PROVE UFFICIALI DEGLI ANNI PASSATI

IMAT

2013

A B ✓ D E

SVOLTA CON SOLUZIONI COMMENTATE

Il perché di ogni risposta

WHAT'S IN THIS DOCUMENT

Prova di ammissione IMAT 2013, 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

Questions	28 questions
Biology	14 questions
Chemistry	5 questions
Physics and Mathematics	7 questions
Total	**54 questions**

This version has **54 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.

QUESTIONS

1 **Ever since Uranus was discovered, astronomers have thought there might be more planets in the Solar System. Because of small deviations in the orbits of Uranus and Neptune - deviations which would occur if another planet existed - some astronomers think there must be an undiscovered planet - Planet X. But these deviations cannot tell us whether Planet X exists, because they would occur if the orbits had been wrongly predicted. Since Uranus and Neptune take many decades to circle the sun, astronomers rely on old data to calculate their orbits. As this is likely to be inaccurate, the calculated orbits are probably wrong, and so Uranus and Neptune will deviate from them even if there is no Planet X.**

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

A Astronomers are right to think that there must be an undiscovered planet.

B The calculations of the orbits of Uranus and Neptune are probably wrong.

C Uranus and Neptune will deviate from the predicted orbits whether or not Planet X exists.

D **The deviations in the orbits of Uranus and Neptune cannot tell us whether Planet X exists.**

E The use of old and inaccurate data indicates that Planet X cannot exist.

Correct answer: D

The passage argues that observed orbital deviations do not prove Planet X exists because they could simply stem from **flawed predictions**. Astronomers rely on decades-old data to calculate planetary paths, making these predictions inherently **unreliable**. Consequently, such deviations **cannot determine** whether an additional planet is present.

Why the other answers are wrong

- **A) Astronomers are right to think that there must be an undiscovered planet.**: The argument directly challenges this inference instead of validating it.
- **B) The calculations of the orbits of Uranus and Neptune are probably wrong.**: This statement acts as a supporting claim rather than the main conclusion.
- **C) Uranus and Neptune will deviate from the predicted orbits whether or not Planet X exists.**: This explains why the orbital changes are inconclusive, providing context rather than the final point.
- **E) The use of old and inaccurate data indicates that Planet X cannot exist.**: Historical inaccuracies affect predicted paths, but they do not rule out Planet X entirely.

2 **Coffee granules are available in two jar sizes, regular and large. The regular jar contains 250 grams and costs €4.50. The large jar is 60% bigger, containing 400 grams, but at €6.30 costs only 40% more than the regular jar.**

By how much per kilogram is the large jar of coffee better value for money than the regular jar?

A 6
B 3.15
C **2.25**
D 0.9
E 3.6

Correct answer: C

1. Calculate the unit cost for each container by dividing the price by the mass in kilograms. 2. Regular jar: $€4.50 \div 0.250\ \text{kg} = €18.00\ /\text{kg}$. 3. Large jar: $€6.30 \div 0.400\ \text{kg} = €15.75\ /\text{kg}$. 4. Find the **difference** between the two rates to determine the savings: $€18.00 - €15.75 = €2.25\ /\text{kg}$.

Why the other answers are wrong

- **A) 6**: It fabricates a $€12.00\ /\text{kg}$ rate for the large jar by wrongly treating the net weight gain as the entire container mass. Subtracting this flawed figure from the actual regular rate compounds the unit inconsistency.
- **B) 3.15**: It incorrectly uses the regular jar's mass to price the large jar content ($€6.30 \div 0.250\ \text{kg} = €25.20\ /\text{kg}$) and then performs an arbitrary subtraction. This double mismatching of weight and cost destroys the valid comparison.
- **D) 0.9**: It subtracts the two jar prices ($€6.30 - €4.50 = €1.80$) and divides the result by the additional $0.200\ \text{kg}$ instead of standardizing both values. This approach confuses absolute jar totals with unit rates.
- **E) 3.6**: It assumes a $60\ \%$ volume increase versus a $40\ \%$ price increase guarantees a $20\ \%$ discount on the base rate. The calculation fails because percentage changes require a consistent **base value** rather than direct subtraction.

3 **According to a recent analysis of university entrance records, you are more likely to go to university if your name is John than if it is Wayne. Therefore, if you want your child to go to university, you are better off calling him John than Wayne.**

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

A It confuses a necessary condition with a sufficient one.

B It draws a general conclusion from specific evidence.

C **It confuses a correlation with a cause.**

D It jumps to a conclusion without any evidence.

E It fails to consider other names than Wayne or John.

Correct answer: C

The records show a statistical **association** between the name John and university attendance, but this does not prove **causation**. Hidden factors like family income or cultural habits likely drive both naming preferences and academic results. Selecting a specific name will not actually improve enrollment chances.

Why the other answers are wrong

- **A) It confuses a necessary condition with a sufficient one.**: The argument never treats either name as a mandatory requirement or a guaranteed pathway. It merely advises picking one based on raw probabilities without claiming logical necessity.
- **B) It draws a general conclusion from specific evidence.**: The reasoning correctly narrows a broad dataset to a targeted advice. The true error stems from treating a population trend as an individual trigger instead of acknowledging confounding variables.
- **D) It jumps to a conclusion without any evidence.**: The premise explicitly cites data from entrance records, so evidence exists. The real problem involves misinterpreting how that data relates to individual choices rather than lacking information entirely.
- **E) It fails to consider other names than Wayne or John.**: Listing extra names does not fix the logical gap in the original claim. Analyzing just the two proposed options suffices to evaluate the recommendation itself.

4 **Horrific images of the earthquake in Haiti were seen immediately all over the world, and by the next day the full extent of the damage was seen by the entire world. Clearly, the main problem was moving aid from the airport to distant areas, and with the roads largely blocked the only practical method was to use helicopters. The great nations of the world should be ashamed that food was not getting to the people who needed it, and that even a week later their relief still depended on the ability of courageous and skillful drivers to reach them in trucks.**

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

A There was enough food in Haiti to supply all the people in the weeks after the earthquake.

B The relief agencies were able to import trucks to Haiti but not helicopters.

C The images failed to prompt the great nations of the world into relief operations after the earthquake.

D The people of Haiti were able to clear their roads within a week of the earthquake.

E The great nations of the world had helicopters at their disposal which could reach Haiti within a week.

Correct answer: E

The argument states that **blocked roads** made **helicopters** the only viable transport method, yet it condemns **world nations** for depending on trucks a week later. This condemnation logically requires assuming those nations had ready access to helicopters that could reach Haiti within that timeframe. Without this specific capability, the criticism loses its foundation.

Why the other answers are wrong

- **A) There was enough food in Haiti to supply all the people in the weeks after the earthquake.**: The discussion centers on logistical distribution challenges instead of pre-existing domestic food reserves, making local stockpiles irrelevant to the critique.
- **B) The relief agencies were able to import trucks to Haiti but not helicopters.**: If agencies could import trucks but not helicopters, relying on ground vehicles would be a logical adaptation rather than a failure deserving criticism.
- **C) The images failed to prompt the great nations of the world into relief operations after the earthquake.**: The complaint targets inefficient delivery methods instead of questioning whether any aid activities commenced, so the existence of initial operations does not affect the argument.
- **D) The people of Haiti were able to clear their roads within a week of the earthquake.**: The text emphasizes persistent road obstructions rather than suggesting locals cleared them quickly, so assuming clearance contradicts the stated premise about transport difficulty.

5 **The pasta that I buy in the local supermarket usually costs €1.60 per packet. This week the packet is marked '€0.20 off normal price'.**

In addition the following sign is on display '10% off all bills when you spend €10 or more'. Assuming that I spend over €10 altogether, how much will the packet of cereal cost?

A 1.24
B **1.26**
C 1.12
D 1.3
E 1.18

Correct answer: B

The **first discount** reduces the price from €1.60 to €1.40. The 10% discount is then calculated on the **new price**, reducing it by €0.14 to €1.26.

Why the other answers are wrong

- **A) 1.24**: This uses 10% of the original €1.60, which is €0.16, instead of calculating the discount on the already reduced price of €1.40.
- **C) 1.12**: This could result from subtracting €0.20 and then taking 20% off, or from applying the 10% discount twice. Either way, the total reduction is too large.
- **D) 1.3**: This subtracts the €0.20 correctly but treats 10% of €1.60 as €0.10, so the percentage discount is miscalculated.
- **E) 1.18**: This overstates the total discount. After subtracting €0.20, reaching €1.18 would require a percentage discount larger than 10%, about 15%.

6 **There is an increasing number of historical or significant buildings in the UK which are said to be 'At Risk'. Without a change in the law most of these buildings are doomed to crumble into the ground. This is because these buildings are no longer structurally sound. The exisiting strict renovation laws mean that they are too expensive or impractical for private individuals or developers to renovate or repair. There are certainly people out there who would be willing to maintain these buildings if they could use more modern and less expensive techniques and materials. Surely it is better to sacrifice some of the original building's character rather than lose the entire structure.**

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

A Historians can learn more from buildings which have not been modernised by modern developers.

B **A change in the law is needed if we hope to preserve more 'At Risk' buildings.**

C Existing laws make 'At Risk' buildings too expensive for most developers.

D At Risk' buildings need to be renovated according to strict rules.

E There is nothing wrong with changing the character of historic buildings.

Correct answer: B

The author argues that **existing renovation laws** force maintenance costs beyond the reach of private owners or developers. Consequently, most **'At Risk' buildings** face structural collapse. **Modern techniques** would provide a practical alternative, making a **legal reform** essential to preserve these structures rather than losing them entirely.

Why the other answers are wrong

- **A) Historians can learn more from buildings which have not been modernised by modern developers.**: The text contains no information regarding historians or educational benefits from non-modernised structures.
- **C) Existing laws make 'At Risk' buildings too expensive for most developers.**: This statement functions as a premise supporting the need for legal change, not as the main conclusion itself.
- **D) At Risk' buildings need to be renovated according to strict rules.**: The passage explicitly states that current strict regulations prevent renovation by making it too costly or impractical.
- **E) There is nothing wrong with changing the character of historic buildings.**: While the author suggests accepting minor compromises in original features to save a building, they do not argue that all modifications are acceptable without restriction.

