



## APOLLOX

**Total Questions: 35**

**Maximum Marks: 140**

**Marking Scheme: +4,-1**

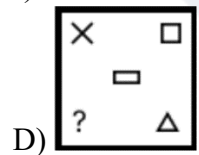
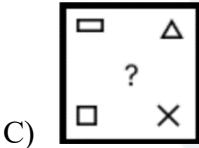
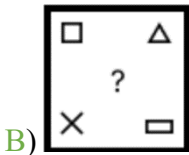
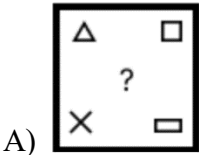
**Duration: 150mins**

# APOLLOX

Q1 Today is a significant day for Ash as he gets to choose his starter Pokemon. Professor Oak arrives at the Cerulean City train station at 6 p.m. to catch a train to his laboratory in Pallet Town. Typically, his granddaughter Daisy leaves from their home in Pallet Town, picks him up at the station at exactly 6 p.m. and drives him home. However, on this particular day, Professor Oak arrives at the station an hour early and starts walking home. Daisy eventually meets him on the road, and together, they get home by car 20 minutes earlier than usual. The distances and speeds are unspecified but constant. How long was he walking? (in minutes)

- A) 50
- B) 20
- C) 60
- D) 30

Q2Ash is guided by Oak to acquire all the Gym Badges. On his first venture, he heads to Pewter City, where he discovers that he must battle Gym Leader Brock. Eager to challenge Brock, Ash finds out that accessing his gym requires a password to unlock the gym gates. Discover the final piece of the puzzle from the options given below



Q3. To access the gym, he must complete the puzzles to prove himself worthy. Ash finds an elevator to the battle arena in Brock's gym, where he needs to place "n" number of rocks on the other side of the elevator to elevate it. The sign on the elevator says, "n! ends in 100 zeroes, put n number of rocks." How many rocks should he put?

- A) 417
- B) 405
- C) 100
- D) 400

Q4 Ash engages in a battle against Brock, during which they confront each other in an arena, shaped as a regular polygon with 'n' sides, each of length 'd'. These sides are labelled consecutively from 1 to n. As part of the Gym ritual, Brock deploys his Pokémon at each vertex, assuming he has enough Pokémon available. At a certain point, all the Pokémon begin chasing each other at equal and constant speeds denoted as 'v'. The chase unfolds as follows: the Pokémon at vertex 1 pursues the one at vertex 2, who, in turn, chases the Pokémon at vertex 3, and so forth. Ultimately, the Pokémon at vertex n pursues the one that started at vertex 1. As they change positions, they maintain their targeting direction towards the initial Pokémon that they were chasing. Eventually, all the Pokémon converge at the center of the polygon. How long does this ritual last (in seconds)?

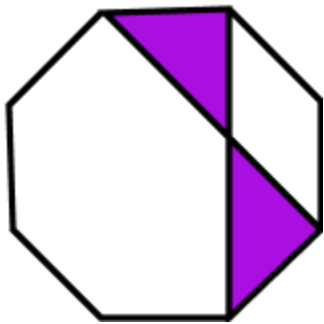
A)  $\sin^2 \frac{\pi}{n}$

B)  $\frac{2}{\sin^2 \frac{\pi}{n}}$

C)  $\frac{3}{\sin \frac{\pi}{n} \cos((\frac{\pi}{2n})(n-2))}$

D)  $\frac{2}{\sin \frac{\pi}{n} \cos((\frac{\pi}{2n})(n-2))}$

Q5. After defeating Brock, delighted by Ash's humility, Brock decides to join him on his adventure. On the way to his next Gym Battle, they arrive in Cerulean City, where they encounter a peculiar path leading to the gym. Ash discovers a unique pattern on the ground, shown below. The password to the gym gate is the value of the perimeter of the given regular octagon that equals the area of the shaded region. What is the password?



