International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

Sports, Exercise and Health Science

Standard level

Specimen papers 1, 2 and 3

For first examinations in 2014

CONTENTS

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SPORTS, EXERCISE AND HEALTH SCIENCE
STANDARD LEVEL
PAPER 1

SPECIMEN PAPER

45 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is *[30 marks]*.

1. Which best describes flat bones?

A. Complex and varied in shape, such as the vertebrae

B. The type of bones found in the skull and the shoulder blade

C. Bones that are longer than they are wide

D. Bones found in the wrist and ankle

2. What fluid filled sacs are associated with certain synovial joints?

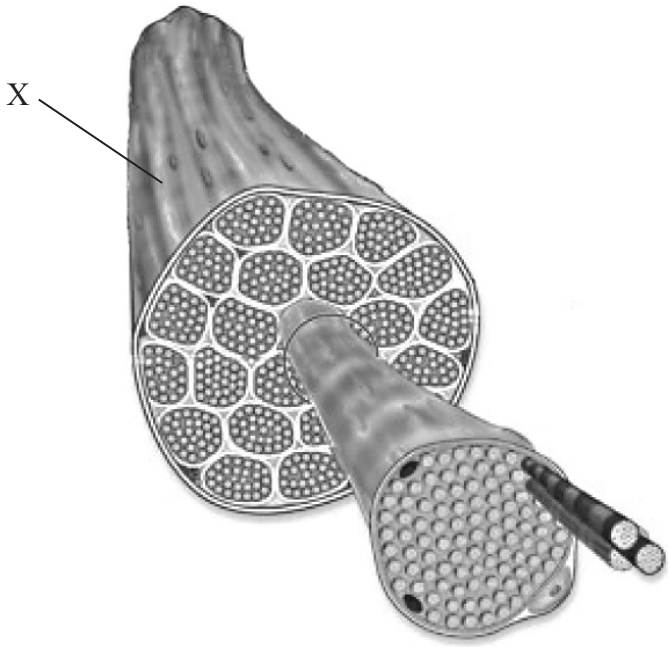
A. Ligaments

B. Bursae

C. Articular capsule

D. Synovial membrane

3. What is the name of the outermost covering of the skeletal muscle as indicated by label X?



[Source: adapted from M McKinley and V O'Loughlin, (2006), *Human Anatomy*, 1st Edition, page 289, Copyright © The McGraw-Hill Companies, Inc.]

A. Endomysium

B. Perimysium

C. Sarcomere

D. Epimysium

4. What is the main role of hemoglobin during exercise?

A. To transport ATP to the muscles

B. To transport the excess hydrogen ions produced by the muscles

C. To carry oxygen for dissociation at the muscle tissues

D. To change the pH of the blood

5. The table below shows respiratory rates and lung volumes for an endurance-trained athlete.

Respiratory rates and volumes	**Recorded results**
Pulmonary ventilation	61.0 litres min^{-1}
Tidal volume at rest	0.5 litres
Maximal tidal volume	3.9 litres
Vital capacity	6.2 litres
Residual volume	1.2 litres

[Data from W L Kenny, J H Wilmore and D L Costill, (2012), *Physiology of Sport and Exercise*, 5th Edition, Champaign, IL: Human Kinetics, 267]

What is the total lung capacity?

A. 7.4 litres

B. 6.7 litres

C. 4.7 litres

D. 10.9 litres

6. Which valve is located between the right atrium and the right ventricle?

A. Bicuspid valve

B. Pulmonary valve

C. Tricuspid valve

D. Aortic valve

7. Which component of blood is required to form a blood clot?

A. Plasma

B. Platelets

C. Erythrocytes

D. Leucocytes

8. Which is responsible for the electrical impulse that regulates the contraction of the atria in the heart?

A. Atrio-ventricular node

B. Purkinje tissue

C. Bundle of His

D. Sinoatrial node

9. What is the definition of *diastolic blood pressure*?

A. The blood pressure in the human body during ventricular contraction

B. The upper measurement when reporting blood pressure

C. The pressure in the brachial artery as the ventricles relax and are filling with blood

D. The blood pressure in the human body during atrial relaxation

10. Which most likely results from participation in a long-term aerobic training programme?

A. Increased left ventricular volume

B. Decreased plasma volume

C. Increased resting heart rate

D. Decreased arterio-venous oxygen difference

11. Which is an example of a macronutrient?

I. Lipid
II. Protein
III. Carbohydrate

A. I only
B. I and II only
C. II and III only
D. I, II and III

12. Which correctly describes non-essential amino acids?

A. They are synthesized by the human body.
B. They are unable to be manufactured by the human body.
C. They are found in abundance in plant-based food sources.
D. They must be obtained from the diet.

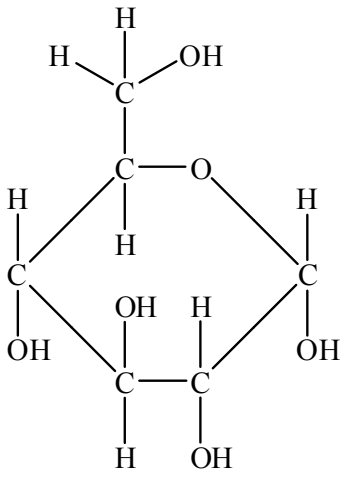
13. What needs to be considered when recommending a balanced diet?

I. Habitual physical activity level of the person
II. Age of the person
III. Climate where the person lives

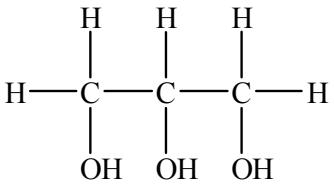
A. I only
B. I and II only
C. II and III only
D. I, II and III

14. Which is the general structure of a glucose molecule?

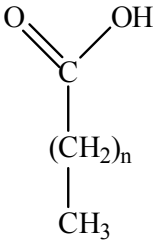
A.



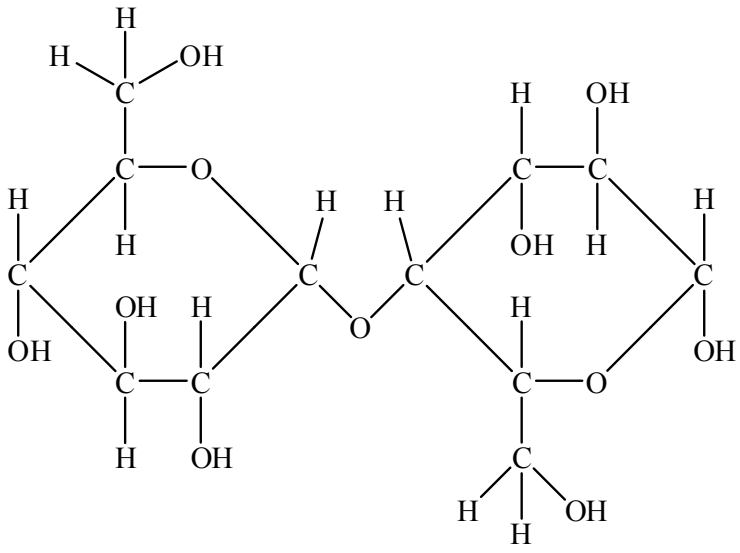
B.