7 **A nationwide survey showed that the majority of people would not be willing to give up their car in favour of public transport. However, in a recent survey of people living in an area with heavy traffic problems, 76% stated that they would prefer to travel to work by public transport if the system was made more reliable. This shows that the previous findings were wrong. We should, therefore, restrict car use and start a programme of improving the nation's public transport network as soon as possible.**

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

A The counter arguments are not explained in detail.
B It does not consider the 24% who would not prefer to use public transport.
C It fails to specify which types of public transport are to be improved.
D **The statistic presented may not be representative of the whole population.**
E It fails to explain how the public transport system can be improved.

Correct answer: D

The recent data only reflects commuters in **one district** facing traffic congestion. Their support relies on assumed system improvements. This restricted group cannot stand for the **wider citizenry**, meaning the new poll does not disprove the first report.

Why the other answers are wrong

- **A) The counter arguments are not explained in detail.**: Omitting detailed counterarguments does not generate the invalid conclusion. The error lies in misinterpreting **survey scope**, not in poor documentation.
- **B) It does not consider the 24% who would not prefer to use public transport.**: The passage explicitly states that 76% agreed, so leaving out dissenters is intentional. The real mistake occurs when treating partial agreement as universal proof.
- **C) It fails to specify which types of public transport are to be improved.**: Listing specific transit modes would not eliminate the **sampling issue**. Geographic limitation remains the primary reason the data lacks broad relevance.
- **E) It fails to explain how the public transport system can be improved.**: The logical defect centers on using a local survey to challenge nationwide results. Designing an improvement plan falls outside the scope of this statistical comparison.

8 **The low level of literacy among science undergraduates is an issue across all universities. One of the biggest problems is that pupils in school spend more time perfecting their SMS text messaging and emailing skills than they do writing grammatically correct pieces of literature. It is important to get across to undergraduates that good writing matters. Employers take on scientists believing they can communicate their findings fluently and accurately. We need to deliver science graduates with these skills.**

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

- A **Students must be helped to recognise the importance of good literacy skills.**
- B Students do not concentrate properly in lessons in school.
- C Education is failing those who leave with poor writing skills.
- D Employment often depends on good ability in literacy.
- E Many science graduates are unable to write in a grammatically correct way.

Correct answer: A

The argument identifies poor literacy among science undergraduates and says students need to understand that **good writing matters**. Employers expect scientists to communicate their findings **fluently and accurately**, which explains why students should be helped to recognise the importance of literacy.

Why the other answers are wrong

- **B) Students do not concentrate properly in lessons in school.**: The passage says pupils spend more time practising text messaging and emailing than writing grammatically correct literature. It does not say that they fail to concentrate in lessons.
- **C) Education is failing those who leave with poor writing skills.**: The passage does not make this broader judgement about education.
- **D) Employment often depends on good ability in literacy.**: This supports the conclusion by explaining why writing matters, but it is not the main conclusion.
- **E) Many science graduates are unable to write in a grammatically correct way.**: Poor literacy among science undergraduates is the problem the argument starts from, not the conclusion it argues for.

9 **Stephen is currently involved in a long distance charity walk from Alphcaster to Omegham. He left Alphcaster 9 days ago and has just completed 60% of his journey.**

He hopes to complete 60% of the rest of the walk during the next 4 days. This will leave him just 60 miles from Omegham, which he aims to complete in a further 2 days.

How far is it from Alphcaster to Omegham?

A 450 miles
B 250 miles
C 225 miles
D 300 miles
E 375 miles

Correct answer: E

1. Let the **total distance** be D miles. 2. Stephen has already walked $0.60D$, leaving a **remaining portion** of $D - 0.60D = 0.40D$. 3. He plans to cover 60% of this remainder in four days, which equals $0.60 \times 0.40D = 0.24D$. 4. The **final segment** left after those days is $0.40D - 0.24D = 0.16D$. 5. Setting this equal to 60 miles gives $0.16D = 60$, so $D = 60 \div 0.16 = 375$.

Why the other answers are wrong

- **A) 450 miles**: Calculating the leftover distance gives $0.16 \times 450 = 72$ miles, which exceeds the expected length.
- **B) 250 miles**: Calculating the leftover distance gives $0.16 \times 250 = 40$ miles, which does not match the target.
- **C) 225 miles**: Calculating the leftover distance gives $0.16 \times 225 = 36$ miles, which is not 60 miles.
- **D) 300 miles**: Calculating the leftover distance gives $0.16 \times 300 = 48$ miles, which falls short of the required value.

10 **A significant social trend in the 20th century was for people to move away from their place of birth in order to access education and work. This gave individuals more opportunities and helped the economy by producing mobility within the workforce. The negative side of this is now being felt as more and more elderly people face the problems of old age without family members nearby to care for them. This has negative effects on the economy as well as on the individual, as more and more state funding for care is needed.**

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

A Elderly people are expecting the state to provide care for them rather than relying on their children.

B People should make caring for their elderly parents a priority over choice of work opportunities.

C **The benefits of a mobile workforce have to be compared with the costs to elderly people and the economy.**

D The state should provide care for elderly people to make mobility of the workforce possible.

E People should try to find education and work close to their place of birth.

Correct answer: C

The passage outlines the **benefits** of workforce mobility through improved individual opportunities and economic growth, while also highlighting the **costs** of aging without nearby family support and rising state care expenses. Because the text explicitly presents both positive outcomes and negative consequences, the logical conclusion requires **weighing these advantages against the associated disadvantages**.

Why the other answers are wrong

- **A) Elderly people are expecting the state to provide care for them rather than relying on their children.**: The argument focuses on the financial reality that governments must increase care budgets, rather than describing any expectations or preferences held by older adults themselves.
- **B) People should make caring for their elderly parents a priority over choice of work opportunities.**: Although caring for aging relatives is identified as a societal concern, the text does not claim that familial duties must outweigh professional career choices.
- **D) The state should provide care for elderly people to make mobility of the workforce possible.**: The passage notes that state funding for elderly care is becoming necessary due to demographic shifts, but it never argues that government support should be mandated to facilitate workforce mobility.
- **E) People should try to find education and work close to their place of birth.**: Suggesting individuals should seek education and employment near their birthplace introduces a prescriptive solution that remains completely absent from the original argument.

11 **It has recently been suggested that some degrees can be completed in two years instead of the traditional three years. But staff teaching engineering and medicine at degree level say that the current first year mostly involves getting students up to a common level of maths and physics, which in the past was achieved by high school teaching. By the end of the second year few students have reached the level of attainment that students did 40 years ago. Two year degrees are not realistic - certainly not for engineering.**

Which one of the following is an assumption of the argument in the passage above?

A School examinations are easier now than they were 40 years ago.

B Maths and physics are more important elements of engineering than they were 40 years ago.

C Engineering students are less motivated than they were 40 years ago.

D Two year degree courses will be more popular with students than three year courses.

E **Two year degree courses will have the same amount of teaching per year as three year courses.**

Correct answer: E

The argument claims that the current curriculum requires a three-year span because the initial phase brings students to a **common standard** and overall results have dropped compared to forty years ago. For the conclusion that a faster track is unfeasible to stand, the reasoning must assume that the total **teaching load** stays constant rather than being accelerated. Option A confirms this fixed input, making the **compressed schedule** unrealistic.

Why the other answers are wrong

- **A) School examinations are easier now than they were 40 years ago.**: The comparison between historical and modern secondary education highlights actual learning deficits, rendering exam grading scales irrelevant.
- **B) Maths and physics are more important elements of engineering than they were 40 years ago.**: The text focuses on prior knowledge gaps in quantitative and scientific fields instead of evaluating how their academic weight has shifted over time.
- **C) Engineering students are less motivated than they were 40 years ago.**: The passage attributes lower attainment to inadequate preparation, not to diminished student drive.
- **D) Two year degree courses will be more popular with students than three year courses.**: Enrollment trends or market demand do not influence whether rigorous academic benchmarks can be achieved within a reduced duration.

12 **A multi-storey car park has eight levels.**
On the top seven levels there are eight rows of parking. Two of these rows hold 15 cars each whilst the others hold 10 cars each.
On the road level there are two rows holding 15 cars but only four rows holding 10 cars each.
The entry control system counts cars in and out. The system stops admitting cars once 90% of the total capacity is in use.
Four spaces on the road level are reserved for staff parking and these are not available to the public.
What is the maximum number of public cars which can be admitted?

A **626**
B 644
C 500
D 630
E 696

Correct answer: A

Each upper level holds $2 \times 15 + 6 \times 10 = 90$ cars, so the seven upper levels hold 630. The road level holds $2 \times 15 + 4 \times 10 = 70$, giving a **total capacity** of 700. The **90\% limit** is 630 cars, including the four staff spaces, so at most $630 - 4 = 626$ public cars can be admitted.

Why the other answers are wrong

- **B) 644**: This could result from first removing the four staff spaces, calculating $700 - 4 = 696$, and then mistakenly applying a percentage other than 90%, such as 92.5%. Alternatively, it could result from adding the 14 surplus road-level spaces to 630. Either way, it does not apply the exact 90% rule.
- **C) 500**: This implies a much smaller limit. It could result from forgetting the two 15-car rows on each upper level or from taking 90% of only the road-level capacity.
- **D) 630**: This correctly takes 90% of the total capacity, but forgets to remove the four **staff-only spaces**, counting cars that the public cannot park there.
- **E) 696**: This is the total number of spaces available to the public, $700 - 4 = 696$, but it ignores the entry-control limit.

13 **The table below shows the consumer price inflation and unemployment rate for 5 countries:**

A newspaper comparing March to February reported that: 'Unemployment has fallen but there has been a rise in the inflation rate'

Which country is the statement referring to?

Consumer price inflation % rate	March	February
United States	+0.4	+0.3
Japan	+0.2	+0.5
Germany	+0.1	+0.1
France	+0.3	0.0
UK	+0.2	+0.5
Unemployed % rate	March	February
United States	5.9	6.1
Japan	3.0	3.0
Germany	9.2	9.3
France	12.6	12.6
UK	9.1	9.2

A Japan
B France
C Germany
D **United States**
E UK

Correct answer: D

Between February and March the **United States** recorded inflation increasing from 0.3% to 0.4%. During the same interval unemployment decreased from 6.1% to 5.9%. These matching figures satisfy the newspaper report exactly.