- A) 32
- B) 64
- C)  $64\sqrt{3}$
- D)  $32\sqrt{3}$

Q6 On his way to the Cerulean City gym, Ash encounters Gary, who begins to brag about his badges and his Pokémon. With his ego, Gary attempts to break Ash down by saying, 'I'm sure you aren't even competent enough to solve this question, let alone fight and win against me.' The question is given below. Help Ash solve it:

$f : \mathbb{R} \rightarrow \mathbb{R}$ ,  $f(2)=0$  , if successive image of  $f(x)$  about x-axis and  $x=2$  coincide with  $f(x)$ ,then  $f(x-2)$  is:

- A) Even
- B) Odd
- C) Periodic
- D) None

Q7. After defeating Gary, Ash, with his pride held high, is confident about fighting against Misty. Brock suggests he should practice a bit before the battle, but his overconfidence convinces him otherwise. He enters the gym, where he encounters the former master, Jessica, Misty’s elder sister. To challenge the current gym leader, Misty, Jessica presents Ash with the following question. Can you help him solve it?

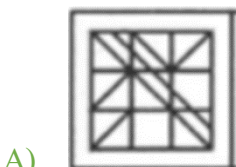
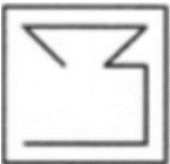
A and B are two sets,  $n(A) = 5$  and  $n(B) = 6$ .  $A_i, B_i$  denote  $i^{\text{th}}$  elements of A and B .  $f: B \rightarrow A$ ,  $P(A_i)$  denotes the number of elements in the pre-image set of  $A_i$

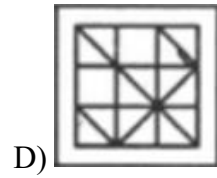
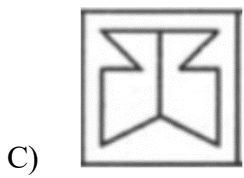
$$M = \prod_{i=1}^5 P(A_i) + \sum_{i=1}^5 P(A_i) \quad \text{where} \quad \prod_{i=1}^n A_i \quad \text{denotes} \quad A_1 * A_2 * A_3 * \dots * A_n.$$

What is  $[\text{Max}(M) , \text{Min}(M)] = ?$

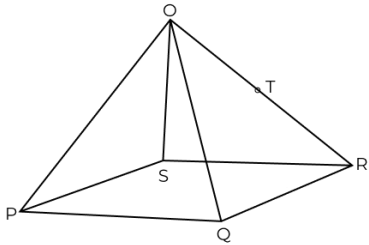
- A) (8,6)
- B) (6,4)
- C) (8,4)
- D) (6,6)

Q8. After her defeat, Misty is fascinated by Ash’s love for his Pokémons and his passion for becoming a Pokémon Master. She goes out to find Ash until she discovers that she is trapped in a room by Team Rocket and all her Pokemons have been stolen. She realizes that the key to the door is in her possession, but she doesn't know where it fits. Can you assist her? In which of the following images, the key pattern(x) is present?





**Q9. After escaping the room, Misty finds herself at top a regular square pyramid. But not just any pyramid—it's the Battle Pyramid, the revered sanctuary where Pokémon Masters refine their skills. Misty realises she must venture inside the pyramid, where Team Rocket has taken her Pokémon captive. As she cautiously enters, she encounters the ancient guardian of the pyramid. He permits entry only to those who can calculate the shortest distance inside its labyrinthine corridors. Can you assist Misty in finding the shortest distance (along the surface of the pyramid) from P to T, where T is the mid-point of OR given that the side length of base square measures 20 units?**



- A)  $10\sqrt{7 + 2\sqrt{3}}$   
 B)  $10\sqrt{7}$   
 C)  $20\sqrt{3}$   
 D)  $10\sqrt{2\sqrt{3}}$

**Q10. Misty needs the 1234th term of a series following the pattern 1, 1, 2, 1, 2, 3, 1, 2, 3, 4, and so on, to unlock the chamber where her Pokémon are held captive by Giovanni, the leader of Team Rocket. She has only one attempt to decipher the constantly updating password. Can you help her find the correct password?**

- A) 52  
 B) 48  
 C) 9  
 D) 8

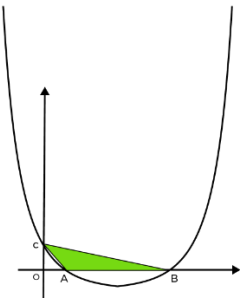
**Q11. After opening the door to the room inside the Battle Pyramid, Misty successfully retrieves her Pokémon. However, her escape attempt is thwarted when Giovanni swiftly captures her, confining her within a cage. The only way to unlock the cage is by solving the following question:**