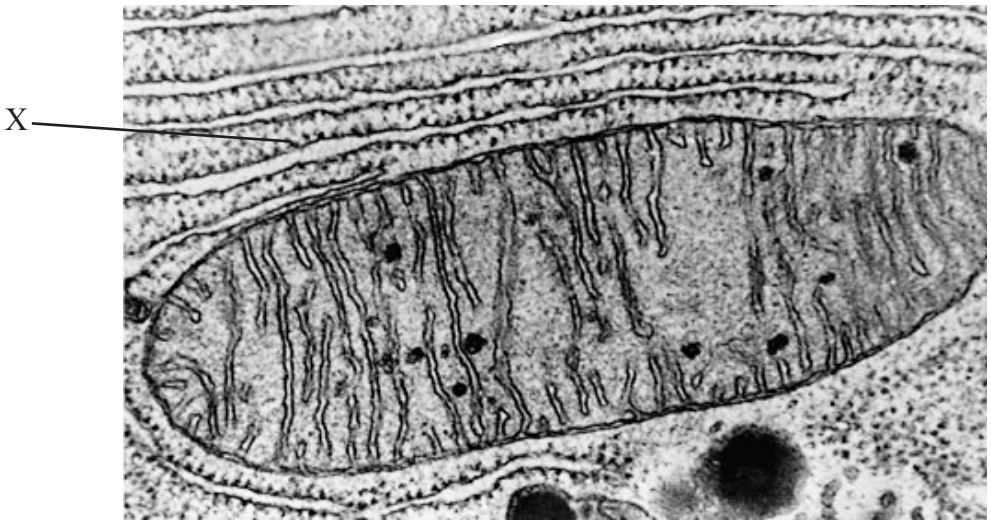
C.



D.



15. The diagram below shows the ultrastructure of a generalized animal cell. What structure is indicated by label X?



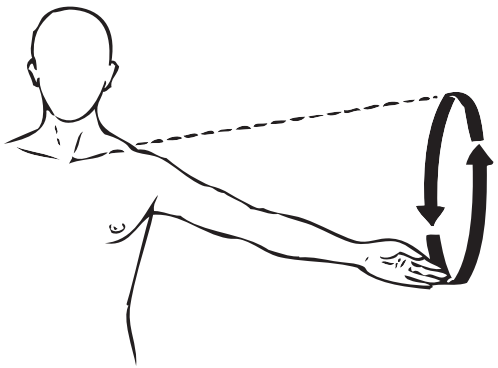
A. Lysosome

B. Rough endoplasmic reticulum

C. Nucleus

D. Mitochondrion

16. What is the type of movement performed in the diagram below?



A. Pronation

B. Adduction

C. Circumduction

D. Elevation

17. What occurs during an isometric contraction?

A. The muscle shortens and tension is developed.

B. The muscle length does not change and no tension is developed.

C. The muscle length does not change while tension is developed.

D. The muscle shortens and no tension is developed.

18. What is the name of the gap between two neurons?

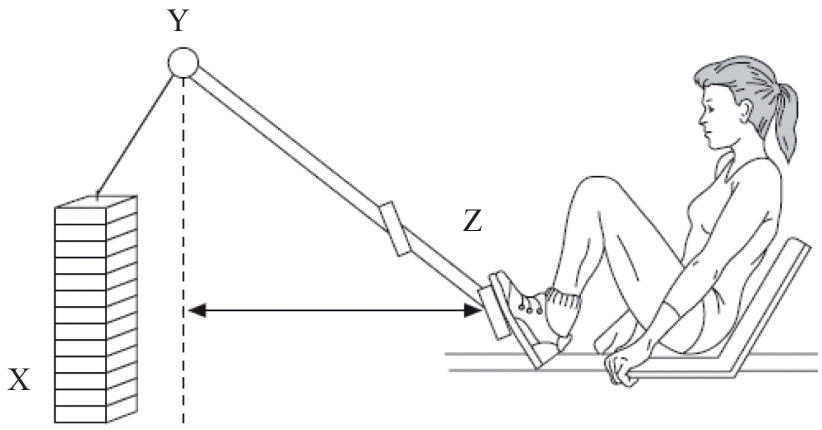
A. Synapse

B. Dendrite

C. Axon

D. Cell body

19. The diagram below demonstrates an athlete performing a leg press. Which correctly identifies the fulcrum, effort and load for this first class lever?



[Source: Physical Education Exam VCE Units 1 and 2, Malpeli / Telford © 2008, Cengage Learning Australia. Reprinted with the permission of Cengage Learning Australia.]

A. X = Fulcrum, Y = Effort and Z = Load

B. X = Fulcrum, Y = Load and Z = Effort

C. X = Load, Y = Effort and Z = Fulcrum

D. X = Load, Y = Fulcrum and Z = Effort

20. Which law states: "for every action force, there is an equal and opposite reaction force"?

A. Newton's first law

B. Newton's second law

C. Newton's third law

D. Law of Conservation of Momentum

21. What is the definition of the term *skill*?

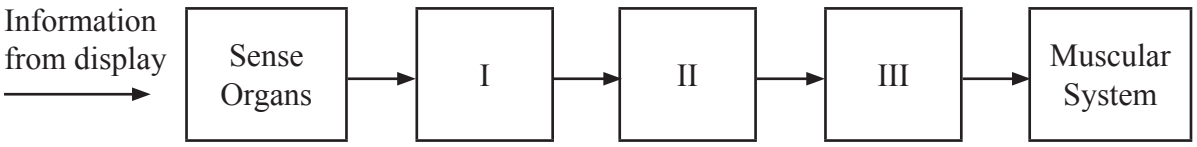
A. A stable, enduring characteristic that is genetically determined

B. Basic movements in sport

C. A set of movements which are genetically determined

D. The consistent production of goal-orientated movements, which are learned and specific to the task

22. What are the information processing mechanisms that match the numerals in the diagram below?



	I	II	III
A.	Effector mechanism	Perceptual mechanism	Decision Mechanism
B.	Decision Mechanism	Perceptual mechanism	Effector mechanism
C.	Perceptual mechanism	Effector mechanism	Decision Mechanism
D.	Perceptual mechanism	Decision Mechanism	Effector mechanism

23. What term is given to the interval between the sound of the starting pistol and the initiation of a dive into the pool during a swimming event?

A. Reaction time

B. Response time

C. Movement time

D. Stimulus-response compatibility

24. With respect to learning, which statement best describes a positive acceleration curve?

A. The performer has reached their best possible performance.

B. The individual's learning is low in the early stages but increases in later stages.

C. The performer enters a period where there is no improvement in learning.

D. The rate of learning is faster in the early stages than in the later stages.

25. In the spectrum of teaching styles, what best describes the command style?

A. Assists in developing the communication skills of the learner

B. Encourages the learners to be creative and develop their own performance process

C. The teacher or coach makes all the decisions

D. Invites the learners to work in pairs to give each other feedback

26. Which is classified as a health-related fitness component?

A. Flexibility

B. Coordination

C. Agility

D. Power

27. Which of the following is true for an athlete who consistently weighs his/herself on a set of broken scales?

I. The results are reliable.

II. The results are accurate.

III. The results are valid.

A. I only

B. I and II only

C. II and III only

D. I, II and III

28. Which fitness test is the most appropriate for measuring coordination?

A. Vertical jump test

B. Hand wall toss test

C. Drop test

D. Illinois Agility test

29. What is the name of the method of assessing exercise intensity involving the following calculation?

$$\text{Training heart rate} = ((HR_{max} - HR_{rest}) \times \% \text{ intensity}) + HR_{rest}$$

A. Borg scale

B. Karvonen method

C. Cardiac output

D. Maximal oxygen consumption

30. The mean ($\pm$ SD) exercise heart rate of a group in a physical education class is 155 beats per minute (bpm) ($\pm$ 14). What percentage of the group has an exercise heart rate between 141 bpm and 169 bpm?