Why the other answers are wrong

- **A)** Japan experienced a price decline from 0.5% to 0.2% while joblessness remained fixed at 3.0%. It fails both the inflation and unemployment conditions.
- **B)** France showed inflation climbing from 0.0% to 0.3% yet unemployment held steady at 12.6%. There was no reduction in joblessness to support the statement.
- **C)** Germany recorded a slight unemployment drop from 9.3% to 9.2% but consumer prices stayed flat at 0.1%. The required rise in inflation did not happen.
- **E) UK**: The United Kingdom had unemployment fall from 9.2% to 9.1% but inflation actually dropped from 0.5% to 0.2%. The second criterion contradicts the reported trend.

15 **At a society meeting, 1000 people are entitled to vote in the elections for Chairperson with a one- person-one-vote system. The election rules state if no candidate obtains more than 50% of the votes cast in the first ballot, a second ballot must be held between the top two candidates. 350 votes were cast for a particular candidate in the first ballot. Then a second ballot took place.**

Under these circumstances which one of the following is possible?

- **A** **The candidate either won the election or came second**
- **B** The candidate definitely won the election
- **C** The candidate came second or third, but did not win
- **D** The candidate came third
- **E** The candidate won the election, came second, or came third

Correct answer: A

The candidate secured 350 votes out of at most 1000 cast. An **outright victory** occurs only if the total votes fall below 700, since 350 exceeds half of that amount. When turnout reaches the threshold, a second ballot triggers between the top two contenders. Advancing to this stage guarantees the participant avoids elimination. Consequently, the individual secures either first or **second place**.

Why the other answers are wrong

- **B) The candidate definitely won the election**: Assumes certainty regarding the final rank. Election outcomes depend entirely on actual turnout. Participants reaching 700 votes prevent automatic qualification.
- **C) The candidate came second or third, but did not win**: Rules out victory and permits third place. Winning remains valid when abstentions reduce the base. Third place stays blocked by the arithmetic ceiling.
- **D) The candidate came third**: Focuses exclusively on an eliminated position. Reaching third demands two opponents with strictly more votes. The electorate capacity makes this configuration mathematically unachievable.
- **E) The candidate won the election, came second, or came third**: Includes finishing third, which contradicts the vote limit. Placing third requires two rivals to exceed 350 each. The calculation $350 + 351 + 351 = 1052$ shows a total surplus. This figure surpasses the registered electorate.

16 **A safe has external dimensions as follows:**

Width 48cm
Depth 44cm
Height 52cm

The entire safe is made of steel 4cm thick except the base which is 8cm thick. What are the internal dimensions of the base of the safe?

A 40cm x 32cm
B 36cm x 36cm
C **40cm x 36cm**
D 44cm x 40cm
E 40cm x 40cm

Correct answer: C

The internal **width** requires subtracting twice the standard plate thickness from the outer measure: $48\ \text{cm} - 2 \times 4\ \text{cm} = 40\ \text{cm}$. The internal **depth** applies the identical reduction to the remaining axis: $44\ \text{cm} - 2 \times 4\ \text{cm} = 36\ \text{cm}$. The thicker **base** influences only the vertical clearance, preserving the horizontal layout. The resulting floor span measures $40\ \text{cm} \times 36\ \text{cm}$.

Why the other answers are wrong

- **A) 40cm x 32cm**: Keeps the accurate width figure but deducts $12\ \text{cm}$ from the depth, falsely assuming the depth walls are $6\ \text{cm}$ thick.
- **B) 36cm x 36cm**: Subtracts $12\ \text{cm}$ from the length instead of $8\ \text{cm}$, which treats each lateral panel as $6\ \text{cm}$ thick.
- **D) 44cm x 40cm**: Omits the plate thickness entirely for the depth dimension and only removes $8\ \text{cm}$ from the width, ignoring the material on that side.
- **E) 40cm x 40cm**: Finds the correct internal width but mistakenly applies the same $8\ \text{cm}$ reduction to the depth without adjusting for its smaller starting value.

18 **A study on identical twins concluded that genes contribute roughly half of the attributes we need to be happy. People often find such studies scary, seeing something sinister about us being mere puppets of our biology. However, put in non-scientific terms, it sounds like common sense. Parents talk about how their children had different personality traits from a very young age. Perhaps it's nicer to think this is caused by something 'fluffy' like a soul - but even if that were true, why is that more reassuring than the thought that genes are responsible? Either way, you're born as you are.**

Which one of the following statements is best supported as the conclusion of the passage above?

A The person you are at birth is the person you will be throughout your life.

B Whether or not you are happy in life is not something over which you yourself have any control.

C Roughly half of what we need to be happy is decided by our genetic make up.

D Whether or not you are happy in life is either determined by your soul or your genes.

E **We may as well accept the idea that our potential for happiness in life is to some extent decided at birth.**

Correct answer: E

The passage concludes that since innate traits stem from genes or a soul, individuals are essentially **predetermined** at birth. Therefore, people should **accept** this early determination of happiness potential instead of fearing it.

Why the other answers are wrong

- **A) The person you are at birth is the person you will be throughout your life.**: Starting with fixed characteristics does not imply permanent stagnation. Human development and adaptation allow for meaningful changes over time.
- **B) Whether or not you are happy in life is not something over which you yourself have any control.**: Acknowledging biological or spiritual predispositions does not eliminate free will or external life circumstances. Personal control remains possible.
- **C) Roughly half of what we need to be happy is decided by our genetic make up.**: This option merely restates the initial study data used as a premise. The author builds an argument beyond reporting raw scientific findings.
- **D) Whether or not you are happy in life is either determined by your soul or your genes.**: The text examines factors influencing happiness rather than claiming absolute determination by exactly two causes. It does not support a strict binary outcome.

19 **The table below shows the winning time for the men's 200m run in the Olympic Games since 1900, when the event was first held, until 1988.**

What is the longest number of years for which the Olympic record stood unbroken?

year	seconds	year	seconds
1900	22.2	1948	21.1
1904	21.6	1952	20.81
1908	22.6	1956	20.75
1912	27.1	1960	20.62
1916	*	1964	20.36
1920	22.0	1968	19.83
1924	21.6	1972	20.00
1928	21.8	1976	20.23
1932	21.2	1980	20.19
1936	20.7	1984	19.80
1940	*	1988	19.75
1944	*	-	-

*** Olympics not held in these years.**

A 24
B 6
C 20
D 16
E **28**

Correct answer: E

First, identify the **record-setting years** when a faster time actually appeared: 1900, 1904, 1932, 1936, 1960, 1964, 1968, 1984, and 1988. Next, calculate the **duration** each record stood unbroken by subtracting consecutive years. The intervals are 4, 28, 4, 24, 4, 4, 16, and 4 years respectively. The maximum span is **28 years**, confirming C.

Why the other answers are wrong

- **A) 24**: This matches the **24-year gap** between the 1936 and 1960 marks, but it is not the longest interval in the dataset.
- **B) 6**: There is no six-year interval present among the calculated gaps between successive records.
- **C) 20**: No recorded transition in the table spans exactly 20 years.
- **D) 16**: This corresponds to the 16-year period the 1968 record lasted until 1984, which falls short of the 28-year maximum.

20 **Any company that wishes to sell a new drug must provide the government with details of research about its safety and possible side effects. At present, this information is confidential, but there are plans to make it available to the public. While patients are surely entitled to more information about the drugs they are prescribed, this will also inevitably make public vital details about the ingredients of certain drugs and how they are manufactured. Drug companies are naturally reluctant to release this information to their competitors. Therefore, through fear of imitators, drug companies will no longer introduce new and important drugs into the country.**

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

A The drug industry is a very competitive business and secrecy is vital if companies are to survive.

B There are sufficient drugs already on the market and so there is no necessity to introduce new ones.

C People are better informed about the side effects of drugs abroad than they are in this country.

D **Strong patent laws prevent companies from using the information to create rival drugs.**

E People may be reluctant to use certain drugs when they have fuller information about them.

Correct answer: D

The argument claims that **public disclosure** of research details will discourage companies from launching new drugs due to **fear of imitation**. Strong **patent laws** legally protect inventions and block competitors from using that data to produce **rival drugs**. This directly removes the economic incentive to withhold new medications.

Why the other answers are wrong

- **A) The drug industry is a very competitive business and secrecy is vital if companies are to survive.**: This reinforces the original concern by stating that secrecy is essential in a competitive industry, actually supporting the argument rather than weakening it.
- **B) There are sufficient drugs already on the market and so there is no necessity to introduce new ones.**: This questions the current market demand for new medications, but it leaves the core claim about competitor imitation completely unchanged.
- **C) People are better informed about the side effects of drugs abroad than they are in this country.**: This compares international knowledge levels regarding side effects, which has no logical connection to whether public data would enable competitors to reverse engineer or copy the formulations.
- **E) People may be reluctant to use certain drugs when they have fuller information about them.**: This focuses on patient reluctance based on better information, which does not address whether competitors can legally copy the drugs.

21 **After looking at interviews conducted with a number of adult learners, our research suggested that the learners who felt they were most successful were all highly motivated. We noticed that early success had heightened motivation in some cases and saw that both success and motivation may be due to a special aptitude for learning. We also noticed that many of those who felt they were most motivated were also learning in favourable conditions or for fun, which meant they may have become motivated since starting their classes. Though these conditions seemed persuasive, the results led us to the same conclusion.**

It's impossible to learn anything without motivation.

Which one of the following is NOT a flaw in the above argument?

A The research does not establish that there are no successful learners who lacked motivation.
B The research is only concerned with adult learners.
C It assumes that those who felt they were successful actually were.
D **It assumes that in order to be motivated you have to have a special aptitude for learning.**
E It assumes that those who felt they were motivated actually were.

