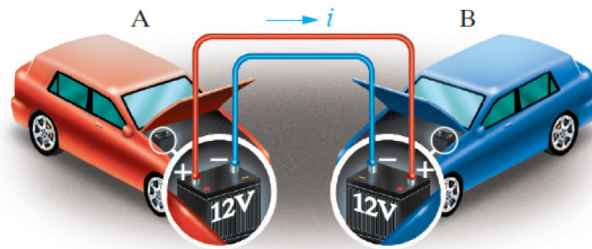


**Question 1** [10]

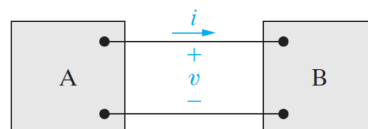
When a car has a dead battery, it can often be started by connecting the battery from another car across its terminals. The positive terminals are connected together as are the negative terminals. The connection is illustrated in the figure below. Assume the current  $i$  in the Figure is measured and found to be 40 A.



- (a) Which car has the dead battery?
- (b) If this connection is maintained for 90 seconds, how much energy is transferred to the dead battery?

**Question 2** [10]

Two electric circuits, represented by boxes A and B, are connected as shown in the figure below. The reference direction for the current  $i$  in the interconnection and the reference polarity for the voltage  $v$  across each interconnect are shown. For each of the following sets of values, calculate the power in the interconnection and state whether the power is flowing from A to B or vice versa.



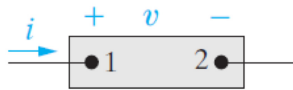
- (a)  $i = 6 \text{ A}$ ,  $v = 30 \text{ V}$
- (b)  $i = -8 \text{ A}$ ,  $v = -20 \text{ V}$
- (c)  $i = 4 \text{ A}$ ,  $v = -60 \text{ V}$
- (d)  $i = -9 \text{ A}$ ,  $v = 40 \text{ V}$

**Question 3** [10]

The voltage and current at the terminals of the circuit shown below are zero for  $t < 0$  and  $t > 40$  s. In the interval between 0 s and 40 s,

$$v(t) = t(1 - 0.025t) \text{ V}, \quad 0 < t < 40 \text{ s};$$

$$i(t) = 4 - 0.2t \text{ A}, \quad 0 < t < 40 \text{ s}.$$



- At what instant of time is the power being delivered to the circuit element maximum?
- What is the power at the time found in (a)?
- At what instant of time is the power being extracted from the circuit maximum?
- What is the power at the time from (c)?
- Calculate the net energy delivered to the circuit at 0, 10, 20, 30, and 40 s.

#### Question 4 [10]

The voltage and current at the terminals of the above circuit element are zero for  $t < 0$ . For  $t \geq 0$ :

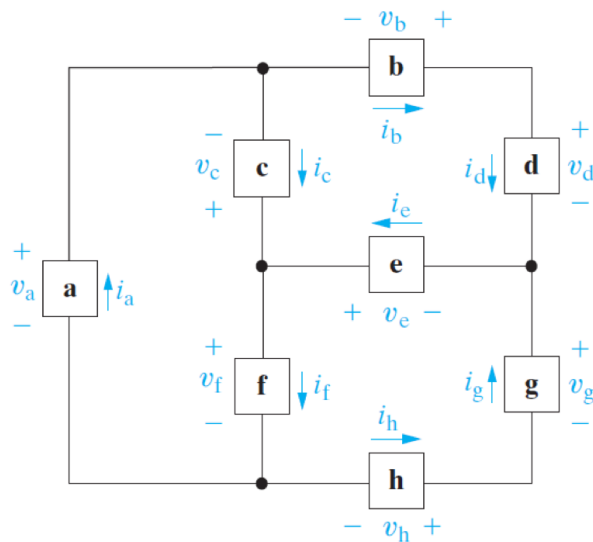
$$v(t) = (1500t + 1)e^{-750t} \text{ V},$$

$$i(t) = 40e^{-750t} \text{ mA}.$$

- At what time is the power delivered a maximum?
- Find the value of the maximum power in mW.
- Find the total energy delivered to the circuit element in  $\mu\text{J}$ .

#### Question 5 [10]

Assume you are an engineer in charge of a project and one of your subordinate engineers reports that the interconnection in the given figure does not pass the power check. The data for the interconnection are given in table.



Element	Voltage (V)	Current (A)
a	900	-22.5
b	105	-52.5
c	-600	-30.0
d	585	-52.5
e	-120	30.0
f	300	60.0
g	585	82.5
h	-165	82.5

- Is the subordinate correct? Explain your answer.
- If the subordinate is correct, can you find the error in the data?