commit similar offences.

B Freedom of speech is a right that is too important to give up.

C The media should not report all the details of a crime.

D Censorship of the media would reduce the crime rate.

E **The media should be permitted to report crimes even if other crimes sometimes result from this reporting.**

Correct answer: E

The **main conclusion** is that the media should be free to report crimes, even if this sometimes leads to copycat offences. The argument supports this by saying that freedom of speech is too important to sacrifice.

Why the other answers are wrong

- **A) Publicity about crimes can encourage others to commit similar offences.**: The argument acknowledges that publicity about crimes can encourage others to commit similar offences, but presents this as a possibility, not as its conclusion.
- **B) Freedom of speech is a right that is too important to give up.**: The importance of freedom of speech is the **reason** given in support of the conclusion, not the conclusion itself.
- **C) The media should not report all the details of a crime.**: The argument opposes forbidding the media to divulge details of crimes, since that would amount to censorship.
- **D) Censorship of the media would reduce the crime rate.**: The passage mentions the possibility of copycat offences, but does not claim that censorship would reduce the overall crime rate.

11 **Smoking cigarettes causes a speeding up in the rate of blood flow, which in turn increases the risk of heart disease. It was thought that this speeding up of blood flow was caused solely by the gas carbon monoxide, which is absorbed during smoking, and not by nicotine, which is also absorbed from the smoke in the lungs. However, tests have shown that using nicotine patches (from which nicotine is absorbed through the skin) or chewing nicotine gum also causes the rate of blood flow to increase. This shows that the nicotine in cigarettes is also responsible for the increased risk of heart disease among smokers.**

Which one of the following is not an assumption of the argument in the passage above?

A The effect of nicotine on the body does not depend on the way in which it was absorbed.

B Carbon monoxide is not absorbed from nicotine patches and nicotine chewing gum.

C **Carbon monoxide would not produce a rise in the rate of blood flow in the absence of nicotine.**

D There is nothing else in nicotine patches and chewing gum which might cause an increase in the rate of blood flow.

E Any differences between the amount of nicotine absorbed from smoking and the amount absorbed from nicotine patches and chewing gum can be disregarded.

Correct answer: C

The argument concludes that **nicotine** also increases blood flow and raises heart disease risk based on tests with patches and gum. An unstated premise must be necessary for this conclusion. Choice D claims carbon monoxide cannot raise blood flow alone. This independence would not weaken the nicotine claim, so it is not assumed.

Why the other answers are wrong

- **A) The effect of nicotine on the body does not depend on the way in which it was absorbed.**: The reasoning presumes identical **physiological impact** regardless of entry route. If lung absorption acted differently than skin or oral exposure, the experimental findings would not extend to smoking.
- **B) Carbon monoxide is not absorbed from nicotine patches and nicotine chewing gum.**: The reasoning depends on the absence of **carbon monoxide** in alternative products. If these products delivered carbon monoxide, they would offer an alternative explanation for the faster blood flow.
- **D) There is nothing else in nicotine patches and chewing gum which might cause an increase in the rate of blood flow.**: The reasoning requires that **other ingredients** do not trigger the speed up. Without excluding them, the patch and gum results could not prove nicotine causes the effect.
- **E) Any differences between the amount of nicotine absorbed from smoking and the amount absorbed from nicotine patches and chewing gum can be disregarded.**: The reasoning assumes comparable **absorption amounts** across different delivery methods. Significant dose variations would prevent applying patch or gum data to cigarette smokers.

12 **In many countries shocking images of the damage smoking can do to the body are displayed on cigarette packets. Images of rotting teeth, mouth tumours and cancerous lungs are among the grim pictures. A review concluded that shocking pictures of the damage smoking can do are a cost effective way to help smokers to quit and discourage others from starting. All countries should introduce these kinds of images to discourage smoking.**

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

A Smokers are likely to die younger than non smokers.

B Governments receive a significant amount of revenue from taxes on tobacco products.

C The USA is planning to display shocking images on cigarette packets.

D **In countries using the images there are high taxes on tobacco and a ban on advertising.**

E Pictures that arouse emotions are especially effective.

Correct answer: D

The argument attributes lower smoking rates to **graphic pack images** based on a published review. Nations adopting these warnings simultaneously enforce **higher tobacco taxes** and strict **advertising bans**. These **stricter regulatory measures** likely drive the **observed decline** in tobacco use rather than the visual warnings. Consequently, mandating the images globally would not guarantee the intended public health results.

Why the other answers are wrong

- **A) Smokers are likely to die younger than non smokers.**: Statistical life expectancy gaps highlight biological damage from nicotine addiction. Longevity outcomes describe disease severity rather than measuring warning label utility.
- **B) Governments receive a significant amount of revenue from taxes on tobacco products.**: Tax collection generates substantial government income from tobacco sales. This economic benefit explains potential political reluctance to cut consumption, yet it never questions the actual effectiveness of the pictures.
- **C) The USA is planning to display shocking images on cigarette packets.**: Administrative scheduling merely indicates institutional preference. Proposed implementation timelines cannot verify whether the visual deterrents actually modify consumer behavior.
- **E) Pictures that arouse emotions are especially effective.**: Strong emotional responses directly enhance persuasive messaging. This fact validates the core claim that distressing photographs actively discourage tobacco initiation.

13 **There is a special offer on jars of coffee this week. Customers who buy two jars at the normal price have the option to buy up to four more jars at one quarter of the normal price.**

For customers buying coffee this week, which of these bar graphs shows how the average cost per jar (as a percentage of the normal cost) varies with the number of jars bought?

A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fc18c81c8c8icoxo.png?alt=media&token=6265e80b-1cbd-4126-a7aa-86c73d022796<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Faucashcjzxhucqsuh1.png?alt=media&token=d61c4641-f6f3-43d8-9140-a005b60781b5<i>

C <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fe1x8saxmzmmzz.png?alt=media&token=dbd685e9-6f54-42a6-97cf-bfd81dc827ed<i>

D <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fcvcmvcnm1dmskadmsdk.png?alt=media&token=b45d141e-484d-47a0-8282-f149f43bf717<i>

E **<i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fsad8s8a8c8c8c.png?alt=media&token=76e4b317-e3ba-4f3f-8f83-032bb291deeb<i>**

Correct answer: E

Let P be the **normal price**. The first two jars cost P, while up to four additional jars are sold at a reduced rate of $P/4$. The **average cost** percentage for each purchase quantity is: 1. One jar: 100% 2. Two jars: 100% 3. Three jars: $\frac{2P+\frac{P}{4}}{3} = 75\%$ 4. Four jars: $\frac{2P+\frac{2P}{4}}{4} = 62.5\%$ 5. Five jars: $\frac{2P+\frac{3P}{4}}{5} = 55\%$ 6. Six jars: $\frac{2P+\frac{4P}{4}}{6} = 50\%$ Graph A displays the **correct progression**.

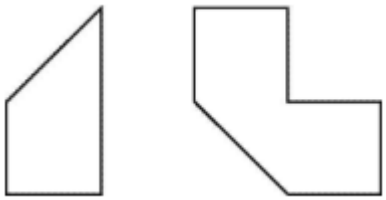
Why the other answers are wrong

- **A) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fc18c81c8c8icoxo.png?alt=media&token=6265e80b-1cbd-4126-a7aa-86c73d022796<i>**: Decreases prematurely before the third jar. Both initial jars are bought at full price, so the average must stay at 100% for the first two quantities.
- **B) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Faucashcjzxhucqsuh1.png?alt=media&token=d61c4641-f6f3-43d8-9140-a005b60781b5<i>**: Groups bars into equal pairs near 100%, 75%, and 50%. Every extra discounted jar actually creates a unique new average instead of repeating previous values.
- **C) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fe1x8saxmzmmzz.png?alt=media&token=dbd685e9-6f54-42a6-97cf-bfd81dc827ed<i>**: Misses the correct sequence. The second bar drops below 100%, and the remaining heights do not match 75%, 62.5%, or 55%.
- **D) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fcvcmvcnm1dmskadmsdk.png?alt=media&token=b45d141e-484d-47a0-8282-f149f43bf717<i>**: Holds the first three bars at 100% and the last three at 50%. Adding a discounted jar immediately lowers the mean to 75%, and subsequent averages decline gradually rather than plateauing.

14 **During a recent storm the plastic company logo fell off the outside of the office building of Fleesam Ltd. and broke cleanly into the two pieces shown below:**

A junior clerk took the two pieces to a signmaker to show what had happened, and asked him to make a new logo. Unfortunately after the clerk had left, the signmaker realised that he didn't know how the two pieces had fitted together originally.

Which one of the following could not be Fleesam's logo?



A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fdfe288feu8f8vevu.png?alt=media&token=cd4c4619-0bfe-4f76-b258-e18f6e9c4fa0<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx2e1s9a9sqc.png?alt=media&token=56f672ac-51f3-42f4-a573-4b093d845226<i>

C <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx12eusudususdfc.png?alt=media&token=164c8429-1949-47b5-a060-91d10fe815e5<i>

D **<i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx12ekaskskss.png?alt=media&token=97925e9d-63f5-4463-a142-8f01ea1c7bb5<i>**

E <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fd12d8s88dsdc8.png?alt=media&token=89dfe418-fb92-47c5-8d43-dd44e8b16989<i>

Correct answer: D

When the plastic broke, the fracture line formed exactly one **vertical segment** connected to a **45° sloping segment**. Option A lacks a **notch** that matches this combined profile in the required orientation and lengths, so the fragments cannot reassemble into it.

Why the other answers are wrong

- **A) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fdfe288feu8f8vevu.png?alt=media&token=cd4c4619-0bfe-4f76-b258-e18f6e9c4fa0<i>**: Provides an L-shaped groove containing a single vertical side and a single 45° side at the correct proportions, making reassembly possible.
- **B) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx2e1s9a9sqc.png?alt=media&token=56f672ac-51f3-42f4-a573-4b093d845226<i>**: Offers a matching single vertical drop followed by a single 45° incline of identical dimensions, enabling the original logo to be reconstructed.
- **C) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx12eusudususdfc.png?alt=media&token=164c8429-1949-47b5-a060-91d10fe815e5<i>**: Displays a complementary cutout with a vertical wall and a 45° slope that match the exact height and length of the broken edges, allowing the pieces to slot together perfectly.

- **E) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fd12d8s88dsdc8.png?alt=media&token=89dfe418-fb92-47c5-8d43-dd44e8b16989<i>**: Contains the proper vertical-plus-45° indentation in the correct position and size, so the two broken fragments would fit back exactly.

---

15 **A golf tournament is played over 10 rounds, on successive Saturdays. The winner of each round scores 3 points and the player finishing second scores 1 point. The tournament is won by the competitor with the most points over the 10 rounds. Alan Vinci, Barry Durand, Carl Johansson and Daniel and Eric Lim were the participants in this year's tournament. All five won at least one round, but either Barry, Daniel or Eric finished second on each occasion. The 1 2 finishing order was different every round, and the Lim brothers didn't both score points in the same round at any time.**

Who won this year's tournament?