Correct answer: D

The argument states that success and motivation **may** stem from a special aptitude for learning. It does not treat this aptitude as a **necessary condition** for motivation. Selecting B highlights a misrepresentation of the premise rather than a genuine logical error. **Why the other options are not the answer Answer A**: The interviews record learners' self-reported perceptions of success. These accounts lack independent verification, so assuming objective outcomes introduces a measurement flaw. **Answer C**: The research treats subjective feelings of motivation as definitive proof. Confusing personal experience with measurable reality distorts the observed correlation. **Answer D**: Identifying motivated students among successful learners does not demonstrate that motivation is strictly required for all learning. Overlooking potential unmotivated successes breaks the claimed necessity. **Answer E**: Data collected exclusively from adult learners cannot substantiate a universal claim about every educational population. Conflating a specific demographic with a general rule creates a scope flaw.

Why the other answers are wrong

22 **Many people believe that foreign travel broadens the mind and that there is some inherent benefit in spending some time in a culture different from your own. Many students are taking 'gap' years where they spend time in another country. Whilst this may offer some benefits in terms of confidence and independence, it is wrong to assume that foreign travel alone can provide this. Global travel can have negative impacts on local cultures and the environment. Home country based 'gap' projects are often seen as unglamourous but the benefit of working with different groups and cultures within our own society can be equally rewarding.**

Which one of the following is the main conclusion of the above passage?

A Foreign travel is not the only way to gain confidence and independence.

B There is inherent benefit in spending some time abroad.

C **Projects within our own society can be as rewarding as foreign travel.**

D It is important that gap year students consider the impact of their travel on the communities they work in.

E Foreign gap year projects must have an element of community work for them to be worthwhile.

Correct answer: C

The passage acknowledges that foreign travel builds confidence and independence while noting its potential environmental drawbacks. It concludes that participating in domestic gap year programs allows students to engage with diverse communities and achieve **comparable personal growth** without traveling abroad.

Why the other answers are wrong

- **A) Foreign travel is not the only way to gain confidence and independence.**: This statement provides supporting evidence for domestic alternatives yet remains too limited to function as the overall conclusion.
- **B) There is inherent benefit in spending some time abroad.**: This choice restates a popular opinion introduced at the beginning of the text rather than the author's actual stance.
- **D) It is important that gap year students consider the impact of their travel on the communities they work in.**: The passage briefly notes possible harms from overseas trips but explicitly states these observations are not its **central point**.
- **E) Foreign gap year projects must have an element of community work for them to be worthwhile.**: The original text imposes no mandatory criteria regarding community involvement for foreign programs to hold any value.

23 **My packet of washing powder claims to contain enough powder for 24 washes. This claim is based on using the plastic scoop supplied with the packet and filling it once for each wash.**

Living in a soft water area I find I only need to fill the scoop three-quarters full.
How many washes can I get from this packet?

A 30
B **32**
C 18
D 42
E 26

Correct answer: B

The packet contains enough powder for 24 full scoops. Using soft water reduces the **dose** to $\frac{3}{4}$ of a scoop per wash. Dividing the **supply** by the reduced amount gives $24 \div \frac{3}{4} = 32$ washes.

Why the other answers are wrong

- **A) 30**: This number often comes from confusing $\frac{3}{4}$ with 0.8 or rounding down to a nearby multiple of five. The exact calculation $24 \div 0.75$ yields 32, not 30.
- **C) 18**: This value emerges when multiplying the total scoops by the usage fraction, like $24 \times \frac{3}{4} = 18$. That operation calculates how many scoops are consumed after eighteen cycles instead of determining the possible cycle count.
- **D) 42**: This result appears by **multiplying** instead of dividing, such as computing $24 \times 1.75 \approx 42$. It may also stem from dividing by half a scoop rather than three quarters, which incorrectly inflates the total.
- **E) 26**: This figure usually arises from rough estimates, such as treating $\frac{3}{4}$ as $\frac{4}{5}$ (0.8) and applying flawed adjustments. Arithmetic slips like subtracting a quarter of twenty-four and then adding back incorrectly also lead to this number.

24 **Two companies have just started a round-the-clock air taxi service between Rome and Milan. They use the same flight path and fly at constant speeds at different altitudes. Planes owned by the company Alpha-Air take off from Rome every 10 minutes and take 90 minutes to reach Milan. Planes owned by the company Beta-Air take off every 5 minutes and take 60 minutes to reach Milan. Captain Johnston, who flies for Beta-Air, takes off from Rome 5 minutes after the previous Alpha-Air flight has departed.**

How many Alpha-Air planes (flying from Rome to Milan) will Captain Johnston have passed as he lands in Milan?

A 1
B 2
C **3**
D 4
E 0

Correct answer: C

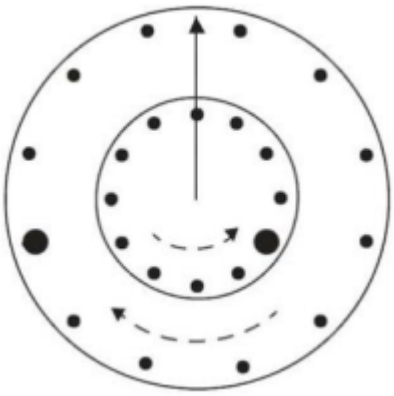
1. Let the distance be D. Speeds are $v_{\mathrm{A}} = D/90$ and $v_{\mathrm{B}} = D/60$. 2. The **relative speed** is $D/180$ per minute. 3. If an Alpha plane departs a minutes earlier, Johnston catches it after $t = 2a$. 4. The **catch threshold** requires $t \leq 60$, so $a \leq 30$. 5. Alpha flights leave every 10 minutes at intervals of 5, 15, and 25 minutes prior. 6. Exactly **three planes** meet this limit before Johnston lands.

Why the other answers are wrong

- **A) 1**: This counts only the flight departing 5 minutes earlier and overlooks those leaving 15 and 25 minutes earlier, which remain inside the valid time window.
- **B) 2**: This misses the plane departing 25 minutes earlier, which Johnston actually catches 50 minutes into his journey, leaving 10 minutes before arrival.
- **D) 4**: This incorrectly adds the flight departing 35 minutes earlier, because the required catch time would reach 70 minutes and exceed the actual flight duration.
- **E) 0**: This assumes zero encounters, ignoring that Beta is 1.5 times as fast and inevitably closes the distance on slower planes departing shortly before takeoff.

25 **A novelty shop sells a rather unusual clock designed to puzzle users. There is only one hand, which points upwards. It has two faces. The larger hour face rotates clockwise and the smaller minute face rotates anticlockwise. Each face has one big dot, representing 12 o' clock or 0/60 minutes and 11 smaller marks counting one hour or five minute divisions. There are no numbers.**

What time is it when the clock looks as shown in the diagram?



A 8:20
B 3:20
C **8:40**
D 3:40
E 9:20

Correct answer: C

The outer hour ring **rotates clockwise**, with each mark representing one hour. The inner minute ring **rotates anticlockwise**, with each mark representing five minutes. The outer dot rests at the **eight** mark from the top, establishing eight hours. The inner dot rests at the **eight** mark in reverse, yielding $8 \times 5 = 40$ minutes. This arrangement points to **8:40**.

Why the other answers are wrong

- **A) 8:20**: Assuming twenty minutes would require the inner dot to cover only four anticlockwise steps, but the dot actually sits twice that distance away.
- **B) 3:20**: Both values contradict the visual evidence since neither dot matches the three-hour nor the twenty-minute positions.
- **D) 3:40**: Assuming three hours would require the outer dot to cover only three clockwise steps, which contradicts its actual position much further along the dial.
- **E) 9:20**: The outer dot passes the ninth mark, ruling out nine hours, while the inner dot does not align with the fourth anticlockwise step required for twenty minutes.

26 **The headquarters of the World Health Organisation (WHO) is found in which of these cities?**

A London
B Washington DC
C Rome
D Nairobi
E Geneva

Correct answer: E

The **World Health Organization** is a United Nations specialized agency responsible for global public health. Its main headquarters have been located in **Geneva**, Switzerland, since **1948**. Therefore, Geneva is the correct choice.

Why the other answers are wrong

- **A)** London is home to institutions such as the International Maritime Organization and the Commonwealth Secretariat, while the WHO headquarters remains elsewhere.
- **B)** Washington DC hosts the Pan-American Health Organization and numerous international bodies, but it does not contain the WHO global headquarters.
- **C)** Rome accommodates several UN agencies focused on food and agriculture like the FAO, IFAD, and WFP instead of the WHO.
- **D)** Nairobi functions as the headquarters for the United Nations Environment Programme and UN-Habitat, making it incorrect for this agency.

27 **A placebo is:**

A a form of mild stimulant
B a type of pain killer
C a sedative
D a form of local anaesthetic
E an inactive drug or treatment

Correct answer: E

A placebo contains no **active pharmacological ingredient** relevant to the condition. Any therapeutic effect stems exclusively from **psychological response** and mental processing. This separates it from substances with direct chemical actions.

Why the other answers are wrong

- **A) a form of mild stimulant**: A stimulant actively increases physiological activity through substances like caffeine or amphetamine. These agents produce genuine biological responses rather than relying on mental processing.
- **B) a type of pain killer**: Pain killers contain active ingredients that directly reduce pain perception through biochemical pathways. Their established physiological action prevents classification as an inactive treatment.
- **C) a sedative**: Sedatives depress central nervous system function to promote relaxation or sleep. Their measurable impact on neural signaling relies on active properties rather than inert composition.
- **D) a form of local anaesthetic**: Local anaesthetics block nerve conduction in specific target areas using defined molecular mechanisms. This direct interference with sensory transmission requires actual chemical activity.

28 **Which general famously crossed the Alps with his army?**

A Antony
B Augustus
C Octavius
D Hamilcar
E **Hannibal**

Correct answer: E

Hannibal Barca commanded Carthaginian forces during the **Second Punic War** and executed a surprise winter crossing of the **Alps**. His column transported roughly **40,000 troops** and **war elephants** from Spain into northern Italy. This strategic maneuver bypassed Roman coastal defenses and enabled subsequent victories at Trebia, Trasimene, and Cannae.

