CORE 2: FACTORS AFFECTING PERFORMANCE

CQ: HOW DOES TRAINING AFFECT PERFORMANCE?

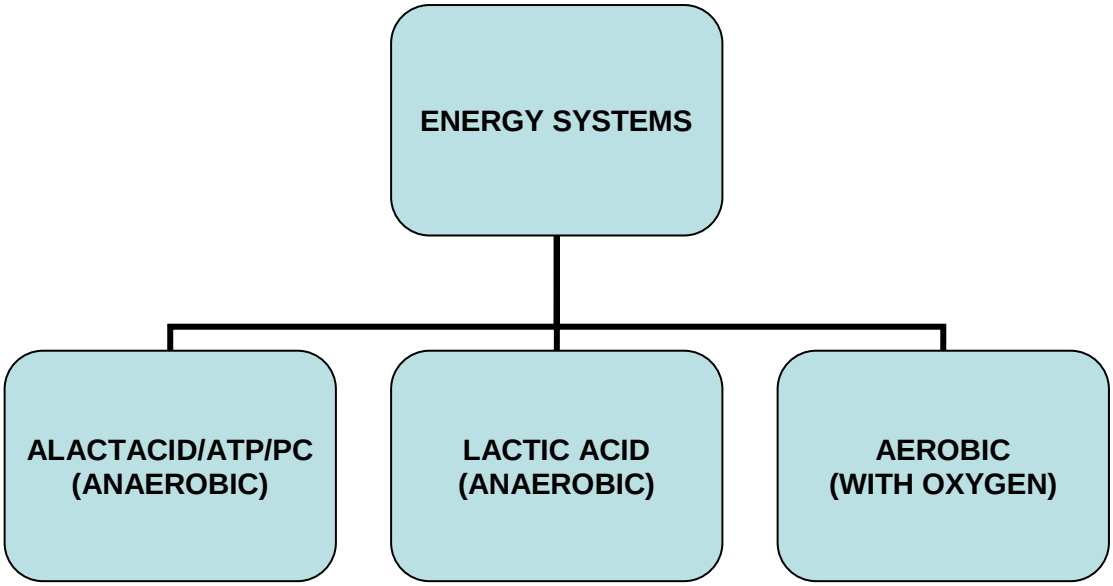
Energy Systems:

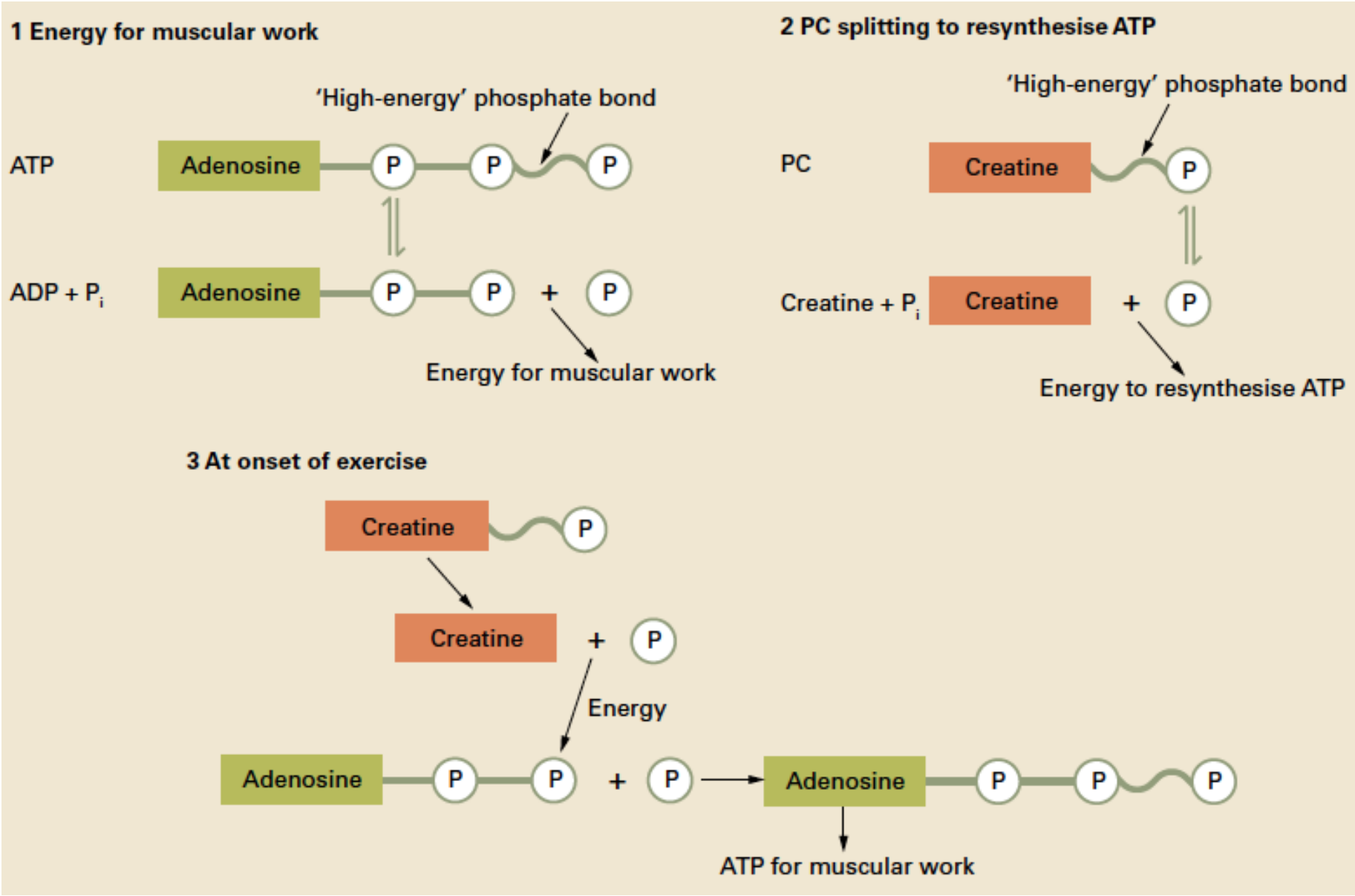
- Alactacid system - ATP/PC System – Phosphate System
- Lactic acid system
- Aerobic system

ENERGY SYSTEMS

Chemical energy (food) is converted to mechanical energy through the energy systems of the body. Carbohydrate, fat and protein break down to resynthesise ATP (adenosine triphosphate) which the body can use as mechanical energy. All three energy systems use ATP for muscular contraction.

There is essential knowledge that must be known for each of these energy systems. That essential knowledge is 1) source of fuel for the system 2) Efficiency of ATP production 3) Duration of the energy system 4) cause of fatigue 5) By products of energy production 6) process and rate of recovery.




1 Energy for muscular work
'High-energy' phosphate bond
ATP
Adenosine
P
P
P
ADP + Pi
Adenosine
P
P
+
P
Energy for muscular work
2 PC splitting to resynthesise ATP
'High-energy' phosphate bond
PC
Creatine
P
Creatine + Pi
Creatine
+
P
Energy to resynthesise ATP
3 At onset of exercise
Creatine
P
Creatine
+
P
Energy
Adenosine
P
P
+
P
Adenosine
P
P
P
ATP for muscular work

ENERGY – THE ALACTACID/ATP-PC SYSTEM

The ATP/ PC energy system is the energy used for instant energy. It relies completely on the ATP energy stored in the cell.

Imagine if you are in a car at a red light. When the light goes green and you drive forward you can only go a short distance before you have to change out of first gear.

The ATP-PC system is first gear.