A Alan Vinci
B Daniel Lim
C **Barry Durand**
D Eric Lim
E Carl Johansson

Correct answer: C

1. There are 10 rounds, and each winner-runner-up pair is different. Only Barry (B), Daniel (D), or Eric (E) can finish second. The possible pairs are (A,B), (A,D), (A,E), (B,D), (B,E), (C,B), (C,D), (C,E), (D,B), (D,E), (E,B), and (E,D). 2. The pairs (D,E) and (E,D) are impossible because the Lim brothers cannot both score in the same round. Exactly 10 pairs remain, so all must occur once: (A,B), (A,D), (A,E), (B,D), (B,E), (C,B), (C,D), (C,E), (D,B), and (E,B). 3. Alan wins 3 rounds, scoring $3 \times 3 = 9$ points. Barry wins 2 rounds and finishes second 4 times, scoring $2 \times 3 + 4 \times 1 = 10$ points. Carl wins 3 rounds, scoring 9 points. Daniel and Eric each win once and finish second 3 times, scoring $3 + 3 = 6$ points apiece. 4. Barry has the **highest total**, with **10 points**, so he wins.

Why the other answers are wrong

- **A) Alan Vinci**: Alan finishes with 9 points, one point behind Barry.
- **B) Daniel Lim**: Daniel scores only 6 points.
- **D) Eric Lim**: Eric scores 6 points, well short of Barry's 10.
- **E) Carl Johansson**: Carl also scores 9 points, tying Alan but finishing behind Barry.

---

16 **The owner of a hotel needs to decorate 20 rooms. He has found prices for four different types of interior wood paint and calculated the volume of paint he needs for each room. He will use the same type of paint for all the rooms.**

What is the least amount he needs to spend on paint?

Type of paint	*375 ml*	*750 ml*	*1.25 l*	*2.5 l*	*Volume needed per room*
Non Drip Gloss	€4.50	€8.00	€10.00	€16.00	1.4 litres
Satinwood	€5.00	€8.00	€11.00	€20.00	1.1 litres
Quick Dry Gloss	N/A	€10.00	N/A	€20.00	1.0 litres
Once Gloss	€4.50	€8.00	€12.00	€18.00	0.8 litres

A 108
B 112
C 116
D **120**
E 126

Correct answer: D

1. Determine the **total volume** required per paint type: Non Drip Gloss requires $20 \times 1.4\ \mathrm{L} = 28\ \mathrm{L}$; Satinwood requires $20 \times 1.1\ \mathrm{L} = 22\ \mathrm{L}$; Quick Dry Gloss requires $20 \times 1.0\ \mathrm{L} = 20\ \mathrm{L}$; Once Gloss requires $20 \times 0.8\ \mathrm{L} = 16\ \mathrm{L}$. 2. Identify the pack with the **lowest unit cost**: The $2.5\ \mathrm{L}$ tin is always the cheapest per litre. Prioritize these tins and fill remaining gaps with smaller packs. 3. Calculate the **minimum purchase cost** for each product: Non Drip Gloss totals €184; Satinwood totals €179; Quick Dry Gloss totals €160; Once Gloss totals €120 using six $2.5\ \mathrm{L}$ tins and one $1.25\ \mathrm{L}$ tin. 4. Confirm that €120 is the absolute lowest expenditure across all valid combinations.

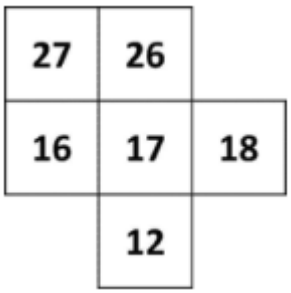
Why the other answers are wrong

- **A) 108**: Six $2.5\ \mathrm{L}$ tins of Once Gloss cost €108, but only supply $15\ \mathrm{L}$. This results in an **insufficient quantity** for the $16\ \mathrm{L}$ actually required.
- **B) 112**: The available pack volumes and fixed prices cannot be combined to equal exactly €112 while meeting any of the calculated volume targets.
- **C) 116**: No packaging mix for any single paint type produces a final price below €120.
- **E) 126**: Seven $2.5\ \mathrm{L}$ tins of Once Gloss cost €126, but substituting one large tin with a $1.25\ \mathrm{L}$ tin lowers the price to €120 without reducing coverage, making €126 an **unnecessary expense**.

17 **The diagram below shows the layout of a game playing board with the square board numbered as indicated. The numbers on the board start with 1 on the bottom left and finish with 25 at the top right. A larger, square playing board is numbered in a similar way and divided into pieces which fit together to make the whole board.**

21	22	23	24	25
20	19	18	17	16
11	12	13	14	15
10	9	8	7	6
1	2	3	4	5

One piece of this larger board is shown below: How many squares are there on this larger board?



A 81
B 64
C 25
D 121
E **49**

Correct answer: E

The board follows a **boustrophedon numbering** pattern with rows alternating direction. Let N be the number of columns and r, c the row and column of 17. For the odd row, the value is $17 = (r-1)N + c$, while for the even row immediately below it is $12 = (r-1)N - c + 1$. Subtracting the equations yields $5 = 2c - 1$, giving $c = 3$. Substituting back solves $(r-1)N = 14$: the only valid factorization is $N = 7$, making the board 7×7 with **49** squares.

Why the other answers are wrong

- **A) 81**: A 9×9 board fails to reproduce the displayed arrangement of the labels.
- **B) 64**: An 8×8 board does not match the relative positions of 12, 16, 17, 18, 26, and 27.
- **C) 25**: Would indicate a 5×5 board, which cannot contain the visible labels 26 and 27.
- **D) 121**: An 11×11 board has incorrect vertical and horizontal label relationships for the given piece.

18 **Sally owns a small business which produces hand crafted jewellery. The materials used to create a necklace cost €1.50 on average. She pays her staff €5.40 an hour. For a standard piece of jewellery she charges 70% more than it costs to produce.**

To make a particular Italian style glass necklace it takes 30 minutes. How much does she sell this single necklace for?

A **€7.14**
B €5.40
C €11.73
D €2.94
E €11.34

Correct answer: A

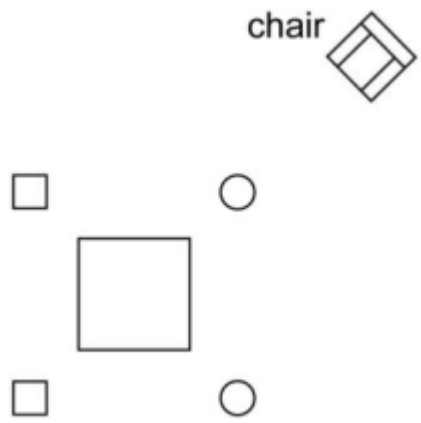
1. Calculate the **production cost** by adding material expenses (1.50) and labor wages ($0.5 \times 5.40 = 2.70$). 2. The resulting base amount equals 4.20. 3. Multiply this sum by 1.70 to apply the 70% **markup** and determine the final **selling price** ($1.70 \times 4.20 = 7.14$).

Why the other answers are wrong

- **B) €5.40**: 5.40 is merely the hourly wage rate. It disregards both the reduced time needed for the task and the mandatory addition of material expenses plus the pricing markup.
- **C) €11.73**: 11.73 happens if you calculate labor for a full hour (5.40) rather than the actual thirty minutes (2.70). An inflated base of 6.90 multiplied by 1.70 produces this erroneous figure.
- **D) €2.94**: 2.94 represents only the added profit margin (0.70×4.20). It omits the original production cost entirely, so it shows the gain rather than the complete transaction amount.
- **E) €11.34**: 11.34 appears when you take the correct selling price (7.14) and incorrectly add the total cost (4.20) a second time. This double counts the initial expenses instead of raising the price through a percentage increase.

19 **The diagram below is a plan of the raised flower beds and a chair in my garden.**

Which one of the following can not be a view of the raised beds from my chair?



A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F1xu2euxueus.png?alt=media&token=f0326ed4-9eed-4d33-ad2a-aa9e17d7daae<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fsaicsucu11ucu.png?alt=media&token=0313a445-80ef-4d9e-a4a2-7d40a84bd89c<i>

C <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx1e221uu21e1uedcc.png?alt=media&token=0fb2bc3c-8104-4d2f-8a1f-f64640855f9a<i>

D <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fasdasisikmm.png?alt=media&token=48730b40-a950-441f-ba26-26b534cb685f<i>

E **<i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fc31c181c81c.png?alt=media&token=52cd7ac2-9fc3-4e2d-8693-ccc3f93caa72<i>**

Correct answer: E

Both small beds lie west of the big bed, so they must appear on its **left**. One is at about the same height as the big bed, while the other appears **lower**. D places a small bed on the **right**, so it cannot be a valid view.

Why the other answers are wrong

- **A) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F1xu2euxueus.png?alt=media&token=f0326ed4-9eed-4d33-ad2a-aa9e17d7daae<i>**: Both small beds are on the left, at different apparent depths: one level with the big bed and the other lower. This is consistent with the plan.
- **B) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fsaicsucu11ucu.png?alt=media&token=0313a445-80ef-4d9e-a4a2-7d40a84bd89c<i>**: One small bed is at the same height as the big bed and out to the left, while the other is below it. This matches the plan.
- **C) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx1e221uu21e1uedcc.png?alt=media&token=0fb2bc3c-8104-4d2f-8a1f-f64640855f9a<i>**: One small bed is directly left at mid-height, and the other is directly below the big bed. This is another acceptable rendering of the arrangement.

- **D) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fasdasisikmm.png?alt=media&token=48730b40-a950-441f-ba26-26b534cb685f<i>**: One small bed is left of the big bed and the other is below it, matching the required layout.

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20 **Last month Karl walked from Starton to Endham, raising money for charity. His target, successfully achieved, was to complete the walk in ten days. He started later than intended and had only completed 12 km by the end of the first day. However, he walked 45 km on each of the second, third and fourth days, and after the fifth day he was exactly half way. Poor weather on the sixth day restricted his progress, but 41 km on both the seventh and eighth days meant that he had completed exactly three quarters of the walk with two days left. On the ninth day he covered three fifths of the remaining distance, completing the last 36 km on the tenth day.**

How far did Karl walk from Starton to Endham?

