Q2. Battery Selection

Solution:

Motor Power Requirements:

- Voltage: 48V
- Average current: 30A
- Peak current: 47A
- Motor power = 48V × 30A = 1440 w
- Additional electronics: 150W
- Total power = 1440W + 150W = 1590W
- Required power (due to efficiency)= 1590W ÷ 0.82 = 1939W
- Total required energy = 1939W × 2h = 3878Wh

> Since our voltage requirement is 48V and each battery is 24V, we need to connect batteries in series to achieve 48V.However, one pair of batteries won't provide enough energy as from table we can see that :

Even when we consider battery E which gives maximum energy that 24 x 67 = 1608 Wh it becomes insufficient when we connect them in series (1608x2 = 3216 <3878).

We need at least 2 parallel strings of series-connected batteries to meet our energy requirement.

Also considering the potential 15% increase in current draw due to weight:

- Increased average current = 30A × 1.15 = 34.5A
- Increased peak current = 47A × 1.15 = 54.1A

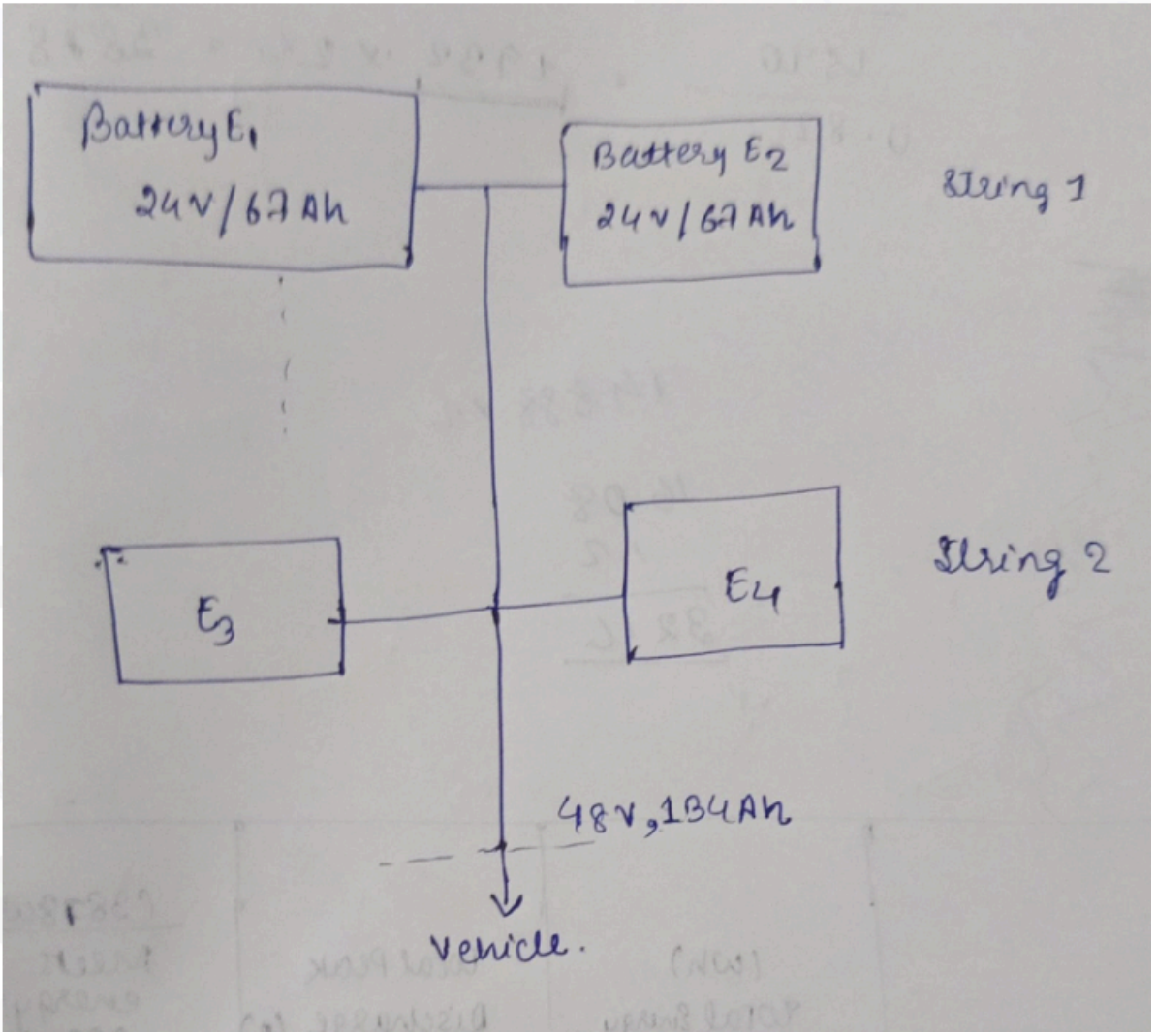
Taking the connection as 2 PARALLEL STRINGS (4 BATTERIES IN TOTAL): Considering energy density, capacity, and C-rate, Option E