A. 5 %

B. 68 %

C. 85 %

D. 95 %

SPEC/4/SPEXS/SPM/ENG/TZ0/XX/M

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MARKSCHEME

SPECIMEN PAPER

SPORTS, EXERCISE AND HEALTH SCIENCE

Standard Level

Paper 1

2 pages

1.	B	16.	C	31.	–	46.	–
2.	B	17.	C	32.	–	47.	–
3.	D	18.	A	33.	–	48.	–
4.	C	19.	D	34.	–	49.	–
5.	A	20.	C	35.	–	50.	–
6.	C	21.	D	36.	–	51.	–
7.	B	22.	D	37.	–	52.	–
8.	D	23.	A	38.	–	53.	–
9.	C	24.	B	39.	–	54.	–
10.	A	25.	C	40.	–	55.	–
11.	D	26.	A	41.	–	56.	–
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14.	A	29.	B	44.	–	59.	–
15.	B	30.	B	45.	–	60.	–

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SPORTS, EXERCISE AND HEALTH SCIENCE
STANDARD LEVEL
PAPER 2

SPECIMEN PAPER

1 hour 15 minutes

Candidate session number

0	0							

Examination code

				–				

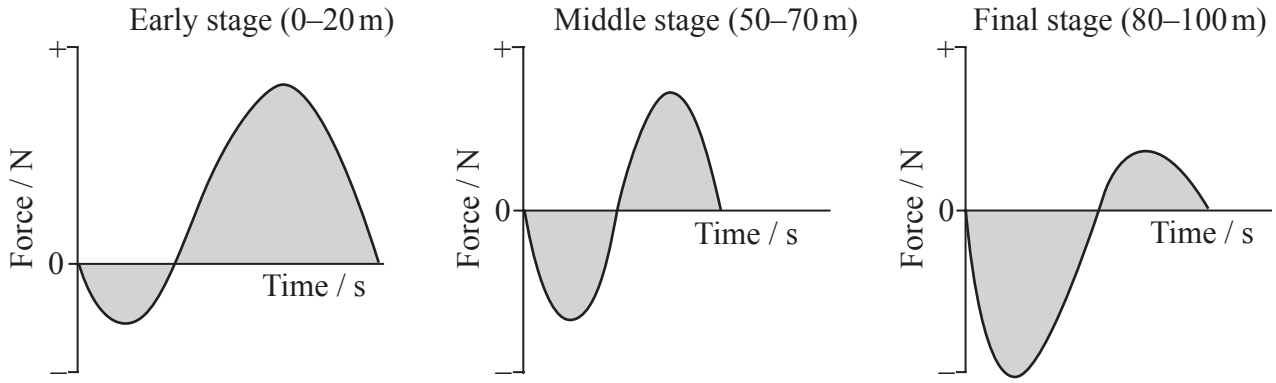
INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[50 marks]*.

SECTION A

*Answer **all** the questions. Write your answers in the boxes provided.*

1. A study was undertaken of Asafa Powell during his 100 m sprint for a world record of 9.74 s in Italy in 2007. The graphs below represent the impulse recorded from a single footfall (from first contact to the foot leaving the ground). Each graph represents a different stage of the sprint.



[Source: adapted from J Rhodes, (2008), Biomechanics. *PE Review*, **3** (2), pages 21–25. Reproduced in adapted form by permission of Philip Alan Updates.]

(a) Define the term *impulse.* *[1]*

. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

(b) Net impulses are a combination of positive and negative impulses. Describe the net impulse during the 100 m sprint for each of the following stages:

(i) Early stage *[1]*

. . . . . .
. . . . . .

(ii) Middle stage *[1]*

. . . . . .
. . . . . .

(iii) Final stage *[1]*

. . . . . .
. . . . . .

(c) Compare the acceleration of Asafa Powell in the early stage to the final stage of the 100 m sprint. *[2]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

Usain Bolt, the winner of the 100 m sprint at the 2008 Olympics, reaches his peak velocity later in the sprint than Asafa Powell.

(d) Using the information above, predict how Usain Bolt's middle stage force–time graph would be different from Asafa Powell's for the 100 m sprint. *[2]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .

The frames below were captured from a cyclist.

Frame 1 Frame 2 Frame 3

[Source: images captured by *Siliconcoach Video Analysis Software.* Used by permission.]

(e) (i) State the type of movement occurring at the cyclist's right hip from Frames 1 to 3. *[1]*

. . . . . .

(This question continues on the following page)

(Question 1 continued)

(ii) State the type of muscle contraction that is occurring from Frames 1 to 3 in the vastus medialis of the right leg. *[1]*

. . . . . .

(f) Explain the concept of reciprocal inhibition in relation to the action occurring at the right knee of the cyclist from Frames 1 to 3. *[3]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

2. (a) (i) State where glycogen is stored in the body. *[1]*

. . . . . .

(ii) Outline how the polysaccharide glycogen is formed. *[2]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(b) Outline the role of glucagon in relation to the breakdown of glycogen. *[2]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .

(c) Compare the fuel source and by-products of anaerobic glycolysis (lactic acid system) and the aerobic energy system. *[2]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 2 continued)

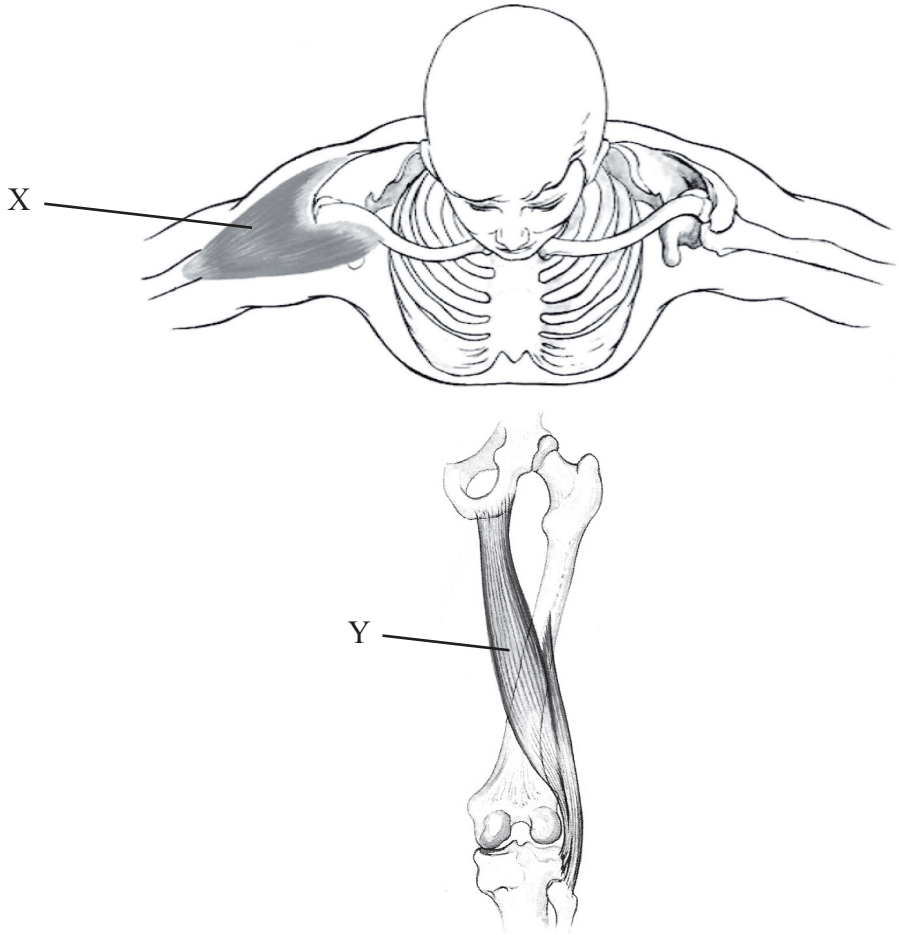
(d) After an athlete crossed the finish line of the 100 m sprint he was breathing rapidly. Explain why in relation to excess post-exercise oxygen consumption (EPOC). *[3]*

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

3. (a) Define the term *origin* of a muscle. *[1]*

. . . . . .
. . . . . .

