A LEVEL Cambridge Topical Past Papers

PHYSICAL EDUCATION

2017 — 2023

P3

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1 - (9396/32_Winter_2017_Q1) - *Exercise And Sport Physiology*

(a) Describe the roles of the Krebs cycle and the electron transport (transfer) chain of the aerobic system in causing the complete breakdown of a glucose molecule. [6]

(b) Explain how improved efficiency of the aerobic system results in higher levels of fitness for an elite endurance athlete. [3]

(c) Strength endurance is a component of fitness that is required not only by elite athletes but by the general public as well.

(i) Define the term *strength endurance* and identify **three** factors that affect it. [4]

(ii) Describe a recognised test to evaluate strength endurance. [3]

(iii) Describe the physiological adaptations that occur after a prolonged strength training programme. [5]

(d) Reversibility and moderation are two principles of training that a coach should take into consideration when planning a training programme.

Define these **two** principles and explain how you would apply them to a fitness programme of your choice. [4]

(e) Elite athletes may have a high body mass index (BMI).

Discuss the view that a high BMI is harmful to the health of elite athletes. [5]

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2 - (9396/32_Winter_2018_Q1) - *Exercise And Sport Physiology*

(a) The body requires energy for physical activity and power is important in many sports.

(i) Define the terms *energy* and *power*. [2]

(ii) Glucose is a fuel that can be broken down to release energy for physical activity.

State **three** other fuels that can provide energy for physical activity. [3]

(b) Name and describe the predominant energy system used during a 100-metre sprint. [5]

(c) Outline the physiological benefits of a warm up. [4]

(d) Aerobic capacity is defined as 'the maximum amount of oxygen that can be taken in and used in one minute'. It is also known as VO_2 max.

(i) Describe **one** recognised method of evaluating aerobic capacity. [4]

(ii) Outline an interval training programme to improve aerobic capacity. [4]

(e) In order to enhance their performance, marathon runners may use nutritional aids during the event.

State **two** nutritional aids that would enhance performance during a marathon and explain how each aid benefits a marathon runner. [4]

(f) Describe the physiological effects of alcohol on performance in sport. [4]

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3 - (9396/33_Winter_2018_Q1) - *Exercise And Sport Physiology*

(a) The table shows an energy continuum.

aerobic percentage	anaerobic percentage	sporting activity
0	100	100 m sprint
20	80	kayaking
40	60	tennis
60	40	1500 m run
80	20	cross-country running
100	0	marathon running

Justify why tennis has been placed in this position on the continuum. [4]

(b) After intense exercise the body begins the recovery process and will have an oxygen debt, which is also known as EPOC.

(i) Explain the causes of an oxygen debt/EPOC. [2]

(ii) Outline the different processes that occur during the recovery process. [5]

(c) During a training programme, the principle of overload must be applied if physiological adaptations are to occur.

Describe **three** ways that overload can be achieved. [3]

(d) Static strength is needed in many physical activities.

(i) Define *static strength* and give a sporting example of its use. [2]

(ii) Describe, using practical examples, a type of training that could be used to develop static strength. [3]

(e) Good flexibility provides health benefits as well as enhancing performance.

(i) State **three** factors that affect flexibility. [3]

(ii) Describe a recognised method of evaluating flexibility. [4]

(f) Discuss the use of human growth hormone (HGH) as an ergogenic aid to performance in sport. [4]

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4 - (9396/32_Winter_2019_Q1) - *Exercise And Sport Physiology*

(a) A gymnast performing a floor routine relies heavily on the lactic acid system for ATP resynthesis.

(i) Describe the lactic acid system. [5]

(ii) Once the floor routine is completed, the gymnast begins the recovery process.

Explain the processes that occur during the first few minutes of recovery. [4]

(b) Periodisation of training involves splitting the training year into blocks of time.

Explain, using sporting examples, the following terms:

- *macrocycle*
- *mesocycle*
- *microcycle*. [3]

(c) Flexibility and balance are important components of fitness that will impact on the effective performance of a range of motor skills.