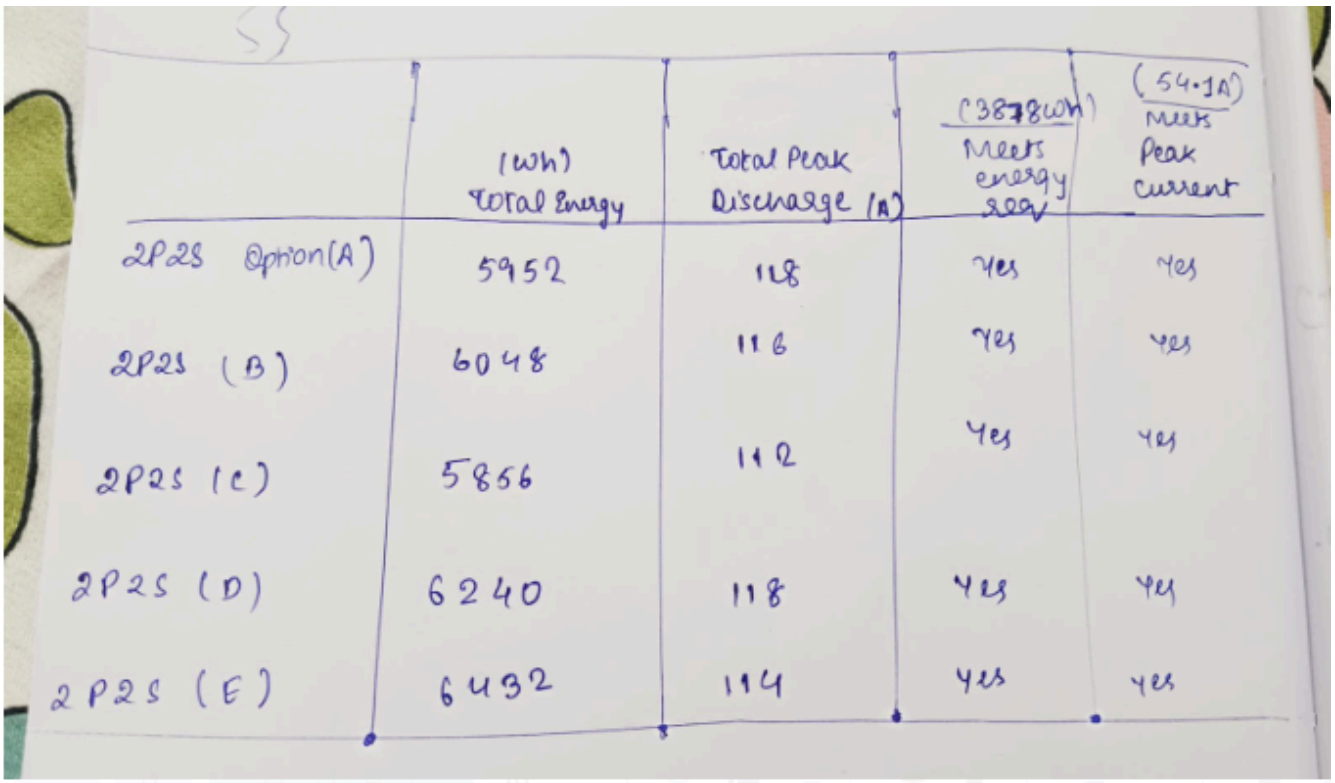
provides the highest energy capacity. A 2P2S configuration (2 parallel strings, each with 2 batteries in series) of Option E batteries provides:

Two sets of Option E in series will give us: 48V, 67Ah, 57A peak

To meet the capacity requirement, we connect two of these series sets in parallel

- Total energy: 6432Wh (exceeds our requirement of 3878Wh)
- Total peak discharge capability: 114A (exceeds our requirement of 54.1A)
- Sufficient voltage: 48V
- With a 48V, 40A charger, the ideal charging time for the battery pack would be 134Ah / 40A = 3.35 hours.





	(Wh) Total Energy	Total Peak Discharge (A)	(3878Wh) Meets energy req?	(54.1A) Meets Peak current
2P2S Option(A)	5952	118	Yes	Yes
2P2S (B)	6048	116	Yes	Yes
2P2S (C)	5856	112	Yes	Yes
2P2S (D)	6240	118	Yes	Yes
2P2S (E)	6432	114	Yes	Yes