The diagrams below show skeletal muscles located in two different regions of the body.



[Source: adapted from C Thompson, (1985), *Manual of Structural Kinesiology*, 10th Edition.
Copyright © The McGraw-Hill Companies, Inc.]

(b) State the name of the muscles shown in the diagrams above. *[2]*

X: . . . . . .
Y: . . . . . .

(This question continues on the following page)

(Question 3 continued)

(c) Identify the type of joint that is found between the ribs and the sternum. *[1]*

. . . . . .

(d) Compare **three** structural characteristics of slow twitch (type I) and fast twitch (type IIb) muscle fibres. *[3]*

Structural characteristic	Slow twitch (type I)	Fast twitch (type IIb)
1.	. . . . .	. . . . .
2.	. . . . .	. . . . .
3.	. . . . .	. . . . .

SECTION B

*Answer **one** question. Write your answers in the boxes provided.*

4. (a) State the name of **four** principal structures of the ventilatory system. *[2]*

(b) Explain the muscular mechanics involved in ventilation. *[6]*

(c) Outline the control of ventilation during exercise. *[2]*

(d) Describe the relationship between heart rate, stroke volume and cardiac output during rest, sub-maximal rowing and maximal rowing. *[5]*

(e) Compare the heart rate, stroke volume and cardiac output of trained rowers versus untrained rowers during rest and exercise. *[5]*

5. (a) Outline **two** methods which can be employed to improve a person's memory. *[2]*

(b) Identify **two** factors that contribute to different rates of learning between individuals. *[2]*

(c) Outline the **two** continua of motor skill classification below. Illustrate your answers using sporting examples.

(i) Fine and gross *[3]*

(ii) Externally and internally paced skills *[3]*

(d) Compare the type of performance you would expect to observe between a skilled performer and a novice performer. *[4]*

(e) Using sporting examples, discuss motor programmes from open loop and closed loop perspectives. *[6]*

6. (a) Describe why reliability is important with regard to administering the sit and reach test. *[2]*

(b) Outline what is meant by correlation. *[2]*

(c) Discuss **two** advantages and **two** disadvantages of sub-maximal tests of fitness. *[4]*

(d) Outline a fitness test for a tennis player to assess each of the following:

(i) Reaction time *[2]*

(ii) Strength *[2]*

(e) Explain the importance of study design to investigate the effectiveness of a new training programme for competitive swimmers. *[8]*

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MARKSCHEME

SPECIMEN PAPER

SPORTS, EXERCISE AND HEALTH SCIENCE

Standard Level

Paper 2

10 pages

SECTION A

1. (a) the product of force and time / the application of force over a period of time (which changes the velocity of the body);
the area under a force–time graph;
the product of the magnitude of a torque and its time of application; ***[1 max]***

(b) (i) net positive impulse ***[1]***

(ii) net zero impulse ***[1]***

(iii) net negative impulse ***[1]***

(c) in the early stage Powell is accelerating/there is positive acceleration, in the final stage Powell is decelerating/there is negative acceleration;
in both the early and final stage the deceleration is rapid; ***[2]***

(d) net impulse is positive for Bolt;
Bolt's graph would show a greater amount of positive force than negative force;
ratio of positive to negative force is greater / ratio of negative to positive force is less;
Bolt's graph would show a lesser amount of negative force; ***[2 max]***
Award credit for an accurate graphical representation.

(e) (i) extension ***[1]***

(ii) concentric / isotonic concentric ***[1]***

(f) reciprocal inhibition is where one muscle contracts and its opposite partner relaxes / contraction of a prime mover (agonist) with the simultaneous relaxation of the other (antagonist) muscles;
the hamstrings are considered the antagonist / hamstrings are relaxing;
the quadriceps are considered the agonist / quadriceps are contracting; ***[3]***

2. (a) (i) in the liver/muscles ***[1]***

(ii) (glycogen is formed) by linking together large numbers of glucose molecules;
glycogen is formed by a condensation reaction with glucose molecules / polysaccharides form through a process known as condensation;
condensation may occur many times to yield polysaccharides; ***[2 max]***

(b) glucagon is a hormone released by the pancreas;
glucagon increases the blood glucose level when it falls below normal levels;
glucagon accelerates the conversion of glycogen in the liver into glucose / glycogenolysis;
glucagon is released during exercise/after fasting; ***[2 max]***

(c)

	anaerobic glycolysis (lactic acid system)	**aerobic system**
fuel source	glycogen/glucose	glycogen, fats and proteins / glucose, lipids and amino acids;
by-products	heat/energy, hydrogen ions (lactic acid)	carbon dioxide/CO_2, water/H_2O and heat/energy;

[2]

*Award **[1]** for each correct row.*

(d) during the initial minutes of recovery from the 100 m sprint oxygen demand remains elevated temporarily;
oxygen consumption immediately after the 100 m sprint exceeds resting oxygen consumption / EPOC is in addition to the oxygen normally consumed at rest;
after several minutes of recovery from the 100 m sprint breathing rate will return to resting values;
during the initial stage of the 100 m sprint some oxygen is borrowed from the oxygen stores (hemoglobin and myoglobin) and the oxygen must be replenished;
breathing/respiratory rate remains temporarily elevated following the 100 m sprint in an effort to clear CO_2 that has accumulated in the tissues (as a by-product of metabolism);
body temperature is elevated from participation in the 100 m sprint, keeping (metabolic and) breathing/respiratory rates temporarily high (requiring more oxygen);
higher arousal from participation in the 100 m sprint elevates adrenaline levels and this contributes to elevated (metabolism and) breathing/respiratory rates (requiring more oxygen);
EPOC helps rebuild ATP and PCr and clear lactate produced by anaerobic metabolism during the 100 m sprint; ***[3 max]***

3. (a) the attachment of a muscle tendon to the stationary bone / the tendon at the static end of the muscle (is called the origin) / (a muscle's origin is) the attachment that is closer to the midline of the body whilst in the anatomical position ***[1]***

(b) X: deltoid;
Y: biceps femoris; ***[2]***

(c) cartilaginous ***[1]***

(d)

Structural characteristic	*Slow twitch (type I)*	*Fast twitch (type IIb)*
colour	red	white;
capillary density	high	low;
fibre diameter	small	large;
size of motor neuron	small	large;
myoglobin content	high	low;
mitochondrial density	high	low;
triglyceride stores	high	low;
glycogen stores	low	high;
phosphocreatine content	low	high;

[3 max]

*Award **[1]** for each correct row.*

SECTION B

4. (a) nose / mouth / pharynx / larynx / trachea / bronchi / bronchioles / alveoli / lungs ***[2]***
*Award **[1]** for every **two** correct answers.*

(b) *inspiration: **[3 max]***
intercostals contract;
ribs move upwards;
internal intercostals relax;
diaphragm contracts/flattens;
increasing the volume of the cavity (thoracic);
reducing the pressure of the cavity (thoracic);
this forces air to be drawn into the lungs;

*expiration: **[3 max]***
intercostals relax;
ribs move downwards;
diaphragm relaxes;
decreasing the volume of the cavity (thoracic);
increasing the pressure of the cavity (thoracic);
this forces air out of the lungs; ***[6 max]***
Accept any of the marking points above on an annotated diagram.

