Physical Education (H155, H555)

H555/01, Physiological factors affecting performance (A Level), June 2022
Louise Bugler

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 Explain how the conduction system of the heart controls diastole.

[2]

2 Identify the processes that occur during the fast component of excess post exercise oxygen consumption (EPOC).

[2]

3 Performers compare energy expenditure to energy intake to manage body weight.

Describe **two** factors that performers use to work out their (daily) energy expenditure.

1

2

[2]

4 If a sports performer is suspected of suffering a concussion, the IRB's "Recognise and Remove" 6 R's protocol should be followed.

Complete the table to name and describe the missing stages of the 6 R's.

1	Recognise	Coaches should be aware of the symptoms of concussion.
2	Remove	Player with suspected concussion must be removed from the field of play.
3		
4	Rest	Player must rest until free of symptoms.
5		
6	Return	Player must have written authorisation and complete the 'graduated return to play' protocol before returning to play

[2]

5 Describe how the use of a wind tunnel could help an elite track cyclist to enhance their performance.

[2]

6(a) **Fig. 6.1** shows the performance of the upward phase of a leg curl when moving from position A to position B.

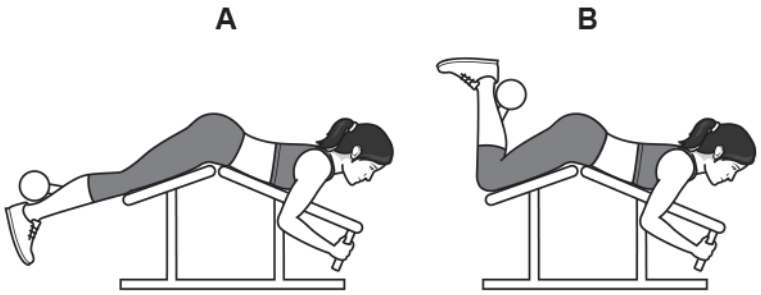


Fig. 6.1

(i) Complete the table below to analyse the movement at the knee joint in **Fig. 6.1** when performing the leg curl.

	Movement	Agonist muscle	Plane of movement
Knee joint			

[3]

(ii) Describe the role of **two** respiratory muscles during expiration at rest.

1 .....

.....

2 .....

.....

[2]

(b) Explain how neural factors control heart rate at the start of exercise and during recovery.

[6]

(c) During exercise the working muscles have an increased need for oxygen.

Assess how changes in the pressure gradient and the dissociation of oxyhaemoglobin affect oxygen diffusion at the working muscles during exercise.

Changes in the pressure gradient

Changes in dissociation of oxyhaemoglobin

[6]

(d) The highest football stadium in the world is home to the Bolivian national team and stands 3,601 m above sea level.

(i) How long before a match should a team arrive at this altitude in order to acclimatise?

[1]

(ii) Describe the physiological processes of acclimatisation to altitude.

[2]

7(a)

(i) Name a sport where performers might use anabolic steroids to enhance their performance.

[1]

(ii) Give **one** potential benefit and **one** risk of using anabolic steroids to enhance performance.

Benefit

Risk

[2]

(b) An elite marathon runner is using a multi-gym to develop their strength endurance.

(i) Use your knowledge of strength training guidelines to complete the table with appropriate values.

Strength endurance training guidelines		
Resistance	Repetitions	Sets

[3]

(ii) Explain how the physiological adaptations from strength training may benefit the marathon runner.

[4]

(c) **Fig. 7.1** shows a swimmer performing front crawl.

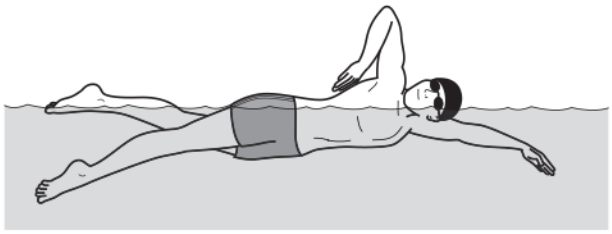


Fig. 7.1

(i) Explain why good shoulder flexibility is a key fitness component for a swimmer.

---

[1]

(ii) Evaluate isometric stretching as a method to improve flexibility.

---

[4]

(d)

(i) Explain why a simple fracture is an example of an acute, hard tissue injury.

[1]

(ii) Describe the use of surgery to treat acute, hard tissue injuries.