A 384 km
B 294 km
C 240 km
D 328 km
E 360 km

Correct answer: E

1. In the first four days, Karl walked $12 + 3 \times 45 = 147\ \text{km}$. If the total distance is D, then on day 5 he walked $D/2 - 147$ to reach the halfway point. 2. Let y be the distance walked on day 6. After days 7 and 8, he had walked $147 + (D/2 - 147) + y + 82 = 3D/4$, so $y = D/4 - 82$. 3. After day 8, $D/4$ remained. Day 9 covered three fifths of this, so day 10 covered the other two fifths: $2/5 \times D/4 = D/10$. Since day 10 was $36\ \text{km}$, $D/10 = 36$, giving $D = 360\ \text{km}$. 4. For this total, days 5, 6, and 9 were $33\ \text{km}$, $8\ \text{km}$, and $54\ \text{km}$ respectively, all consistent with the account.

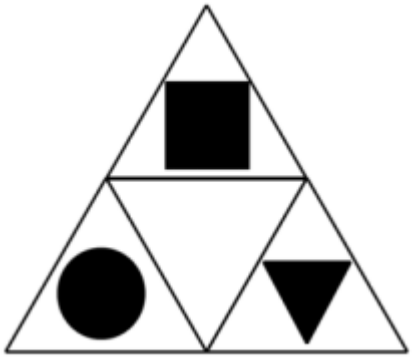
Why the other answers are wrong

- **A) 384 km**: A total of $384\ \text{km}$ would make the day-10 distance $38.4\ \text{km}$, not $36\ \text{km}$, and would alter the required distances for the subsequent days.
- **B) 294 km**: A total of $294\ \text{km}$ would make the day-10 distance $29.4\ \text{km}$, not $36\ \text{km}$. It would also make the day-6 distance negative: $D/4 - 82 = -8.5\ \text{km}$.
- **C) 240 km**: A total of $240\ \text{km}$ would make the day-10 distance $D/10 = 24\ \text{km}$, contradicting the stated $36\ \text{km}$.
- **D) 328 km**: A total of $328\ \text{km}$ would make the day-10 distance $32.8\ \text{km}$. It would also make the day-6 distance $D/4 - 82 = 0\ \text{km}$, an unrealistic day with no walking given the story.

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21 **The net shown can be folded to make a tetrahedron with each of the shapes showing on the outside.**

Which one of the following nets can be folded to make a tetrahedron identical to the one shown above?



A <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx28e218x8e2121thhh.png?alt=media&token=4ad23d9f-cc10-41a2-b119-463b63d0e7a5<i>

B <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F218e12z8e1812e.png?alt=media&token=5f52bd23-168a-41c0-ab70-81dca8dbe635<i>

C **<i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F12i12812821.png?alt=media&token=57949781-cf1a-4809-bced-bdc70869097a<i>**

D <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fiexi1i12i21e11x221aaa.png?alt=media&token=f3062487-e27d-43b4-b5ee-e5b9cb427805<i>

E <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F12iei1ie1ie12ie.png?alt=media&token=b11f5239-8064-45de-a099-92bec6fe89cb<i>

Correct answer: C

A tetrahedron has four triangular faces, with **three meeting at each vertex**. In the target solid, the **marked faces** (□, ●, ▼) must converge at one common corner. Net A positions exactly those three triangles around a **single shared point** in the flat layout. Folding lifts them around that corner while the blank triangle wraps around to close the fourth face.

Why the other answers are wrong

- **A) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fx28e218x8e2121thhh.png?alt=media&token=4ad23d9f-cc10-41a2-b119-463b63d0e7a5<i>**: The square rests on the lone flap. When folded inward it lands on the interior or an incorrect orientation, so it cannot meet the circle and triangle at an outer vertex.
- **B) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F218e12z8e1812e.png?alt=media&token=5f52bd23-168a-41c0-ab70-81dca8dbe635<i>**: The triangle occupies the isolated extra flap, which folds adjacent to only one other marked face. This spatial separation stops the triangle from touching both the circle and the square at a shared vertex.
- **D) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2Fiexi1i12i21e11x221aaa.png?**

alt=media&token=f3062487-e27d-43b4-b5ee-e5b9cb427805<i>: All marks are scattered across the net without sharing a single corner. No folding configuration can bring the circle, square, and triangle together at one point.

- **E) <i>https://firebasestorage.googleapis.com/v0/b/e2-ms01.appspot.com/o/Assets%2FImages%2FQuizzes%2F12iei1ie1ie12ie.png?alt=media&token=b11f5239-8064-45de-a099-92bec6fe89cb<i>**: The circle and square touch, but the triangle sits on a separate flap that does not reach both of them at the same point. This geometry prevents all three marks from converging during assembly.

22

Tessa makes bracelets. She works five days each week, from Monday to Friday. Her contract requires her to make a minimum of 150 bracelets every working day, for which she is paid a basic wage of $320 per week. She can also earn a bonus of $3 per bracelet for everyone above 175 that she makes on any particular day.

Last week, Tessa earned $515 in total. On Friday she made 205 bracelets, the most she has ever made in one day.

What is the minimum number of bracelets that Tessa made last week?

A 940
B 805
C 865
D 815
E **890**

Correct answer: E

Explanation of the correct answer (B – 890) 1. Basic information • Tessa is paid a fixed $320 each week. • For every bracelet made above 175 in one day she earns a $3 bonus. • Last week she was paid $515. • Therefore the bonus she earned was 515 – 320 = $195. 2. How many bonus-eligible bracelets were made? $195 ÷ $3 = 65 bracelets above 175 were produced during the week. 3. What happened on Friday? Friday's output was 205 bracelets. Bracelets above 175 on Friday = 205 – 175 = 30. Thus 30 of the 65 bonus bracelets are already accounted for, leaving 65 – 30 = 35 bonus bracelets that must have been made from Monday to Thursday. 4. Where can the remaining 35 bonus bracelets be put? • To collect any bonus on a particular day Tessa has to pass the 175 mark. That means she must first make the 25 "extra but unpaid" bracelets that lie between 150 and 175. • Therefore every additional day on which she exceeds 175 automatically adds 25 uncompensated bracelets to the weekly total. • To minimise the overall number made, we want to exceed 175 on as few days as possible. Can we put the whole 35-bracelet surplus on one day? – No, because that day would contain 175 + 35 = 210 bracelets, but the question states that 205 on Friday is "the most she has ever made in one day." So no other day can reach 210; the 35 bonus bracelets must be split over at least two days. Best (smallest) way to split them while staying below 205 each day: • Day 1: 29 bonus bracelets → 175 + 29 = 204 bracelets • Day 2: 6 bonus bracelets → 175 + 6 = 181 bracelets (Two days above 175, each below 205.) 5. Count the total bracelets for the week Minimum 150 on every day ..... 5 × 150 = 750 Extra, Day 1 (between 150 & 175) ..... 25 Bonus, Day 1 ..... 29 Extra, Day 2 (between 150 & 175) ..... 25 Bonus, Day 2 ..... 6 Extra on Friday (between 150 & 175) ..... 25 Bonus on Friday ..... 30 ---------- Total bracelets = 750 + 25 + 29 + 25 + 6 + 25 + 30 = 890 Any other arrangement either • requires three (or four) days above 175, which adds another 25 (or 50) "free" bracelets and pushes the total above 890, or • tries to put all 35 bonus bracelets on one day, which is impossible because it would exceed her record of 205. Hence 890 is the smallest number of bracelets she could have made.

Why the other answers are wrong

23 **15 runners took part in this year's Marathon of Marathons (eight marathon races on consecutive days). Points were awarded to the first seven to finish in each race, as follows:**

Winner 11 points
Second 8 points
Third 6 points
Fourth 4 points
Fifth 3 points
Sixth 2 points
Seventh 1 point

All 15 runners finished in the first three at least once, but only Philip, who was the overall winner with a total of 61 points, finished in the first three every time.

How many of the eight races did Philip win?

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

Correct answer: E

Let x, y, and z represent the number of first, second, and third place finishes for Philip. Since he completed eight races, $x + y + z = 8$. His accumulated points create $11x + 8y + 6z = 61$. Simplifying the **equation** by substitution yields $5x + 2y = 13$. Testing values shows that only $x = 1$ provides an **integer** result for y, confirming exactly one victory.

Why the other answers are wrong

- **A) 5**: Five wins force $25 + 2y = 13$, leading to $y = -6$, contradicting the minimum possible score distribution.
- **B) 4**: Plugging four wins into $5x + 2y = 13$ gives $20 + 2y = 13$, requiring $y = -3.5$, which is mathematically invalid.
- **C) 2**: Two wins result in $10 + 2y = 13$, giving $y = 1.5$, but race positions must be counted as **whole numbers**.
- **D) 3**: Three wins produce $15 + 2y = 13$, demanding $y = -1$, again violating the non-negative placement requirement.

24 **William Harvey, who wrote the book commonly referred to as 'De Motu Cordis' is famous for his description:**

A of how anaemia can be caused by a lack of iron
B of the different forms of blood cells and platelets
C **of the circulation of the blood**
D of how blood plasma carries heat and urea as well as carbon dioxide
E of the interaction between antigens and antibodies

Correct answer: C

William Harvey published *De Motu Cordis* in 1628 and used quantitative experiments to prove that the **heart acts as a pump** maintaining **continuous circulation** through the vascular network. This anatomical breakthrough replaced ancient theories about blood production and defined both systemic and pulmonary pathways.

Why the other answers are wrong

- **A) of how anaemia can be caused by a lack of iron**: The connection between **iron deficiency** and anaemia was identified in the nineteenth century, leaving Harvey's seventeenth-century text without any discussion of mineral metabolism.
- **B) of the different forms of blood cells and platelets**: Classifying distinct blood elements required advanced **microscopy** and staining methods developed by scientists like Virchow and Ehrlich during the mid-to-late nineteenth century, which Harvey could not access.
- **D) of how blood plasma carries heat and urea as well as carbon dioxide**: Harvey focused on mechanical blood movement rather than chemical transport, meaning details about heat, urea, and carbon dioxide carried by **blood plasma** belong to later physiological research.
- **E) of the interaction between antigens and antibodies**: Understanding immune responses relies on **immunology** and antigen-antibody models that emerged in the late nineteenth and early twentieth centuries, far beyond the scope of classical anatomy.

25 **Which popular website was founded in 2004 by Mark Zuckerberg?**

A Twitter
B Wikipedia
C YouTube
D eBay
E Facebook

Correct answer: E

Facebook was created in **February 2004** at Harvard University by Mark Zuckerberg, together with fellow students Eduardo Saverin, Dustin Moskovitz and Chris Hughes. It quickly expanded beyond the campus and became one of the world's largest social-networking platforms.

Why the other answers are wrong

- **A)** Twitter was created in **2006** by Jack Dorsey, Biz Stone, Evan Williams and Noah Glass, not by Zuckerberg and not in 2004.
- **B)** Wikipedia went online in **2001** under Jimmy Wales and Larry Sanger, so both its founding year and founders differ.
- **C)** YouTube launched in **2005**, founded by Chad Hurley, Steve Chen and Jawed Karim. Neither the year nor the founders match the question.
- **D)** eBay was founded in **1995** by Pierre Omidyar, long before 2004 and without Mark Zuckerberg's involvement.