(c) higher centres of the brain (voluntary changes);
peripheral chemoreceptors in carotid and aorta (O_2, pH, CO_2);
central chemoreceptors (pH, CO_2);
proprioception in muscles and joints; ***[2 max]***

(d) cardiac output is found by multiplying the heart rate (bpm) by the stroke volume (ml blood $beat^{-1}$);
heart rate increase in direct proportion to the increase in exercise intensity;
initially cardiac output/Q increases as a result of both increases in heart rate and stroke volume;
maximal stroke volume is achieved during sub-maximal exercise/rowing;
any increase in cardiac output during maximal exercise is due solely to an increase in heart rate; ***[5]***

(e)

variable		**trained**	**untrained**
heart rate	*rest*	lower	higher;
	exercise	lower	higher;
stroke volume	*rest*	higher	lower;
	exercise	higher	lower;
cardiac output	*rest*	higher	lower;
	exercise	higher	lower;

*Award **[1]** for each correct row.* ***[5 max]***

5. (a) *Award **[1 max]** for a correct method and a correct description.*

brevity *e.g.* giving a learner a small amount of information at a time to avoid overload;

clarity *e.g.* avoid trying to learn or teach two similar but distinct items in the same session, as the memory of one may interfere with the memory of the other;

chunking *e.g.* learners can hold more in the short-term memory if the information is "chunked", instead of being presented as individual items;

organization *e.g.* we remember more easily if we organize the way in which we are to learn and ensure that the information is meaningful / coaches often use imagery to aid organization / *OWTTE*;

association *e.g.* good coaches and teachers always ensure that new learning is linked to what players already know;

practice *e.g.* no skill is learned without practice / practice shuttles the image of the skill backwards and forwards between the short-term and long-term memory and in doing so establishes what is known as a "memory trace"/pathway;

rehearsal *e.g.* processed mentally or physically;

coding *e.g.* name/label sets of information; ***[2 max]***
*Award **[1 max]** if two methods named with no description.*

(b) motivation;
personal abilities / genetics;
coach ability;
previous experience;
age/maturation of performer;
environment;
task difficulty;
fatigue;
anxiety;
preferred learning style; ***[2 max]***

(c) (i) *fine and gross:*
this is concerned with the precision of accuracy of movement / involvement of muscle mass;
gross motor skills involve large muscle movements *e.g.* running/jumping;
fine motor skills involve more intricate movements using small muscle groups *e.g.* rifle shooting / finger action across the seam of cricket ball; ***[3]***

(ii) *externally and internally paced skill:*
this refers to the timing of the movements / the extent to which the performer has control over the timing of the movement;
external paced skills are sailing/windsurfing/receiving a serve;
internal paced skills are javelin throw/gymnastics routine; ***[3]***

(d)

feature	**skilled**	**novice**
consistency	high	low;
accuracy	high	low;
learned nature	good/autonomous	poor/cognitive;
control	high	low;
efficiency	high	low;
certainty	high	low;
fluency	smooth	erratic;
goal direction	good	poor;

[4 max]

*Award **[1]** for each correct row.*

(e) *open loop:* ***[3 max]***

Award ***[1 max]*** *for a suitable sporting example.*
e.g. hitting a moving tennis ball during a game of tennis / catching a tennis ball during a match / a motor skill that involves a non-stable, unpredictable environment where an object/environmental context is in motion and determines when to begin the action;

discussion: ***[2 max]***
this theory suggests that when a skill is being learned an overall plan/programme of that skill is built up in long-term memory;
skills are built up in a hierarchical or schematic way *i.e.* the executive programme is made up of a number of (sub) routines, which consist of small routine units;
the programme is ordered sequentially / it is able to tell the muscles in what order to produce the appropriate subroutines *e.g.* learning a skill means practising the skill so that the subroutines are properly sequenced and coordinated and also become increasingly automated and subconscious;
once this skill is learned, open loop theory suggests that it can be put into action without feedback being used to control the movement;
knowledge of results is used only at the end of the movement to give the learner feedback on the outcome;

closed loop: ***[3 max]***

Award ***[1 max]*** *for a suitable sporting example.*
e.g. shooting an arrow at a stationery target / hitting a golf ball off a tee / a motor skill performed in a stationery environment where the performer determines when to begin the action;

discussion: ***[2 max]***
motor programme is structured in the same way (as open loop) but its commands can be countermanded/reversed by the need to correct errors;
kinaesthetic/internal feedback is used;
closed loop movement control is more effective with skills requiring slower limb movements or movements taking place over longer periods of time;
it is suggested that performers are continually moving between open and closed loop control;
short-term memory compares with the long-term memory, if the match is good the movement continues;
short-term memory compares with the long-term memory, if there is a mismatch the learner tries to correct the error; ***[6 max]***

6. (a) a test is reliable when you undertake a retest under the same conditions as the original and a similar result is obtained;
a test needs to be consistent to show the effect of changes in the variables;
reliability in any kind of testing questions the accuracy of test results; ***[2 max]***

(b) a correlation is used to describe/measure the relationship/relatedness between variables;
correlation does not imply a causal relationship;
correlation indicates the magnitude/amount of relationship / a degree of linear association between the two variables;
the correlation coefficient can be a positive or negative value;
a value of zero suggests no relationship;
correlations can, in some cases, help predict outcomes; ***[2 max]***

(c) *Advantages:* ***[2 max]***
less stressful on individuals / minimize risk of injury;
can perform repeats/other tests within a shorter time frame;
they generally have a good correlation to VO_2 max (80 % – 90 %) / can be extrapolated to estimate VO_2 max ;
minimal equipment needed for some examples *e.g.* Harvard Step Test, 12 Minute Run, Astrand test;

Disadvantages: ***[2 max]***
hard to set the intensity level accurately;
pacing is needed (for 12 Minute Run) which is difficult;
the correlation between test results and cardiovascular respiratory fitness is not perfect;
VO_2 max is an estimation as opposed to an actual measure;
level of motivation required; ***[4 max]***

(d) (i) *e.g.* ruler drop test / reaction time sticks;
how long it takes an individual to respond to the dropping of a ruler/stick; ***[2]***

(ii) *e.g.* hand grip strength test / hand grip dynamometer;
assesses the maximum isometric strength of the (dominant) hand and forearm muscles;
best result from three trials is recorded (ensuring recovery time between each trial); ***[2 max]***

(e) identification of the research question *e.g.* has a specific problem identified;
identification of the variables/independent variable/dependent variable;
selection of suitable/appropriate statistical tests;
selection of suitable/appropriate methods for data collection;
pre-test standardization of nutritional status and activity profile of subjects;
appropriate recording of the data;
appropriate amount of data is recorded;
the need for controls;
randomization;
placebos;
blinding / double-blinding;
acknowledgment of the limitations of the study;
ethical approval required;
adherence to health and safety practices;
informed consent of subjects; ***[8 max]***

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SPORTS, EXERCISE AND HEALTH SCIENCE
STANDARD LEVEL
PAPER 3

SPECIMEN PAPER

1 hour

Candidate session number

0	0							

Examination code

				–				

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the options.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[40 marks]*.

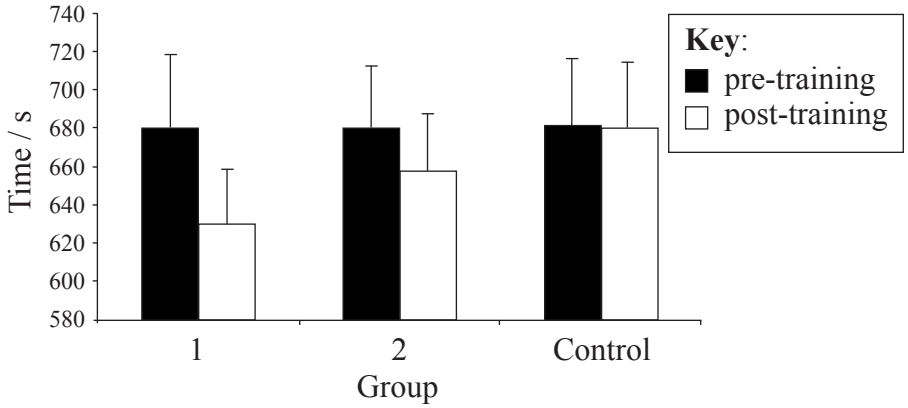
18 pages

Option A — Optimizing physiological performance

A1. A study was undertaken to compare the effects of training programmes on 3 km running performance time. The subjects were divided into 3 groups and trained twice a week for 10 weeks. Each training session lasted for 60 minutes.