[4]

8(a) Sport performers will manipulate factors that affect the size of the friction force acting on them.

(i) Why do performers want to increase friction?

---

[1]

(ii) Using examples from sport, explain how performers increase friction.

---

[3]

(b) A basketball player jumps upwards from one foot to reach a rebound.

Draw a free body diagram to show the vertical forces acting at take off and explain the resulting motion of the basketball player.

Free body diagram

Explanation _____

_____

_____

_____

_____

---

[5]

(c) A rugby player of mass 96 kg takes 2.5 seconds to accelerate from a standing start to 8 m/s.

Calculate the weight of the player, their acceleration between 0 s and 2.5 s and their momentum at maximum velocity.

(Assume g = 10 m / s^2)

Weight of rugby player:

Acceleration between 0 s and 2.5 s:

Momentum at maximum velocity:

---

[5]

(d) Complete the **four** missing parts of the table below in relation to the quantities of angular motion and describe the factors affecting the size of the moment of inertia of a rotating body.

Angular motion quantity	Definition	Unit of measurement
Angular momentum		kg m^2 rad/s
	The rate of change in angular displacement	rad/s
Moment of Inertia		

Description _____

_____

_____

_____

[6]

9 **Fig. 9.1** is a velocity/time graph showing the motion of a hockey ball that is hit at the goal and rebounds off the post.

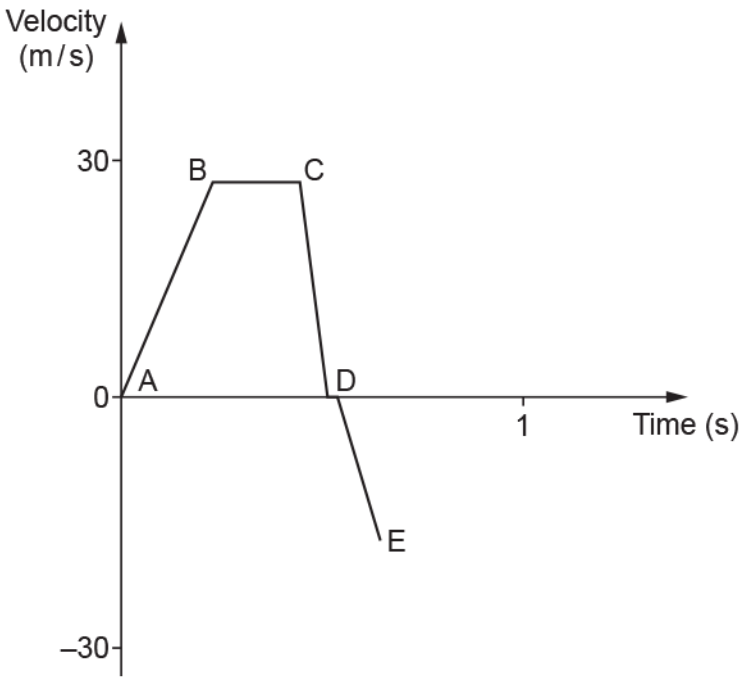


Fig. 9.1

Use the graph in **Fig. 9.1** to explain the motion of the ball.

Hockey is a team game that involves intermittent exercise of differing intensities and durations.

Analyse the interplay of the energy systems during intermittent exercise and the factors that affect this interplay. Use examples from a team game of your choice to support your analysis.

[20]

END OF QUESTION PAPER

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td></td><td></td><td>Two marks from

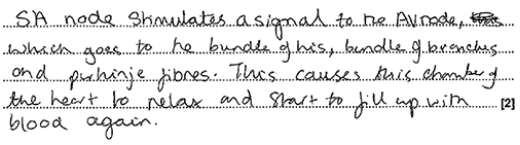
<table><tr><td>1. (Atria relax)</td><td>Atria/ventricles do not contract
or atria/ventricles relax
or atria/ventricles are filling/fill with blood</td></tr><tr><td>2. (No impulse)</td><td>(due to …) No (electrical) impulse/signal</td></tr></table></td><td>2(AO1)</td><td>Do not accept: Reference to the heart

Do not accept: reference to a delay of impulse to the AV node

<u>Examiner’s Comments</u>

Candidates generally scored well although some lacked precision in their responses talking about the heart rather than the specific chambers. Others performed less well discussing the process of conduction and systole rather than diastole. Few candidates considered the absence of the cardiac impulse.