**Suppose a and b are real numbers such that  $ab \neq 1$ , the equations  $120a^2 - 120a + 1 = 0$  and  $b^2 - 120b + 120 = 0$  hold. Find the value of  $\frac{1 + b + ab}{a}$**

- A) 200  
 B) 270  
 C) 300  
 D) 240

**Q12. Misty manages to escape the cage, but her freedom comes at a cost – she must now prove her worthiness to battle Giovanni. The question he presents to her is:**

"The figure shows a curve with equation  $x^2 + bx + c = 0$  with roots  $\alpha$  and  $\beta$ . The triangle OBC is a right-angled isosceles triangle with AC being a median. If  $\alpha - \beta$  and  $\alpha + \beta$  are roots of  $x^2 - px + 3 = 0$ . Find the value of p."



Answer- 4

Q13. After defeating Giovanni, Misty revels in the satisfaction of teaching him a lesson. She then joins Ash and Brock, her spirits high, ready for the adventures that lie ahead. Giovanni, defeated but not deterred, hastily retreats, hoping to salvage his sinister plans. Upon meeting Ash again, he proposes a challenge, but this time, he tests his intellectual prowess with a question:

$P(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + \dots + a_nx^n$  ;

$a_i = \text{non negative integer, } i \in \{0, 1, 2, 3, \dots, n\}$  ;

$P(1) = 4, P(5) = 136$ ;

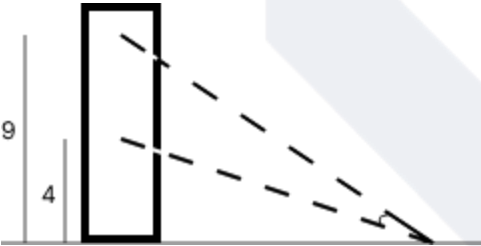
Find  $P(3)$ ?

- a.)34      b.)31      c.)28      d.)37

Q14. Misty and Brock form a deep bond of friendship with Ash. They decide to manoeuvre on this adventure together, relying on the strength of their camaraderie to overcome challenges. Their next mission is to defeat the Electric-type Pokémon master, Lieutenant Surge. However, as they approach the gym, an old man stationed at the gate confronts them. "I am going to ask you a question," he states solemnly. "According to a prophecy, your ability to answer this question will determine your fate in the match. Answer correctly, and victory is yours. Fail, and you are destined to lose." If the equation  $x^4 + ax^3 + 2x^2 + bx + 1 = 0$  ( $a, b \in \mathbb{R}$ ) has a real solution then the minimum value of  $(a^2 + b^2)$

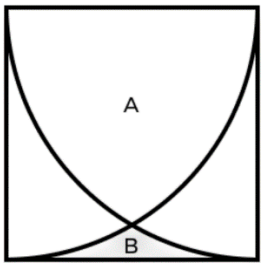
- A.) 2      B.)4      C.)6      D.)8

Q15. Lieutenant Surge stands at top a tower that is 9 meters tall. The tower has a window located 4 meters above the ground where Raichu, Surge's Pokémon is resting. Ash intends to initiate the battle by sending his Poké Ball towards Surge. However, he needs to calculate the optimal distance from the front of the tower, where he is standing, to maximize the difference in the angles of elevation between the two points. Can you assist him in this calculation?



- A) 5      B) 6  
C) 3      D) 10

Q16. Ash sends out his first Pokémon, Pikachu. However, Surge, aiming to test Ash's worthiness, challenges him to find the area of the gym. He mocks, "I am certain you're so incompetent that winning the badge seems out of your reach. I doubt you can even guess the area of this gym where we are currently sitting," and laughs dismissively. Fueled by anger, Ash is determined to prove himself. He seeks assistance in calculating the total area of the Gym in the Region A and B (Assume the given box is a square of side length of 4 units).



- A)  $8 + 4\pi/3 + 4\sqrt{3}$   
 C)  $16 + 8\pi/3 - 8\sqrt{3}$

- B)  $16 + 8\pi/3$   
 D)  $4\pi/3 - \sqrt{3}$

Q17 The mathematician who helped Ash in solving the previous puzzle thought of a way to trick Ash into giving up his Pikachu and challenged Ash to a riddle, Ash accepted the challenge in overconfidence and is now stuck. Help Ash solve the riddle and

save his Pikachu. Given that  $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n} = \log_e 2$

Then find the value of  $\sum_{n=1}^{\infty} \frac{(-1)^n}{n(n+1)}$ .