Group	Method of training
1	High-intensity running bouts with a work-to-rest ratio of 1:1
2	High-intensity running bouts with a work-to-rest ratio of 1:3
Control	Steady state running

The graph below shows the pre-training and post-training 3 km running performance times.



[Source: Reprinted from Journal of Science and Medicine in Sport, 10/1, F Esfarjani and P Laursen, Manipulating high-intensity interval training: Effects on VO_2 max, the lactate threshold and 3000 m running performance in moderately trained males, pages 27–35, Copyright (2012), with permission from Elsevier.]

(a) (i) State the **two** different methods of training used in this study. *[2]*

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(ii) Compare the pre-training 3 km running performance times of the three groups. *[1]*

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(This question continues on the following page)

(Question A1 continued)

(iii) Identify which group had the most improved post-training 3 km running performance time. *[1]*

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(iv) Suggest **one** reason why the work-to-rest ratio has resulted in a difference in the post-training running performance times between groups 1 and 2. *[1]*

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(v) Identify a different training method that could be used to improve a 3 km running performance time. *[1]*

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(b) Distinguish between training and over-training. *[3]*

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A2. (a) Explain the relationship between cellular metabolism and the production of heat in the human body during rest and exercise. *[2]*

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(b) Describe the formation of sweat during exercise in hot, dry environments. *[2]*

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(c) Outline **two** steps that an individual can take to prevent heat-related disorders during sports competitions in hot, dry environments. *[2]*

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(This question continues on the following page)

(Question A2 continued)

(d) Explain why the body surface area-to-body mass ratio is important in terms of thermoregulation during exercise. *[3]*

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A3. Discuss a named non-nutritional ergogenic aid which an athlete may use to increase his/her strength. *[2]*

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Option B — Psychology of sport

B1. A study was conducted into achievement goal orientation in youth sport. Achievement goal orientation for a high task versus a high outcome group was assessed on several variables; performance satisfaction, conflict with team-mates, sports enjoyment and friendship. Higher scores are associated with a stronger correlation between variable and group. The results are shown in the table below.

Variable	High task group	High outcome group
satisfaction with own performance	4.40	3.65
satisfaction with team performance	4.65	3.93
conflict with team-mates	1.52	2.13
sports enjoyment	4.76	4.00
friendship	3.83	3.58

(a) (i) State which group reported more conflict with team-mates. *[1]*

. . . . . .

(ii) State which variable had the strongest significant difference between groups. *[1]*

. . . . . .

(iii) State which group reported a lower satisfaction with their own performance. *[1]*

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(This question continues on the following page)

(Question B1 continued)

(b) Distinguish between an outcome goal-oriented athlete and a task goal-oriented athlete. *[3]*

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B2. (a) Using an example from a sport event of your choice, distinguish between internal and external imagery. *[4]*

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(b) Explain when to use imagery to improve your sports performance. *[3]*

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B3. (a) Discuss measures of personality in sporting situations. *[4]*

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(b) The Sport Competition Anxiety Test (SCAT) is a measure of competitive trait anxiety. Evaluate SCAT as an instrument to measure anxiety. *[3]*

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Option C — Physical activity and health

C1. Regular brisk walking reduces the risk of chronic health problems. A study investigated the perceived barriers elderly people had against walking in their neighbourhood. The table below shows details of the types of perceived barriers pre (before) and post (after) attending a 12 month neighbourhood "walking the way to health" scheme led by trained walk leaders.

Perceived barriers *I would walk around my neighbourhood, but…*	**% response pre-walking scheme**	**% response post-walking scheme**
I have no one to walk with.	25.4	20.5
there is nowhere pleasant to walk near my home.	8.0	11.7
I worry about my personal safety.	30.5	19.1
I worry about being knocked down by a cyclist riding on the pavement.	10.8	17.0
I worry about tripping over broken paving stones.	17.9	23.5
there is too much traffic on the roads where I live.	17.6	22.1

[Source: adapted from British Journal of Sports Medicine, 2007, 41, pages 562–568; reproduced with permission from the BMJ Publishing Group]

(a) Identify which was the greatest perceived barrier before attending the walking scheme. *[1]*

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(This question continues on the following page)

(Question C1 continued)

(b) Calculate the percentage change for worrying about tripping over broken paving stones after attending the walking scheme. *[1]*

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(c) Comment on **one** positive outcome of this study in relation to the perceived barriers to walking. *[2]*

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(d) Describe **three** strategies for enhancing adherence to exercise. *[3]*

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C2. (a) Outline the characteristics of the following hypokinetic diseases:

(i) Stroke *[1]*

. . . . . .
. . . . . .

(ii) Osteoporosis *[1]*

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(b) Discuss the main factors affecting energy balance in individuals with sedentary occupations (sitting for long periods during the working day). *[4]*

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C3. (a) Compare the treatments for type 1 and type 2 diabetes. *[3]*

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(b) Describe **two** aims of therapeutic exercise for individuals with a hypokinetic disease. *[2]*

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(c) Outline the effects of exercise on changing mood states. *[2]*

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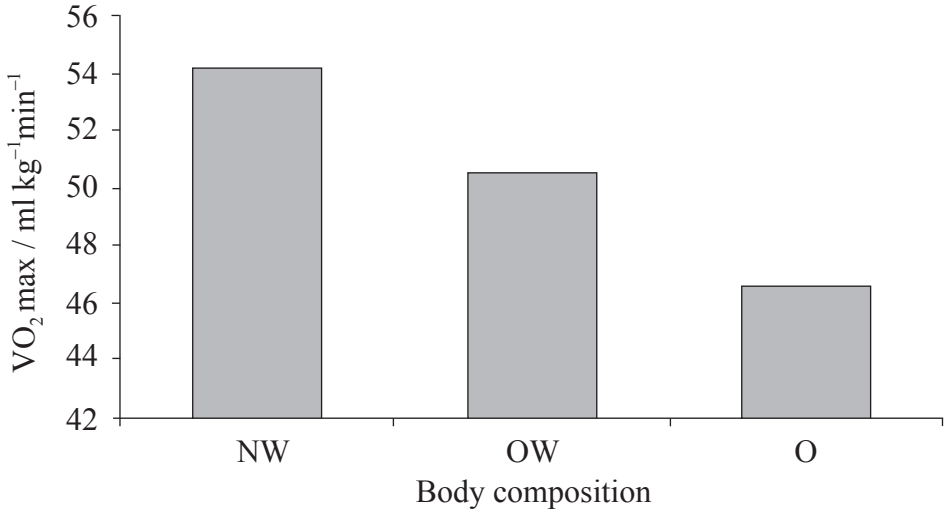
Option D — Nutrition for sport, exercise and health

D1. A study investigated the relationship between cardio-respiratory fitness levels and body composition in Irish boys aged 7 and 10 years. Body mass index (BMI) was used to divide the boys into three groups based on body composition; normal weight (NW), overweight (OW) and obese (O). The 20 m multistage running test was used to estimate cardio-respiratory fitness (VO_2 max). The graph below shows the relationship between body composition and VO_2 max reported in the study.