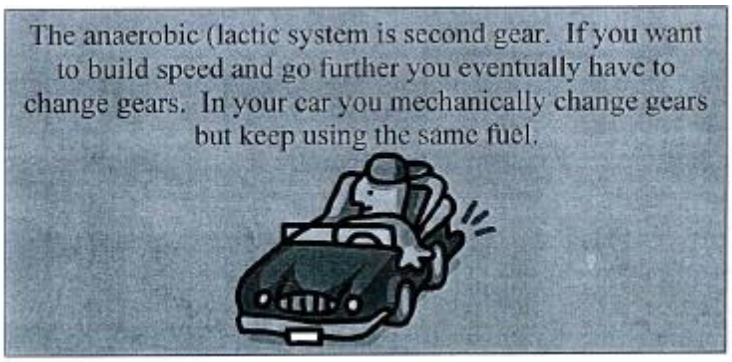
- ATP is stored in the muscles ready to be used when needed. You only have about 1-2 seconds worth before it needs to be resynthesised.
- When you need energy immediately, the ATP's are used and then the body uses the available phosphate creatine to resynthesise more ATP. The body only has about 10-12 seconds worth of phosphates however to achieve this task
- Unfortunately only enough ATP and PC can be stored to provide energy for a few seconds of high intensity work, so if you want to perform something longer than a short sprint or a few kicks or throws, there need to be other ways to re-supply the muscle with more ATP.

List 5 events that would use this system:

1. _____
2. _____
3. _____
4. _____
5. _____

SHORT TERM/HIGH INTENSITY ENERGY

THE ANAEROBIC (LACTIC) SYSTEM



In the body you are still producing ATP but with this energy system you use a different chemical pathway to generate the energy you need.

This energy system uses special enzymes to break down fuels in the blood and muscles to produce more ATP. Each step in the chemical pathway has its own enzyme.

- Carbohydrate fuel is stored in the body as glucose (when it is in the blood) or glycogen (when it is stored in the muscle or liver).

The chemical breakdown of glucose is called **glycolysis** – so the anaerobic system is sometimes called the **anaerobic glycolytic** energy system.

- When the anaerobic/lactic energy system is activated, a specialised enzyme converts glucose or glycogen into a new compound.

- A different enzyme converts that compound to yet another new compound. After several similar steps in the chemical pathway, ATP (and a compound called lactic acid) is produced. The ATP is used in the same way to produce energy (and heat as described above).

Outline why the 400 m sprint is one of the hardest events in terms of energy systems.

