2024 Sec 4 Physics Assignment 17
Practical Electricity- Answers

Note: State **formulae** applied
- Use more s.f. (4 or 5) for intermediate values.
- Check final numerical answers to have **2 or 3 s.f.**!

1 (a) The expected operating potential difference is 240 V,
and when the p.d. across the lamp is 240 V,
it will consume 50 W of power and operate at normal brightness.
50 J of electrical energy is converted into thermal and light energy every second.

(b)(i)

50 W = 50 J per second

$P = V I$

$I = P / V \quad \Rightarrow \quad I_1 = 50\ W / 240\ V = 0.208\ A$

$I_2 = 80\ W / 240\ V = 0.333\ A$

(b)(ii)
Current supplied = $I_1 + I_2 = 0.208\ A + 0.333\ A = 0.541\ A$
$R_{effective} = V / I = 240\ V / 0.541\ A = 443\ \Omega$

Alternatively:
$P = V^2 / R \quad \Rightarrow \quad R = V^2 / P$ (using ratings for each lamp)
$\Rightarrow \quad R_1 = 1152\ \Omega, \quad R_2 = 720\ \Omega$

$R_{effective} = (1/R_1 + 1/R_2)^{-1} = 443\ \Omega$

(b) (iii) P =80 + 50 = 130 W

(b) (iv) **Energy Used = $P \times t$**
= 0.130 W × 2 h × 30 (2 hours a day for 30 days)
= 7.8 kW h

Cost = E (in kWh) × unit cost
= 7.8 × $0.25
= $1.95

(c) When the lamps are connected in series, the potential difference across each lamp is lower than 240 V. Hence, the power dissipated by each lamp is lower than the rated power and the total power dissipated decreases.

Extension:

$R_{effective} = R_1 + R_2 = 1152 + 720 = 1872\ \Omega$

$e.m.f. = I \times R_{effective}$

Current $I = 240 / R_{effective} = 0.128 \approx 0.13$ A (2sf)

$P = I^2 \times R_{effective} = 30.8 \approx 31$ W (2sf)

OR $P = V I$ = e.m.f. $\times I$ = 240 V × 0.128 A = 31 W (2sf)

Note:

- Given rating of a lamp (P, V), values of P, V and current I may vary according to circuit arrangement, **only R is fixed**.
- The e.m.f. in this **series circuit** is 240 V and the same current flows through each lamp.

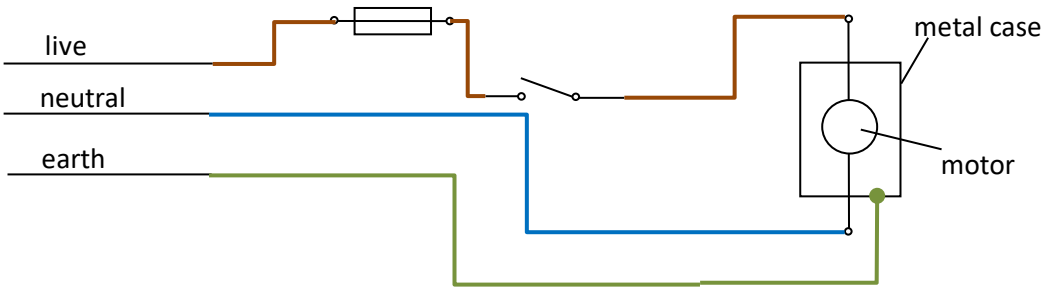
2 Water in contact with exposed electrical wires provides a **conducting** path for current.

Wet skin lowers resistance of human body **to a few hundred ohms**.

Hence, touching a live appliance with wet hands will cause a **very large current** to pass through the body, (since current and resistance are **inversely proportional**), bringing the user an **electric shock**.

*Refer to textbook chapter on **Practical Electricity**!*

3 (a)



(b) A fuse protects an electrical appliance from damage or a user from electric shock by preventing excessive current from flowing through it.

(c) When the current exceeds the fuse rating, the wire inside the fuse will melt (i.e. the fuse 'blows').

The circuit is opened, hence preventing excessive current from damaging the equipment and the wiring.

(d)

(i) A suitable fuse rating here is 10 A.

(ii) Since the normal current exceeds the fuse rating,
when the computer works normally, a current of 6.1 A would cause the fuse of rating 6.0 A to blow and stop the current flowing in the circuit.

(iii) If there is an electrical fault and the current surge to a high value, say 25 A, an electrical fire can be started but the fuse does not blow.