Exam 7

Feb 24th Monday

Muscle making ATP figure 9-22

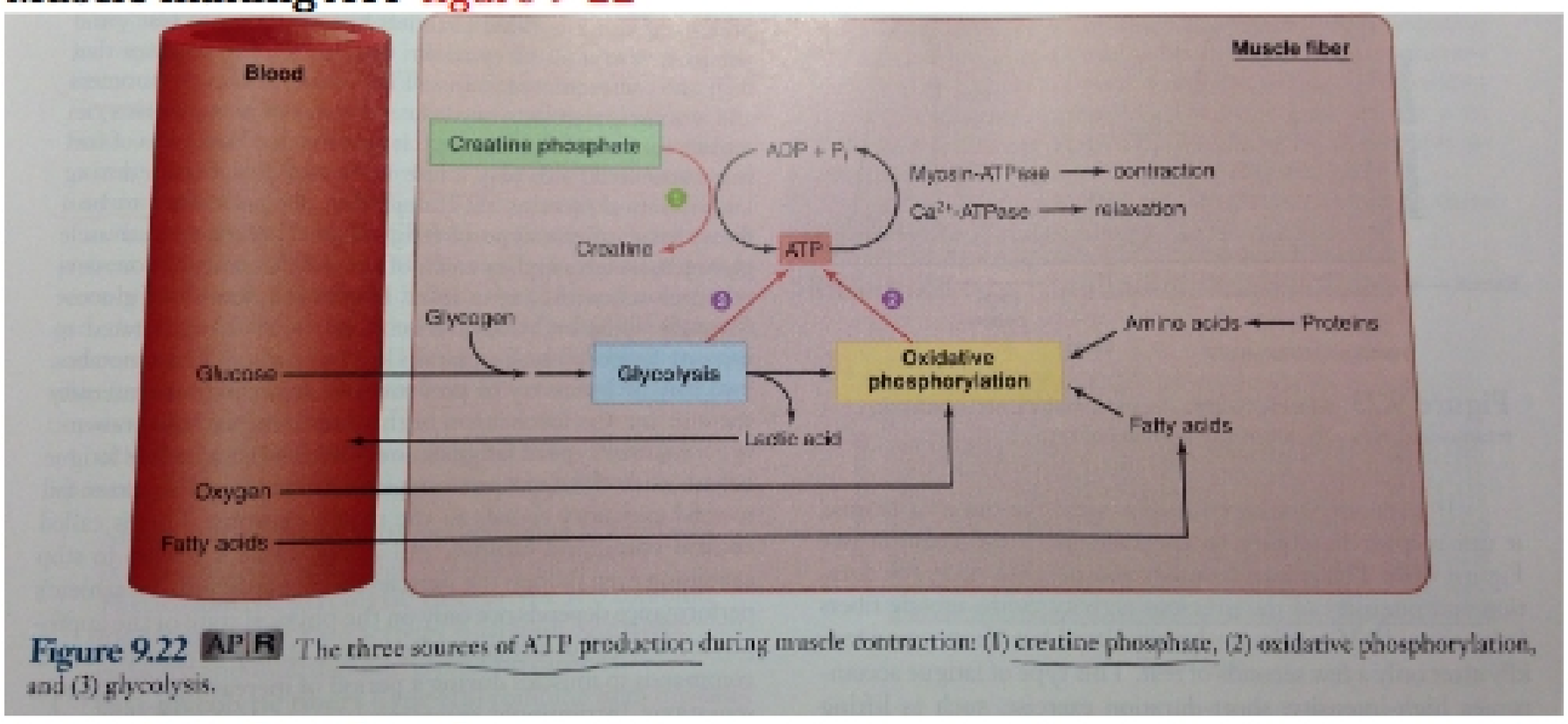

Figure 9.22 AP|R The three sources of ATP production during muscle contraction: (1) creatine phosphate, (2) oxidative phosphorylation, and (3) glycolysis.