Why the other answers are wrong

- **A) Antony**: Mark Antony conducted military campaigns in the eastern Mediterranean alongside Cleopatra and focused his efforts far from European alpine routes.
- **B)** Augustus consolidated permanent borders after assuming power in 27 BCE and relied on fortified frontier posts instead of repeat offensive mountain marches.
- **C) Octavius**: Gaius Octavius directed Roman operations across multiple provinces while historical archives contain no record of an organized Alpine trek.
- **D)** Hamilcar served as a celebrated commander in the First Punic War and expanded Carthaginian holdings in Spain without attempting any mountain passage.

29 **In which modern day country was the Inca civilization centred?**

A Chile
B Brazil
C Ecuador
D **Peru**
E Bolivia

Correct answer: D

The political and economic heart of the Inca Empire was **Cuzco**, situated in the Andes mountains of modern-day **Peru**. From this capital the empire expanded along the Andean spine while retaining its administrative and ceremonial core in the same territory. Major sites like Machu Picchu and the Sacred Valley further anchor the civilisation within current borders.

Why the other answers are wrong

- **A) Chile**: Southern campaigns pushed into northern present-day Chile, but this region functioned strictly as a frontier zone rather than a territorial heartland.
- **B) Brazil**: Expansion reached only the eastern lowland fringes, leaving the Amazon Basin largely outside direct control and distant from the Andean core.
- **C) Ecuador**: Military expeditions incorporated parts of the Ecuadorian highlands, yet these lands operated as provincial peripheries instead of the imperial seat.
- **E) Bolivia**: The Bolivian highlands contained culturally important landmarks like Lake Titicaca and earlier structures such as Tiwanaku, but their position southeast of the capital made them geographically secondary.

30 **Which one of these did Galileo NOT do?**

A Develop the microscope

B **Design an electric battery**

C Design a thermometer

D Develop the telescope

E Discover that the movement of a pendulum produces a regular time measurement

Correct answer: B

Galileo never designed an electric battery. The first functional battery was created by **Alessandro Volta** in **1799**, more than 150 years after **Galileo** died in 1642. His research focused on **motion** and **astronomy** using optical and thermal instruments. He had no involvement with **electricity**.

Why the other answers are wrong

- **A) Develop the microscope**: In 1609–1610 he adapted his lens crafting techniques to build an early compound microscope named occhiolino. He demonstrated it to scholars in 1610 and gifted one to the Accademia dei Lincei to advance microscopy.
- **C) Design a thermometer**: Around 1592–1593 he devised the thermoscope, a glass tube with a bulb to compare relative temperatures. It lacked a numerical scale but represents one of the earliest steps toward the modern thermometer.
- **D) Develop the telescope**: While Dutch artisans first invented the refracting telescope, he independently constructed superior versions in 1609 reaching up to approximately 30x magnification. He became the first to deploy it systematically for astronomical observations, revealing Jupiter's moons, lunar craters, and sunspots.
- **E) Discover that the movement of a pendulum produces a regular time measurement**: As a young man watching a swinging lamp in Pisa Cathedral, he noticed that equal length pendulum swings take nearly identical durations. This observation of isochronism led him to propose the pendulum for accurate timekeeping.

BIOLOGY

31 **A sample of DNA contains 32 % guanine.**

Which answer shows the percentage of thymine in the same sample?

A 32
B **18**
C 23
D 34
E 24

Correct answer: B

1. DNA follows **complementary** pairing rules where guanine matches cytosine and adenine matches thymine. 2. Pair percentages **equal**, so 32% guanine means 32% cytosine. 3. The **remaining** bases occupy $100\% - (32\% + 32\%) = 36\%$. 4. **Dividing** this amount equally yields 18% thymine.

Why the other answers are wrong

- **A) 32**: Setting thymine at 32% implies adenine is identical, causing all four bases to sum to 128%.
- **C) 23**: Assuming 23% thymine forces adenine to match, which makes the total composition **exceed** 110% .
- **D) 34**: Choosing 34% thymine requires a matching adenine value, leading to an impossible 132% total.
- **E) 24**: Selecting 24% thymine sets adenine to 24%, pushing the combined percentage to 112%.

32 **Which one of the following does not contain amino acids?**

A Antibodies
B **Amylose**
C Enzymes
D Cell membranes
E Viruses

Correct answer: B

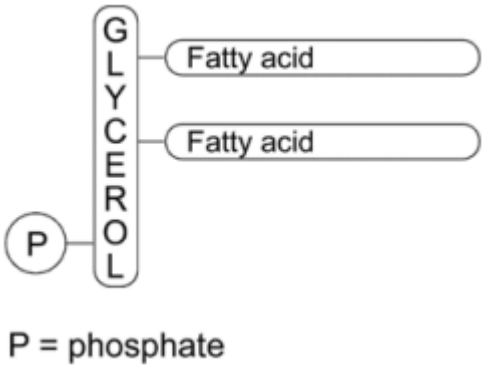
Amylose is a **polysaccharide** composed exclusively of glucose units joined by glycosidic bonds. Being a pure carbohydrate, it lacks nitrogen-containing groups and peptide linkages, so it contains no amino acids.

Why the other answers are wrong

- **A)** Antibodies operate as adaptive immune defenders and belong to the immunoglobulin family. Their characteristic structure derives from heavy and light polypeptide chains made entirely of amino acids.
- **C)** Enzymes function as biological catalysts and are predominantly proteins. They consist of one or more polypeptide chains built from amino acid monomers.
- **D)** Cell membranes form selective barriers while hosting diverse molecular machinery. Transport channels and signaling receptors integrated into these layers are embedded proteins constructed from amino acids.
- **E) Viruses**: Viral particles package genetic material inside a protective shell. This outer **capsid** is strictly assembled from viral proteins that require amino acids for synthesis.

33 **The diagram below shows a phospholipid.**

When this molecule is broken into a phosphate, glycerol and two fatty acids, the number of water molecules released is:



A 1
B 2
C **0**
D more than 3
E 3

Correct answer: C

The breakdown of a phospholipid into glycerol, fatty acids, and phosphate proceeds through **hydrolysis**. This reaction **consumes** water molecules to cleave the existing ester and phosphoester linkages. Therefore, the process releases exactly **zero** water molecules.

Why the other answers are wrong

- **A) 1**: Selecting one water molecule incorrectly assumes that only a single chemical bond is being cleaved during the reaction.
- **B) 2**: This option counts only the two fatty acid ester bonds while completely ignoring the additional phosphoester bond.
- **D) more than 3**: Only three specific bonds require hydrolysis, so even if each released water the theoretical maximum would still remain at three.
- **E) 3**: Three water molecules would be generated during **dehydration synthesis** when building the phospholipid, not when dismantling it.

34 **A liver cell in the metaphase of mitosis can be identified as being eukaryotic because it has:**

1. mitochondria
2. ribosomes
3. a nucleus

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

Correct answer: B

To distinguish a eukaryotic cell from a prokaryotic one, we must identify structures exclusive to eukaryotes. **mitochondria** are membrane-bound organelles found only in eukaryotes. **ribosomes** occur in both domains and cannot differentiate them. During **metaphase** the nuclear envelope disassembles, so a discrete nucleus is not visible. Therefore, only mitochondria reliably mark the cell as eukaryotic.

Why the other answers are wrong

- **A) 2 and 3 only**: Omits mitochondria and incorrectly combines two unreliable markers: non-diagnostic ribosomes and a temporarily absent nucleus.
- **C) 1 and 2 only**: Includes ribosomes, which are universal cellular components and provide no diagnostic distinction between prokaryotes and eukaryotes.
- **D) 1, 2 and 3**: Repeats the same errors as Answers A and B by including universal ribosomes and a metaphase-invisible nucleus alongside the correct marker.
- **E) 1 and 3 only**: Relies on a nucleus, which cannot be observed during metaphase because the nuclear envelope has already broken down.

35 **In which of the following stages of mammalian respiration is CO_2 released?**

1. Glycolysis
2. Anaerobic respiration
3. Krebs cycle

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

Correct answer: E

Cytosolic **glycolysis** splits glucose into two **pyruvate** molecules without losing carbon atoms. Mammalian anaerobic respiration converts pyruvate to lactate via a **redox** change that lacks **decarboxylation**. The Krebs cycle executes oxidative decarboxylations in the mitochondrial matrix, ejecting two CO_2 molecules per turn. Therefore, only stage 3 generates CO_2.

Why the other answers are wrong

- **A) 2 and 3 only**: Incorrectly pairs anaerobic respiration with the Krebs cycle; only the Krebs cycle releases CO_2.
- **B) 2 only**: Lactate fermentation reduces pyruvate to lactate using $NADH$ without cleaving carbon bonds, yielding no CO_2.
- **C) 1 and 2 only**: Combines glycolysis and anaerobic respiration; both pathways lack decarboxylation steps in mammals and produce no CO_2.
- **D) 1 only**: Glycolysis retains all six carbons from glucose within the two pyruvate products, so zero CO_2 is generated.

36 **Which one of the following molecules is made in both photosynthesis and respiration?**

A Reduced NADP
B Glucose
C Carbon dioxide
D Oxygen
E ATP

Correct answer: E

Both processes produce **ATP** by chemiosmotic phosphorylation of ADP. Photosynthesis makes ATP by **photophosphorylation** in the light-dependent reactions. Respiration produces it by substrate-level phosphorylation and, especially, **oxidative phosphorylation** in mitochondria or across prokaryotic plasma membranes.

Why the other answers are wrong

- **A)** Reduced NADP, NADPH, is formed in the light reactions and provides reducing power for the Calvin cycle. Respiration uses the reduced coenzymes NADH and $\mathrm{FADH_2}$ instead, so it does not produce reduced NADP.
- **B)** Glucose is produced in photosynthesis during the Calvin cycle, but respiration consumes and breaks it down rather than synthesising it.
- **C)** Carbon dioxide, $\mathrm{CO_2}$, is released during the Krebs (citric acid) cycle of respiration. Photosynthesis removes and fixes carbon dioxide rather than producing it.
- **D) Oxygen**: Molecular oxygen is generated by **photolysis** of water in the light reactions. Respiration consumes oxygen as the final electron acceptor and does not generate it.