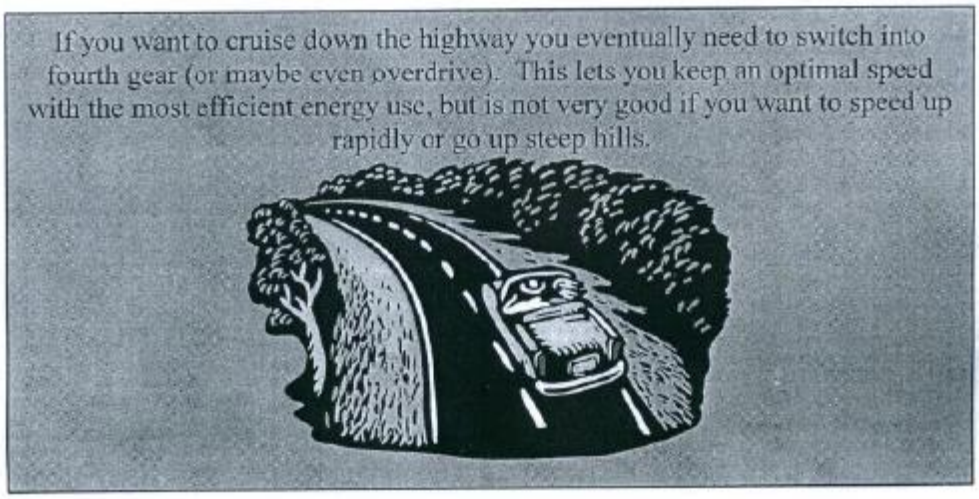
_____

_____

_____

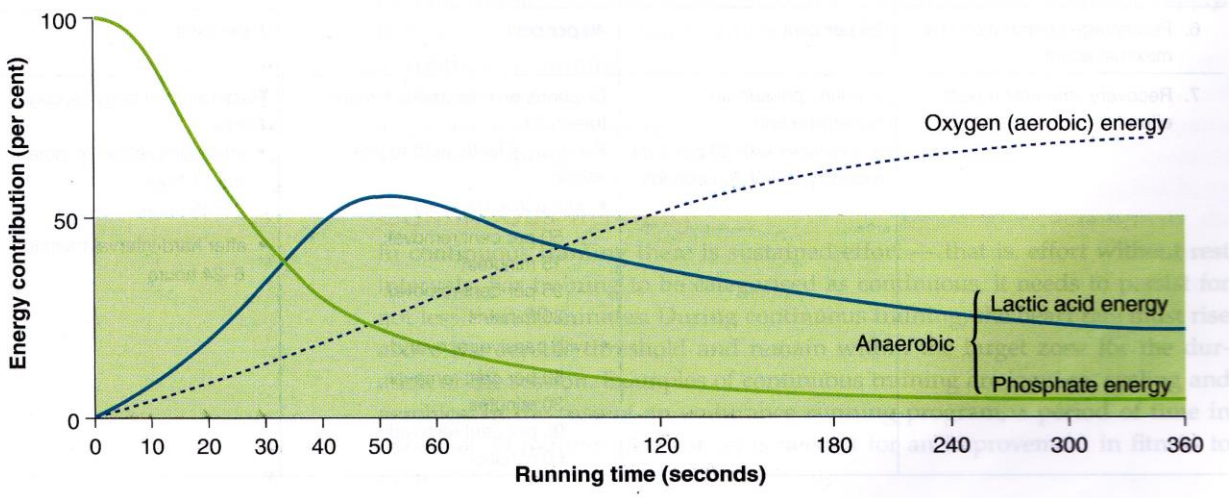
LONG-TERM ENERGY

THE AEROBIC SYSTEM



The third gear in the body's energy system is the aerobic system. This energy system uses most of the same chemical reactions used in the anaerobic/lactic energy system described earlier, however instead of stopping at the last step of anaerobic system (lactic acid), the aerobic system continues on, using more enzymes and chemical reaction to produce more ATP.

The very last chemical reaction in this system uses oxygen, which is carried to the last muscle cell by haemoglobin to produce large quantities of ATP (and carbon dioxide). Because oxygen is involved in the last chemical reaction this system is called the aerobic system.



	ATP/PC System	Lactic Acid System	Aerobic System
Fuel	Phosphocreatine (C=P)	Carbohydrates	Carbohydrates Fats Protein
Efficiency of ATP Production	Limited (1 g : 1 ATP) Very Fast Production	Limited (1 g : 2 ATP) Fast Production	Almost Unlimited (1 g : 36 ATP) Slower Production
Duration of System	7-10 seconds	30 seconds – 3 minutes	Unlimited at lower intensity
By-products of energy production	Heat	Lactic acid	CO_2 Water
Cause of Fatigue	Depletion of CP stores	Increased accumulation of hydrogen ions, which increases acidosis of the muscle	Depletion of glycogen and fat stores
Recovery Time	2 minutes for full recovery	30 minutes – 2 hours	Up to 48 hours if glycogen fully depleted
Related Sports	Javelin 100 m sprint	800 m run 400 m swim	Marathon Open water 10 km swim

PRINCIPLES OF TRAINING

Principles of training:

- Progressive overload
- Specificity
- Reversibility
- Variety
- Training thresholds
- Warm up and cool down

Complete the following table:

Progressive Overload	
Specificity	
Reversibility	
Variety	
Training Thresholds	
Warm Up / Cool Down	

TYPES OF TRAINING AND TRAINING METHODS

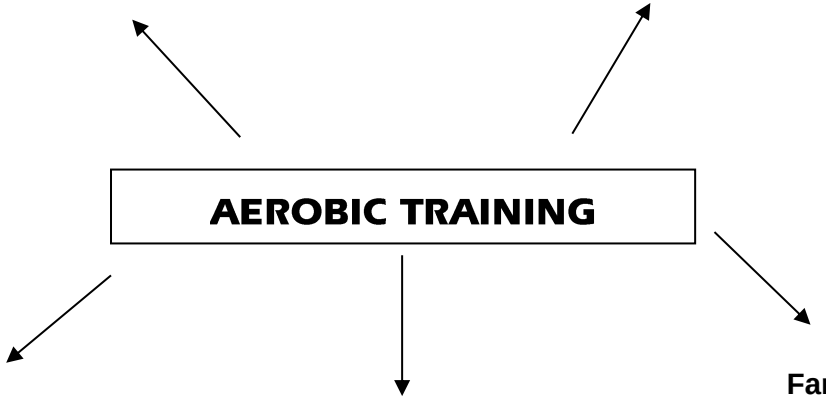
- Aerobic
- Anaerobic
- Strength (free/fixed weights, elastic, hydraulic)
- Flexibility (static, ballistic, PNF)