(i) Define the term *balance* and, using practical examples, identify the **two** dimensions of balance. [3]

(ii) Describe a recognised test to evaluate balance. [3]

(iii) Describe the types of training used to develop flexibility. [6]

(iv) Describe the physiological adaptations to flexibility training that will enhance sporting performance. [3]

(d) Caffeine is an ergogenic aid that is used by many athletes.

Explain, using a sporting example, how caffeine enhances performance. [3]

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5 - (9396/31_Summer_2020_Q1) - *Exercise And Sport Physiology*

(a) State **three** forms of energy that are present in the human body. [3]

(b) Explain the role of ATP in exercise physiology. [4]

(c) During a match a performer may use all three energy systems.

Explain, using examples from a game, why the predominant energy system will change. [3]

(d) It is important to have a good knowledge of the recovery process in order to plan effective training sessions.

(i) Define the term *recovery process*. [1]

(ii) When planning a training session a cool down should be included.

Explain the other implications of the recovery process that should be considered when planning training sessions. [3]

(iii) Describe the benefits of a cool down after a strenuous training session. [4]

(e) State **four** factors that may affect the aerobic capacity of an individual. [4]

(f) The body composition of an individual depends on the lean body mass and fat mass in the body.

(i) Describe a method of evaluating body composition. [3]

(ii) Outline a suitable exercise programme to reduce the fat mass of an overweight individual. [5]

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ANSWERS

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1 - (9396/32_Winter_2017_Q1) - *Exercise And Sport Physiology*

(a)	6 marks for 6 of: (Krebs cycle) (sub-max. 4) *Accept use of diagrams in descriptions if arrows show direction.* 1 (acetyl co-enzyme A) combines with oxaloacetic acid to form citric acid; 2 … which undergoes several reactions to become oxaloacetic acid again / regeneration of oxaloacetic acid; 3 2 ATP produced; 4 CO_2 is by-product; 5 hydrogen is removed; 6 takes place in (matrix of) mitochondria; (Electron Transport (Transfer) Chain) (sub-max. 4) 7 hydrogen is transported to cristae / inner membranes (of mitochondria) 8 (hydrogen) is split into a proton / H^+ **and** electron / H^- / hydride; 9 electrons are passed down the electron chain releasing energy; 10 32–34 ATP produced; 11 (hydrogen) combines with oxygen to produce water;	**6**
(b)	3 marks for any 3 of: (higher fitness levels because …) 1 increased VO_2 max. / aerobic capacity; 2 improved ability to transport oxygen / increased capillarisation / more haemoglobin / increased blood volume; 3 more myoglobin / mitochondria / more slow-twitch fibres / greater oxygen uptake at muscles; 4 increased use of alveoli / greater lung volumes / greater oxygen uptake at lungs; 5 able to use / break down fats for energy / fats require more oxygen than carbohydrates; 6 use of fats reduces depletion of carbohydrates / glycogen sparing; 7 quicker removal of lactic acid / delayed lactate threshold / OBLA / athlete can work aerobically at higher intensity; 8 increase in oxidative enzymes;	**3**
(c)(i)	1 mark for: 1 the ability to sustain a number of muscular contractions for a period of time OR the ability to sustain a number of muscular contractions and withstand fatigue / OWTTE; 3 marks for any 3 of: 2 muscle fibre type; 3 cross-sectional area / size of muscle; 4 lifestyle / training; 5 gender; 6 age; 7 hormones / testosterone;	**4**

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<table>
<tr><td>(c)(ii)</td><td>3 marks for any 3 of (Accept any recognised test that measures strength endurance.):

<table>
<tr><td>1 (name)</td><td>NCF abdominal curl conditioning test;</td><td>press up / sit up / pull up test;</td><td>bent arm hang;</td></tr>
<tr><td>2 (description – protocol)</td><td>perform sit ups in time with bleeps on a CD until you can no longer keep up with bleeps;</td><td>perform as many repetitions as possible in a given time period / 30 seconds / 1 minute;</td><td>hang from a bar with elbows bent and chin above bar for as long as possible / until chin drops below bar;</td></tr>
<tr><td>3 (description – measure)</td><td>record the level and number of sit ups completed;</td><td>count / record the number of reps performed;</td><td>(use stopwatch to) measure time that position is held;</td></tr>
<tr><td>4 (evaluation)</td><td colspan="3">compare result to standardised table / norms to give a rating;</td></tr>
</table></td><td>3</td></tr>
<tr><td>(c)(iii)</td><td>5 marks for any 5 of:

1 (muscle / cardiac) hypertrophy / increase in size / mass of muscle;
2 hyperplasia;
3 increase in ATP / PC stores;
4 increase in glycogen stores;
5 increased tolerance to lactic acid / delayed OBLA / delayed lactic threshold;
6 quicker removal of lactic acid / improved buffering capacity;
7 increased enzyme activity;
8 increased density of / more myoglobin / mitochondria;
9 increased capillarisation;
10 increased recruitment / co-ordination (of muscle fibres / motor units);
11 increased strength of ligaments / tendons / connective tissue;</td><td>5</td></tr>
</table>

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(d)	4 marks for: 1 (reversibility – def.) physiological adaptations will be lost if training stops, OWTTE; 2 (application) avoid periods of inactivity such as illness by following a healthy lifestyle OR avoid injury by warming up / using correct techniques / not overtraining OR if a holiday is booked continue training by booking hotel with gym or running / swimming regularly OR alternative training methods while injured etc.; 3 (moderation – def.) if training is too intense overuse injuries will occur, OWTTE; 4 (application) apply principle of progression / gradually increase the training load OR include rest or recovery periods in training OR do not train when in pain or fatigued OR vary the intensity of training etc.;	**4**
(e)	5 marks for 5 of (sub-max. 3 marks for points 1–4): 1 BMI is a measure of body composition based on height and weight / weight divided by height squared; 2 a BMI of 30+ is classed as obese; 3 health implications of obesity / high BMI include: high cholesterol / atherosclerosis / hypertension / coronary heart disease / strokes / diabetes / gall bladder disease / cancers / psychological problems; 4 credit a second health risk from list above; 5 (however) elite athletes generally have a much higher percentage of muscle mass; 6 and increased bone density / muscle weighs more than fat; 7 which means that they have a very low percentage body fat (despite high BMI) / BMI does not distinguish between muscle and fat;	**5**

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2 - (9396/32_Winter_2018_Q1) - *Exercise And Sport Physiology*

(a)(i)	2 marks for: 1 (energy) the capacity / ability to perform work / ability to create movement; 2 (power) the rate at which work is performed **OR** amount of work performed per unit of time **OR** strength × speed;	**2**
(a)(ii)	3 marks for any 3 of: 1 ATP; 2 PC; 3 carbohydrates; 4 glycogen; 5 fats / lipids / FFAs; 6 proteins; 7 lactic acid; *Accept other examples of correct fuels.*	**3**
(b)	5 marks for 5 of: (sub-max. 1 mark) 1 ATP / PC system **OR** alactic system; (sub-max. 4 marks) 2 anaerobic / does not need oxygen; 3 phosphocreatine / PC is broken down to produce energy **OR** PC → P + C + energy; 4 energy is used to resynthesise ATP **OR** energy + ADP + P → ATP; 5 enzyme – creatine kinase; 6 site of reaction – sarcoplasm; 7 yield – 1 ATP per molecule of PC;	**5**
(c)	4 marks for any 4 of: 1 reduces risk of injury / DOMS; 2 increases flexibility / stretch / elasticity of muscle / connective tissue; 3 increases / redirects flow of blood / oxygen to working muscles; 4 activates vascular shunt **OR** dilates blood vessels to working muscles; 5 improves rate of dissociation of oxygen from haemoglobin; 6 increases enzyme activity; 7 increases speed of nerve impulses **OR** improves reaction time **OR** faster muscle contractions; 8 reduces EPOC / oxygen debt; 9 facilitates release of more synovial fluid into joints;	**4**