26 **The artists Claude Monet and Pierre Auguste Renoir were associated with which art movement?**

A Abstract expressionism
B Pointillism
C Cubism
D Impressionism
E Fauvism

Correct answer: D

Claude Monet and Pierre-Auguste Renoir founded **Impressionism** in late-nineteenth-century France. They practiced outdoor painting with **visible brushstrokes** to capture light and atmosphere instead of academic details. Their famous works inspired the movement's official name.

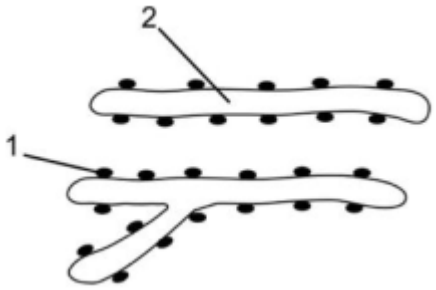
Why the other answers are wrong

- **A) Abstract expressionism**: Abstract Expressionism describes **mid-twentieth century** American art with large non-representational canvases. It appeared decades after the careers of the two French artists.
- **B)** Pointillism relies on tiny separate **dots** of pure color. Georges Seurat and Paul Signac developed this technique after both painters had stopped using it.
- **C)** Cubism fragments subjects into sharp **geometric shapes** starting around 1907. This radical abstraction directly opposes the original focus on natural light and atmospheric effects.
- **E)** Fauvism emphasizes wild **bold colors** and was led by Henri Matisse in the early twentieth century. The earlier painters influenced this group but never participated in it.

BIOLOGY

28 **The diagram shows a section of rough endoplasmic reticulum (RER).**

Which answer correctly identifies the substances associated with structures 1 and 2?



A 1: amino acids; 2: tRNA
B 1: phospholipids; 2: mRNA
C **1: tRNA; 2: polypeptide**
D 1: DNA; 2: carbohydrate
E 1: proteins; 2: DNA

Correct answer: C

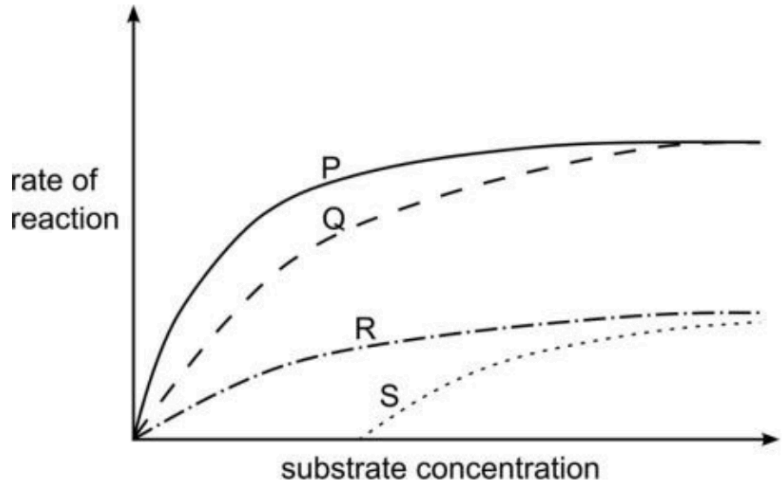
Structure 1 indicates a **ribosome** attached to the cytosolic face of the RER. During **translation**, **tRNA** molecules enter this complex to match mRNA codons and deliver their cargo. Structure 2 points to the RER cisterna, where the emerging **polypeptide** chain is threaded inside for proper folding and post-translational modification.

Why the other answers are wrong

- **A) 1: amino acids; 2: tRNA**: Free amino acids circulate in the cytoplasm but require carrier molecules to reach the decoding center. The luminal label specifically highlights the growing protein strand being secreted, not the transfer RNAs that operate exclusively on the exterior.
- **B) 1: phospholipids; 2: mRNA**: Lipid bilayers constitute the membrane scaffold, but label 1 targets the proteinaceous complex rather than the phospholipid layer. The mRNA template stays anchored to the outer surface and does not cross into the internal compartment.
- **D) 1: DNA; 2: carbohydrate**: Genomic DNA never localizes to cytosolic machinery or enters the secretory pathway. While oligosaccharides can attach to proteins later, the immediate product entering the lumen during translocation is a polypeptide chain.
- **E) 1: proteins; 2: DNA**: Structural proteins exist within ribosomal architecture, yet cellular genomes remain strictly nuclear. The lumen exclusively accommodates translating chains destined for membranes or extracellular release, making any DNA assignment biologically impossible.

30 **Which curves show the results of calculating the initial rate of reaction of an enzyme:**

when the substrate concentration is varied, under optimal conditions and without an inhibitor;
when the substrate concentration is varied, under optimal conditions and fixed, low concentration of a competitive inhibitor?



A (1) curve R; (2) curve P
B (1) curve R; (2) curve S
C **((1) curve P; (2) curve Q**
D 1) curve P; (2) curve S
E (1) curve Q; (2) curve R

Correct answer: C

Under optimal conditions without an inhibitor, the reaction follows standard **Michaelis–Menten** kinetics, yielding the highest V_{max} and the smallest apparent K_m, which corresponds to curve P. Adding a fixed low concentration of a **competitive inhibitor** does not alter V_{max}, but increases the apparent K_m, shifting the curve to the right as shown in curve Q. Thus, option C correctly pairs both scenarios.

Why the other answers are wrong

- **A) (1) curve R; (2) curve P**: This reverses the expected behavior by assigning curve R to the uninhibited state and curve P to the inhibited one. Curve R's lowered plateau rules out an uninhibited reaction, while curve P's high plateau confirms the absence of inhibition.
- **B) (1) curve R; (2) curve S**: Curve R displays a significantly reduced V_{max}, contradicting optimal uninhibited conditions. Curve S is even lower and cannot represent competitive inhibition, which requires an unchanged maximum rate.
- **D) 1) curve P; (2) curve S**: While curve P correctly represents the uninhibited reaction, pairing it with curve S is incorrect. Curve S shows a reduced V_{max}, a hallmark of non-competitive or uncompetitive inhibition rather than competitive inhibition.
- **E) (1) curve Q; (2) curve R**: Placing curve Q as uninhibited is incorrect because its plateau sits below curve P, indicating it did not reach the true maximum rate. Curve R is also wrongly assigned to the inhibited case, since competitive inhibitors never lower V_{max}.

31 **In cells of winter wheat (Triticum aestivum), the fluidity of the cell membrane can be varied by the plant, depending upon the environmental temperature.**

As the weather becomes colder, the cell membrane changes to maintain its fluidity.

Which type of bond would be more common in cell membranes of winter wheat plant cells as their growing conditions become colder?

A C-C
B C-N
C C-O
D C-H
E **C=C**

Correct answer: E

Phospholipid bilayers rely on fatty-acid tail geometry to control lateral mobility. An internal double bond ($C{=}C$) generates an **unsaturated** chain that forces a rigid bend. This spatial distortion prevents neighboring hydrocarbon tails from forming tight **packing** arrays. Maintaining such gaps preserves sufficient membrane flexibility when ambient temperatures drop.

Why the other answers are wrong

- **A) C-C**: Single covalent linkages ($C{-}C$) define saturated chains that align closely and raise membrane **viscosity** exactly against the cold-adaptation requirement.
- **B) C-N**: Nitrogen-containing attachments localize exclusively in polar head regions and integral proteins. They remain structurally isolated from the hydrophobic interface that dictates collective diffusion rates.
- **C) C-O**: Oxygen bridges anchor glycerol moieties and phosphate carriers outside the flexible core zone. Shifting their concentration would not alter the thermodynamic properties governing lateral movement.
- **D) C-H**: These terminal and internal linkages occur uniformly across all lipid tails irrespective of saturation degree. Their fixed stoichiometry cannot be modulated to tune lipid alignment or phase transitions.

32 **The transmission of nerve impulses at a synapse is unidirectional.**

Which of the features of the transmission of nerve impulses given below have a role in maintaining the unidirectional transmission?

1. Exocytosis of neurotransmitter at the presynaptic membrane
2. Neurotransmitter hydrolysing enzyme found on the post synaptic membrane
3. Neurotransmitter receptors found on the post synaptic membrane
4. Sodium gated channels on the post synaptic membrane

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

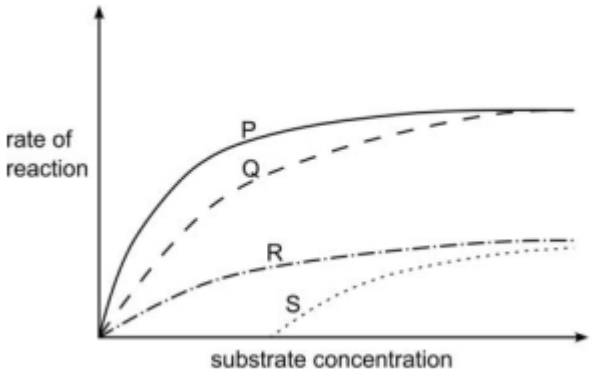
Correct answer: C

Synaptic transmission is unidirectional because the two apposed membranes are structurally and functionally **asymmetric**. Synaptic vesicles and the Ca^{2+}-dependent release machinery are confined to the **presynaptic** knob, so neurotransmitter is released only from that side. Although the transmitter diffuses in all directions through the cleft, its receptors and ligand-gated Na^{+} channels are on the **postsynaptic** membrane: binding opens the channels, depolarizes that membrane and initiates the next action potential. Hydrolysing enzymes such as acetylcholinesterase destroy the transmitter after it acts, limiting signal **duration**, not direction; even if the enzyme were distributed differently, features 1, 3 and 4 would still determine the direction.

Why the other answers are wrong

- **A) 2 and 4 only**: It omits the fundamental feature that neurotransmitter is released only from the presynaptic side and includes the irrelevant hydrolysing enzyme.
- **B) 1, 2 and 4 only**: It includes the non-directional enzyme but omits the receptors. Without receptors, the transmitter cannot trigger the Na^{+} channels.
- **D) 1 and 4 only**: It omits the specific neurotransmitter receptors. Without them, the transmitter cannot trigger the Na^{+} channels.
- **E) 1, 2 and 3 only**: It includes the hydrolysing enzyme, which terminates the signal but does not determine its direction, and omits the Na^{+} channels that contribute to postsynaptic excitation.

33 **Which one of the following names the structure, in humans, that directly detects a change in blood glucose level and then the structure that responds to the change?**



A Liver and adrenal gland

B **Pancreas and pancreas**

C Pituitary gland and liver

D Hypothalamus and pituitary gland

E Adrenal gland and pancreas

Correct answer: B

The **pancreas** directly monitors **blood glucose** concentrations using specialized **islet cells**. Beta cells release **insulin** when glucose rises, whereas alpha cells secrete **glucagon** when glucose falls. This organ performs both detection and the subsequent hormonal regulation.