Exemplar 1

 
SA node stimulates a signal to the AV node, which goes to the bundle of his, bundle of branches and purkinje fibres. This causes this chamber of the heart to relax and start to fill up with blood again. [2]

This candidate has described the conduction system pathway which is not required for an explanation of diastole. The second sentence does not link directly to the first and lacks clarity in terms of the stage of conduction and chamber they are referring to. The response is too vague in the response to the control of diastole.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>2</td><td></td></tr>
<tr><td>2</td><td></td><td></td><td>Two marks from

<table><tr><td>I.(Oxygen)</td><td>Replenish/restore/re-link blood/haemoglobin/muscle/myoglobin with oxygen</td></tr><tr><td>2.(ATP)</td><td>Resynthesise/replenish ATP (in the muscle)</td></tr><tr><td>3.(PC)</td><td>Resynthesise/replenish phosphocreatine/PC
or
Restore (muscle) phosphagen</td></tr></table></td><td>2(AO1)</td><td><u>Examiner’s Comments</u>

A well answered question with clear and succinct responses by most. A few weaker and unsuccessful responses answered with the slow component of EPOC, e.g. lactic acid removal.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>2</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td>Two marks from

<table><tr><td>1.(BMR/RMR)</td><td>(Basal metabolic rate/resting metabolic rate) the minimum amount of energy/calories expended/required to sustain essential body function at rest</td></tr><tr><td>2.(TEF)</td><td>(Thermic effect of food) the energy expended/required to digest/absorb/process food</td></tr><tr><td>3. (Physical activity energy expenditure/MET)</td><td>(Physical activity energy expenditure) the energy/calories expended/required to perform tasks/(sports) activity
or
(Metabolic equivalent of task) is the working:resting metabolic ratio/a measure of the energy expenditure of different activities</td></tr></table></td><td>2(AO1)</td><td>Description required for mark

<u>Examiner's Comments</u>

Candidates had a relatively weak understanding of energy expenditure and this resulted in less successful responses generally. Many focused responses on energy intake and 'calorie counting' which does not satisfy the demand of the question and others stated key terms, 'BMR' or 'TEF' without a description. Those who made attempts to describe factors used to estimate energy expenditure often accessed marks through linking the specific activities to a 'calorie count' or MET value.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>2</td><td></td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td></td><td></td><td>Two marks from:
(Must have correct name and description)

<table><tr><td>1. (Line 3 in table)</td><td>Refer</td><td>Refer immediately to a qualified health care professional / specialist / medical attention</td></tr><tr><td>2. (Line 5 in table)</td><td>Recover</td><td>Players must be symptom free / fully recovered
or
1-week adult/ 2 weeks U18’s
(before seeking an authorised return to play)</td></tr></table></td><td>2(AO1)</td><td>Stamp KU for correctly named key term, then TICK for accompanying correct description.

Must name and describe for each mark.

<u>Examiner’s Comments</u>

A well answered question with the majority of candidates correctly identifying the two missing stages and giving correct descriptions. Few candidates gave the correct stages without accessing marks for the descriptions although this happened more commonly with ‘recover’ rather than ‘refer’. Few candidates did not access the mark scheme, those who did not gave incorrect names of the missing stages.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>2</td><td></td></tr>
</table>

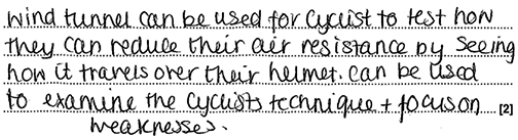
<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5</td><td></td><td></td><td>Two marks from

<table><tr><td>1. (Measure)</td><td>Collect data on/measure/see the effect of air resistance on the <u>cyclist/bike/equipment</u></td></tr><tr><td>2. (Bike)</td><td>To optimise the aerodynamics/ streamline/ airflow around the bike / bike parts/
or
improve bike design</td></tr><tr><td>3. (Clothing/equipment)</td><td>To optimise the aerodynamics/ streamline/ airflow around cyclist’s clothing/equipment (eg helmet/clothing/shoe covers)</td></tr><tr><td>4. (Cyclist)</td><td>To optimise the aerodynamics/ streamline/ airflow around body position/technique</td></tr></table></td><td>2(AO2)</td><td>Accept: ‘Drag’ as equivalent for AR

<u>Examiner’s Comments</u>

A generally well answered question with most candidates accessing the mark scheme. An application of knowledge question required candidates to link to the cyclist’s performance and most candidates did this well. All three elements were considered equally and the key term ‘aerodynamic’ was commonly used. Those candidates who did not access the mark scheme commonly describe the use of a wind tunnel as a training tool.

