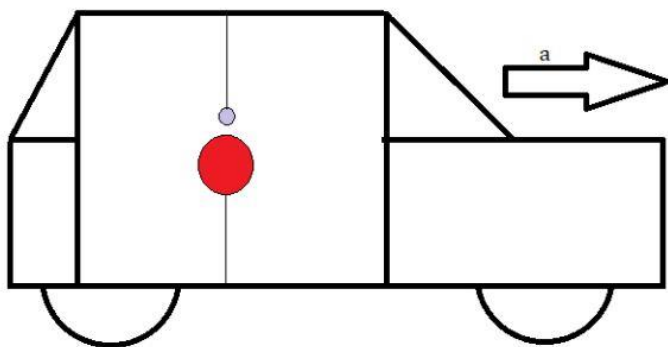# Quadspark (Prelims): Sample Questions

Paper 1 (Science): Sample Questions

Question No. 1 (Physics)

A helium balloon (red) and a mass weighing 20 g (grey) is attached above and below, in a car as shown in the fig. When the car accelerates, what do you think will happen?

(i) The balloon and the weight move forward.
(ii) The balloon and the weight move backward.
(iii) The balloon moves forward while the weight moves backward.
(iv) The balloon moves backward while the weight moves forward.

Answer: (iii) The metal bob moves backward due to inertia, while the balloons move forward due to the fact that the air in the vehicle moves backward due to inertia, resulting in a density difference along the horizontal direction within the car. This causes the air in the back of the car to be denser, hence pushing the balloon forward. This occurs because the force due to compression of the air inside the car is greater than the inertia possessed by the balloon.

Question No. 2 (Chemistry)

Nickel is generally present as a sulphide in its ores. The concentrated ore is smelted in the presence of silica and oxygen present in the air, thereby, removing the iron sulphides present as impurities. Copper impurities are separated mechanically. The nickel sulphide is then roasted in air which on treatment with water gas (CO and H2) gives a volatile complex which is thermally decomposed to produce pure nickel.

Based on the above information, consider the following options.

(i) Both CO and H2 from water gas are capable of acting as reducing agents
(ii) Iron is removed as an impurity in the form of Fe2SiO3
(iii) Only CO from water gas reduces the Ni ions
(iv) Iron is removed as an impurity in the form of FeSiO3

A, C and D (From Theory)

Question No. 3 (Biology)

Genome sequencing reveals that the genome of species A and B is 69% similar and that of species C and A is 79% similar.
(For i to iii) Both species A and B can fly and have wings, but species C does not fly, but possesses rudimentary (ill-developed) wings.
 Choose the most appropriate statement(s):
(i) If Species A is found in the rainforests of Amazon and Species B is found in the rainforests of Africa, then the species B is more closely related to species A than species C.
(ii) If Species A is found in the rainforests of Africa and Species B is found in the deserts of Africa, then species A and C are more closely related than the species A and B.
(iii) If Species A is found in the rainforests of Africa and Species B is found in the deserts of Africa, then species A and B are more closely related than the species A and C.
(iv) If Species A is found in Australia and Species B is found in South America, and species A, B and C are plant species, then the species A and B are more closely related than the species A and C.

Ans: (ii), Species A and C are genetically more related than the species A and B. Hence, they are more closely related to each other. The % difference between species and not their habitat decides how related they are, phylogenetically.

Paper 2 (Mathematics): Sample Questions

Question No. 1

At home, Sita uses two glasses to dissolve sugar in milk where she continuously shifts (completely pours) the milk in two glasses alternatively. Assume one glass is cylindrical and other is conical. While she shifts the milk into conical glass, 25% of milk falls out (& is wasted) but nothing falls out when she shifts into cylindrical glass (No wastage).Initial height of milk in cylinder is 256mm. Record the height of milk (for 5 complete shifts including initial) every time when milk is shifted into cylinder.

Height 1 : Initial Height of milk in cylinder
Height 2 : Height of milk in cylinder after 1st shift

...

Height 5 : Height of milk in cylinder after 4th shift
Out of these 5 heights,find probability of heights which are multiples of 24?

(i) 4/5
(ii) 1/5
(iii) 2/5
(iv) None of the above

25% of milk is wasted.
V' = 3V/4 => h' = 3H/4
H1 = 256 = 4^4
H2 = 256*3/4 = 4^3 * 3
H3 = 256*3/4*3/4 = 4^2 * 3^2
H4 = 256*3/4*3/4*3/4 = 4 * 3^3
H5 = 256*3/4*3/4*3/4*3/4 = 3^4

Multiple of 24: H1 & H2 are multiples of 24
P = 2/5

Question No. 2

Consider the set S of all real numbers which are greater than or equal to 1.

Define two operations $(+')$ and $(.')$ on this set S, as follows:

$x(+')y = log_2(x*y+1)$ and $x(.')y = sqrt(x*x + y*y - 1)$, where x and y are two elements of the set S. * is the usual multiplication and + is the usual addition. - is the usual subtraction.