37 **Which of the following comes immediately after anaphase in mitosis?**

A Prophase
B Metaphase
C Telophase
D Cytokinesis
E Interphase

Correct answer: C

After anaphase, mitosis proceeds to **telophase**. The chromosomes reach opposite poles, de-condense, and become surrounded by newly formed nuclear envelopes, re-establishing two nuclei.

Why the other answers are wrong

- **A) Prophase**: **Prophase** is the first recognizable stage of mitosis, occurring well before metaphase and anaphase, so it cannot follow anaphase.
- **B) Metaphase**: **Metaphase** comes before anaphase, when chromosomes align at the metaphase plate. It does not follow chromosome separation.
- **D) Cytokinesis**: **Cytokinesis** is the physical division of the cytoplasm that creates two daughter cells. It typically begins late in anaphase or during telophase, but is distinct from the mitotic phases and overlaps with or follows telophase rather than replacing it.
- **E) Interphase**: **Interphase** is not a stage of mitosis. It is the period of growth and DNA replication, including the G_1, S, and G_2 phases, and occurs before prophase.

38 **Which statement about ribosomes is NOT correct?**

A Ribosomes are involved in protein synthesis

B **Ribsosomes can carry out transcription**

C Ribosomes can be found in the cytoplasm

D Ribosomes can have RNA associated with them

E Ribosomes can be found on rough endoplasmic reticulum (RER)

Correct answer: B

Ribosomes do not perform **transcription**, a process driven by **RNA polymerase** that copies DNA into RNA. This occurs in the nucleus or nucleoid region. Ribosomes actually execute **translation**, reading mRNA sequences to assemble polypeptide chains. **Why the other answers are not the answer Answer A**: True. Ribosomes decode messenger RNA sequences to build polypeptide chains, serving as the primary machinery for protein synthesis. **Answer B**: True. Binding to the cytosolic side of the endoplasmic reticulum creates its rough texture and directs protein production toward secretion, membranes, and lysosomes. **Answer C**: True. These structures are ribonucleoprotein assemblies containing ribosomal RNA and proteins, while temporarily holding messenger and transfer RNAs during decoding. **Answer E**: True. Unbound particles remain suspended in the cytosol of both cell types to manufacture proteins required within the cellular fluid.

Why the other answers are wrong

39 **A section of one strand of DNA has a base sequence of: ACG-GCT-GGT-TCC Which of the following are correct?**

1. The other DNA strand would include a CGA triplet
2. If adenine always binds with 2 H bonds to its complementary base and guanine with 3 H bonds, then each of these triplets will have a total of 8 H bonds
3. The mRNA sequence transcribed from this DNA sequence would contain 3 uracil bases

A 2 and 3 only

B **1 and 2 only**

C 2 only

D 3 only

E 1 only

Correct answer: B

The provided sequence acts as a **template** for synthesis. Standard **base pairing** links adenine to thymine with two hydrogen bonds and guanine to cytosine with three. Summing these interactions across every triplet yields exactly eight bonds per codon. Transcription reads this strand to generate mRNA, which contains only one **uracil** instead of three.

Why the other answers are wrong

- **A) 2 and 3 only**: Combines the valid statement 2 with the false statement 3, invalidating the pair.
- **C) 2 only**: Overlooks statement 1, which accurately identifies the complementary DNA triplet.
- **D) 3 only**: Selects statement 3, which incorrectly predicts three uracil bases in the transcript.
- **E) 1 only**: Excludes statement 2, which correctly calculates the bond total for each triplet.

40 **The direct product of transcription of recombinant DNA can be:**

A insulin
B monoclonal antibodies
C **mRNA**
D the primary structure of a protein
E a replicate DNA molecule

Correct answer: C

During **transcription**, RNA polymerase reads a DNA template to synthesize a complementary RNA strand. This mechanism applies equally to recombinant DNA sequences. The immediate molecular output is specifically **mRNA**.

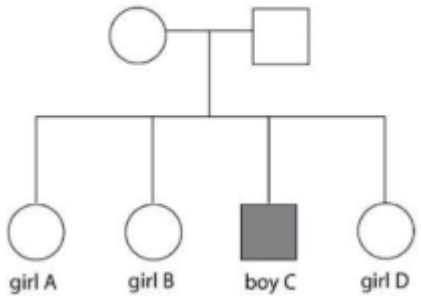
Why the other answers are wrong

- **A) insulin**: Insulin is a polypeptide hormone synthesized during **translation**. Ribosomes assemble its amino acid chain before independent folding and enzymatic processing occur.
- **B) monoclonal antibodies**: Monoclonal antibodies are proteins constructed from heavy and light polypeptide chains. These chains originate from ribosomal synthesis and require further chemical modification inside the endoplasmic reticulum and Golgi apparatus.
- **D) the primary structure of a protein**: The primary structure defines a linear amino acid sequence within a protein. Ribosomes generate this sequence during protein synthesis rather than producing it through transcriptional mechanisms.
- **E) a replicate DNA molecule**: A duplicate DNA molecule is the exclusive outcome of **DNA replication** driven by DNA polymerases. Transcription exclusively incorporates RNA nucleotides to form RNA transcripts and cannot generate new genetic copies.

41 **The family pedigree shows that boy C has a genetic condition.**

No other member of the family shows the same genetic condition.

Which one of the following could NOT explain why boy C has the condition?



A **Sex-linked dominant condition**
B Mutation
C Sex-linked recessive condition
D Both parents are carriers
E Autosomal recessive condition

Correct answer: A

In an **X-linked dominant** condition, boy C would inherit the mutant allele on his X chromosome from his mother. She would also carry the allele and be affected, but she is unaffected in the pedigree.

Why the other answers are wrong

- **B) Mutation**: A new mutation in boy C could explain why no other family member has the condition.
- **C) Sex-linked recessive condition**: In an **X-linked recessive** condition, a carrier mother can be unaffected. A son who inherits her mutant X chromosome would be affected, while daughters would be much less likely to be affected because they would need two mutant X chromosomes.
- **D) Both parents are carriers**: If the condition were autosomal recessive, both parents could be healthy carriers. They would have a 25% chance of having an affected child who is homozygous for the recessive allele, which fits the pedigree.
- **E) Autosomal recessive condition**: In an **autosomal recessive** condition, unaffected parents can each carry one recessive allele. Their son could inherit both mutant copies and be affected, while his sisters might inherit one copy or none.

42 **The increase in the frequency of one phenotype in a wild population of fish could be due to:**

1. an advantageous mutation.
2. increased reproductive success of individuals with that phenotype.
3. a change in the environment.

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

Correct answer: E

The frequency of a phenotype increases when its carriers contribute more offspring to the next generation than other individuals. An **advantageous mutation** introduces or enhances traits that improve survival or reproduction. **Increased reproductive success** allows existing carriers to produce larger offspring pools naturally. A **change in the environment** alters selective pressures, making specific traits highly favorable under new conditions. Any single factor or their combination drives the observed evolutionary shift.

Why the other answers are wrong

- **A) 3 only**: Attributes the rise exclusively to ecological shifts, omitting the direct impact of genetic mutations or inherent breeding advantages.
- **B) 2 and 3 only**: Merges reproductive output with external conditions but excludes how novel mutations originate entirely new phenotypic variations.
- **C) 1 only**: Restricts the mechanism to mutations alone, disregarding how differential reproduction or habitat shifts independently raise carrier proportions.
- **D) 1 and 2 only**: Connects genetic changes with breeding rates while ignoring how abiotic or biotic transitions independently trigger rapid population adjustments.

43 **Which one of the following is found below the diaphragm in a human?**

A Heart
B Alveoli
C **Liver**
D Pulmonary artery
E Pulmonary vein

Correct answer: C

The diaphragm is a dome-shaped sheet of skeletal muscle that separates the **thoracic cavity** from the abdominal cavity. The **liver** is a large abdominal organ that occupies most of the right upper quadrant and lies immediately beneath the right hemidiaphragm.

Why the other answers are wrong

- **A) Heart**: The heart is housed in the mediastinum of the thoracic cavity, directly above the central tendon of the diaphragm. Although it sits against the diaphragm, it is not located below it.
- **B)** Alveoli are microscopic air sacs inside the lungs where gas exchange occurs. The lungs lie in the thoracic cavity, on the superior surface of the diaphragm, not below it.
- **D) Pulmonary artery**: The pulmonary arteries leave the right ventricle and run entirely within the thoracic cavity, above the diaphragm, carrying deoxygenated blood to the lungs.
- **E) Pulmonary vein**: The pulmonary veins return oxygenated blood from the lungs to the left atrium. They are located in the thoracic cavity, above the diaphragm.

44 **Which one of the following is not involved in defending the body against infection?**

A B cell
B **Beta cell**
C Antibodies
D T cell
E Phagocyte

Correct answer: B

Beta cells reside in the pancreatic islets of Langerhans. They synthesize and secrete **insulin** to maintain blood glucose homeostasis. These endocrine structures operate outside the **immune system** and do not participate in infection defense.

Why the other answers are wrong

- **A) B cell**: B lymphocytes identify specific antigens and differentiate into plasma cells. They generate targeted humoral protection during adaptive responses.
- **C) Antibodies**: Immunoglobulins bind directly to pathogen surfaces to block invasion. This binding event also tags microbes for clearance by professional scavengers.
- **D)** T cells regulate cellular protection and synchronize broader immune signals. Helper variants coordinate activation, whereas cytotoxic subsets eliminate compromised host cells.
- **E) Phagocyte**: Resident defenders like neutrophils and macrophages execute direct ingestion of invaders. Phagocytic activity provides rapid mechanical clearance of bacteria and tissue debris.