Why the other answers are wrong

- **A) Liver and adrenal gland**:
- **C) Pituitary gland and liver**:
- **D) Hypothalamus and pituitary gland**:
- **E) Adrenal gland and pancreas**:

34 **One set of semi lunar valves in the human heart closes when:**

A the blood pressure is greater in the left ventricle than in the aorta

B the oxygen level in blood decreases at the respiring tissues

C the blood pressure in the aorta is greater than in the vena cava

D another set of semi lunar valves opens

E the blood pressure in the right ventricle is less than in the pulmonary artery

Correct answer: E

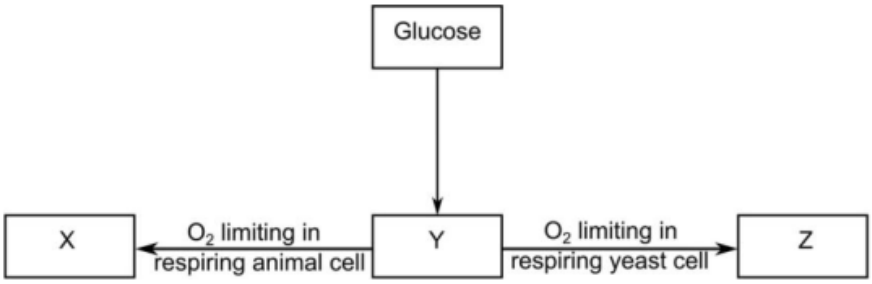
Semi-lunar valves close passively due to **reversed blood flow** during ventricular relaxation. When **arterial pressure** exceeds **ventricular pressure**, the backflow fills the cusps and shuts them. Answer E correctly identifies this condition for the pulmonary valve.

Why the other answers are wrong

- **A) the blood pressure is greater in the left ventricle than in the aorta**: Elevated pressure in the left ventricle relative to the aorta triggers valve opening to eject blood into systemic circulation.
- **B) the oxygen level in blood decreases at the respiring tissues**: Valve movement relies entirely on mechanical pressure differences, not on local metabolic conditions like tissue oxygen levels.
- **C) the blood pressure in the aorta is greater than in the vena cava**: This pressure difference remains constant throughout the cardiac cycle and does not coordinate the rapid opening or closing events.
- **D) another set of semi lunar valves opens**: The two valve sets function independently, with each reacting solely to the pressure relationship between its paired chamber and vessel.

35 **The diagram shows the respiration process in the cytoplasm of a yeast cell or an animal cell when O_2 is limiting:**

Which option correctly identifies substances X, Y and Z?



A **X = lactate; Y = pyruvate; Z = ethanol**

B X = pyruvate; Y = ethanol; Z = lactate

C X = pyruvate; Y = lactate; Z = ethanol

D X = lactate; Y = ethanol; Z = pyruvate

E X = ethanol; Y = pyruvate; Z = lactate

Correct answer: A

Under low O_2, glycolysis in the cytoplasm produces **pyruvate**, so Y is pyruvate. In animal cells, pyruvate is reduced to **lactate** by lactate dehydrogenase, regenerating NAD^+, so X is lactate. In yeast, pyruvate is decarboxylated to acetaldehyde and CO_2, then reduced to **ethanol** by alcohol dehydrogenase, regenerating NAD^+, so Z is ethanol.

Why the other answers are wrong

- **B) X = pyruvate; Y = ethanol; Z = lactate**: This misplaces all three substances. Pyruvate is the product of glycolysis and must be Y, not X; lactate is formed in animal cells and is X, not the yeast product Z.
- **C) X = pyruvate; Y = lactate; Z = ethanol**: This incorrectly identifies Y as lactate. Lactate is formed from pyruvate, so Y must be pyruvate, not lactate.
- **D) X = lactate; Y = ethanol; Z = pyruvate**: This places ethanol in the middle step and pyruvate at Z, contradicting the pathway order: glucose is converted to pyruvate, which is then converted to fermentation products.
- **E) X = ethanol; Y = pyruvate; Z = lactate**: This swaps the products of the two fermentations. Ethanol is made by yeast, not animal cells, so it cannot be X.

37 **Which of the following molecules are associated with the Human Immunodeficiency Virus (HIV)?**

1. DNA
2. RNA
3. Phospholipids
4. Reverse transcriptase

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

Correct answer: A

HIV is a retrovirus whose mature virion contains two identical strands of single-stranded, positive-sense **RNA**. It acquires a phospholipid envelope from the host-cell plasma membrane as it buds from the cell, and carries **reverse transcriptase**, which converts viral RNA to DNA after entry into a host cell. The free virion does not contain **DNA**: viral DNA is produced only after infection, inside the host cell.

Why the other answers are wrong

- **B) 1, 2, 3 and 4**: It includes DNA, which is not present in the free virion. The other three listed molecules are present, but including DNA makes the option incorrect.
- **C) 1 and 2 only**: It includes DNA, which is not present in the free virion, and omits phospholipids and reverse transcriptase, both of which are present.
- **D) 2 and 3 only**: It correctly includes RNA and phospholipids but omits reverse transcriptase, an essential component carried inside the virion.
- **E) 1, 2 and 4 only**: It includes DNA, which is not present in the free virion, and omits phospholipids, which are present in the viral envelope.

38 **A circular bacterial plasmid consists of 1000 base pairs (bp).**
A specific restriction enzyme has three recognition sites within this plasmid. The sites are at 150 bp, 250 bp and 950 bp.

After complete restriction, what size are the fragments?

A 100 bp, 150 bp, 200 bp only
B 50 bp, 100 bp, 150 bp, 200 bp and 700 bp
C **100 bp, 200 bp and 700 bp only**
D 50 bp, 100 bp and 700 bp only
E 50 bp, 100 bp, 150 bp and 700 bp only

Correct answer: C

The **circular** plasmid measures 1000 bp. Cutting at three recognition sites produces exactly three fragments. Measuring the distances between adjacent sites gives $250 - 150 = 100$ bp, $950 - 250 = 700$ bp, and $(1000 - 950) + 150 = 200$ bp for the wrap-around segment. The resulting fragments are 100 bp, 200 bp, and 700 bp.

Why the other answers are wrong

- **A) 100 bp, 150 bp, 200 bp only**: Replaces the 700 bp fragment with a 150 bp piece. The physical distance between the 250 bp and 950 bp sites is 700 bp, not 150 bp.
- **B) 50 bp, 100 bp, 150 bp, 200 bp and 700 bp**: Lists five fragments, which violates the rule that n cuts on a circular DNA yield exactly n fragments. It carries forward the same mathematical error of treating the wrap-around region as two independent pieces.
- **D) 50 bp, 100 bp and 700 bp only**: Counts only the 50 bp gap from 950 bp to the end of the sequence. This ignores that the circle continues to the first site at 150 bp, so the true fragment sums to 200 bp.
- **E) 50 bp, 100 bp, 150 bp and 700 bp only**: Proposes four fragments. Three restriction cuts on a circular molecule can only generate three separate fragments. It also incorrectly splits the actual 200 bp segment into 50 bp and 150 bp.

39 **Which of the following can produce vesicles?**

1. RER

2. Golgi

3. Cell surface membrane

A 1 and 3 only

B 2 and 3 only

C **1, 2 and 3**

D 2 only

E 1 and 2 only

Correct answer: C

All three structures can form vesicles through distinct cellular mechanisms. The rough endoplasmic reticulum buds **transport vesicles** containing newly synthesized proteins toward the Golgi. The Golgi apparatus modifies and packages cargo into different classes for delivery. The **plasma membrane** generates vesicles during **endocytosis** and participates in exocytosis when internal vesicles fuse with the surface.

Why the other answers are wrong

- **A) 1 and 3 only**: This omits the Golgi apparatus, a major site for sorting and packaging lipids and proteins into various functional vesicles.
- **B) 2 and 3 only**: This option leaves out the rough endoplasmic reticulum, which is the primary origin of **transport vesicles** carrying proteins to the Golgi.
- **D) 2 only**: This answer ignores both the rough endoplasmic reticulum's vesicle budding and the plasma membrane's capacity for endocytic and exocytic vesicle formation.
- **E) 1 and 2 only**: This choice excludes the cell surface membrane despite its clear role in generating vesicles during endocytosis and exocytosis.

40 **Two disease free cells, P and Q, were studied. Which option correctly identifies cell P as a typical plant cell and cell Q as a typical prokaryote?**

	Cell P	*Cell Q*
Row 1	Gene for RuBisCo is present	Susceptible to penicillin
Row 2	Plasmids present	Centrioles found as a pair
Row 3	Outermost layer is selectively permeable	SER present
Row 4	Glycogen can be present	Cell wall is present
Row 5	Organelle with grana present	Nucleolus may be present

A Row 3
B Row 4
C **Row 1**
D Row 2
E Row 5

Correct answer: C

Row 1 identifies the plant cell through the gene for **RuBisCO**, which produces the essential Calvin cycle enzyme located in chloroplasts. It correctly labels the prokaryote based on its susceptibility to penicillin, a drug that specifically targets the peptidoglycan cell walls of most bacteria.

Why the other answers are wrong

- **A) Row 3**: A selectively permeable outermost layer merely describes the universal plasma membrane found in every living cell. Prokaryotes entirely lack internal membrane compartments like the smooth endoplasmic reticulum.
- **B) Row 4**: Plant cells store starch rather than glycogen, which properly characterizes the energy reserves of animals and fungi. Prokaryotes are not uniquely distinguished by a cell wall since plant cells also possess this rigid exterior structure.
- **D) Row 2**: Plant cells do not typically contain plasmids, which are predominantly bacterial genetic elements. Prokaryotes completely lack centrioles, an organelle usually found as a pair only in animal cells.
- **E) Row 5**: Organelles containing grana correctly identify plant chloroplasts and their role in photosynthesis. Prokaryotes completely lack a true nucleus and therefore cannot possibly house a **nucleolus**.

41 **The diagram shows a sequence of bases on a DNA template:**
CAC GTT CGC ATA GAC

Which one of the following shows the sequence of bases on the complementary mRNA strand with one substitution mutation?

A CUC GTT CGC UTT GUC
B GTG CAA GGG TAT CTG
C GTG CAA GCG TAT CTG
D **GUG CAA CCG UAU CUG**
E GUG CAA GCG UAU GUC

Correct answer: D

To obtain the normal mRNA, transcribe the DNA template using **complementary** base pairing (A↔U, T↔A, C↔G) while replacing thymine with uracil. This produces the **expected** sequence GUG CAA GCG UAU CUG. Comparing the options reveals that only option D differs by exactly one base change, satisfying the requirement for a **single substitution** mutation.

