AQA A-Level Physics: Current Electricity Calculation Questions There is Physics: Current Electricity — Calculation Questions Praneel Physics 1. Calculate the current through a 12Ω resistor with 36V across it. (P)

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Working and Answer:
$$I = \frac{V}{R} = \frac{36}{12} = 3 \text{ A.}$$

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2. Find the resistance when $0.5\,A$ flows with $6\,V$ applied. **(P)**

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Working and Answer:
$$R = \frac{V}{I} = \frac{6}{0.5} = 12 \,\Omega.$$

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Working and Answer: $? = \frac{V}{I} = \frac{6}{0.5} = 12 \,\Omega.$ Praine Charles 3. Calculate the power dissipated in a 8Ω resistor with 4A flowing. (P)

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Working and Answer:
$$P = I^2R = 4^2 \times 8 = 128W.$$

7 4 4. Determine the charge flowing in $15\,s$ with $2\,A$ current. (P) Praineel Philippines

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Working and Answer:
$$Q = It = 2 \times 15 = 30 \, C.$$

Working and Answer: $0 = It = 2 \times 15 = 30$ 5. Calculate the energy transferred by 9V moving 4C of charge. (P) Praine Charles

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Working and Answer:
$$E = VQ = 9 \times 4 = 36 \ J.$$

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6. Find the potential difference across 5Ω with 0.8A flowing. (P)

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Working and Answer:

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$$V = IR = 0.8 \times 5 = 4V$$
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A $3\,m$ wire of diameter $0.5\,mm$ has resistance $6\,\Omega$. Calculate its resistivity. (PP)

1. Area
$$A = \pi (0.25 \times 10^{-3})^2 = 1.96 \times 10^{-7} m^2$$

2. $\rho = \frac{RA}{L} = \frac{6 \times 1.96 \times 10^{-7}}{3} = 3.93 \times 10^{-7} \Omega m$.

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8. Calculate total resistance and current for 4Ω and 6Ω in series with 12V. (PP)

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Working and Answer:

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1.
$$R_{total} = 4 + 6 = 10 \,\Omega$$

2.
$$I = \frac{12}{10} = 1.2 A$$
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Aineel Philipsics **9.** A 100W bulb operates at 230V. Find its resistance. **(PP)**

1.
$$P = \frac{V^2}{R}$$

Working and Answer:
1.
$$P = \frac{V^2}{R}$$

2. $R = \frac{230^2}{100} = 529 \Omega$.

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10. Calculate drift velocity for 2A current in $1mm^2$ copper wire $(n = 8.5 \times 10^{28} \, m^{-3})$. (PP)

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Working and Answer:

1.
$$v = \frac{I}{nAe} = \frac{2}{8.5 \times 10^{28} \times 10^{-6} \times 1.6 \times 10^{-19}}$$

2. $v \approx 0.147 \, mm/s$.

11. Find the emf when 3A flows through 4Ω with 0.5Ω internal resistance. (PP)

1.
$$\epsilon = I(R+r) = 3(4+0.5) = 13.5 V$$
.

12. Calculate energy stored in $470 \,\mu F$ capacitor charged to $12 \, V$. (PP)

Working and Answer:

1.
$$E = \frac{1}{2}CV^2 = 0.5 \times 470 \times 10^{-6} \times 144 = 0.0338 J.$$

13. A thermistor's resistance is $8 k\Omega$ at $20^{\circ}C$ and $2 k\Omega$ at $60^{\circ}C$. Find its resistance at $35^{\circ}C$ (linear assumption). (PPP)

1. Rate:
$$\frac{\Delta R}{\Delta T} = \frac{2000 - 8000}{60 - 20} = -150 \,\Omega/^{\circ}C$$

2. $R = 8000 + (-150)(35 - 20)$

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$$R = 8000 + (-150)(35 - 20)$$

3.
$$R = 8000 - 2250 = 5.75 \,k\Omega$$
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14. A potential divider uses $5 k\Omega$ and $10 k\Omega$ resistors with 15 V supply. Find V_{out} . (PPP)

Working and Answer:

1. Total resistance: $15\,k\Omega$

2. Current: $I = \frac{15}{15000} = 1 \, mA$ 3. $V_{out} = I \times 10000 = 10 \, V$.

15. A battery ($\epsilon=6\,V,\,r=0.4\,\Omega$) powers a $5\,\Omega$ resistor. Find the terminal pd. (PPP)

Working and Answer:

1. Current: $I = \frac{6}{5+0.4} \approx 1.11 A$ 2. Terminal pd: $V = 6 - (1.11 \times 0.4) \approx 5.56 V$.

16. Calculate resistivity of a $4\,m$ wire with $0.8\,mm^2$ area and $3.2\,\Omega$ resistance. (PPP)

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Working and Answer:

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1.
$$\rho = \frac{RA}{L} = \frac{3.2 \times 0.8 \times 10^{-6}}{4}$$

2. $\rho = 6.4 \times 10^{-7} \,\Omega m$.

17. A $60\,W$ bulb operates at $240\,V$. Find its resistance and current. (PPP)

1.
$$R = \frac{V^2}{P} = \frac{240^2}{60} = 960 \,\Omega$$

2.
$$I = \frac{P}{V} = \frac{60}{240} = 0.25 A$$
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18. A capacitor charges to 9V with 45 mC. Calculate its capacitance. (PPP)

Working and Answer:

1.
$$C = \frac{Q}{V} = \frac{45 \times 10^{-3}}{9} = 5 \, mF$$
.

19. A battery ($\epsilon = 12 V$, $r = 0.8 \Omega$) supplies parallel 3Ω and 6Ω resistors. Calculate total power dissipated. (PPPP)

- 1. Parallel resistance: $R_p=(1/3+1/6)^{-1}=2\,\Omega$ 2. Total resistance: $2+0.8=2.8\,\Omega$

- 3. Current: $I = \frac{12}{2.8} \approx 4.29 A$ 4. Power: $P = I^2 R_p \approx 4.29^2 \times 2 \approx 36.8 W$.

20. A copper wire $(\rho = 1.7 \times 10^{-8} \Omega m, \text{ diameter } 1 mm)$ carries 3 A. Calculate electric field strength. (PPPP) Praineel Pinysics

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Praineel Physics Working and Answer:

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- 1. Area: $A = \pi (0.5 \times 10^{-3})^2 = 7.85 \times 10^{-7} \, m^2$ 2. Resistance per meter: $\frac{R}{L} = \frac{\rho}{A} \approx 0.0217 \, \Omega/m$ 3. Potential gradient: $\frac{V}{L} = I \frac{R}{L} = 3 \times 0.0217 \approx 0.065 \, V/m$ R. r. allie ed. R. r. Praineel P
 - 4. Electric field: E = 0.065 V/m.

21. A capacitor $(100 \,\mu F)$ discharges through $10 \,k\Omega$. Calculate time for charge to halve. (PPPP)

Working and Answer:

- 1. Time constant: $\tau = RC = 10000 \times 100 \times 10^{-6} = 1 s$
- 2. $t_{1/2} = \tau \ln 2 \approx 0.693 \, s$.

22. A Wheatstone bridge has $R_1 = 120 \Omega$, $R_2 = 240 \Omega$, $R_3 = 180 \Omega$. Find R_4 for balance. (PPPP)

- 1. Balance condition: $\frac{R_1}{R_2} = \frac{R_3}{R_4}$ 2. $R_4 = R_3 \times \frac{R_2}{R_1} = 180 \times 2 = 360 \,\Omega$.

23. A 24V battery powers series 6Ω and parallel $4\Omega + 12\Omega$ resistors. Find the current. Meel (PPPP) raineel Philipsics Praince.