Circuit training

- Can include work stations to provide variety
- Overload easily applied (eg. less rest)
- Can be used anaerobically or aerobically

Continuous

- Needs to be at least 20 mins in duration
- In the aerobic zone
- Sustained workload
- Jogging, cycling, swimming



Interval

- Alternate work and recovery
- Characterised by repetitions
- Easily manipulated

Aerobics

- Dance and flexibility program that targets the aerobic zone

Fartlek

- Continuous but includes bursts of speed lasting 2-3 mins
- Can include variation in terrain to produce ‘surges’

PRINCIPLES OF TRAINING APPLIED TO AEROBIC TRAINING

Progressive Overload	
Specificity	
Reversibility	
Variety	
Training Thresholds	
Warm Up / Cool Down	

HSC TIP: Be sure to include lots of examples in your answer to improve the depth of response.

CONTINOUS TRAINING

In continuous training, exercise is performed at about the same level throughout the conditioning period that is, it is a continuous, sustained effort.

Heart rate should be the determinant of **intensity**. As a guide, it should be kept within the **training zone** for a minimum of 20 minutes, at least 4 times per week.

TRAINING ZONE HEART RATES FOR CONTINUOUS TRAINING

Age (years)	15	20	25	30	40	45	50	55	60	65	65+
Minimum Heart rate (beats/15 sec)	44	43	41	40	39	38	37	36	35	34	33
Maximum Heart rate (beats/ 15 secs)	36	35	34	33	32	32	31	40	29	28	27

The heart rate must rise above the aerobic threshold (the level at which an improvement will take place) to have a training effect. In other words:

- During: 30+ minutes
- Intensity: 70-85 % of MHR
- Frequency: 4-5 times per week

Continuous training is used to improve aerobic capacity and muscular endurance.

Activities include:

- 7 km run at a steady pace, jogging
- 2 km swim, swimming
- 15 km cycle, cycling
- Aerobics

In an **endurance running program** a period of between 60 and 120 minutes per session is needed for an improvement in fitness to occur.

FARTLEK TRAINING

Fartlek training is often called ‘speed play’. Developed in Sweden, fartlek training is a variation of continuous training. The participants vary their speed in a number of different ways to use different energy systems. It includes short burst (5-10 seconds) of faster work, occurring every 2-3 minutes.

While remaining heavily aerobic in nature, Fartlek training involves a contribution from the aerobic energy system.

This form of training is vital for improvement of the anaerobic threshold (the level at which lactate build up inhibits muscular contraction) i.e. the anaerobic system is developed.

Fartlek training is very good for pre-season training and in preparation for activities which require an interchange of systems (for example, football, basketball, soccer).

Activities include:

- A 7 km run with sprinting between telegraph poles every three minutes.
- A 2 km swim with a fast 25 m every fourth lap.
- Cross country running, covering a variety of terrains.
- Running up and down sand hills.
- Group running with changing leadership.

CIRCUIT TRAINING

Circuit training was developed in England, Leeds and consists of a number of different exercises arranged in a sequence. Each exercise is allocated a station and the sequence is performed a number of times in the same order until they complete the circuit.

Circuits can be designed to improve any of the components of fitness and skills. This is achieved by varying the number of repetitions, the amount of resistance or the work-rest ratio.

The major advantages of circuit training are:

1. Can be conducted with or without equipment.

2. Variety:

    - Any number of exercises can be used in any order.
    - Work time can vary from 15 to 90 seconds.
    - Resistance can be increased using weights, or using increased repetitions i.e. overload principle is applied.
    - Rest time can vary from none to all as much as is appropriate.