Why the other answers are wrong

- **A) CUC GTT CGC UTT GUC**: Contains several thymine bases instead of uracil, which cannot exist in mRNA. It also differs from the normal sequence in more than one position.
- **B) GTG CAA GGG TAT CTG**: Uses thymine instead of uracil throughout the sequence. It also introduces multiple independent changes such as GTG for GUG, GGG for GCG, and TAT for UAU.
- **C) GTG CAA GCG TAT CTG**: Again replaces uracil with thymine. On top of that, it misreads the first codon as GTG instead of GUG and the fourth as TAT instead of UAU, creating multiple mismatches.
- **E) GUG CAA GCG UAU GUC**: Matches the first four codons perfectly, but the last codon reads GUC instead of the required CUG. This requires two nucleotide changes, exceeding the allowed limit.

42 **Which one of the following statements about both asexual and sexual reproduction is correct?**

A Mitosis leads to sperm formation in asexual reproduction and sexual reproduction

B Only the gametes (and not body cells) undergo meiosis in sexual reproduction compared with

C Variation is only required for sexual reproduction and not for asexual reproduction

D Some organisms can carry out both asexual and sexual reproduction

E Mutations only occur in sexual reproduction and not in asexual reproduction

Correct answer: D

Many fungi, most flowering plants, several algae, some protozoa, and invertebrates such as aphids, hydra, and certain worms can reproduce in both ways. They may switch between **asexual and sexual life cycles** depending on the season, resource availability, or other environmental cues.

Why the other answers are wrong

- **A) Mitosis leads to sperm formation in asexual reproduction and sexual reproduction**: Sperm are produced only in sexual reproduction. In animals, sperm arise from germ-line cells through **meiosis**, followed by some mitotic divisions, rather than directly through mitosis. Asexual reproduction does not involve sperm.
- **B) Only the gametes (and not body cells) undergo meiosis in sexual reproduction compared with**: This refers only to sexual reproduction, so it does not compare both modes. In animals, body cells do not undergo meiosis, but in many plants and fungi some somatic tissues, such as sporangia, do, so "only the gametes" is not universally true.
- **C) Variation is only required for sexual reproduction and not for asexual reproduction**: **Genetic variation** benefits populations by providing raw material for evolution and adaptation, regardless of their mode of reproduction. Sexual reproduction generates more variation through recombination, but asexual lineages also benefit from variation and can evolve through variation arising from mutations or other mechanisms.
- **E) Mutations only occur in sexual reproduction and not in asexual reproduction**: **Mutations** are random changes in DNA that can occur during DNA replication or because of environmental factors, in both asexual and sexual organisms. In asexual organisms, mutations are the sole source of new genetic variation.

CHEMISTRY

43 **A battery has lead plates dipped in sulfuric acid.**
When charged, the positive plate is covered with PbO_{2-}.
After discharge both plates are covered with $PbSO_{4-}$

Which option below correctly describes the overall change in the oxidation number of the lead involved in the chemical reaction during discharge?

- **A** **Positive plate: 4 → 2; Negative plate: 0 → 2**
- B Positive plate: 4 → 0; Negative plate: 0 → 2
- C Positive plate: 4 → 1; Negative plate: 1 → 0
- D Positive plate: 4 → 1; Negative plate: 0 → 1
- E Positive plate: 4 → 2; Negative plate: 2 → 0

Correct answer: A

During discharge the positive electrode hosts PbO_2 and the negative electrode holds pure Pb. Both surfaces convert to $PbSO_4$ when the circuit closes. The **oxidation state** of lead drops from $+4$ to $+2$ at the cathode via **reduction**. At the anode it rises from 0 to $+2$ through **oxidation**.

Why the other answers are wrong

- **B) Positive plate: 4 → 0; Negative plate: 0 → 2**: The positive plate proposal incorrectly implies full reduction to elemental lead. The active material only accepts electrons to reach $+2$ before precipitating. The negative plate path is valid, yet any single mismatch discards the whole option.
- **C) Positive plate: 4 → 1; Negative plate: 1 → 0**: The positive plate assumes an impossible charge during electron transfer. The negative plate falsely attributes a pre-existing charge to the fresh grid, ignoring that commercial cells always load the electrode with solid metal at zero charge.
- **D) Positive plate: 4 → 1; Negative plate: 0 → 1**: Both proposed transitions invent a fractional intermediate value. Chemical stability in acidic electrolyte forces lead to occupy only even electron configurations throughout the cycle.
- **E) Positive plate: 4 → 2; Negative plate: 2 → 0**: The positive plate shift correctly identifies the drop to $+2$. The negative plate claim reverses the actual process because the material starts as neutral metal at 0 and transforms into $PbSO_4$ at $+2$, not vice versa.

45 **How many of the following compounds are acidic, alkaline or amphoteric (react with both acids and alkalis)?**

Al_2O_3	Cl_2O_7	CO_2	HCl	H_3PO_4	K_2O	KOH
MgO	Na_2O	NO_2	P_4O_{10}	SiO_2	SO_2	

A Acidic = 6; Amphoteric = 1; Alkaline = 6

B **Acidic = 8; Amphoteric = 1; Alkaline = 4**

C Acidic = 7; Amphoteric = 1; Alkaline = 5

D Acidic = 10; Amphoteric = 2; Alkaline = 4

E Acidic = 9; Amphoteric = 2; Alkaline = 2

Correct answer: B

The thirteen compounds are classified by their reactivity with acids and alkalis. Eight function as **acidic** substances (Cl_2O_7, CO_2, HCl, H_3PO_4, NO_2, P_4O_{10}, SiO_2, SO_2). One is **amphoteric** (Al_2O_3). Four are **alkaline** (K_2O, KOH, MgO, Na_2O). This exact count confirms option B.

Why the other answers are wrong

- **A) Acidic = 6; Amphoteric = 1; Alkaline = 6**: Misreports six acidic and six alkaline compounds. The accurate numbers are eight and four.
- **C) Acidic = 7; Amphoteric = 1; Alkaline = 5**: Understates the acidic count at seven and inflates the alkaline count to five. These figures conflict with the verified totals.
- **D) Acidic = 10; Amphoteric = 2; Alkaline = 4**: Lists ten acidic and two amphoteric compounds. It correctly identifies four alkaline substances but miscalculates the remaining categories.
- **E) Acidic = 9; Amphoteric = 2; Alkaline = 2**: Suggests nine acidic compounds and two amphoteric ones. Only aluminium oxide shows amphoterism, and the alkaline group actually contains four members.

46 **The following are some compounds that can be made from ethene:**

$C_2H_4 : C_2H_6, C_2H_5Br, C_2H_5OH, CH_2BrCHCHr_2, -(CH_2CH_2)_n-$

Which one of the compounds is made by oxidising ethene?

A CH_2BrCH_2Br
B C_2H_5Br
C C_2H_5OH
D $-(CH_2CH_2)_n-$
E C_2H_6

Correct answer: A

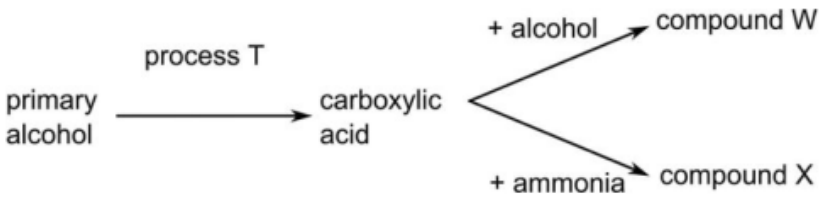
Ethene reacts with liquid bromine or bromine water acting as an **oxidising agent**. Each bromine atom is reduced from oxidation state 0 to −1 while each carbon atom increases its oxidation number from −2 to −1. The resulting product is 1,2-dibromoethane (CH_2BrCH_2Br).

Why the other answers are wrong

- **B)** C_2H_5Br: C_2H_5Br results from hydrohalogenation where HBr adds across the double bond. Since HBr is not an oxidising agent like Br_2, the process does not involve oxidation.
- **C)** C_2H_5OH: C_2H_5OH is produced industrially by reacting ethene with steam over a phosphoric acid catalyst. This reaction is defined as hydration and requires no oxidising agent.
- **D)** $-(CH_2CH_2)_n-$ is obtained through addition polymerisation linking multiple ethene units together. The mechanism involves no change in oxidation states.
- **E)** C_2H_6: C_2H_6 is formed by catalytic hydrogenation through the addition of H_2. This reaction is classified as a reduction rather than an oxidation.

47 **The reaction scheme below shows some reaction conversions of organic molecules.**

Which is the correct combination of process and compounds for this scheme?



A process T: reduction; compound W: ketone; compound X: amide

B process T: reduction; compound W: ketone; compound X: nitrile

C **process T: oxidation; compound W: ester; compound X: amide**

D process T: reduction; compound W: ester; compound X: amide

E process T: oxidation; compound W: ester; compound X: nitrile

Correct answer: C

Converting a primary alcohol ($-\mathrm{CH_2OH}$) to a carboxylic acid ($-\mathrm{COOH}$) increases the oxygen content, so process T is an **oxidation**. Treating this acid with an alcohol under acidic conditions yields an **ester** (compound W) through esterification. Reacting the same acid with ammonia ($\mathrm{NH_3}$) causes a condensation reaction that produces an **amide** (compound X). These three identifications correspond exactly to option C.

Why the other answers are wrong

- **A) process T: reduction; compound W: ketone; compound X: amide**: Reducing a primary alcohol would generate a more reduced molecule such as an alkane, not a carboxylic acid. Moreover, the reaction between a carboxylic acid and an alcohol cannot produce a ketone.
- **B) process T: reduction; compound W: ketone; compound X: nitrile**: Process T must be oxidation instead of reduction. Both compound W and compound X are misidentified because ketones and nitriles do not form in these standard condensation reactions.
- **D) process T: reduction; compound W: ester; compound X: amide**: Compounds W and X are correctly labeled as an ester and an amide, but process T cannot be reduction since oxidizing a primary alcohol is required to reach a carboxylic acid.
- **E) process T: oxidation; compound W: ester; compound X: nitrile**: While the first two identifications are correct, mixing a carboxylic acid with ammonia forms an amide via condensation rather than a nitrile.

48 **The atomic numbers of five atoms are given below.**

Which atom would have an electronic configuration ending in a p^5?

A 5
B **9**
C 7
D 8
E 6

Correct answer: B

1. Electrons occupy orbitals following the standard **filling order**: 1s → 2s → 2p. 2. For atomic number 9, the **electron count** reaches nine, completely filling the lower subshells before placing the remainder in 2p. 3. The resulting configuration is $1s^2\ 2s^2\ 2p^5$, which definitively ends in p^5.