- a.)  $1 + \log 2$   
 b.)  $2\log 2$   
 c.)  $-1 + \log 2$   
 d.)  $1 - 2\log 2$  (Answer)

Q18. It's nighttime, and Ash decides to take a walk. During his stroll, he stumbles upon a cave near Surge's gym. The cave appears deep and mysterious, but Ash feels unusually confident that day. Intrigued, he decides to venture inside. Upon entering, he encounters an old man guarding the gates. The old man informs Ash that he must solve a question to enter the cave which is rumoured to house a legendary Pokémon. Can you assist Ash in solving the question? Consider:

$$r = \sqrt{\cos x - \sqrt{\cos x - \sqrt{\cos x \dots}}}$$

What is the range of possible values of x such that both  $\log(\sin(\cos^{-1}(x-1)))$  and “r” exists and takes real values.

- A)  $[0, \cos^{-1}(-1/4)]$   
 C)  $(0, \cos^{-1}(-1/4))$   
 B)  $(0, \pi/2)$   
 D) None

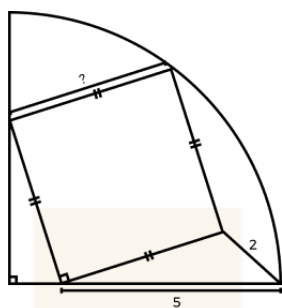
Q19. Ash finds a Pokemon in the caves, Zapdos, one of the flying legendary Pokemons. He decides to catch it and to do that he

must calculate the amount of Experience ( $\alpha$ ) Zapdos has, which varies as  $\alpha = \int \rho dx$  (x is the distance travelled), given that  $\rho = \rho_0 e^{-mgh/Rt}$ , where  $\rho$  is density which has units Kg/m. Also, m, g, h, t has units Kg, m/s<sup>2</sup>, m, s respectively. However, Ash forgets to find the unit of  $\alpha$ . Help him.

- A) Kg m/s  
 B) Kg m/s<sup>3</sup>  
 C) Kg  
 D) Kg<sup>2</sup> m/s



Q20. Ash, excited about catching Zapdos, challenges Misty and Brock to a battle at Squares High in Vermillion City, a public battlefield shaped like a quarter circle with a square inside. Misty taunts Ash, challenging him to guess the length of the square's side. Can you assist Ash in calculating the side length and prove Misty wrong?



(Round off the answer to the nearest integer.)

- A) 2
- B) 4
- C) 3
- D) 6

Q21. Due to Zapdos being a legendary Pokémon, it attracts electric-type Pokémon. All the Pikachu in the area rush towards Zapdos. Zapdos requires a specific number of Thunderstones and Moonstones to get freed from Ash's Pokéball. The number of Pikachu with Thunderstones is twice the number of Pikachu with only Moonstones. Simultaneously, the number of Pikachu with Moonstones is twice the number of Pikachu with only Thunderstones. Which of the following statements is true?

Statement I: The sum of the number of Pikachu that have either Thunderstones or Moonstones or both is four times the number of Pikachu that have both stones.

Statement II: The sum of the number of Pikachu with only Moonstones and the number of Pikachu with only Thunderstones is twice the number of Pikachu that have both stones.

- A) I only
- B) II only
- C) I or II both
- D) Neither I nor II

Q22. Ash, after encountering Zapdos, feels a mix of contentment and disappointment as he has to leave the legendary creature behind. Despite this, he continues his journey to challenge Celadon City's Gym Leader Erika for the Rainbow Badge. On his way, he observes three Bulbasaur – Danny, Vanny, and Blob – with different working patterns. Danny takes m hours for m days, Vanny takes n hours for n days, and Blob finishes the task in 16 hours over 16 days when they are working alone one by one. If Blob were to work alone, he could complete the entire task in 29 days with his usual specific working hours. Now, the question arises: if all three of them work together, each employing their respective working hours, how long will it take for them to complete the job?

- A) 13 days
- B) 14 days
- C) 15 days
- D) 16 days

Q23. Ash arrives at the Grass-type Pokémon Gym to challenge Erica, the Gym Leader. However, before he can engage in a battle, Erica informs him that he must first answer a question. With a determined expression, she states, “Only those worthy of solving this question possess the capability to face me in battle.” Ash is determined to prove his worth and obtain the Rainbow Badge. Erica's question is as follows:

Let there be a set of N natural numbers 1,2,3,4.....N . We are allowed to insert a + or - sign in front of each number and add all the resultant numbers. The minimum non-negative value obtained is denoted as D(N).