$x*x$ means the square of x and $sqrt(z)$ means the familiar square-root of z. $log_2(a)$ means log of a, with the base 2.

Define the identity of a binary operation (for this question) to be an element of the set on which the operation is defined (call it A), such that when the operation is applied on that element and any other element c of the set A, the value of c remains unchanged.

The value of the identity should be independent of the choice of c. (Example, 0 is the identity for the usual addition defined on real numbers and 1 is the identity for the usual multiplication defined on real numbers, as per the above definition.) What is the identity of $(+')$ and $(.')$ operations defined on the set S, respectively ?

(i) (1,2)
(ii) (2,9)
(iii) (1, Does Not Exist)
(iv) None of these

By the definition of an identity of $(+')$, if y is an identity of $(+')$, then given an x in the set S,

X $(+')$ y = x

So, log_2 (x*y +1) = x

X*y +1 = 2^(x).

So, y = (2^(x) − 1)/ x.

Y depends on x.

However, as per a statement in the question, the identity should be unique, that is, independent of the choice of the x. **Hence, the identity of $(+')$ does not exist.**

If y is an identity of the operation (.'), then x(.')y = x (by definition), x is in S.

So, x = sqrt (x*x + y*y - 1).

On squaring both sides, x*x = x*x + y*y -1,

So, y = 1 or -1 work.

However, only y = 1 is an admissible solution.

As the solution is independent of the choice of x,

1 is an identity of the operation (.')

Hence, the answer should be **(Does not exist, 1)**

i.e., **option (iii).**

Paper 3 (Reasoning): Sample Questions

Question No. 1

An ironsmith is cutting an iron pipe into equal pieces. To make 3 equal pieces, he takes 10 minutes. To make 15 equal pieces, time required in minutes is? (The cuts are perpendicular to the axis of the pipe)

Ans: 3 pieces means 2 cuts, which takes 10 minutes.
15 pieces means 14 cuts, which will take 10*7 = 70 minutes.

Question No. 2

There exists a strange mirror. When an object is placed in front of it, the curved parts of the object are shown straight in the image, while the straight parts are shown as curved
For e.g., When letter U is placed, the image formed is like this:
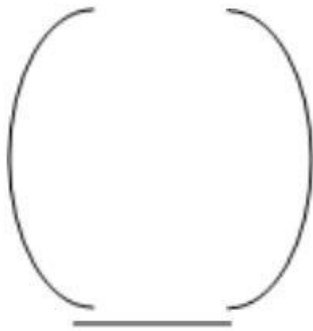
If the word SPARK is placed in front of the mirror, then how many straight lines will be there in the image.
[The conversion of straight lines to curved take place in such a way such that the letter remain identifiable]
(i) 3
(ii) 5
(iii) 7
(iv) 9

Answer: (iii) 7,

From the above picture, it can be seen that the mirror image has 7 straight lines.

Paper 4 (Out of the Box): Sample Questions

Question No. 1

Let's presume there is such an island, which is inhabited by two tribes, the Atans and the Betans. The Atans are known all over the world to be inveterate liars, while a Betan always tells the truth. During one stormy night, a ship has run aground near the island. At dawn a man from the ship approaches the island in a rowboat and in the mist sees a group of three men. Knowing the bad reputation of one of the two tribes he wants to find out which of the two he will have to deal with. So, he addresses the first man on the shore and asks him whether he is an Atan or a Betan. The man's answer is lost in the roaring of the breakers. However, the man in the boat understands what the second man yells across the surf: "he says he is a Betan. He is one and so
am I." Then the third man points at the first and yells: "That is not true. He is an Atan and I am a Betan."

What is the number of possible combinations of people according to above?
Answer: 2
Since the first person will always say he is a Betan, even though he is an Atan, because Atans always lie. Now, the second person confirms that he is the same as the first person and that they both are Betans. This is possible in two cases – When both first and second person are Betans, and when both first and second person are Atans, and they both are saying lies. Now, for the third person, when both first and second person are Betans, he can say that the first person is lying and is an Atan, while he is a Betan, only when he is an Atan because he is lying. So, one possibility is when both first and second person are Betans, while the third is an Atan. Now, consider the second possibility, when first and second person are Atans and they are lying that they are Betans. Then, the third person has to be a Betan, if he says that the first person is an Atan, and he is a Betan, because he is saying the truth. Therefore, there are two possibilities – One where the first two are Betans, and the third is an Atan, and the second possibility when the first two are Atans, and the third is a Betan.

Question No. 2

In the life cycle of a famous genus of spiders, the female spider eats the male spider after being fertilized, and raises the child on its own. Due to its dark coloration and the fact that the female spider is left without a 'husband', this spider genus earns its name. What spiders are we talking about?

Answer: Black Widow