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Subject: Remote powering through RF wave propagation

How to answer:
To answer to the questions, you have to put a cross (X) on the line which seems you correct.

Solution

- The effective isotropic radiated power P_{EIRP} sent by the reader is equal to 35 dBm.
- The operating frequency is equal to the ISM frequency 866 MHz.
- The RFID system operates in air.
- The gain of the antenna of the tag is equal to 1.
- For the sake of simplicity, it is assumed that the internal impedance of the antenna corresponds to a pure radiated resistance R_{rad} equal to 50 Ohms at the operating frequency equal to 866 MHz.

a) The distance between the reader and the tag is equal to 1 m. Justify why the RFID system operates in far field region at this distance of 1 m.

The frequency of 866 MHz corresponds to a wavelength in air equal to 0.3464 m.
The boundary between far field and near field is equal to 0.3464/(2*3.1416) = 0.0551 m.
Therefore, at 1 meter, it is verified that the coupling between the reader and the tag is an electro-magnetic coupling. Therefore, the tag operates in far field region.

Therefore, the good answer is:

Choice 1: the distance is higher than 0.0551 m

b) Indicate what has to be the value of the input impedance of the tag at the operating frequency so that the maximum power is delivered to the tag.

In order to receive the maximum of power at the input of the tag, it is necessary to have impedance matching between the antenna of the tag and the input impedance of the tag. Therefore, the input impedance of the tag has to be equal to 50 Ohms.

Therefore, the good answer is:

Choice 1: the input impedance of the tag is equal to 50 Ohms

c) Calculate the maximum input power which can be delivered to the tag under the above condition explained at question b) for a distance equal to 1 m between the reader and the tag.

Distance = 1 m.
By using the Friis relation, we obtain that :
$P_{in} = (P_{reader} * 1 * 0.3464 * 0.3464) / (4 * 3.1416 * 1)^2$
$P_{in} = 3.1623$ W * 0.00075986074 = 2.4029 mW.

Therefore, the good answer is:

Choice 1: Pin = 2.4029 mW

d) Calculate the maximum input power which can be delivered to the tag under the above condition explained at question b) for a distance equal to 3 m between the reader and the tag.

Distance = 3 m.
By using the Friis relation, we obtain that :
$P_{in} = (P_{reader} * 1 * 0.3464 * 0.3464) / (4 * 3.1416 * 3)^2$
$P_{in} = 0.26699$ mW

Therefore, the good answer is:

Choice 1: Pin = 0.26699 mW