Let K be the value of D(1) + D(2)+...+D(19216812112)

What is the sum of digits of K:

- A) 34
- B) 0
- C) 31
- D) 44

Q24. Ash makes his way to Fuchsia City, determined to challenge Koga, the seasoned Poison-type Gym Leader. Navigating through Koga's cunning traps and facing his formidable Poison-type Pokémon, Ash proves his skills and earns the coveted Soul Badge.

However, Gary, always eager to test Ash's abilities, challenges him further. With a sly grin, Gary challenges Ash with a question, doubting his capability to defeat Koga. "If I couldn't do it, how can you?" he taunts.

Now, let's assist Ash in solving the question posed by Gary. :

Let  $x_i$  be a positive integer, for every  $i \geq 1$  and for  $n > 1$

$$x_{n+1} = 1 + \sum_{i=1}^{n-1} x_i x_{i+1}$$
 . If  $x_5 = 36$  and  $x_1 = 1$ . What is the Sum of the digits of the largest prime factor  $x_7$ ?

ANSWER- 10

Q25. Continuing their journey, Ash and his friends proceed to Saffron City, where they encounter the enigmatic Sabrina, a Gym Leader specializing in Psychic-type Pokémon. Sabrina's formidable psychic abilities pose a tough challenge, but Ash's unwavering determination and strategic prowess enable him to engage in a battle and ultimately claim the Marsh Badge.

However, before facing Sabrina, Ash is put to the test. She presents him with a question that he must answer correctly in order to challenge her in battle:

$$I = \int \frac{\tan 3(\ln(x))}{x} dx$$
 Value of  $I$  is?

- A)  $\frac{1}{2} \tan^2(\ln(x)) + c$

B)  $\frac{1}{2} \tan^2(\ln(|x|) - \ln|\cos(\ln|x|)|) + c$  (Answer B)

C)  $\frac{1}{2} \tan^2(\ln(|x|) + \ln|\cos(\ln|x|)|) + c$

D)  $\ln|\cos(\ln|x|)| + c$

Q26. Ash travels to Cinnabar Island to challenge Blaine, aiming for his sixth badge, the Volcano Badge. He meets Blaine's daughter, who reveals a yearly increase in Charmanders residing in the Gym: 5 in 2013, 7 in 2014, 11 in 2015, 17 in 2016, 25 in 2017, and so on. Till 2023, she seeks the total increment of Charmanders starting from 2013. Can you help her calculate this?

- A) 495

B) 545

C) 380

D) 418

Q27. The little girl, impressed with his mathematical skills, decides to present another question. This time, she wants Ash to calculate the number of food bags required to feed the Charmanders. She has a specific formula in mind, which is equal to the sum of a series.

$$S = 2\left(1 + \frac{1}{2!} + \frac{1}{4!} + \frac{1}{6!} + \dots\right)$$

$$S = a^b + c^d$$

Find out  $\ln(a+c) - \ln(b-d)$

Answer - 1



Q28. Excitedly, the little girl informs her father, Blaine, about Ash’s intelligence. Blaine, already impressed, decides to challenge Ash further by posing another question aiming to test Ash’s skills. The question is:

Let  $f: S \rightarrow S, S \in (0, \infty)$  be a twice differentiable function such that  $f(x+1)=xf(x)$ .

If  $g: S \rightarrow R, g(x)=\ln f(x)$ . If

$h(x) = g''(x + 1) - g''(x)$  . Find,  $\int_1^5 h(x)dx$

A) -4/5

B) 4/5

C) 6/5

D) 5/6

Q29. With Blaine defeated, Ash faces his final challenge: Giovanni, the Ground-type Pokémon specialist and the leader of Team Rocket, at the Viridian City Gym. Despite Misty's warning about Giovanni's strength, Ash, driven by overconfidence, decides to proceed with the battle. According to an ancient legend, a large group of Geodudes from the wild visits the gym daily, placing a certain number of rocks. The sequence follows the pattern: 1, 2, 2, 3, 3, 3, 3, 4, 4, 4, 4, and so on. To find out how many rocks they will place in the gym on the 2020th day.