Why the other answers are wrong

- **A) 5**: Atomic number 5 produces $1s^2\ 2s^2\ 2p^1$, completing the p subshell with just one electron.
- **C) 7**: Atomic number 7 produces $1s^2\ 2s^2\ 2p^3$, leaving three electrons in the final p subshell.
- **D) 8**: Atomic number 8 produces $1s^2\ 2s^2\ 2p^4$, meaning the **outermost subshell** contains four electrons rather than five.
- **E) 6**: Atomic number 6 produces $1s^2\ 2s^2\ 2p^2$, resulting in a p subshell with only two electrons.

49 **The relative molecular mass of calcium carbonate is 100.**

What is the minimum volume of 2.0 M hydrochloric acid that would be needed to completely react with 2.0 g of calcium carbonate?

A $10\ \mathrm{cm}^3$
B $40\ \mathrm{cm}^3$
C $30\ \mathrm{cm}^3$
D **$20\ \mathrm{cm}^3$**
E $5\ \mathrm{cm}^3$

Correct answer: D

The balanced chemical equation shows that $1\ \mathrm{mol}$ of **calcium carbonate** reacts with $2\ \mathrm{mol}$ of **hydrochloric acid**. The initial amount of solid is calculated as $\frac{2.0\ \mathrm{g}}{100\ \mathrm{g\ mol^{-1}}} = 0.020\ \mathrm{mol}$. According to **stoichiometry**, $0.040\ \mathrm{mol}$ of acid is required. Using the given **concentration**, the volume equals $\frac{0.040\ \mathrm{mol}}{2.0\ \mathrm{mol\ dm^{-3}}} = 0.020\ \mathrm{dm}^3$, which converts directly to $20\ \mathrm{cm}^3$.

Why the other answers are wrong

- **A) 10 cm^3**: Delivers $0.010\ \mathrm{dm}^3 \times 2.0\ \mathrm{mol\,dm^{-3}} = 0.020\ \mathrm{mol}$ HCl. This corresponds to a $1:1$ molar ratio instead of $1:2$, supplying only half the necessary acid and leaving unreacted solid behind.
- **B) 40 cm^3**: Supplies $0.040\ \mathrm{dm}^3 \times 2.0\ \mathrm{mol\,dm^{-3}} = 0.080\ \mathrm{mol}$ HCl. This provides exactly double the stoichiometric requirement, creating an even larger surplus than option C.
- **C) 30 cm^3**: Contains $0.030\ \mathrm{dm}^3 \times 2.0\ \mathrm{mol\,dm^{-3}} = 0.060\ \mathrm{mol}$ HCl. This yields a $50\ \%$ excess that successfully finishes the reaction but does not represent the minimum volume needed.
- **E) 5 cm^3**: Provides $0.005\ \mathrm{dm}^3 \times 2.0\ \mathrm{mol\,dm^{-3}} = 0.010\ \mathrm{mol}$ HCl. This quantity amounts to just one-quarter of the required moles, falling significantly short of complete reaction.

50 **What is the pH of 0.1 M HCl?**

$$\mathrm{pH} = -\log_{10}[\mathrm{H}^+]$$

A -0
B -1
C **1**
D 0.1
E -0.1

Correct answer: C

HCl is a **strong acid** that dissociates completely in water. The hydrogen ion concentration matches the acid molarity: $[\mathrm{H}^+] = 0.1\ \mathrm{M} = 1.0 \times 10^{-1}\ \mathrm{M}$. Calculating $-\log_{10}(1.0 \times 10^{-1})$ yields exactly 1.

Why the other answers are wrong

- **A) -0**: Negative zero is mathematically equivalent to zero, implying $[\mathrm{H}^+] = 1\ \mathrm{M}$. Since the actual solution is ten times more dilute, its pH must be greater than 0.
- **B) -1**: Applying the negative sign twice results in –1. A pH of –1 would require $[\mathrm{H}^+] = 10\ \mathrm{M}$, which vastly exceeds the given concentration.
- **D) 0.1**: This choice conflates concentration with pH values. Because pH operates on a **logarithmic scale** rather than a linear one, the number 0.1 cannot represent the pH directly.
- **E) -0.1**: A negative pH occurs only for very concentrated solutions exceeding 1 M. This option reflects a **sign error** by ignoring that taking the negative log of a decimal always produces a positive result.

51 **A student carried out an experiment to find the rate of decomposition of hydrogen peroxide into water and oxygen gas.**
The student used 100 cm^3 of a 1M solution of hydrogen peroxide at 25°C and 1 atm pressure.

1 g of powdered $\mathrm{MnO_2}$ as a catalyst was added and the solution was constantly stirred.
The student 2 measured the total volume of oxygen produced.

The procedure was repeated, but this time using 100 cm^3 of 2M hydrogen peroxide, under identical conditions.

Which option below shows the effect on (R) the rate of reaction, (V) the total volume of oxygen collected, by using the 2M solution compared to the 1M solution?

A R: No effect; V: No effect
B R: No effect; V: Doubled
C R: Doubled; V: Halved
D R: Doubled; V: No effect
E R: Doubled; V: Doubled

Correct answer: E

1. The initial amount of hydrogen peroxide doubles when the concentration increases from $1\ \mathrm{mol\ dm^{-3}}$ to $2\ \mathrm{mol\ dm^{-3}}$ at constant volume ($0.10\ \mathrm{mol}$ to $0.20\ \mathrm{mol}$). 2. According to the balanced equation $2\ \mathrm{H_2O_2(aq)} \rightarrow 2\ \mathrm{H_2O(l)} + \mathrm{O_2(g)}$, twice the reactant yields twice the oxygen gas, doubling the **volume** collected. 3. With excess solid catalyst, the decomposition follows first-order **kinetics** relative to $[\mathrm{H_2O_2}]$, so doubling the **concentration** doubles the initial **rate**. 4. Both the reaction speed and the final gas quantity increase proportionally with the doubled molarity.

Why the other answers are wrong

- **A) R: No effect; V: No effect**: Fails on both points because changing the reactant concentration simultaneously alters the collision frequency affecting kinetics and the total available material determining yield.
- **B) R: No effect; V: Doubled**: Incorrect because the initial rate clearly depends on the peroxide concentration, as more molecules collide with the catalyst surface per unit time.
- **C) R: Doubled; V: Halved**: Contradicts stoichiometry by suggesting the product amount decreases when the starting mass increases under identical conditions, even though the kinetic part is correct.
- **D) R: Doubled; V: No effect**: Wrong since decomposing twice as many moles of hydrogen peroxide produces twice as many moles of oxygen, which directly translates to double the measured volume.

53 **Evaluate:**

$\frac{8\times10^{-5}}{\sqrt{1.6\times10^{7}}} \times \left(1.2 \times 10^{3}\right)^{2}$

A 2.88×10^{-5}

B 2.88×10^{-3}

C 2.88×10^{4}

D **2.88×10^{-2}**

E 2.88×10^{-1}

Correct answer: D

1. Rewrite 1.6×10^{7} as 16×10^{6}. 2. Apply the square root to obtain 4×10^{3}. 3. Perform the division to find 2×10^{-8}. 4. Compute the square to get 1.44×10^{6}. 5. Multiply the two results to reach 2.88×10^{-2}.

Why the other answers are wrong

- **A) 2.88 × 10^{-5}**: The exponent -5 occurs when the final **multiplication** step is overlooked during the exponent balancing.
- **B) 2.88 × 10^{-3}**: The exponent -3 stems from an **incorrect arithmetic** sequence when combining the intermediate powers of ten.
- **C) 2.88 × 10^{4}**: The exponent 4 appears if the division step mistakenly adds the exponents instead of subtracting them.
- **E) 2.88 × 10^{-1}**: The exponent -1 deviates from the correct **square root** evaluation and subsequent power combination.

54 **Four individual spheres have radii:**

$\frac{r}{2}, r, 2r$ and $3r$

What is the sum of their surface areas?

A $58\ \pi r^2$

B $26\ \pi r^2$

C **$57\ \pi r^2$**

D $169\ \pi r^2$

E $25\ \pi r^2$

Correct answer: C

The **surface area** of a sphere follows $SA = 4\pi R^2$. Substituting each radius and computing the **sum** yields: 1. Radius $\frac{r}{2}$: $4\pi(\frac{r}{2})^2 = \pi r^2$ 2. Radius r: $4\pi r^2$ 3. Radius $2r$: $4\pi(2r)^2 = 16\pi r^2$ 4. Radius $3r$: $4\pi(3r)^2 = 36\pi r^2$ The combined result is $57\pi r^2$.

Why the other answers are wrong

- **A) 58** πr^2: Arises from incorrectly evaluating $(\frac{1}{2})^2$ as $\frac{1}{2}$ rather than $\frac{1}{4}$.
- **B) 26** πr^2: Occurs when adding radii without squaring them first, effectively calculating $(\frac{1}{2} + 1 + 2 + 3) \cdot 4\pi r^2$.
- **D) 169** πr^2: Derives from summing all radii into $6.5r$ and treating that total as a single sphere radius.
- **E) 25** πr^2: Results from squaring only the first radius while neglecting the last two.

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55 **What is the equation of the straight line which passes through (–6, 2) and is perpendicular to 4y + 3x = 8?**

A 3y – 4x = 18

B 4y – 3x = 26

C 3y + 4x = 30

D **3y – 4x = 30**

E 3y + 4x = –18

Correct answer: D

Rewriting $4y + 3x = 8$ as $y = -\frac{3}{4}x + 2$ gives a **slope** of $-\frac{3}{4}$. A **perpendicular** line has the negative reciprocal slope, $\frac{4}{3}$. Through $(-6, 2)$: $y - 2 = \frac{4}{3}(x + 6)$, so $3y - 6 = 4x + 24$, that is $3y - 4x = 30$.

Why the other answers are wrong

- **A) 3y – 4x = 18**: It has the right slope, $\frac{4}{3}$, but at $(-6, 2)$ it gives $3 \cdot 2 - 4 \cdot (-6) = 30$, not 18: the line does not pass through the point.
- **B) 4y – 3x = 26**: Its slope is $\frac{3}{4}$, which is not perpendicular to $-\frac{3}{4}$: the product of the two slopes is not -1.
- **C) 3y + 4x = 30**: Its slope is $-\frac{4}{3}$, with the wrong sign, and at $(-6, 2)$ it gives $6 - 24 = -18$, not 30.
- **E) 3y + 4x = –18**: Its slope is $-\frac{4}{3}$: the sign is wrong, so it is not perpendicular to the given line.

56 **A computer game is on sale for €32.00.**
The price ticket shows that this cost is a reduction of 20% of the original price.
What was the original price?