3. Adaptability – circuits can be designed to suit any sport by varying the type of exercise used and work-rest ratios.

4. Multiple purpose – circuits can be designed to incorporate all components of fitness, or to specialise in just a few. Record cards monitor improvement and players are aware of their progress.

INTERVAL TRAINING

Interval training involves alternating periods of **work** and **rest** (recovery) within a training session. For example, a session might be 5 x 200 m at near race pace, leaving on the minute (approx. 25 seconds work and 35 seconds rest).

The ratio between work and rest period durations is the key to interval overload. The advantage of the training method allows the athlete to work hard but avoid fatigue. A normal walk or slow walk recovery is suggested rather than sitting or lying.

As anaerobic work is generally of high intensity, interval training allows for performance of a number of high-intensity conditioning bouts. If 100% effort is required work interval is short.

To perform at the same workload without rest would result in early fatigue, leading to cessation of training or poor-quality work for the remainder of the session.

Depending on the length of the rest periods interval training can be used to increase the efficiency of not only the ATP-PC system and lactic acid energy systems, but also the aerobic energy system.

Cool down exercises promotes removal of lactate from muscles.

PHYSIOLOGICAL ADAPTATIONS

Physiological adaptations in response to aerobic training:

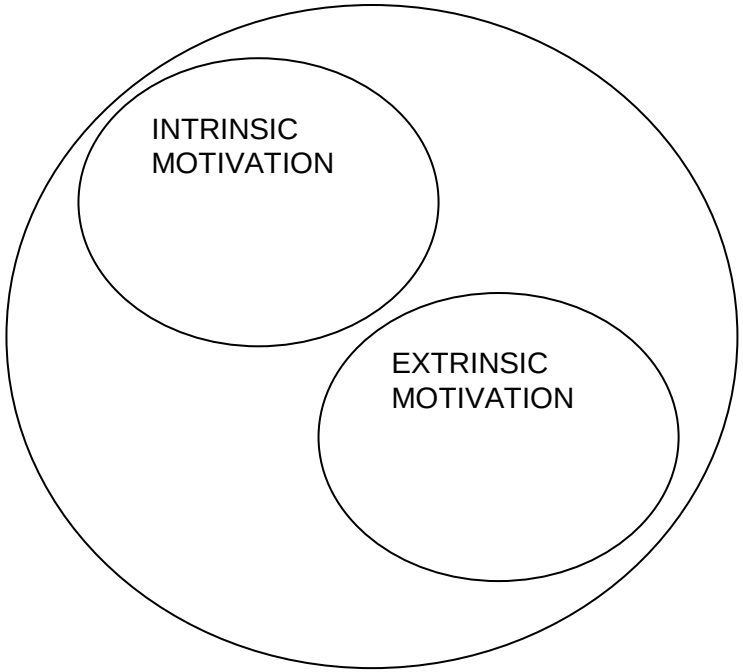
Resting Heart Rate	
Stroke Volume	
Cardiac Output	
Oxygen Uptake	
Lung Capacity	
Haemoglobin Level	
Muscle Hypertrophy	
Effect on Fast & Slow Twitch Muscle Fibres	