[Source: adapted from British Journal of Sports Medicine, 2007, 41, pages 311–316; reproduced with permission from the BMJ Publishing Group]

(a) State, with appropriate units, the VO_2 max of the normal weight group. *[1]*

. . . . . .

(b) Using the data above, analyse the relationship between body composition and cardio-respiratory fitness. *[3]*

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(This question continues on the following page)

(Question D1 continued)

(c) Discuss the limitations of using body mass index (BMI) to assess the categories of normal weight, overweight and obese. *[3]*

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D2. (a) Outline the features of the following components of the digestive system:

(i) Mouth *[1]*

. . . . . .
. . . . . .

(ii) Pancreas *[1]*

. . . . . .
. . . . . .

(b) State the typical range of pH values found in the following:

(i) Stomach *[1]*

. . . . . .

(ii) Salivary fluids *[1]*

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(This question continues on the following page)

(Question D2 continued)

(c) State **three** areas where extracellular fluid can be located in the body. *[3]*

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(d) Explain why endurance athletes require a greater water intake. *[4]*

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(This question continues on the following page)

(Question D2 continued)

(e) From the list below, identify **four** sources of protein for vegetarian athletes. *[2]*

lean beef
peanuts
cow's milk
fish
beans
lentils
almonds

1. . . . . .
2. . . . . .
3. . . . . .
4. . . . . .

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SPEC/4/SPEXS/SP3/ENG/TZ0/XX/M

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MARKSCHEME

SPECIMEN PAPER

SPORTS, EXERCISE AND HEALTH SCIENCE

Standard Level

Paper 3

10 pages

Option A — Optimizing physiological performance

A1. (a) (i) interval running with different work-to-rest ratios;
continuous / long, slow distance running; ***[2]***

(ii) all nearly identical/equal/similar/(approximately) 680 seconds ***[1]***
*Award **[1]** only if all three groups are referred to.*

(iii) (group) 1 ***[1]***

(iv) the 1:3 work-to-rest ratio allowed for too much recovery time between work bouts;
the 1:1 work-to-rest ratio provides a greater aerobic stress/overload / *OWTTE*;
the group 1 programme resulted in an improved anaerobic threshold compared to group 3;
the intense group 1 programme provided greater training stimulus;
group 2 recovery time was too long for a maximum training effect; ***[1 max]***

(v) fartlek training / speed play;
cross-training / circuit training with a high aerobic component;
uphill running;
high-altitude training; ***[1 max]***

(b) *training*: ***[2 max]***
is performing exercise in an organized manner on a regular basis with a specific goal in mind;
there needs to be a balance between training, competition and rest/recovery;
the principles of progressive overload, specificity and reversibility govern the nature and extent of physiological and metabolic adaptations to training;

over-training:
is when an athlete attempts to do more training than he/she is able to tolerate physically and/or mentally / exceeds more than they can cope with;
is a condition in which underperformance is experienced despite continued or even increased training; ***[3 max]***

A2. (a) humans require energy to produce heat in order to maintain the internal body temperature at around 37 °C;
humans require energy to perform mechanical work, which includes exercise;
the body utilizes oxygen and food to produce energy;
during biochemical reactions heat energy (enthalpy) becomes available;
ATP is the only form of chemical energy that can be converted into other forms of energy used by living cells;
during exercise there is a net increase in ATP production;
typically 60 % to 70 % of the total energy expended by the human body is degraded to heat / all biochemical reactions are inefficient, which means that not all the energy released can be conserved or used to do work, therefore some energy is always lost as heat / *OWTTE*;
when metabolism increases, additional heat is produced / when metabolism decreases, less heat is produced;
constant rate of heat production at rest if within a stable thermoneutral environment; ***[2 max]***

(b) sweating is the body's major way of getting rid of excess body heat, which is produced by metabolism and working muscles;
the amount of sweat produced depends upon air temperature and the level of physical activity;
the thermoregulatory centre is sensitive to the temperature of the blood / elevated blood temperature results in nerve signals being sent to the sweat glands;
sweat is formed by the secretory portion of the sweat glands / sweating is an active secretory process from sweat glands;
sweat secretion over a given region of skin is dependent on the density of the sweat glands (*i.e.* number / cm^2)/on the amount of sweat secreted per gland;
sweating provides moisture which evaporates from the skin surface to try to maintain homeostasis;
sweat is formed through the filtration of plasma;
sweat is mostly water with some sodium and chloride and a low concentration of potassium;
during exercise in hot, dry environments there is likely to be increased peripheral blood flow; ***[2 max]***

(c) acclimatize in similar temperature and/or humidity to the competition environment prior to the sports competition;
wear lightweight, loose-fitting clothing during competition;
avoid lengthy warm-up periods on the day of the competition;
know his/her sweat rate and the amount of fluid that he/she should drink/ingest;
ensure that acclimatization training allows for frequent hydration;
hydrate to ensure that his/her body weight is within 1 % of his/her normal body weight during the day of the competition;
learn how to monitor his/her urine colour with reference to hydration status;
exercise in an environmental chamber;
tapering; ***[2 max]***

(d) the body surface area is directly related to the heat exchange between the body and the environment;
individuals with a greater body surface area relative to mass should speed up/expedite heat dispersion;
heat transfer between the body and the environment is related to the exposed surface area;
the processes of sweat evaporation and convection eliminate body heat at the skin surface;
when the air/ambient temperature is lower than skin temperature, individuals with a greater body surface area relative to mass should reduce heat storage/thermoregulate more effectively during exercise;
when the air/ambient temperature is higher than skin temperature a higher body surface area-to-body mass ratio acts disadvantageously to absorb body heat from the environment; ***[3 max]***

A3. *named ergogenic aid:*
anabolic steroids / growth hormone;

use of ergogenic aid: ***[1 max]***
designed to increase muscle mass/strength;
faster recovery between training sessions;
promotes faster healing/recovery from injury; ***[2 max]***

Option B — Psychology of sport

B1. (a) (i) high outcome group ***[1]***

(ii) sports enjoyment ***[1]***

(iii) high outcome group ***[1]***

(b) *outcome goal-oriented:* ***[2 max]***
judges success by how they compare to others;
emotionally fragile when they perceive they may be evaluated negatively;
is more likely to reduce their efforts/cease trying/make excuses;
is more likely to select tasks in which they are guaranteed success;
is associated with higher levels of competitive state anxiety;

task goal-oriented: ***[2 max]***
has a strong work ethic / good at maintaining effort without immediate reward;
does not fear failure;
is protected from disappointment/frustration / less prone to emotional changes as a result of negative outcomes;
is protected from having a lack of motivation when the performance of others is superior;
selects realistic tasks and challenges;
associated with intrinsic motivation/effort/persistence/enjoyment; ***[3 max]***

B2. (a) *internal imagery:*
is predominately visual / is visualizing participation in the event, what it feels like to compete;
a suitable sporting example of the use of internal imagery;

external imagery:
is visualizing yourself from the outside, as if on video;
a suitable sporting example of the use of external imagery; ***[4]***

(b) before and after practice *e.g.* to focus concentration / to review skills and strategies;
before and after competition *e.g.* part of a pre-event routine or after competition, to replay success and increase self-confidence;
during breaks in the action *e.g.* to correct an error in the execution of a skill;
during personal time *e.g.* to develop routines of deep breathing and positive self-talk whilst imagining a successful penalty in football/hockey;
when recovering from injury *e.g.* to reduce anxiety about the injury / to rehearse the emotions they anticipate experiencing upon return to competition; ***[3 max]***