CHEMISTRY

45 **Which name of the following phase changes is NOT correct?**

A Gas to liquid = Condensation

B Solid to liquid = Melting

C Liquid to gas = Evaporation

D Solid to gas = Sublimation

E Gas to solid = Freezing

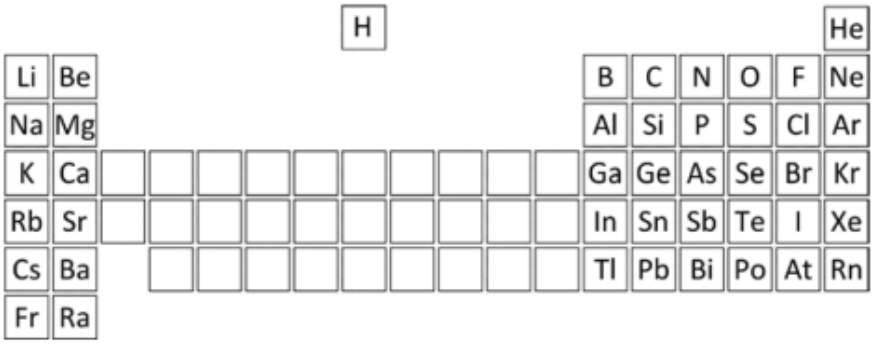
Correct answer: E

Freezing is the change from liquid to solid, so it does not describe gas changing to solid. That change is called **deposition**, sometimes desublimation. **Why the other answers are not the answer Answer A**: Melting is the accepted term for the transition from solid to liquid. **Answer B**: Sublimation is the direct change from solid to gas without passing through the liquid phase. **Answer C**: Condensation is the process by which a gas becomes a liquid. **Answer D**: Evaporation describes the change from liquid to gas. Vaporization or boiling may also describe this change, depending on the conditions.

Why the other answers are wrong

46 **The positions of the main group elements in the Periodic Table are shown below:**

Which one of the following formulae is NOT correct?



A $CsNO_3$
B $GaCO3$
C $Ba\,(HCO_3)_2$
D SnS_2
E $BeSO_4$

Correct answer: B

Gallium belongs to **Group 13** and typically releases a Ga^{3+} cation, whereas carbonate is the CO_3^{2-} anion. Stable ionic compounds must exhibit a net electric charge of zero. Balancing these valences requires two gallium ions (+6 total) combined with three carbonate ions (-6 total), which yields $Ga_2(CO_3)_3$. Proposing $GaCO_3$ leaves an unbalanced positive charge and breaks fundamental charge balance rules. **Why the other answers are not the answer Answer A**: Cesium resides in Group 1 and forms a singly charged Cs^+ ion. Nitrate carries a single negative unit (NO_3^-). These opposite charges cancel perfectly in a one-to-one ratio, making $CsNO_3$ chemically sound. **Answer B**: Barium is a Group 2 alkaline earth metal that produces Ba^{2+}. Bicarbonate bears a charge of -1 (HCO_3^-). Two bicarbonate anions are mathematically required to neutralize one barium cation, confirming the stoichiometry of $Ba(HCO_3)_2$. **Answer C**: Beryllium behaves as a light divalent metal in Group 2, generating Be^{2+}. Sulfate features an identical -2 charge (SO_4^{2-}). Matching magnitudes allow a direct pairing without subscripts, validating $BeSO_4$. **Answer D**: Tin possesses variable oxidation states; here it operates as Sn^{4+}. Each sulfide ion supplies -2 (S^{2-}). Doubling the sulfide component exactly offsets the +4 magnitude of tin(IV), proving SnS_2 correct.

Why the other answers are wrong

48 **The following are some compounds of nitrogen:** $\mathrm{NOCl}, \mathrm{KNO_2}, \mathrm{NO_2}, \mathrm{NO_2Cl}, \mathrm{Ca\,(NO_3)_2}$

What oxidation numbers are shown by nitrogen in these compounds?

A 4, 5, 6
B 2, 3, 4, 5
C **3, 4, 5**
D 3, 4, 5, 6
E 2, 3, 4, 5, 6

Correct answer: C

To determine the **oxidation numbers** of nitrogen, apply standard **assignment rules** ($\mathrm{O} = -2$, $\mathrm{Cl} = -1$, $\mathrm{K} = +1$, $\mathrm{Ca} = +2$) and set the **algebraic sum** to zero for neutral molecules or to the ion charge. 1. NOCl : $x + (-2) + (-1) = 0 \Rightarrow x = +3$ 2. $\mathrm{KNO_2}$: $(+1) + x + 2(-2) = 0 \Rightarrow x = +3$ 3. $\mathrm{NO_2}$: $x + 2(-2) = 0 \Rightarrow x = +4$ 4. $\mathrm{NO_2Cl}$: $x + 2(-2) + (-1) = 0 \Rightarrow x = +5$ 5. $\mathrm{Ca(NO_3)_2}$: $x + 3(-2) = -1 \Rightarrow x = +5$ Nitrogen exhibits only $+3$, $+4$, and $+5$ across these compounds.

Why the other answers are wrong

- **A) 4, 5, 6**: Misses the valid state $+3$ found in NOCl and $\mathrm{KNO_2}$, while incorrectly substituting it with $+6$.
- **B) 2, 3, 4, 5**: Includes $+2$, which does not match any of the five calculated results and is absent in the provided list.
- **D) 3, 4, 5, 6**: Introduces $+6$, an oxidation state that never appears in these nitrogen compounds and exceeds the highest calculated value.
- **E) 2, 3, 4, 5, 6**: Adds both non-existent states $+2$ and $+6$ to the correct set, completely misrepresenting the observed oxidation range.

49 **Which of the following are correct about carbon to carbon bonds?**

1. The length of carbon to carbon bonds increases in the order C≡C, C=C, C-C
2. The strength of the C=C bond is less than twice the strength of the C-C bond
3. The carbon atoms are joined by six electrons in the C≡C bond

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

Correct answer: C

All three statements are correct. Bond lengths increase from $\mathrm{C} \equiv \mathrm{C}$ to $\mathrm{C} = \mathrm{C}$ to $\mathrm{C} - \mathrm{C}$, approximately $120\ \mathrm{pm}$, $134\ \mathrm{pm}$, and $154\ \mathrm{pm}$. The $\mathrm{C} = \mathrm{C}$ **bond energy** is about $614\ \mathrm{kJ\,mol^{-1}}$, less than twice the $\mathrm{C} - \mathrm{C}$ value of about $348\ \mathrm{kJ\,mol^{-1}}$. A triple bond shares **six electrons**, or three pairs.

Why the other answers are wrong

- **A) 1 and 3 only**: It omits statement 2. The $\mathrm{C} = \mathrm{C}$ bond energy, about $614\ \mathrm{kJ\,mol^{-1}}$, is less than twice the $\mathrm{C} - \mathrm{C}$ bond energy, about $2 \times 348 = 696\ \mathrm{kJ\,mol^{-1}}$.
- **B) 1 and 2 only**: It omits statement 3, which is true because a triple bond consists of three shared electron pairs, giving six shared electrons.
- **D) 3 only**: It omits statements 1 and 2, both of which are true. Bond lengths increase in the stated order, and the $\mathrm{C} = \mathrm{C}$ bond energy of about $614\ \mathrm{kJ\,mol^{-1}}$ is less than twice the $\mathrm{C} - \mathrm{C}$ value of about $348\ \mathrm{kJ\,mol^{-1}}$.
- **E) 2 and 3 only**: It omits statement 1, which is true: the lengths increase from about $120\ \mathrm{pm}$ for $\mathrm{C} \equiv \mathrm{C}$ to $134\ \mathrm{pm}$ for $\mathrm{C} = \mathrm{C}$ and $154\ \mathrm{pm}$ for $\mathrm{C} - \mathrm{C}$. Confusing bond length with bond strength could lead to judging this statement incorrectly.

52 **Which of the following must be correct about organic isomers?**

1. They have the same molecular formulae
2. Their physical properties are very similar
3. They have different structural formulae

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

Correct answer: E

Isomers have the **same molecular formula** but are not identical: their atoms differ either in bonding order (structural or constitutional isomers) or in three-dimensional arrangement (stereoisomers). When a structural formula includes the details that distinguish molecules, isomers have **different structural formulae**; if every structural detail were identical, they would be the same molecule. Statement 2 is **not guaranteed**: pentan-1-ol (b.p. 138 °C) and methyl-butan-1-ol (b.p. 128 °C) have fairly similar boiling points, as do o-xylene (144 °C) and p-xylene (138 °C), whereas cis- and trans-but-2-ene differ by more than 10 °C in boiling point; enantiomers often have identical melting and boiling points but completely different optical activity.

Why the other answers are wrong

- **A) 1, 2 and 3**: It includes the incorrect blanket claim in statement 2, so the option is wrong even though it contains the two correct statements.
- **B) 1 and 2 only**: It includes statement 2, which is not necessarily true, and omits statement 3, which is obligatory.
- **C) 2 and 3 only**: It omits statement 1, since isomers must have the same molecular formula, and includes statement 2, which is not guaranteed.
- **D) 1 only**: It misses statement 3, which is also obligatory: isomers must differ in some structural detail.

53 **In the expressions below:**

g = gravitational acceleration;
h = height;
m = mass;
R = electrical resistance;
t = time;
v = velocity;
V = voltage.

Which of the following expressions have units of power?

1. $\frac{mv^2}{2t}$
2. $\frac{V^2}{R}$
3. $\frac{mgh}{t}$

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

Correct answer: B

All three expressions simplify to the base SI units for **power** ($\mathrm{kg\,m^2\,s^{-3}}$). 1. The first ratio divides mass and velocity squared by duration, representing kinetic energy per unit **time**. 2. The second ratio derives from the electrical relation $\frac{V^2}{R}$, which equals voltage multiplied by current. 3. The third ratio separates gravitational potential energy by duration, matching mechanical definitions.

Why the other answers are wrong

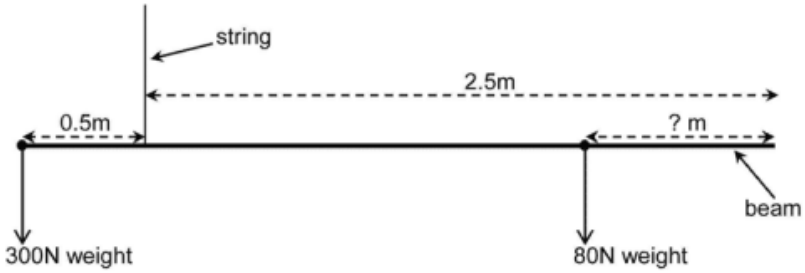
- **A) 1 and 3 only**: It includes the mechanical terms but omits the second expression, which depends solely on resistance and voltage.
- **C) 2 and 3 only**: It accepts the electrical and gravitational forms but wrongly excludes the first expression, which follows standard dimensional analysis.
- **D) 1 and 2 only**: It groups the mechanical and electrical forms but incorrectly discards the third expression involving height and gravity.
- **E) 1 only**: It selects only the first expression while ignoring that the second and third also resolve to watts.