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<table>
<tr><td>(d)(i)</td><td>4 marks for:
<table>
<tr><td>1 (name)</td><td>multi-stage fitness test;</td><td>Cooper OR 12 minute test;</td><td>PWC 170 test;</td><td>step test (various);</td><td>Douglas bag / direct gas / indirect calorimetry;</td></tr>
<tr><td>2 (description)</td><td>run shuttles in time with bleeps on CD (which get progressively quicker);</td><td>performer walks / runs round a measured course / athletics track;</td><td>performer cycles (on an ergometer) and heart rate is monitored at (2 or 3) different workloads;</td><td>step up and down on a step / bench at a given rate for a given time;</td><td>run on a treadmill to exhaustion;</td></tr>
<tr><td>3 (result / score from test)</td><td>(when performer cannot keep up with bleeps) the level AND number of shuttles is recorded;</td><td>distance covered in 12 minutes is recorded in metres;</td><td>results are plotted on a graph which is used to estimate / predict workload at 170 bpm;</td><td>heart rate is recorded during and after the test AND a formula is used to give a score;</td><td>amount of oxygen expired is measured (and compared to amount of oxygen inspired);</td></tr>
<tr><td>4 (evaluation)</td><td>result is compared to (normative) table (to give predicted VO_2 max.);</td><td>distance is compared to (normative) table (to give predicted VO_2 max.);</td><td>score is compared to (normative) table (to give predicted VO_2 max.);</td><td>score is compared to (normative) table (to give predicted VO_2 max.);</td><td>to give true / accurate value of VO_2 max.;</td></tr>
</table></td><td>4</td></tr>
<tr><td>(d)(ii)</td><td>4 marks for any 4 of:

1 2 or more times per week;
2 55–90% VO_2 max. OR 60–95% max. HR;
3 high intensity OR (at least) three quarter pace;
4 400 metres or further OR 45 seconds or longer;
5 work:relief ratio 1:1 or less (time for relief less than or equal to work time);
6 (type) running / swimming / cycling / rowing / jogging;</td><td>4</td></tr>
</table>

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<table>
<tr><td>(e)</td><td>4 marks for 4 of:

(sub-max. 2 marks for aids and sub-max. 2 marks for benefits)

<table><tr><th>aid</th><th>benefit</th></tr><tr><td>1 fluid / water / hypotonic drinks;</td><td>2 prevents dehydration OR reduce (core) body temperature OR prevents blood becoming too viscous / thickening;</td></tr><tr><td>3 isotonic drinks / salt;</td><td>4 maintain / replace electrolyte levels OR replace lost sodium / potassium / chlorine OR boost blood glucose OR maintain hydration;</td></tr><tr><td>5 energy / sports / glucose / hypertonic drinks / gels / energy bars / glucose / carbohydrates;</td><td>6 boost blood glucose / delay hitting the wall;</td></tr><tr><td>7 fruit / nuts;</td><td>8 boost carbohydrate / protein / electrolyte / mineral stores;</td></tr><tr><td>9 caffeine / ginseng / ephedrine / herbal infusions;</td><td>10 enhances fat metabolism OR glycogen sparing;</td></tr></table></td><td>4</td></tr>
<tr><td>(f)</td><td>4 marks for any 4 of:

1 impairs motor ability / coordination / balance / reaction time;
2 causes dehydration;
3 reduces availability of glucose OR may cause hypoglycaemia;
4 reduces anxiety / physical effects of anxiety, e.g. shaking / muscle tremor;
5 reduces sensation of pain OR allows performer to train / work harder;
6 reduces body's ability to remove lactic acid;
7 impairs decision-making / lose concentration;</td><td>4</td></tr>
</table>

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3 - (9396/33_Winter_2018_Q1) - *Exercise And Sport Physiology*

