Physical Education (H155, H555)

H555/01, Physiological factors affecting performance (A Level), November 2021

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Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 120 mins

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **90**.
- The total number of marks may take into account some 'either/or' question choices.

1 Muscles contract to create movement about a joint.

Which joints do the following muscles act on?

Iliopsoas _____

Latissimus dorsi _____

[2]

2 State **one** enzyme that is active when each of the following energy systems is in use.

ATP-PC (Phosphocreatine) system _____

Aerobic system _____

[2]

3 Describe the terms ‘active’ and ‘passive’ in reference to the assessment of sporting injuries using SALTAPS.

Active _____

_____

Passive _____

_____

[2]

4 Outline what is meant by the term ‘exercise-induced muscle damage’. Describe a sporting situation that may cause exercise-induced muscle damage.

Exercise-induced muscle damage

Sporting situation

[2]

5 Give a practical example of each of the following planes of movement.

Sagittal

Transverse

[2]

6(a) **Fig. 6.1** shows the performance of the upward phase of a press-up.

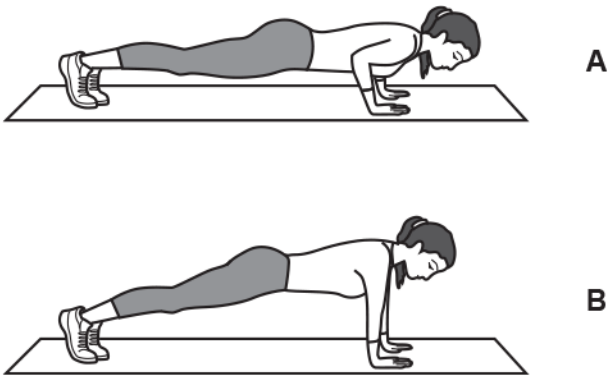

Fig. 6.1

Complete **Table 6.1** to analyse the movement at the elbow during the upward phase of the press-up (as shown in diagram B).

Joint	Movement	Agonist	Type of contraction of agonist	Antagonist
Elbow	.....	.....	.....	.....

Table 6.1 **[4]**

(b) Describe **four** mechanisms of venous return that maintain blood flow back to the heart.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

(c) **Table 6.2** shows the lung volumes of an untrained and a trained individual at rest and during maximal exercise with some missing values, **A**, **B** and **C**.

Untrained individual	**Rest**	**Maximal exercise**
Breathing frequency	**A**	40 breaths / min
Tidal volume	0.5 litres	2.5 litres
Minute ventilation	7 litres / min	100 litres / min
Trained individual	**Rest**	**Maximal exercise**
Breathing frequency	12 breaths / min	50 breaths / min
Tidal volume	**B**	**C**
Minute ventilation	6 litres / min	150 litres / min

Table 6.2

(i) Using the data in **Table 6.2**, calculate **A**, **B** and **C**.

A

B

---

[3]

(ii) Explain why the minute ventilation of the trained individual is lower at rest than that of the untrained individual.

---

[3]

(iii) Tidal volume changes during exercise and recovery. Describe the role of proprioceptors in the control of these changes.

During exercise

During recovery

[3]

(d) Explain the term ‘excess post-exercise oxygen consumption’ (EPOC).

[3]

7(a) Describe intermittent hypoxic training. Identify **one** benefit and **one** risk associated with its use.

Description

Benefit

Risk

[4]

(b) **Table 7.1** shows the fitness test results of two performers.

Performer	Multi-stage fitness test (ml / kg / min)	Abdominal curl test (no. of sit-ups)	Sit and reach test (cm)
A	54.2	92	17
B	49.8	147	4

Table 7.1

(i) Identify which performer had the greater aerobic capacity, and which performer showed greater strength endurance.

Greater aerobic capacity _____

Greater strength endurance _____

[2]

(ii) Explain how age and gender may account for differences in VO_2 max in the two performers.

Age _____

_____

_____

_____

Gender _____

_____

_____

_____

[4]

(c) Outline the timing and the main objectives of the preparatory and transition phases of training. You must apply your knowledge to a sport of your choice.

Sport: _____

Preparatory phase

Timing _____

Objective 1 _____

_____

Objective 2 _____

_____

Transition phase

Timing _____

Objective 1 _____

_____

Objective 2 _____

_____

[6]

(d) Explain **two** extrinsic risk factors that may cause injury in sport or physical exercise.

Use practical examples to support your answer.

