

Chapter 7 · Physiology and Injuries in Sports

CBSE Class 12 Physical Education (048) · Unit 7 = 8 marks (4 + 4 b*) · Ultimate Revision Sheet

60-SECOND RECALL

Muscle fibre types	Slow twitch (Type I) = red, endurance · Fast twitch (Type II) = white, speed and power
Long-term exercise effect	Hypertrophy of muscle · lower resting heart rate (bradycardia) · larger stroke volume · higher VO₂ max
Cardiac output	Stroke Volume × Heart Rate
Tidal volume	Air inhaled or exhaled in one normal breath (about 500 ml)
Injury types	Soft tissue (contusion, strain, sprain, abrasion, laceration, incision) · Bone (fractures) · Joint (dislocation)
First aid	PRICE — Protection, Rest, Ice, Compression, Elevation

1. Physiological Factors Determining Components of Fitness

Component	Physiological factors that determine it
Strength	Size of the muscle (bigger = stronger) · muscle composition (more fast-twitch fibres = more strength) · body weight · intensity of nerve impulse · number of motor units recruited
Speed	Muscle composition (fast-twitch fibres) · explosive strength · flexibility · biochemical reserves (ATP, phosphocreatine) · mobility of nervous system
Endurance	Aerobic capacity / VO₂ max · oxygen intake, transport and uptake · energy reserves (glycogen) · slow-twitch fibre percentage · lactic acid tolerance
Flexibility	Muscle strength · joint structure · age and gender (flexibility falls with age; women generally more flexible) · internal and external temperature · previous injury

2. Effect of Exercise on the Muscular System

IMMEDIATE (short-term) EFFECTS Increase in **muscle temperature** · increased **blood flow** to working muscles · **micro-tears** in muscle fibres · accumulation of **lactic acid** causing fatigue · increased oxygen demand

LONG-TERM EFFECTS — the exam answer

1. **Muscle hypertrophy** — increase in the **size** of muscle fibres, so the muscle becomes bigger and stronger.
2. **Increased number of capillaries** — better oxygen and nutrient supply to the muscle.
3. **Increased number and size of mitochondria** — more aerobic energy production.
4. **Increased stores of glycogen and myoglobin** — more fuel and better oxygen storage.
5. **Improved muscle tone and posture.**
6. **Delayed fatigue** — better lactic acid tolerance and removal.
7. **Stronger tendons and ligaments; increased bone density.**
8. **Improved reaction time and coordination.**

TRAP Exercise causes **HYPERTROPHY** (increase in the **size** of existing fibres), **not hyperplasia** (increase in the **number** of fibres). The number of muscle fibres is fixed at birth. This exact distinction is asked.

3. Effect of Exercise on the Cardio-Respiratory System

- CARDIOVASCULAR — long-term effects**
1. **Cardiac hypertrophy** — the heart muscle (especially the left ventricle) becomes **larger and stronger** — the “athlete’s heart”.
 2. **Decreased resting heart rate (bradycardia)** — an athlete may have a resting pulse of 40–50 against a normal 72.
 3. **Increased stroke volume** — more blood pumped per beat, which is **why** the resting heart rate falls.
 4. **Increased cardiac output** during maximal exercise.
 5. **Increased blood volume and haemoglobin** — better oxygen carrying capacity.
 6. **Faster recovery rate** — the pulse returns to normal more quickly.
 7. **Reduced blood pressure** and lower risk of heart disease.

$$\text{Cardiac Output} = \text{Stroke Volume} \times \text{Heart Rate}$$

- RESPIRATORY — long-term effects**
1. **Increased vital capacity** — more air can be expelled after a maximal inhalation.
 2. **Increased tidal volume** during exercise.
 3. **Decreased resting respiratory rate** — breathing becomes deeper and more efficient.
 4. **Stronger respiratory muscles** — diaphragm and intercostals.
 5. **Increased number of alveoli in use** and better gaseous exchange.
 6. **Increased VO_2 max** — the single best marker of aerobic fitness.
 7. **Reduced oxygen debt** and faster recovery.

Term	Meaning
Tidal Volume	Air inhaled or exhaled in one normal breath — about 500 ml
Vital Capacity	Maximum air that can be expelled after a maximum inhalation — about 4800 ml
Residual Volume	Air remaining in the lungs after maximum exhalation — about 1200 ml
Second Wind	A phenomenon where an athlete, after initial breathlessness and fatigue, regains comfort and continues performing
Oxygen Debt	The extra oxygen consumed after exercise to repay the deficit incurred during anaerobic work