(a)	4 marks for any 4 of: 1 tennis has periods of high intensity **AND** low intensity work; 2 (aerobic), e.g. long duration of match **OR** match requires high level of stamina; 3 (aerobic), e.g. rest periods between points / games / changeover of ends; 4 (anaerobic), e.g. nature of some strokes, e.g. serve / smash / drive / volley; 5 (anaerobic), e.g. sprinting across court to reach ball **OR** strength endurance for long rally;	**4**
(b)(i)	2 marks for any 2 of: 1 insufficient oxygen was available (during exercise / for aerobic respiration); 2 cardiovascular system needs time to get enough oxygen to muscles; 3 anaerobic systems were being used;	**2**
(b)(ii)	5 marks for 5 of: (sub-max. 3 marks for each component / stage) (alactacid) 1 alactacid stage / debt component; 2 re-synthesis of ATP/PC **OR** restoration of muscle phosphagen; 3 replenishment of myoglobin stores with oxygen **OR** restoration of oxy-myoglobin link; 4 takes 2–3 minutes **OR** uses up to 4 litres of oxygen; (lactacid) 5 lactacid stage / debt component; 6 removal of lactic acid; 7 takes about 1 hour **OR** uses 5–8 litres of oxygen; 8 replenishment of glycogen stores;	**5**
(c)	3 marks for any 3 of: 1 (frequency) increase frequency of training **OR** increase number of sessions per week; 2 (intensity) increase intensity of training **OR** work at higher percentage of max. HR / at higher percentage of max 1 RM / run faster / more reps / heavier weights; 3 (time) increase duration of training **OR** longer training session; 4 (rest) reduce rest periods during training;	**3**
(d)(i)	2 marks for: 1 (definition) strength exerted against a resistance with no movement / change of muscle length **OR** strength exerted isometrically; 2 (examples) rugby scrum / tug-of-war / handstand;	**2**

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<table>
<tr><td>(d)(ii)</td><td>3 marks for any 3 of:

1 (type) resistance / weight / isometric / circuit training / interval training;
2 named exercise, e.g. plank / bridge OR weight held in stationary position;
3 (position held for) at least 10 seconds (depending on weight);
4 at least 2 repetitions / sets;
5 resistance at least 70% of 1 RM;</td><td>3</td></tr>
<tr><td>(e)(i)</td><td>3 marks for any 3 of:

1 type of joint;
2 length / elasticity of muscle / ligaments / tendons / skin / connective tissue;
3 shape of bones (at joint) / joint structure;
4 temperature;
5 age;
6 gender;
7 injury;
8 training / lifestyle;
9 muscle / fat bulk;</td><td>3</td></tr>
<tr><td>(e)(ii)</td><td>4 marks for:

<table>
<tr><td>1 (name)</td><td>sit and reach test;</td><td>goniometer / goniometry;</td></tr>
<tr><td>2 (description)</td><td>sit on floor, legs straight, feet against box / bench AND reach forward as far as possible (with arms straight);</td><td>fulcrum / pivot / head of goniometer is placed at joint (axis of rotation) AND arms of goniometer align with bones / limbs;</td></tr>
<tr><td>3 (score / result of test)</td><td>hold position (for 2 seconds) and record score / distance reached;</td><td>record angle in degrees shown (on goniometer);</td></tr>
<tr><td>4 (evaluation)</td><td>compare score to (normative) tables / data;</td><td>compare angle to (normative) tables / data;</td></tr>
</table>
</td><td>4</td></tr>
</table>

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(f)	4 marks for 4 of: *Sub-max. 3 marks for positives only, or negatives only.* (positives – sub-max. 3 marks) 1 increases muscle mass / size / growth **OR** increases strength / power; 2 rapid repair of injured connective tissue; 3 enhances intensity of training; 4 improves recovery rate (after training); 5 increases metabolism **OR** reduces body fat; 6 increases bone density / bone growth / bone strength; 7 difficult to detect; (negatives – sub-max. 3 marks) 1 illegal / banned substance; 2 abnormal growth of bone / muscle tissue; 3 enlargement of vital organs, e.g. heart **OR** can cause heart attacks; 4 growth of hands / feet / face **OR** acromegaly; 5 risk of cancers / diabetes / liver / kidney damage / stroke / infections from needles; 6 high blood pressure; 7 reduces natural HGH production; 8 reduction in size of pituitary gland and / or reduced secretions;	**4**

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