Risk factor 1 _____

_____

_____

_____

Risk factor 2 _____

_____

_____

_____

[4]

8(a) Identify **three** factors that affect the stability of a gymnast.

1 _____

2 _____

3 _____

[3]

(b) A footballer is practising free kicks. After contact, one football travels in a straight line and another swerves during flight.

Explain the effect of the application of force on the resulting motion of each football in flight.

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[4]

(c) Forces act on sports performers when they are in motion.

(i) On the image shown in **Fig. 8.1**, use arrows to show **four** types of force acting on the cyclist while they pedal forwards.

The arrows must show the point of application, the direction of the forces and the magnitude of the forces.

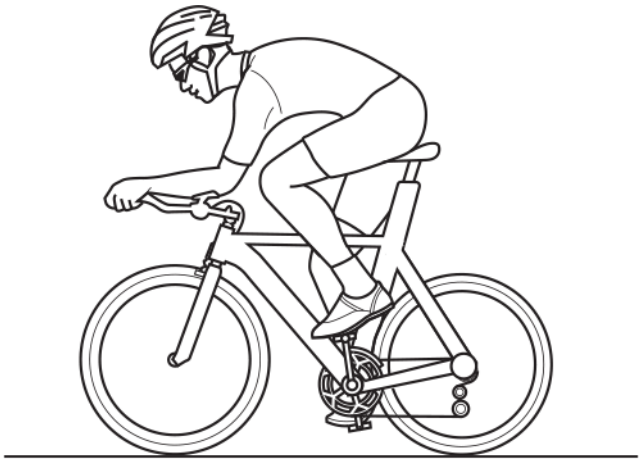

Fig. 8.1

[4]

(ii) An ice skater spins about their longitudinal axis by generating angular momentum.

Use the angular analogue of Newton's 1st law of motion to explain how the skater can increase their rate of spin.

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[4]

(d) **Fig. 8.2** shows a ski jumper in flight.

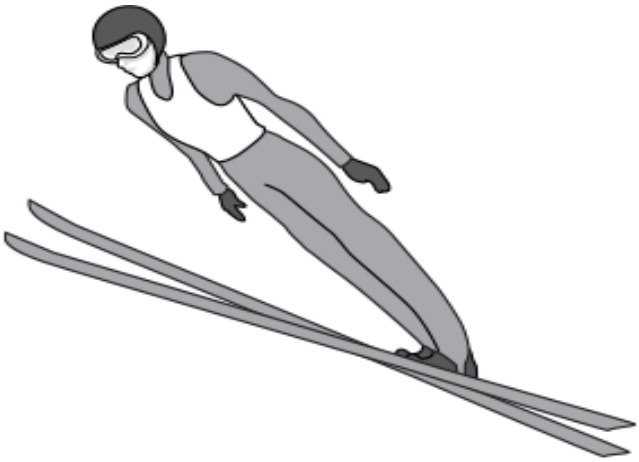


Fig. 8.2

Explain how a ski jumper can apply Bernoulli's principle to maximise the distance travelled through the air.

[5]

9 * Define Newton's laws of motion and apply them to the performance of a vertical jump in sport.

Define the term 'concussion' and describe ways that a concussion may occur in a range of sports.

Explain and evaluate World Rugby's concussion management protocol known as 'Recognise and Remove' (the 6 R's).

[20]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			Two marks for: 1. Hip 2. Shoulder	2 (AO1 x 2)	
			Total	2	
2			Two marks for: 1. (ATP-PC / Phosphocreatine system): creatine kinase 2. (Aerobic system): ATPase / glycogen phosphorylase / GPP / GP / phosphofructokinase / PFK / lipase	2 (AO1 x 2)	Accept first answer only
			Total	2	
3			Two marks for: 1. (active) ask **performer** to move injured body part (without assistance) 2. (passive) **someone else OR first-aider** moves injured body part (through full range of motion)	2 (AO1 x 2)	
			Total	2	
4			Two marks for: 1. Microscopic tears in muscle **OR** delayed onset of muscle soreness 2. eccentric muscle contractions e.g. downhill running / plyometrics	2 (AO1 x 1) (AO2 x 1)	
			Total	2	
5			Two marks for: 1. (sagittal) somersault / tumble turn in swimming 2. (transverse) pirouette / spin / pivot / arm action to throw discus	2 (AO2 x 2)	NB. If a skill has been named that moves through more than one plane - the joint or part of body that moves through the plane stated must be identified. E.g. Golf swing is TV for transverse unless rotation of trunk / body is identified)
			Total	2	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6</td><td>a</td><td></td><td>Four marks for:
<table><tr><th>Joint</th><th>Movement</th><th>Agonist</th><th>Type of Contraction of agonist</th><th>Antagonist</th></tr><tr><td>Elbow</td><td><u>Extension</u></td><td><u>Triceps brachii</u></td><td><u>Concentric</u></td><td><u>Biceps brachii</u></td></tr></table></td><td>4
(AO3 x 4)</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>Four marks from:

1. (Pocket) valves - (one-way valves) that prevent backflow of blood
2. Muscle / skeletal pump - skeletal muscles contract squeezing veins
3. Smooth muscle - in walls of veins contracts / venoconstriction
4. Respiratory pump - pressure differences in thoracic to abdominal cavity during breathing
5. Gravity helps blood from above heart return to heart</td><td>4
(AO1 x 4)</td><td>NB: Mark first four answers only.</td></tr>
<tr><td></td><td>c</td><td>i</td><td>Three marks for:

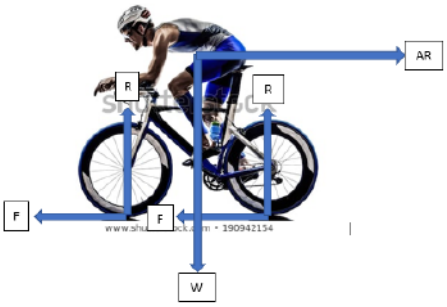
1. A = <u>14 breaths / min</u>
2. B = <u>0.5 litres</u>
3. C = <u>3 litres</u></td><td>3
(AO3 x 3)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>Three marks for:

1. More efficient gas exchange at alveoli / saturation of haemoglobin
2. More efficient transport of oxygen **OR** greater number / density of RBCs
3. More efficient use of oxygen at muscles **OR** better able to meet demands for oxygen **OR** more myoglobin / mitochondria **OR** higher aerobic capacity</td><td>3
(AO1 x 3)</td><td></td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
		iii	Three marks from (sub-max 2 for during exercise): (during exercise) 1. proprioceptors detect motor activity / movement (in joints / muscles) 2. send messages to respiratory control centre / RCC / inspiratory centre 3. **increased** stimulation of diaphragm / respiratory muscles (during recovery) 4. proprioceptors detect that movement has stopped / reduced 5. **reduced** stimulation of diaphragm / external intercostals / respiratory muscles	3 (AO1 x 3)	Accept point 2 anywhere in the answer, but only credit once.
	d		Three marks from: 1. (additional) volume of oxygen needed to return body to pre-exercise state 2. alactacid and lactacid **OR** fast and slow debt components 3. aerobic energy production during recovery 4. (oxygen used to) break down of lactic acid / replenishment of oxy-myoglobin 5. (aerobic energy used to) resynthesise ATP / replenish muscle phosphagen or PC	3 (AO1 x 3)	
			Total	**20**	

Question			Answer/Indicative content	Marks	Guidance
7	a		Four marks for: 1. Interval training 2. under conditions of low oxygen 3. (benefit) increased RBCs / haemoglobin volume **OR** increased oxygen-carrying capacity of blood **OR** increased number / density of mitochondria **OR** increased buffering capacity **OR** increased aerobic capacity / VO_2 max 4. (risk) disruption to training **OR** decreased immune system **OR** increased risk of infection **OR** dehydration **OR** benefits are lost quickly	4 (AO1 x 2) (AO3 x 2)	Accept only 1 benefit and 1 risk.
	b	i	Two marks for: 1. A has greater aerobic capacity 2. B has greater strength endurance	2 (AO3 x 2)	
		ii	Four marks for: 1. (age) from early 20s onwards VO_2 max decreases **OR** A may be younger (than B) 2. Due to reduced elasticity in heart / blood vessels / lungs **OR** reduced efficiency in inspiring / transporting oxygen 3. (gender) females tend to have lower VO_2 max **OR** B may be female 4. Due to lower muscle mass / higher percentage body fat / smaller lung volumes / lower stroke volume / cardiac output **OR** lower haemoglobin levels	4 (AO2 x 4)	N.B credit reduced efficiency in inspiring / transporting oxygen once only. Accept opposites.