- **Creatine phosphate**
  - Initial source of ATP
  - Limited supply
  - Supply replenished during relaxation
- **Glycolysis**
  - Used **alone during intense or prolonged activity**
  - Can be anaerobic (independent of oxygen supply)
  - Replenished during relaxation
- Oxidative phosphorylation (ETS)
  - **Continued supply** during **moderate exercise** comes from aerobic glycolysis
- What's missing from this figure? Krebs Cycle
  (Krebs cycle takes that pyruvate and goes into oxidative phosphorylation)
  - **Amino and fatty acids start there**

Whole muscles

- Contraction produced by cross-bridge cycling
  figure 9-29

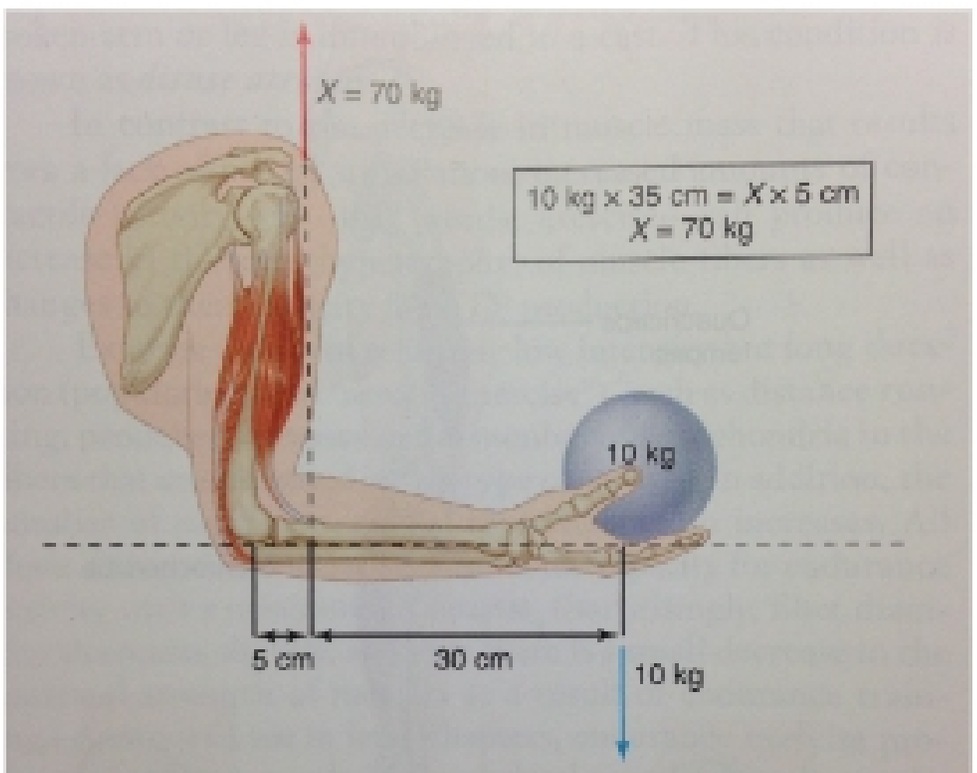

Figure 9.29 AP R Mechanical equilibrium of forces acting on the forearm while supporting a 10 kg load. For simplicity, mass is used as a measure of the force here rather than newtons, which are the standard scientific units of force.

- **Generates a force = tension**
- Opposed by the load
  (Bones, muscles, flesh… The forearm has weight itself - more force generated than the weight applied)
- Muscle shortening depends on
  tension-load
  (It is wrong to think that contraction = shortening)

- **Isometric = no changes in muscle length**
  (Tension is less than the load, e.g., pushing against a wall, muscle cannot actually move something. no lifting/shortening happens, but **still has contraction**)
- **Isotonic = no changes in tension; muscle shortens**
  (Referring to a particular tension, e.g., college students won't pay one penny more for their lunch)
- **Eccentric = lengthens** because L>T
  (The muscle **contracts** while goes **further away from** the direction of tension - when the load wins, weigh too big)
  shortened: sarcomere I band "H" zone
- **Isotonic contraction** figure 9-17