B3. (a) when measuring personality we should consider both situations and psychological traits to understand and predict behaviour;
sport-specific measures of personality predict behaviour in sport settings better than general personality tests do;
CSAI-2;
Cattell developed a personality inventory with 16 independent personality factors (16 PF) that he believed describe a person who is participating in sport / *OWTTE*;
all psychological tests contain a degree of measurement error/use caution in interpreting their results;
benefits and limitations of questionnaires and amounts of data;
benefits and limitations of observation and ecological validity;
benefits and limitations of interviews and complex/"rich" information;
individuals need special training in psychological assessment to be qualified to interpret results from personality tests;
using personality inventories alone to select athletes for a team/to cut them from a team is an abuse of testing (that should not be tolerated);
no specific personality profile has been found that consistently distinguishes athletes from non-athletes; ***[4 max]***

(b) *SCAT:*
is a useful predictor from a practical perspective because it is not always feasible to test athletes immediately before competition to assess how anxious they feel at that moment;
there are important implications for sports coaches, because athletes who have high competitive trait anxiety are more sensitive to criticism, failure, and making mistakes (*i.e.* positive reinforcement, encouragement and support are crucial to helping such athletes improve their performance);
a weak prediction of an athlete's likely state anxiety;

is considered to be a reliable and valid self-report questionnaire;
is easy to administer;
can be used with both small and large groups;
cannot be administered during competition;
is open to response bias; ***[3 max]***

*Award **[2 max]** if only strengths or limitations are included in the response.*

Option C — Physical activity and health

C1. (a) "I worry about my personal safety" ***[1]***

(b) 5.6 % difference / 31.3 % change ***[1]***

(c) *e.g.* "I have no one to walk with" decreased post-walking scheme;
due to forming friendships with other participants / gaining confidence / increased enjoyment;

e.g. "I worry about my personal safety" decreased post-walking scheme;
due to walking with other participants / gaining confidence / safety in numbers; ***[2 max]***
Accept other reasonable responses.

(d) environmental – prompts/contracting/perceived choice;
reinforcement approaches – rewards for attendance and participation / external feedback / self-monitoring;
goal setting and cognitive approaches – associative versus dissociative focus during exercise;
social support approaches – role of significant others (spouse/family/friends) / joining in/adjusting routines/transportation/providing equipment;
relapse prevention;
motivational strategies; ***[3 max]***

C2. (a) (i) (a stroke is) caused by a lack of blood flow/oxygen to the brain;
a condition in which blood supply to some part of the brain is impaired (due to a blocked/burst artery); ***[1 max]***

(ii) decreased bone mineral content that causes increased bone porosity;
osteoporosis means bone *(osteo)* that is porous *(porosis)*;
loss of bone mineral density;
accelerated bone loss;
a disease that causes bones to weaken/become brittle/break more easily; ***[1 max]***

(b) energy balance is the state at which the number of calories eaten equals the number of calories used / energy/caloric balance is the main factor that affects body weight control;
a positive energy balance means that you consume more calories than you expend, *i.e.* you will gain body weight;
energy balance can be unbalanced to cause weight loss by reducing caloric intake below the daily energy requirements/maintaining caloric intake and increasing energy expenditure (physical activity)/combining reduced caloric intake with increased energy expenditure (physical activity) / *OWTTE*;
metabolic rates affect energy/caloric balance;
basal Metabolic Rate (BMR) indicates the energy/calories you expend simply by being alive/resting Metabolic Rate (RMR) is the energy/calories resulting from rest plus BMR;
increased muscle mass from physical activity results in increased BMR / reduced muscle mass from physical inactivity results in decreased BMR;
energy balance is affected by genetics/body size/body composition/level of physical activity; ***[4 max]***

C3. (a) *type 1:* ***[1 max]***
requires daily injections of insulin;
requires constant monitoring of blood sugar levels;

type 2: ***[2 max]***
can be managed through diet;
can be managed through exercise;
can be managed through oral medication;
can be managed by weight loss; ***[3 max]***

(b) to make the most of limited functional capacities / to help maintain mobility;
to alleviate/provide relief from symptoms;
to reduce the need for medication;
to reduce the risk of disease reoccurrence / to limit deterioration of hypokinetic disease/possible cognitive decline;
to help overcome social problems and psychological distress;
to increase energy levels; ***[2 max]***

(c) decreases fatigue/anger/anxiety/depression/confusion/tension/stress;
is recognized/accepted as a useful treatment for depression;
increases vigour/clear thinking/energy/alertness/sense of well-being/motivation/arousal;
regular exercise has been shown to prevent relapses into depression; ***[2 max]***

Option D — Nutrition for sport, exercise and health

D1. (a) 54.5 ml $kg^{-1}min^{-1}$ ***[1]***
Accept answers in the range 54 – 55 ml $kg^{-1}min^{-1}$.

(b) body composition is inversely related/negatively correlated to cardio-respiratory fitness/VO_2 max / *OWTTE*;
VO_2 max/cardio-respiratory fitness reduces by 4 ml $kg^{-1}min^{-1}$ between NW and OW;
VO_2 max/cardio-respiratory fitness reduces by 4 ml $kg^{-1}min^{-1}$ between OW and O;
VO_2 max/cardio-respiratory fitness reduces by 8 ml $kg^{-1}min^{-1}$ between NW and O; ***[3 max]***

(c) Body Mass Index/BMI fails to consider the body's proportional composition / factors other than excess body fat (bone, muscle mass, increased plasma volume due to training) affect the numerator of the BMI equation;
a high BMI could lead to an incorrect interpretation of over-fatness in lean individuals with excessive muscle mass due to training;
there is a possibility of misclassifying an individual as overweight or obese using BMI standards with large sized athletes (*e.g.* field athletes / bodybuilders/rugby players);
racial differences *i.e.* BMI is derived mainly from caucasian populations – but there is evidence that other racial groups may differ from caucasians in their levels of total body fat at a given BMI;
some countries use different cut-off points, with an emphasis on health risks (*e.g.* heart disease/diabetes) instead of weight;
BMI assumes an average degree of maturation, but adolescents can go through puberty early or late;
BMI can underestimate fatness on those with a less lean body mass (*e.g.* the elderly); ***[3 max]***

D2. (a) (i) mechanical/chemical digestion (carbohydrates);
salivary amylase;
pH 7; ***[1 max]***

(ii) production of enzymes;
pancreatic lipase/amylase/trypsin; ***[1 max]***

(b) (i) pH 1.0 – 4.0 ***[1]***

(ii) pH 5.5 – 7.5 ***[1]***

(c) all body fluid outside the cells;
e.g. blood plasma;
e.g. lymph;
e.g. saliva;
e.g. fluid in the eyes / aqueous humour and vitreous body;
e.g. fluid surrounding nerves / spinal cord / cerebrospinal fluid;
e.g. synovial fluid; ***[3 max]***

(d) water intake helps to maintain hydration/avoid dehydration;
water intake helps to maintain body temperature/thermoregulation;
water intake helps to maintain plasma volume;
water loss during prolonged exercise may lead to a decline in athletic performance;
water loss during prolonged exercise may lead to serious medical problems (*e.g.* heat exhaustion or heat stroke);
water loss during prolonged exercise may result in stress on the cardiovascular system;
water loss during prolonged exercise may result in inadequate heat transfer to the skin and environment;
water loss during prolonged exercise is associated with increased plasma osmolality;
water loss during prolonged exercise is associated with decreased plasma volume;
water loss during prolonged exercise may affect the intracellular and extracellular electrolyte balance; ***[4 max]***

(e) *In any order:*
1. peanuts;
2. beans;
3. lentils;
4. almonds; ***[2 max]***

*Award **[2]** for four correct answers, award **[1]** for three or two correct answers.*