Question			Answer/Indicative content	Marks	Guidance
	c		Six marks for: 1. (Preparatory phase) 6 – 12 weeks before start of competition season / e.g. July / August for hockey pre-season 2. (objective) general conditioning / aerobic / strength / mobility training (all sports) 3. (objective) sport-specific training / e.g. basketball skills and drills 4. (Transition) 4 – 6 weeks after end of season / e.g. June for hockey transition season 5. (objective) active rest / recovery / recuperation / variance (all sports) 6. (objective) low-intensity / aerobic work / non-specific activities, e.g. footballer does cycling / swimming activities	6 (AO2 x 6)	Look for application to the named sport, although objectives may be quite general.
	d		Four marks from: 1. Poor coaching / poor technique / poor biomechanical / postural training 2. e.g. poor tackling technique in rugby **OR** poor lifting technique in gym 3. Incorrect equipment / clothing / footwear 4. e.g. use of tennis racquet that is too heavy **OR** cricket helmet does not fit correctly impairing vision 5. Inappropriate overload / overtraining / lack of variance 6. e.g. overuse injuries such as tennis elbow / tendonitis / shin splints when running	4 (AO1 x 2) (AO2 x 2)	Mark first two risk factors only. Practical example must match risk factor.
			Total	20	

Question			Answer/Indicative content	Marks	Guidance
8	a		Three marks for: 1. Height of centre of mass 2. Size of base / area of support 3. Position of line of gravity	3 (AO1 x 3)	Mark first three answers only
	b		Four marks for: 1. Ball travelling in straight line has linear motion 2. (application of) a direct force / through CoM 3. Swerving ball has angular motion 4. (application of) an eccentric force / torque / not through CoM	4 (AO2 x 4)	
	c	i	Four marks for: 1. Weight / W – vertically down from CoM 2. Reaction / R – vertically up from ground on both wheels which equal weight 3. Air resistance / AR – backwards from CoM 4. Friction / F – forwards from ground on both wheels	4 (AO3 x 4)	
		ii	Four marks from: 1. Skater brings arms or legs in (close to longitudinal axis of rotation) 2. Reducing moment of inertia 3. Increasing angular velocity 4. Principle of conservation of angular momentum 5. AM = MI x AV	4 (AO2 x 4)	

Question			Answer/Indicative content	Marks	Guidance
	d		Five marks from: 1. Ski jumper adopts an aerofoil shape 2. Creates an angle of attack / angle of 17° 3. Air travels further over top of ski jumper 4. Air travels faster / at higher velocity over top of ski jumper 5. Lower pressure above the ski jumper **or** creates a pressure gradient 6. Air moves from area of high to low pressure 7. Lift force created	5 (AO2 x 5)	Accept opposites for points 3-5
			Total	20	

Question			Answer/Indicative content	Marks	Guidance
9			Level 4 (17–20 marks) • detailed knowledge and excellent understanding (AO1) • well-argued judgements which are well supported by relevant practical examples (AO2) • detailed analysis and critical evaluation (AO3) • very accurate use of technical and specialist vocabulary • there is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. Level 3 (12–16 marks) • good knowledge and clear understanding (AO1) • judgements will be present but may not always be supported by relevant practical examples (AO2) • good analysis and critical evaluation (AO3) • generally accurate use of technical and specialist vocabulary • there is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence. Level 2 (7-11 marks) • limited knowledge and understanding (AO1) • judgement given but often unsupported by relevant practical examples (AO2) • some evidence of analysis and critical evaluation (AO3) • technical and specialist vocabulary used with limited success • the information has some relevance and is presented with limited structure. The information is supported by limited evidence. Level 1 (1–6 marks)	20	At Level 4 responses <u>are likely</u> to include: • detailed knowledge of Newton's laws of motion, accurately applied to the vertical jump • accurate definition of concussion, together with a range of ways that concussion can occur in sports • detailed explanation with some evaluation of the 6 R's • at the top of this level excellent knowledge is shown in all three areas, and criticisms / abuses of the 6 R's may be present • AO1, AO2 and AO3 all covered well in this level. At Level 3 responses <u>are likely</u> to include: • good knowledge of Newton's laws of motion, concussion and the 6 R's • good application of Newton's laws, together with some examples of ways that concussion may occur in sport • a good explanation of the 6 R's • at the upper end of this level there must be some credit for AO3 • Two parts of the question may have been answered better than the other At Level 2 responses <u>are likely</u> to include: • limited knowledge of Newton's laws of motion, concussion and the 6 R's • some evidence of application of Newton's laws to the vertical jump and / or some examples of how concussion may occur in sport • limited explanation of the 6 R's • One part of the question may have been addressed much more strongly than the others. • maximum of 8 marks to be awarded for AO1 with no application At Level 1 responses <u>are likely</u> to include: • basic knowledge of Newton's laws of motion and concussion.