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R. r. athleel. 12)-1 1. Parallel resistance: $R_p = (1/4 + 1/12)^{-1} = 3\Omega$

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2. Total resistance: $6 + 3 = 9 \Omega$

3. Current: $I = \frac{24}{9} \approx 2.67 A$. raineel Pi

24. A $0.2\,mm$ diameter gold wire $(\rho=2.4\times10^{-8}\,\Omega m)$ carries $0.8\,A$. Find power dissipated per meter. **(PPPP)** raineel Philippies Praineel. Philipsipes

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Praineel Pins 1. Area: $A = \pi (0.1 \times 10^{-3})^2 = 3.14 \times 10^{-8} \, m^2$ 2. Resistance per meter: $\frac{R}{L} = \frac{\rho}{A} \approx 0.764 \, \Omega/m$ 3. Power: $P = I^2 R \approx 0.8^2 \times 0.764 \approx 0.489 \, W/m$. Praineel Pi Praineel Pi

25. A capacitor $(470 \,\mu F)$ discharges through $2.2 \,k\Omega$. Calculate time for energy to reach 25%of initial. (PPPP) raineel Pinysics

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Praincel Philosophics Working and Answer:

- 1. Energy $\propto V^2$, so need $V=0.5V_0$ 2. Discharge equation: $0.5=e^{-t/RC}$

 - 3. $t = -RC \ln 0.5 \approx 0.693 \times 2200 \times 470 \times 10^{-6}$ Prancel P

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Praineel R 4. $t \approx 0.717 \, s$.

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26. A non-ohmic device follows $I=0.01V^2$. Calculate dynamic resistance at $10\,V$. (PPPPP)

1. Differentiate: $\frac{dI}{dV} = 0.02V$ 2. At 10V: $\frac{dI}{dV} = 0.2 A/V$ 3. Dynamic resistance: $R = 1/(dI/dV) = 5 \Omega$.

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27. A battery ($\epsilon=15\,V,\,r=0.6\,\Omega$) supplies parallel $3\,\Omega$ and $6\,\Omega$ in series with $2\,\Omega$. Find terminal pd. (PPPP) raineel Philipsics Praincel Philipsics

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- 1. Parallel resistance: $R_p = (1/3 + 1/6)^{-1} = 2 \Omega$
- 2. Total resistance: $2 + 2 + 0.6 = 4.6 \,\Omega$

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- 3. Current: $I = \frac{15}{4.6} \approx 3.26 \, A$ 4. Terminal pd: $V = 15 (3.26 \times 0.6) \approx 13.04 \, V$. Praineel P

28. A thermistor $(R_{25^{\circ}C}=10\,k\Omega,\,R_{75^{\circ}C}=2\,k\Omega)$ is used in a potential divider with $8\,k\Omega$ resistor and $12\,V$ supply. Find V_{out} at $50^{\circ}C$ (linear). (PPPP) Praineel Pinysies Praineel Philipsics

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Working and Answer:

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- 1. Rate: $\frac{\Delta R}{\Delta T} = \frac{2000 10000}{75 25} = -160 \,\Omega/^{\circ} C$ 2. $R_{50^{\circ}C} = 10000 + (-160)(50 25) = 6 \,k\Omega$ 3. $V_{out} = 12 \times \frac{8000}{8000 + 6000} \approx 6.86 \,V$.
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29. A $0.05\,mm^2$ carbon wire $(\rho=6\times10^{-5}\,\Omega m)$ carries $20\,mA$. Calculate power density (W/m³). (PPPPP) Praince. raineel. Philippines raineel. Philipsics

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- 1. Resistance per meter: $\frac{R}{L} = \frac{\rho}{A} = \frac{6 \times 10^{-5}}{5 \times 10^{-8}} = 1200 \,\Omega/m$ 2. Power per meter: $P = I^2 R = (0.02)^2 \times 1200 = 0.48 \,W/m$ 3. Volume per meter: $V = 5 \times 10^{-8} \,m^3$
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 - raineel Ri 4. Power density: $\frac{0.48}{5 \times 10^{-8}} = 9.6 \times 10^6 W/m^3$.

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30. A capacitor (C) discharges from 12V to 3V in 4s through $1M\Omega$. Find C. (**PPPPP**)

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- $2. \ 0.25 = e^{-4/RC}$
- 3. $\ln 0.25 = -4/RC$

 - 4. $RC = \frac{4}{\ln 4} \approx 2.89 s$ 5. $C = \frac{2.89}{10^6} \approx 2.89 \,\mu F$.

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