Energy, Power and resistance – 2021/20 GCE Physics A Component 02

1. Nov/2021/Paper_H556_02/No.3

The current in a lamp is 2.0 mA. The potential difference across the lamp is 6.0 V.

What is the energy transfer in the lamp over a period of 3.0 hours?

A 0.012 J

B 0.036 J

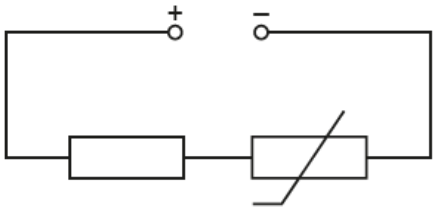
C 2.16 J

D 130 J

Your answer ☐ **[1]**

2. Nov/2021/Paper_H556_02/No.7

A circuit with a thermistor is shown below.



The resistance of the resistor is *R* and the resistance of the thermistor is 2.5*R*.
The potential difference (p.d.) across the thermistor is 5.0 V.

What is the total p.d. across both components?

A 2.0 V

B 7.0 V

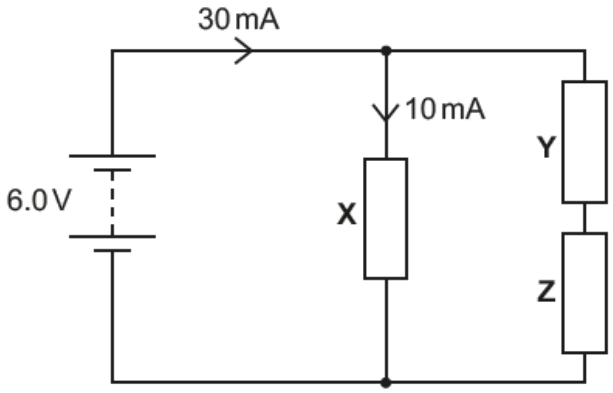
C 12.5 V

D 17.5 V

Your answer ☐ **[1]**

3. Nov/2021/Paper_H556_02/No.10

A battery of electromotive force (e.m.f) 6.0 V and of negligible internal resistance is used in the circuit below.



The current from the battery is 30 mA. The current in the resistor **X** is 10 mA.
The resistors **Y** and **Z** are identical.

What is the power dissipated in the resistor **Z**?

A 30 mW

B 60 mW

C 120 mW

D 180 mW

Your answer ☐ **[1]**

4. Nov/2020/Paper_H556_02/No.14

The potential difference across a lamp is 2.5 V. The current in the lamp is 20 mA.

What is the energy dissipated in the lamp in 3.0 hours?

A 0.050 J

B 0.15 J

C 9.0 J

D 540 J

Your answer ☐ **[1]**

5. Nov/2020/Paper_H556_02/No.18

A resistance wire is coiled around a thermistor. The coil of wire will warm the thermistor.

It is suggested that the relationship between the power P dissipated in the coiled wire and the stable resistance R of the thermistor is given by the expression $P = kR^n$, where k and n are constants.

Describe how an experiment can be conducted to assess the validity of this expression and how the data collected can be analysed to determine k and n.

Use the space below for a circuit diagram. **[6]**

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Additional answer space if required

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6. Nov/2021/Paper_H556_03/No.1b(i)

(b) The overhead cable in **Fig. 1** must be tensioned.
It is constructed from several equal lengths of wire.

Some data for one length of this wire are shown below.

- length = 1500 m
- area of cross-section = $1.1 \times 10^{-4}\,m^2$
- resistivity = $1.8 \times 10^{-8}\,\Omega m$
- the Young modulus = $1.2 \times 10^{10}\,Pa$
- strain = 1.3%

(i) Calculate the resistance R of one length of wire.

R = ... Ω **[2]**

7. Nov/2020/Paper_H556_03/No.4(d)

The International Space Station (ISS) orbits the Earth at a height of 4.1×10^5 m **above** the Earth's surface.

The radius of the Earth is 6.37×10^6 m. The gravitational field strength g_0 at the Earth's surface is $9.81\,N\,kg^{-1}$.

(d) The ISS has arrays of solar cells on its wings. These solar cells charge batteries which power the ISS. The wings always face the Sun.

Use the data below and your answer to **(b)(ii)** to calculate the **average** power delivered to the batteries.

- The total area of the cells facing the solar radiation is 2500 m^2.
- 7% of the energy of the sunlight incident on the cells is stored in the batteries.
- The intensity of solar radiation at the orbit of the ISS is 1.4 $kW\,m^{-2}$ outside of the Earth's shadow and zero inside it.
- The ISS passes through the Earth's shadow for 35 minutes during each orbit.

average power = ... W **[4]**