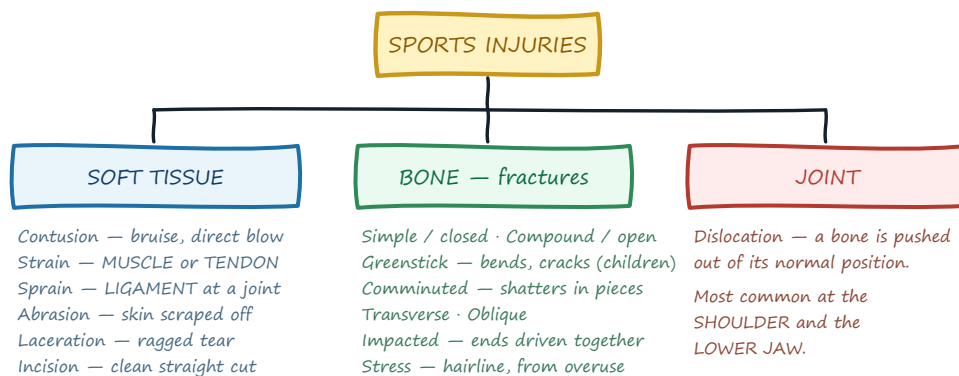
4. Physiological Changes due to Ageing

- **Muscular system** — loss of muscle mass and strength (**sarcopenia**); reduced elasticity; slower reaction.
- **Skeletal system** — reduced bone density (**osteoporosis**); joint stiffness; loss of height; cartilage wear.

- **Cardiovascular** — reduced maximum heart rate, stroke volume and cardiac output; arteries become **less elastic**; blood pressure rises.
- **Respiratory** — reduced vital capacity; weaker respiratory muscles; less efficient gaseous exchange.
- **Nervous system** — slower nerve conduction, poorer balance and coordination, slower reaction time.
- **Other** — declining vision and hearing; reduced flexibility; slower metabolism; changed body composition (more fat, less muscle).

Regular exercise slows all of these — this is why the Rikli and Jones test exists.

5. Sports Injuries — Classification



STRAIN = muscle/Tendon (both have a T) · SPRAIN = Ligament — think ankle sprain

Three families. Only one pair is really tested, and it is strain versus sprain.

THE THREE FAMILIES

Family	Injuries
SOFT TISSUE	Contusion — a bruise from a direct blow; bleeding under the skin Strain — over-stretching or tearing of a MUSCLE or TENDON Sprain — over-stretching or tearing of a LIGAMENT at a joint Abrasion — skin scraped off by friction Laceration — a deep, irregular tear in the skin Incision — a clean cut with sharp, straight edges
BONE	Simple / closed — bone breaks, skin intact Compound / open — broken bone pierces the skin Greenstick — incomplete break; bone bends and cracks — common in children Comminuted — bone shatters into several pieces Transverse — break at a right angle to the bone Oblique — break at an angle Impacted — broken ends are driven into each other Stress — a hairline crack from repetitive overuse
JOINT	Dislocation — a bone is displaced from its normal position at a joint. Common at the shoulder and lower jaw .

THE PAIR THAT DECIDES THE MARK STRAIN vs SPRAIN.

- **Strain** = **MUSCLE** or **TENDON** — think “T” for Tendon. Caused by overstretching or sudden contraction.
 - **Sprain** = **LIGAMENT** at a joint — think “ankle sprain”. Caused by a sudden twist.
- Also: **Laceration** is irregular and torn; **Incision** is clean and straight.

6. Prevention and First Aid

PRICE — immediate management of soft tissue injury P — **Protection** — protect the injured part from further damage

R — **Rest** — stop activity immediately

I — **Ice** — apply for 15–20 minutes to reduce swelling and pain (never directly on skin)

C — **Compression** — a firm bandage to limit swelling

E — **Elevation** — raise the part above heart level to reduce blood flow

Causes of sports injuries: inadequate **warm-up** · poor **fitness** and technique · overuse and fatigue · unsuitable or faulty **equipment** · poor playing surface · not following rules · lack of **protective gear** · extreme weather.

Prevention: proper **warm-up and cool-down** · correct technique and progressive training · balanced diet and hydration · suitable equipment and protective gear · adequate rest and recovery · medical check-ups · following the rules of the game.

7. Question Triggers identify the injury

If the case says...	The answer is
“twisted his ankle, ligament torn”	Sprain
“pulled his hamstring muscle”	Strain
“bruise after a direct blow”	Contusion
“skin scraped after sliding”	Abrasion
“deep irregular tear in the skin”	Laceration
“clean cut with straight edges”	Incision
“bone broke and pierced the skin”	Compound / open fracture
“bone bent and cracked, child”	Greenstick fracture
“bone shattered into many pieces”	Comminuted fracture
“hairline crack from repeated running”	Stress fracture
“shoulder came out of its socket”	Dislocation
“resting pulse of an athlete is 45”	Bradycardia — long-term effect of exercise
“muscles became bigger after training”	Hypertrophy
“breathlessness eased and he continued”	Second wind

MOST-ASKED BOARD QUESTIONS

1. [5M] Explain the effects of exercise on the cardio-respiratory system.

2. [5M] Explain the effects of exercise on the muscular system.
3. [4M] Classify sports injuries and explain soft tissue injuries.
4. [3M] Differentiate between strain and sprain / laceration and incision.
5. [3M] Explain the physiological changes due to ageing.
6. [1M] What does PRICE stand for? → **Protection, Rest, Ice, Compression, Elevation**

THE HABIT THAT SCORES — For “effects of exercise” questions, give **numbered, named effects** — hypertrophy, bradycardia, increased stroke volume, increased VO_2 max. The technical term is the mark; “the heart becomes stronger” without naming **cardiac hypertrophy** earns less.