54 **A uniform beam, 3.0m long, of weight 100N has a 300N weight placed 0.50m from one end.**

The beam is suspended by a string 1.0m from the same end.

A diagram of the weights placed on the beam is given below:

How far from the other end must a weight of 80N be placed for the beam to be balanced?



A 1.25m
B 0.125m
C 2.25m
D **0.75m**
E 1.875m

Correct answer: D

Take the string as the **pivot**, at $1.0\ \mathrm{m}$ from the left end. The $300\ \mathrm{N}$ weight is $0.50\ \mathrm{m}$ to its left, producing a counterclockwise moment of $+150\ \mathrm{N\,m}$. The beam's $100\ \mathrm{N}$ weight acts $0.50\ \mathrm{m}$ to its right, producing a clockwise moment of $-50\ \mathrm{N\,m}$. 1. If the $80\ \mathrm{N}$ weight is d from the right end, it is $2.0 - d$ from the pivot and produces a clockwise moment. 2. Set the moments to zero: $150 - 50 - 80(2.0 - d) = 0$. 3. Thus, $100 = 80(2.0 - d)$, so $2.0 - d = 1.25$ and $d = 0.75\ \mathrm{m}$.

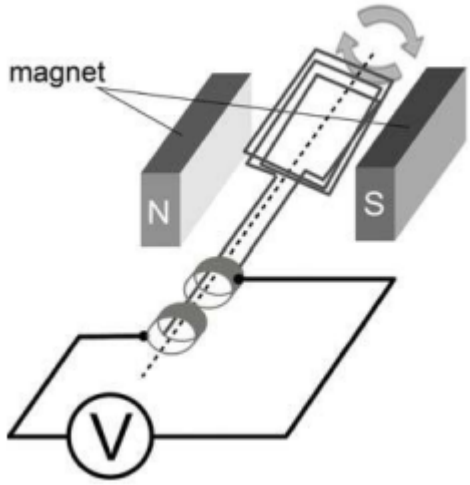
Why the other answers are wrong

- **A) 1.25m**: 1.25 is the value of $2.0 - d$, the weight's distance from the pivot, not its distance d from the right end.
- **B) 0.125m**: This distance is too small and would leave unbalanced torques. Only $0.75\ \mathrm{m}$ satisfies the equilibrium condition.
- **C)** $2.25\ \mathrm{m}$ is the weight's position measured from the left end, calculated as $3.0 - 0.75$. The question asks for its distance from the right end.
- **E) 1.875m**: No moment balance gives this value. It does not satisfy the equation $100 = 80(2.0 - d)$.

55 **In an AC (alternating current) generator, a coil of wire rotates in a magnetic field.**

Which of the following would change the potential difference measured by the voltmeter in the system above?

1. Use more turns of wire in the coil
2. User thicker wire
3. Change the speed of rotation



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

Correct answer: A

The induced **emf** follows Faraday's Law: $\varepsilon = N\frac{d\Phi}{dt}$. Increasing the **number of turns** directly raises the voltage. Changing the **angular speed** alters how fast the magnetic flux changes, also increasing the voltage. Wire thickness only affects **electrical resistance**, which determines current under load, not the **open-circuit voltage** measured by the voltmeter.

Why the other answers are wrong

- **B) 2 only**: Selecting only thicker wire is incorrect because reducing resistance does not alter the induced emf or the measured voltage.
- **C) 1 and 2 only**: Combining turns with wire thickness is invalid because the gauge of the conductor has no impact on the generated potential difference.
- **D) 3 only**: Relying solely on rotation speed is incomplete, since adding more turns independently produces the same effect on the voltage.
- **E) 1, 2 and 3**: Including all three factors overstates the case, as the wire thickness influences current capacity rather than the fundamental induced voltage.

56 **A mass is connected to a spring and it vibrates up and down, forming a simple harmonic system.**

Which of the following are correct?

1. The kinetic energy of the mass is at a maximum half way up.
2. The potential energy of the system is at a maximum at the top of the mass's motion.
3. The potential energy of the system is at a maximum at the bottom of the mass's motion.

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

Correct answer: B

The total mechanical energy remains constant throughout the oscillation. Kinetic energy $K = \frac{1}{2}mv^2$ peaks at the **equilibrium position** where velocity is greatest. Potential energy $U = \frac{1}{2}kx^2$ scales with **displacement squared** and therefore maximizes at both the highest and lowest extremes. All three statements correctly map to these physical principles.

Why the other answers are wrong

- **A) 1 only**: Incorrect because it excludes both vertical extremes where potential energy dominates. Kinetic energy drops to zero exactly where potential energy reaches its peak values.
- **C) 1 and 2 only**: Incorrect because it misses that elastic potential energy also reaches its maximum at the bottom turning point. The spring stores equal potential energy at both vertical extremes.
- **D) 2 only**: Incorrect because it disregards the kinetic energy maximum located halfway along the path. Potential energy is not unique to the top since the system achieves identical maximum storage at the bottom.
- **E) 3 only**: Incorrect because it overlooks the top extreme where potential energy peaks. It also omits the central region where velocity and kinetic energy are largest.

58 **Which of the following is the equation of the circle with centre (-1.5, 0.5) and radius 3?**

A $2x^2 - 6x + 2y^2 + 2y - 13 = 0$

B $2x^2 + 6x + 2y^2 - 2y - 14 = 0$

C $2x^2 + 6x + 2y^2 - 2y - 13 = 0$

D $2x^2 - 6x + 2y^2 - 2y - 13 = 0$

E $2x^2 + 6x + 2y^2 - 2y - 23 = 0$

Correct answer: C

1. The **standard form** uses $(x-h)^2 + (y-k)^2 = r^2$. 2. Insert the coordinates $h = -1.5$ and $k = 0.5$ alongside $r = 3$. 3. Expand the squares to obtain $x^2 + 3x + 2.25 + y^2 - y + 0.25 = 9$. 4. Combine constants to simplify the expression to $x^2 + y^2 + 3x - y - 6.5 = 0$. 5. Multiply the entire equation by 2 to align with the provided choices.

Why the other answers are wrong

- **A)** $2x^2 - 6x + 2y^2 + 2y - 13 = 0$: The positive coefficient for y indicates a vertical shift downward, placing the center at -0.5 instead of $+0.5$.
- **B)** $2x^2 + 6x + 2y^2 - 2y - 14 = 0$: The constant -14 shrinks the circle, producing $r^2 = 7$ and a value near 2.65 instead of 3.
- **D)** $2x^2 - 6x + 2y^2 - 2y - 13 = 0$: The negative coefficient for x places the horizontal center at $+1.5$ instead of -1.5.
- **E)** $2x^2 + 6x + 2y^2 - 2y - 23 = 0$: The constant -23 forces the radius to expand, yielding $r^2 = 19$ and a value near 4.36 rather than 3.

59 **What is the set of values for which $12 - x^2 > 8$ and$2x + 3 \geq 5$?**

A $-1 \leq x < 2$

B $1 \leq x < 2$

C $2 < x$

D $1 \leq x$

E $1 < x \leq 2$

Correct answer: B

1. Subtract 8 from $12 - x^2 > 8$ to obtain $4 > x^2$, which means $-2 < x < 2$. 2. Isolate x in $2x + 3 \geq 5$ to get $x \geq 1$. 3. Find the **intersection** of both conditions: $(-2, 2) \cap [1, \infty) = [1, 2)$, so $1 \leq x < 2$.

Why the other answers are wrong

- **A)** $-1 \leq x < 2$: It starts at -1, including numbers like $x = 0$ that violate $2x + 3 \geq 5$.
- **C)** $2 < x$: It keeps only values larger than 2, where $12 - x^2 \leq 8$ breaks the first condition.
- **D)** $1 \leq x$: It accepts all $x \geq 1$, so any number like $x = 3$ makes $12 - x^2 < 8$ and fails the first inequality.
- **E)** $1 < x \leq 2$: It permits $x = 2$, but at this point $12 - 4 = 8$ is not strictly greater than 8. It also removes $x = 1$, which actually satisfies both inequalities.

60 **The diagram shows a quarter of a circle surrounded by an isosceles triangle. The radius of the circle is r.**

Which one of the following expressions represents the unshaded area?



A $r^2 - \frac{\pi r}{2}$
B $\left(2 - \frac{\pi}{4}\right) r^2$
C $(4 - \pi) r^2$
D $r^2 - \frac{\pi r^2}{2}$
E $\left(1 - \frac{\pi}{4}\right) r^2$

Correct answer: E

The diagram features an **isosceles right triangle** whose legs have length $L = r\sqrt{2}$, giving a total area of $\frac{1}{2}L^2 = r^2$. Subtracting the **quarter-circle area** $\frac{\pi r^2}{4}$ from the triangle yields the **unshaded region**: $r^2 - \frac{\pi r^2}{4} = \left(1 - \frac{\pi}{4}\right) r^2$.

Why the other answers are wrong

- **A)** $r^2 - \frac{\pi r}{2}$: It suffers from a dimensional error because the second term scales linearly with r (a length) instead of quadratically with r^2 (an area).
- **B)** $\left(2 - \frac{\pi}{4}\right) r^2$: It wrongly assumes the triangle area equals $2r^2$, effectively adding an extra r^2 before subtracting the circular sector.
- **C)** $(4 - \pi) r^2$: This expression would arise if the triangle had an area of $4r^2$, which does not correspond to any configuration shown in the diagram.
- **D)** $r^2 - \frac{\pi r^2}{2}$: It incorrectly subtracts a half-circle area $\frac{\pi r^2}{2}$ rather than the quarter-circle sector actually depicted.

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