Question			Answer/Indicative content	Marks	Guidance
			• basic knowledge and little understanding (AO1) • little or no attempt to give opinion or judgement (AO2) • little relevant analysis or critical evaluation (AO3) • little or no attempt to use technical and specialist vocabulary • the information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. **(0 marks)** No response or no response worthy of credit.		• 6 R's may be described with little or no explanation • description of one or two ways that a concussion may occur • some inaccurate or irrelevant information may be present • mainly AO1 content. **Indicative content:** **AO1 - KU** **(Newton's laws of motion)** 1. A body continues in a state of rest or uniform velocity unless acted on by an external force 2. Law of inertia 3. A body's rate of change in momentum is proportional to the size of the force applied and acts in the direction that the force is applied 4. Law of acceleration 5. For every action (force) there is an equal and opposite reaction (force) 6. Law of reaction **(concussion and its possible causes)** 7. A (traumatic) brain injury 8. direct impact 9. blow to head / whiplash 10. contact with ground **(Explain and evaluate 6 R's)** 11. (Recognise) be aware of / signs / symptoms of concussion / that the situation / incident may result in concussion 12. (Remove) take player off field of play immediately 13. (Refer) player to a qualified healthcare professional for evaluation 14. (Rest) abstain from exercise until symptom-free 15. (Recover) Player must allow fully recovery or be symptom-free before returning to play / training 16. (Return) Player must be symptom-free to return to play 17. Abuse of concussion laws in sport / rugby union 18. Ease of 6Rs protocol

Question			Answer/Indicative content	Marks	Guidance
					AO2 – EG (Newton's laws of motion) 1. Jumper will remain on floor until an external / unbalanced force acts 2. Greater the mass of jumper greater the inertia 3. The greater the force applied to the ground, the greater the acceleration 4. The greater the acceleration or change in momentum the higher the performer will jump AO2 greater action force applied = greater change in momentum 5. The jumper applies an action force into the ground 6. The ground provides an equal and opposite force to the jumper (concussion and its possible causes) 8. e.g. punch in boxing / kick to head in kick boxing 9. e.g. clash of heads in rugby / football e.g. whiplash following a dominant tackle in rugby 10. e.g. fall in horse racing / off high bar in gymnastics (Explain and evaluate 6 R's) 11. Symptoms include headaches / dizziness / nausea / impaired balance and hearing 12. Stop play immediately / do not wait for next stoppage in game / ball out of play 13. Head injury assessment / HIA a part of the game of rugby (and other sports)/ e.g. scans 15. Named specific treatments, e.g. graduated return to play / GRTP programme 16. Written authorisation from healthcare professional Player must follow minimum timescale for recovery Player has completed graduated return to play programme AO3 - DEV (Newton's laws of motion) 1. Gravity is external force that prevents constant velocity upwards

Question			Answer/Indicative content	Marks	Guidance
					2. Force must be greater than weight to cause jumper to leave floor 3. The force must be applied directly downwards to produce a vertical jump/ acceleration is vertically upwards 4. F = ma / momentum = mass x velocity (concussion and its possible causes) 7. Disturbance of brain function 8. Impact of brain on inner lining of cranium 9. May or may not result in unconsciousness (Explain and evaluate 6 R's) 11. Parents / players / coaches / officials all have role to play Signs or symptoms may not be obvious 12. Legal obligation of officials / coaches to players in their care But player may deny concussion / want to stay on field 13. At lower levels healthcare professionals may not be immediately available Monitor for signs of deterioration for at least 24 hours While asleep player should also be closely monitored 14. Player should abstain from alcohol / work / school / physical exertion 15. Adults 1-week minimum recovery in RU OR U18s 2-weeks minimum recovery in RU 17. Use of HIA to allow player to get extra treatment for other injuries without making an official substitution Intimidation of healthcare professionals to enable player to return to field and play on In football once a player is substituted they cannot return to pitch, so incentive to leave player on pitch to see if player is OK / can run off injury before removing 18. Easy to remember / learn / educate / advertise / use 6Rs protocol

Question			Answer/Indicative content	Marks	Guidance
			Total	20	