TYPES OF MOTIVATION

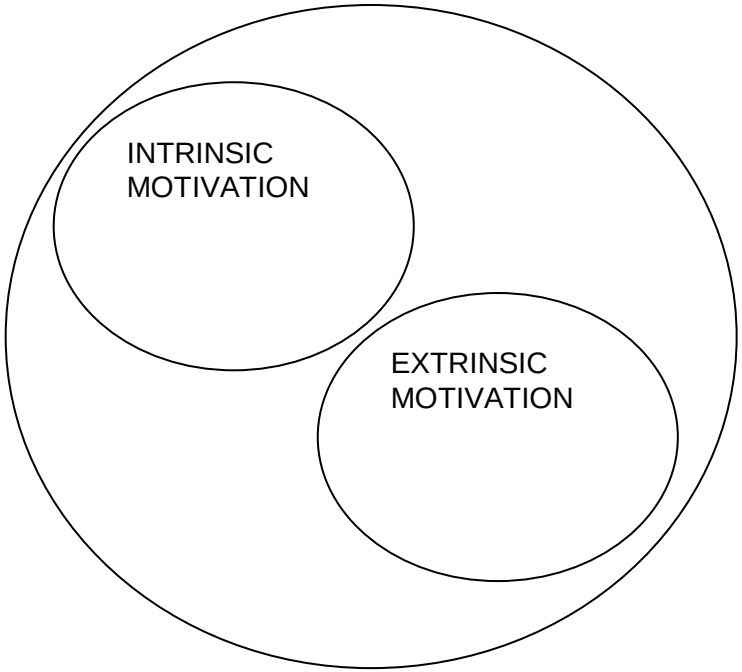
CQ: HOW CAN PSYCHOLOGY AFFECT PERFORMANCE?

Motivation:

- Positive and negative
- Intrinsic and extrinsic



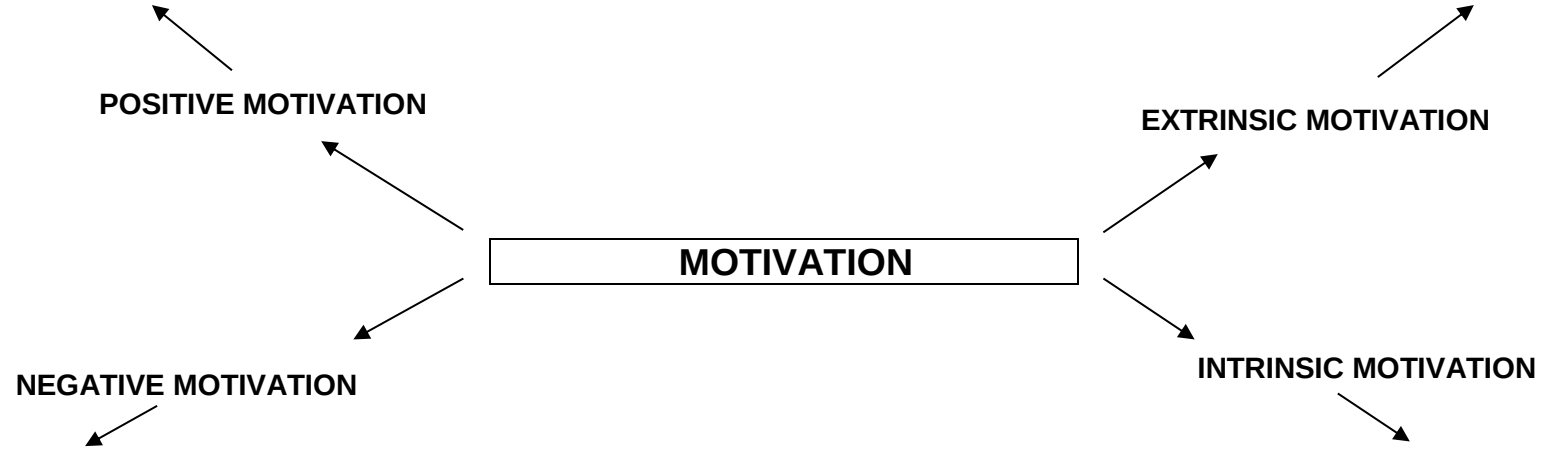
POSITIVE MOTIVATION



NEGATIVE MOTIVATION

Individual's performance is rewarded through praise or recognition.
Athlete then motivated to reproduce performance.

Individuals attempt to change behaviour because of influences outside the body.



Individual's performance is met with negative reactions performance.

Athlete is then motivated to change.
Motivation that comes from within the athlete.
Usually the most powerful motivational tool.

Classify the following examples:

1. Coach progress chart
2. Media coverage of event
3. Gold medal
4. Personal best time
5. Fans wanting autographs
6. Sponsorship incentives
7. Working hard at training to avoid coach's ridicule
8. Self-talk before a gymnastics routine
9. Dropped from starting lineup.
10. A player enjoying a game.