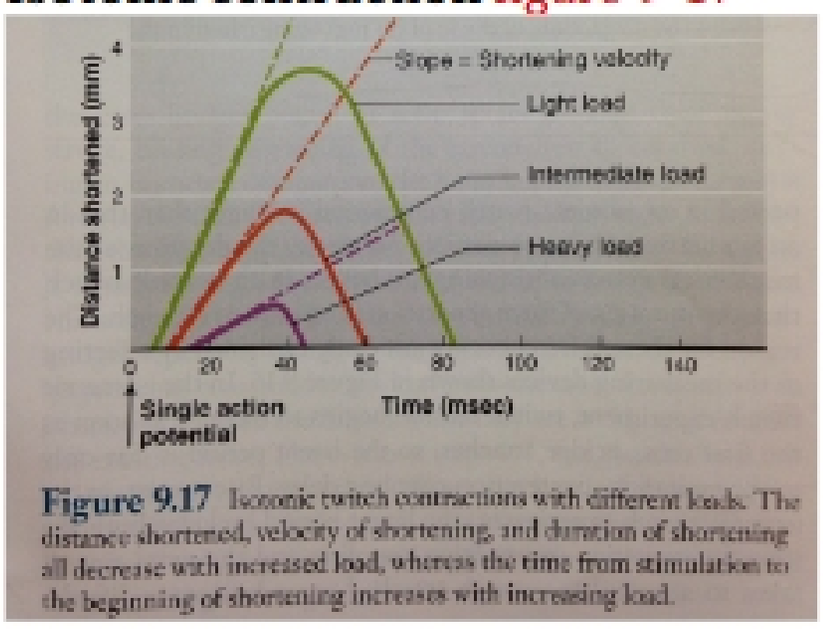

Figure 9.17 Isotonic twitch contractions with different loads. The distance shortened, velocity of shortening, and duration of shortening all decrease with increased load, whereas the time from stimulation to the beginning of shortening increases with increasing load.

- Degree of contraction related to load
  - **Initial period of isometric contraction** (tension < load)
  - **Shortening** begins after tension > load

(To get to the isotonic contraction, one first has a period of isometric contraction where the tension is increased. In the figure, the purple one takes longer time to start, e.g., weightlifting)

- Relationships
  - Increased load
    - →Increased latency
    - →Decrease velocity
    - →Decrease response

    (Bigger load, longer time - **inverse relationship**)

- Impact of repeated stimulations (APs) figure 9-20

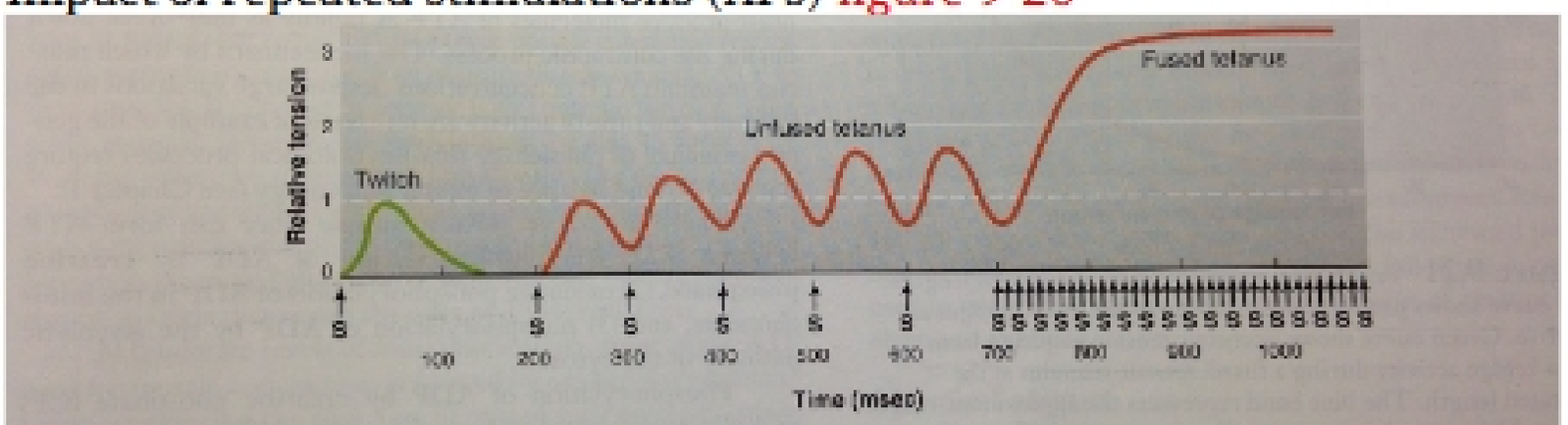

Figure 9.20 Isometric contractions produced by multiple stimuli (S) at 10 stimuli per second (unfused tetanus) and 100 stimuli per second (fused tetanus), as compared with a single twitch.

  - Tension is summed (just as we build on depolarization of one neuron with another depolarization)
  - Maintained contraction = tetanus (if you are invaded by a parasite, the toxins that parasite creates can cause stimulation, and tension can happen. You get the shot, prevents your body from being a nice home for the critters. You want tetanus to happen in your body. You have tetanus happening in your body now! – the unfused kind)
    - **Unfused (incomplete) tetanus**: maintaining contraction but allow **partial relaxation between stimuli**
      (Very rapid sequence of stimuli, occurs with higher frequency stimulation 20-40 stimuli/sec)
    - Fused (tetanus): no time between stimuli to return Ca^{+2}
      (Higher potential level. Max contraction happens, too quick for the Ca+2 to restore, ATPase cannot catch up, so a bigger tension happens, non of the Ca+2 get put away)

- Differences between myofibers figure 9-15