Graph Algorithms - Quiz

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Answers

#	**Question**	**Answer**	**Explanation**
1	2022-104	B	See section 1
2	2021-028	D	See section 2
3	2021-003	A	See section 3
4	2022-086	A	See section 4
5	2022-184	E	See section 5
6	2021-021	C	See section 6
7	2022-163	D	See section 7
8	2021-068	D	See section 8
9	2022-127	A	See section 9
10	2022-182	A	See section 10

1 2022-104

Using the formulas provided in the question:

$$\cos^2(x) = \frac{1}{4}\left(e^{2ix} + 2 + e^{-2ix}\right)$$

Then the integral is:

$$\int \frac{1}{4}\left(e^{2ix} + 2 + e^{-2ix}\right) dx = \frac{1}{4}\left(\frac{e^{2ix}}{2i} + 2x - \frac{e^{-2ix}}{2i}\right) + c$$

2 2021-028

In the Barabási-Albert model, the nodes do not have a fitness, which is equivalent to all nodes having the same fitness.

in the book, the author states that "When all fitnesses are equal, the Bianconi-Barabási model reduces to the Barabási-Albert model".

3 2021-003

$$A = \frac{dV}{dr} = \frac{d}{dr}\left(\frac{4}{3}\pi r^3\right) = 4\pi r^2$$

4 2022-086

The instantaneous rate of change of pink dolphins is the derivative with time:

$$\frac{dF}{dt} = \frac{d}{dt}\left(-10 \cdot \ln(t+1) + 3100 \cdot e^{-0.3 \cdot t}\right) = -10 \cdot \frac{1}{t+1} + 3100 \cdot (-0.3) \cdot e^{-0.3 \cdot t}$$

So:

$$\frac{dF}{dt}(t=5) = -209.17771560470638 \approx -209$$

5 2022-184

Check out the code of the file `2022_184.py`, it outputs:

```
Modularity = 0.2978395061728395
```

There is no option close to that number, so the answer is "None of the above".

6 2021-021

Let G be a graph with n nodes and k tree edges. Suppose that G has c connected components. In a DFS, each connected components is a tree t with n_t nodes and k_t edges, with $k_t = n_t - 1$. Therefore, the number of tree edges can be computed as:

$$e = \sum_{t=1}^{c} k_t = \sum_{t=1}^{c} (n_t - 1) = \left(\sum_{t=1}^{c} n_t\right) - c = n - c$$

Therefore:

$$c = n - k$$

which corresponds to option C.

7 2022-163

A. wrong, it is proportional to $ln(ln(N))$, see Box 4.5;

B. wrong, $\langle k \rangle$ is finite, see Box 4.5;

C. wrong, $\langle k^2 \rangle$ is finite, see Box 4.5;

D. Correct, tha is the equation 4.18 in Hubs Section;

E. only if all previous ones are wrong;

8 2021-068

Check out the code of the file `2021_068.py`, it outputs:

```
m(g(1)) = 0.48958333333333337
m(g(2)) = 0.4131944444444445
```

The network with the smallest modularity is the 2, and it has modularity approximately equals to 0.41, thus the answer is D.

9 2022-127

I. True;

II. False, Scale-free networks DO follow a power-law degree distribution;

III. False, the Barabási-Albert model do not remove links;

IV. True;

Thus the answer is A.

10 2022-182

I. True (the book says "small-degree nodes tend to connect to other small-degree nodes");

II. False, that is what is expected of a Neutral Network. The probability of connecting a node with degree k to another of degree k' is smaller than $\frac{k \cdot k'}{2 \cdot L}$;

III. False. Take for instance the complete graph with two nodes, it has no cycle, yet it is perfectly assortative;

IV. False, $\mu > 0$ for assortative networks;

Thus the answer is A (Only I).