A €33.60
B €52.00
C €38.40
D **€40.00**
E €25.60

Correct answer: D

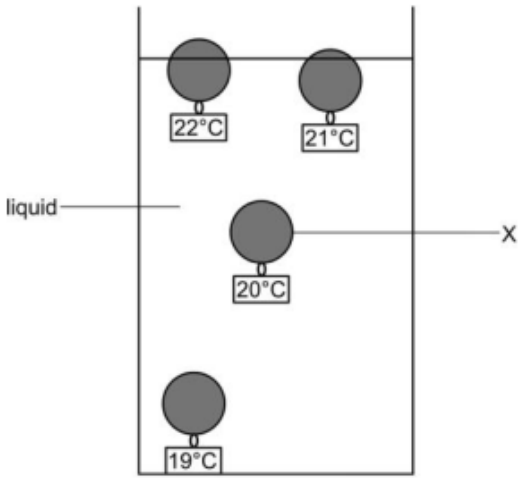
A 20 % **discount** means the **sale price** represents 80 % of the **original price**. Solving the **equation** $0{,}80 \cdot x = 32$ gives $x = 32 \div 0{,}80 = 40$. Therefore the original price was €40.

Why the other answers are wrong

- **A) €33.60**: Verifying $80\,\% \times 33{,}60$ produces $26{,}88$. This value is far too low because it stems from a miscalculated intermediate step.
- **B) €52.00**: Calculating $80\,\% \times 52$ yields $41{,}60$, which does not match the sale price. This figure appears when one assumes a starting amount that is too high.
- **C) €38.40**: Adds $20\,\%$ of the discounted price ($32 \times 0{,}20 = 6{,}40$) to the sale price, resulting in $38{,}40$. The mistake arises because $6{,}40$ is 20 % of the reduced price, not 20 % of the original amount.
- **E) €25.60**: Computes $32 \times 0{,}80 = 25{,}60$ directly. This happens when a student treats the final price as the starting point and applies the discount factor forward instead of reversing the operation.

57 **An ornamental thermometer, commonly known as a Galileo thermometer, contains a number of spheres of hollow coloured glass, representing different temperatures, immersed in a column of ethanol. A particular sphere (X) rises from the bottom to the top of the column of liquid when the temperature falls below the value it represents.**

Which statement best explains why the sphere rises when the temperature falls?



A The mass of the sphere has decreased

B **The density of the liquid has increased**

C The temperature of the sphere is different from that of the liquid

D The pressure exerted by the liquid has decreased

E The volume of gas inside the sphere has increased

Correct answer: B

As ethanol cools, its molecules draw closer together and its density increases. By Archimedes' principle, the buoyant force is $F_{\text{b}} = \rho_{\text{liquid}} V_{\text{displaced}} g$, so it increases for the sphere, whose mass and volume are fixed. Once the buoyant force exceeds the sphere's weight, it rises, which happens when the column cools below $20\ ^{\circ}\text{C}$.

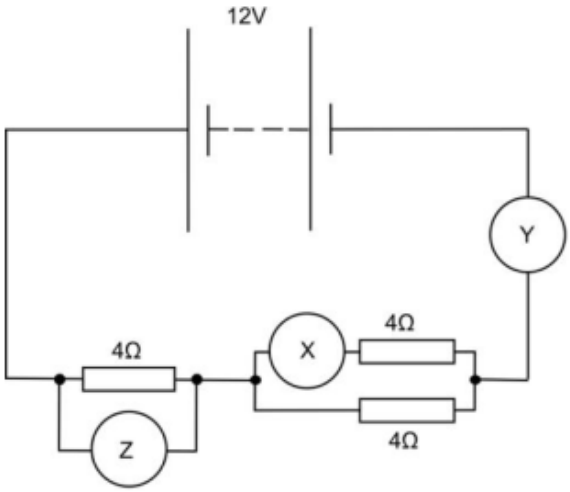
Why the other answers are wrong

- **A) The mass of the sphere has decreased**: Each sphere is **sealed and rigid**, so its mass remains constant regardless of temperature.
- **C) The temperature of the sphere is different from that of the liquid**: In equilibrium, the glass sphere and the surrounding ethanol have the **same temperature**. A temperature difference does not cause the upward motion; the change in liquid density alters the buoyant force.
- **D) The pressure exerted by the liquid has decreased**: If the liquid's density increases, the hydrostatic pressure at a given depth **increases slightly**. In any case, a pressure change is not the primary cause of the sphere's rise: it is the change in buoyancy due to the liquid's density.
- **E) The volume of gas inside the sphere has increased**: Each sphere is a **rigid, sealed vessel**, so the gas volume inside changes negligibly with these small temperature variations. Cooling would slightly shrink the gas volume, and the sphere rises because the liquid's density changes, not because the gas volume increases.

58 **The circuit shown contains three identical resistors, two ammeters X and Y, and a voltmeter Z. The internal resistance of the battery is negligible.**

Which option shows the readings on the three meters?

[Assume the ammeters have negligible resistance, and negligible current flows through the voltmeter.]



A X = 1.0 A; Y = 0.0 A; Z = 12 V
B X = 3.0 A; Y = 6.0 A; Z = 12 V
C **X = 1.0 A; Y = 2.0 A; Z = 8.0 V**
D X = 1.0 A; Y = 2.0 A; Z = 6.0 V
E X = 2.0 A; Y = 0.0 A; Z = 4.0 V

Correct answer: C

The battery feeds a single path through a left $4\ \Omega$ resistor to junction A, where the circuit splits into two parallel branches before recombining at junction C and passing through ammeter Y to the positive terminal. This **parallel combination** of two identical $4\ \Omega$ branches yields an equivalent resistance of $R_{\text{eq}} = \frac{4\times4}{4+4} = 2\ \Omega$, setting the **total resistance** at $6\ \Omega$. By **Ohm's law** the circuit draws a **total current** of $I = \frac{12\ \text{V}}{6\ \Omega} = 2\ \text{A}$, which flows through the left resistor and ammeter Y. The identical branches cause the current to **split equally**, giving ammeter X a reading of $1.0\ \text{A}$. Voltmeter Z connects junction A to the negative rail and measures the potential drop across the left resistor, calculating $V = 2\ \text{A} \times 4\ \Omega = 8.0\ \text{V}$.

Why the other answers are wrong

- **A) X = 1.0 A; Y = 0.0 A; Z = 12 V**: If ammeter Y read $0.0\ \text{A}$, the circuit would become open and no charge could return to the battery terminal, which directly contradicts the closed conductive loop formed by the resistors and meters.
- **B) X = 3.0 A; Y = 6.0 A; Z = 12 V**: These magnitudes imply a total resistance of only $2\ \Omega$ derived from a $6\ \text{A}$ total current, whereas the actual series and parallel arrangement results in $6\ \Omega$.
- **D) X = 1.0 A; Y = 2.0 A; Z = 6.0 V**: The listed currents correctly reflect the branch split, but the voltmeter probes the left $4\ \Omega$ resistor carrying the full $2\ \text{A}$, which necessarily produces an $8.0\ \text{V}$ reading rather than $6.0\ \text{V}$.
- **E) X = 2.0 A; Y = 0.0 A; Z = 4.0 V**: A zero reading at Y eliminates the return path to the positive terminal, and branch X cannot independently carry $2.0\ \text{A}$ since every electron leaving the node must ultimately traverse ammeter Y to complete the circuit.

59 **A book of mass 0.40 kg rests on a horizontal surface with which it has a coefficient of dynamic friction of 0.50.**

If this book is now pushed by an external horizontal force of 10 N, what will be its acceleration immediately after it has started to move?

[Assume the gravitational field strength is $10\mathrm{N kg}^{-1}$, that air resistance is negligible and that the orientation of the book does not change.]

A $12.5\ \mathrm{ms}^{-2}$
B $50.0\ \mathrm{ms}^{-2}$
C **20.0** ms^{-2}
D $25.0\ \mathrm{ms}^{-2}$
E $15.0\ \mathrm{ms}^{-2}$

Correct answer: C

1. The **weight** is $W = mg = 0.40\ \mathrm{kg} \times 10\ \mathrm{N\,kg}^{-1} = 4\ \mathrm{N}$. On a horizontal surface the **normal force** equals the weight. 2. The **kinetic friction** force opposes motion with magnitude $F_f = \mu_k N = 0.50 \times 4\ \mathrm{N} = 2\ \mathrm{N}$. 3. The **net force** is $F_{\mathrm{net}} = 10\ \mathrm{N} - 2\ \mathrm{N} = 8\ \mathrm{N}$. 4. Newton's second law gives the **acceleration** $a = F_{\mathrm{net}}/m = 8\ \mathrm{N}/0.40\ \mathrm{kg} = 20\ \mathrm{m\,s}^{-2}$.

Why the other answers are wrong

- **A) 12.5** ms^{-2}: This corresponds to a net force of $5\ \mathrm{N}$ and a friction force of $5\ \mathrm{N}$ ($\mu \approx 1.25$), contradicting the given μ_k. The error likely stems from confusing static and kinetic friction or miscalculating the normal force.
- **B) 50.0** ms^{-2}: This would require a net force of $20\ \mathrm{N}$, which exceeds the applied force. It typically arises from halving the mass to $0.20\ \mathrm{kg}$ or doubling the applied force while still neglecting friction.
- **D) 25.0** ms^{-2}: This result assumes a net force equal to the full applied push, effectively treating friction as zero. It completely ignores the resistive frictional force.
- **E) 15.0** ms^{-2}: This value implies a net force of $6\ \mathrm{N}$ and requires a friction force of $4\ \mathrm{N}$ ($\mu = 1.0$), which doubles the stated coefficient. It results from using an incorrect friction coefficient.

60 **An earthed magnet is near a bar of material which is seen to be repelled by the magnet.**

What could the bar of material be?

[The system is isolated and no currents are induced.]

- **A** **A bar of magnetised steel**
- **B** A bar of electrostatically charged aluminium
- **C** A bar of electrostatically charged copper
- **D** A bar of unmagnetised cobalt
- **E** A bar of unmagnetised soft iron

Correct answer: A

A magnet repels a ferromagnetic object only if the object is already magnetised with the same pole facing the magnet. Steel is ferromagnetic and can retain **permanent magnetisation**, so like poles can repel. **Earthing** removes any static charge from the magnet but does not affect the magnetic interaction.

Why the other answers are wrong

- **B) A bar of electrostatically charged aluminium**: Static electric charge and magnetism are different phenomena. A static charge on aluminium is unaffected by a steady magnetic field, so there would be no magnetic attraction or repulsion.
- **C) A bar of electrostatically charged copper**: As with aluminium, a static charge on copper is unaffected by a steady magnetic field. No magnetic repulsion would be observed.
- **D) A bar of unmagnetised cobalt**: Cobalt is also ferromagnetic. An unmagnetised cobalt bar develops an induced opposite pole next to the magnet and is attracted; without prior magnetisation, it cannot present a like pole to the magnet.
- **E) A bar of unmagnetised soft iron**: Soft iron is ferromagnetic, but an unmagnetised bar develops an induced opposite pole next to the magnet's pole, so it is attracted. It could repel only if it were first magnetised with the same pole facing the magnet, contrary to the option.

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