A) 62

B)63

C) 64

D) 65

Q30. Furious after his defeat against Misty, Giovanni attempts to revive his age-old experiment, Mewtwo. Ash stumbles upon Mewtwo in a laboratory and resolves to confront Giovanni and put an end to his plans. However, before the battle can commence, Ash must answer a question to prove his worth.

$f$  is a differentiable function, such that  $f(f(x)) = x$  where  $x \in [0, 1]$ .

Also ,  $f(0)=1$ . Find the value of  $\int_0^1 (x - f(x))^{2016} dx$

A) 2/2017

B)1/2016

C) 1/2017

D)2/2015

Q31. Giovanni is defeated, but Mewtwo has disappeared. Mewtwo fights Giovanni willing to destroy him, however, Ash tries to stop Mewtwo and convinces him to take what he wants and leave. Stubborn Giovanni tries to run away, but Ash snatches what seems to be an enchanted Moon Stone that Mewtwo uses to restore his energy, and hands it back to Mewtwo. Giovanni becomes angered and traps Ash and his friends inside a cage. The cage unlocks using a password which is found by solving the question given below:

Let  $n$  and  $k$  be positive integers such that  $n \geq \frac{k(k+1)}{2}$  . If the number of solutions

$(x_1, x_2, \dots, x_k)$  , where  $x_1 \geq 1, x_2 \geq 1, \dots, x_k \geq 1$  , all being integers satisfying  $x_1 + x_2 + \dots + x_k = n$  is  $C_{k-1}^m$ , such that  $m = n - f(k)$ , then  $f(20)$  is equal to

A) 171

B) 190

C) 153

D) 181

**Q32.**After escaping the cage, Ash pursues Giovanni to dissuade him from his evil plans. Giovanni justifies his actions, revealing the Enchanted Stone's high cost of over 1 million yen. Giovanni awards Ash the last badge for his journey, the Earth Badge and leaves via helicopter, gifting him some rare Premier Balls. However, the Premier Balls are among five mixed Pokeballs in a bag. Two balls are drawn, revealing both balls to be Premier Balls. What is the probability that all the remaining three balls are not Premier balls?

A) 1/20

B) 1/2

C) 3/10

D) 3/20

**Q33**With all the necessary badges, Ash is poised to continue on his journey toward defeating the champions and becoming the Pokémon Master. His path leads him to face formidable opponents like Lorelei, Bruno, Agatha, and Lance in succession. However, before challenging them, he must answer a question to gain entry into the Pokemon League. The question posed to him is

$$S_n = \lim_{x \rightarrow \infty} \left( \left( x + \frac{1}{\sqrt{4n^2}} \right) \left( x + \frac{1}{\sqrt{4n^2 - 1^\alpha}} \right) \left( x + \frac{1}{\sqrt{4n^2 - 2^\alpha}} \right) \dots \left( x + \frac{1}{\sqrt{4n^2 - (n-1)^\alpha}} \right) \right)^{1/n} - x$$

And for  $\alpha=1$  ,  $L = \lim_{n \rightarrow \infty} n.(S_n)$  and for  $\alpha=2$  ,  $M = \lim_{n \rightarrow \infty} n.(S_n)$

Calculate  $[3L+100M]$ . ([ ] represents Greatest Integer Function)

- A) 3

B) 21

C) 103

D) 53

**Q34.** After achieving the title of Pokémon Master, Ash receives 10 identical bags. Each bag contains 100 identical coins. In 9 bags, there are gold coins, each weighing 1 gram. One bag holds copper coins, each weighing 0.9 grams. Ash possesses an electrical weighing machine on which only one bag can be placed and capable of measuring up to 5 significant figures, but he can use it only once. Given an infinite number of empty identical bags, how many minimum coins should he weigh to determine the bag containing copper coins? (Note: bags cannot store more than 100 coins, the bags have no mass, all coins are physically identical)

Answer - 55

**Q35**After becoming the Pokémon Master and returning home to Palette Town, the townspeople celebrate his return with a huge get-together. All the friends that he had made along his journey congratulated him on achieving his dream. But then, to reaffirm the fact that he has indeed grown up to become a Champion and a responsible citizen, they present him with a final task:-

The sum of the series  $\sum_{n=1}^{\infty} n^2 e^{-n}$  is

- A)  $\frac{e^2}{(e-1)^3}$

B)  $\frac{e^2 + e}{(e-1)^3}$

C) 3/2

D)  $\infty$