Exemplar 2

This candidate has responded well with a clear and concise description of how a wind tunnel can enhance a cyclist’s performance. They have identified the purpose of a wind tunnel and linked air resistance to the cyclist – in this case the equipment: helmet. They gained the marks for point 1 the measurement of air resistance on the cyclist’s equipment (helmet) and examination of the cyclist’s technique, and point 3 through the application of knowledge, in this case the enhancement of performance – ‘reducing’ the air resistance of the cyclist’s equipment (helmet).</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>2</td><td></td></tr>
</table>

<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>i</td><td>Three marks from

<table><tr><td></td><td>Movement</td><td>Agonist muscle</td><td>Plane of movement</td></tr><tr><td></td><td>1. Flexion</td><td>2. Biceps Femoris or semi-membranosus or semi-tendinosus</td><td>3. Sagittal</td></tr></table></td><td>3(AO3)</td><td>Mark first answer only

<u>Examiner's Comments</u>

Most candidates scored well on this question, correctly identifying the movement and plane. Most candidates also correctly identified the agonist muscle with very few not scoring due to the muscle group being stated rather than the specific muscle.</td></tr>
<tr><td></td><td></td><td>ii</td><td>Two marks from

<table><tr><td>1.</td><td>Diaphragm relaxes/domes</td></tr><tr><td>2.</td><td><u>External</u> intercostals relax</td></tr></table></td><td>2(AO1)</td><td>Accept: Combined answer
eg: "diaphragm and external intercostal muscles relax" = 2 marks

<u>Examiner's Comments</u>

Most candidates gained the 2 marks available with correct knowledge and understanding demonstrated.</td></tr>
<tr><td></td><td>b</td><td></td><td>Six marks

<table><tr><td>1.(ANS)</td><td>Heart rate regulated/controlled by the autonomic nervous system/ANS</td></tr><tr><td>2. (CCC)</td><td>Cardiac control centre receives information from the receptors</td></tr></table><u>(Exercise – submax 3)</u><table><tr><td>3.(Receptors)</td><td>Chemoreceptors detect increased (pp)CO_2/acidity/lactic acid or decreased (pp)O_2/pH
or
proprioceptors / mechanoreceptors detect (increased) motor activity/movement
or
baroreceptors detect increased blood pressure</td></tr><tr><td>4. (Sympathetic system)</td><td>sympathetic nervous system (to increase HR)</td></tr></table></td><td>6(AO1)</td><td>Sub-max 3 marks for exercise/recovery

<u>Examiner's Comments</u>

Generally, candidates demonstrated good knowledge and understanding in both the exercise and recovery phase, commonly securing points 2, 3, 6, 7 and 11. Some candidates showed a depth of insight with knowledge of the specific nervous system and nerve in operation in each phase, whereas others mistakenly used the VCC or only covered exercise or recovery rather than both.</td></tr>
</table>

Question	Answer/Indicative content	Marks	Guidance
	5.(Cardiac accelerator nerve) — (Cardiac) accelerator nerve (stimulated) 6.(SA node) — SA node increases firing rate/HR (Recovery – submax 3) 7. (Receptors) — Chemoreceptors detect **decreased** (pp)CO_2/acidity/ lactic acid or **increased** (pp)O_2/pH or proprioceptors / mechanoreceptors detect decreased motor activity/movement or baroreceptors detect **decreased** blood pressure 9. (Parasympathetic system) — parasympathetic nervous system (to decrease HR) 10. (Vagus nerve) — Vagus nerve (stimulated) 11. (SA node) — SA node decreases firing rate/HR		

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>c</td><td></td><td>Six marks from:

(Changes in the pressure gradient: submax 4)

<table>
<tr><td>1.(Pressure gradient)</td><td>Gradient is steeper/increased</td></tr>
<tr><td>2.(ppO_2 in muscles)</td><td>(pp)O_2 in working muscles is reduced/lower</td></tr>
<tr><td>3.(Reason)</td><td>Because the working muscles are using more O_2 for <u>aerobic respiration/energy system</u></td></tr>
<tr><td>4.(O_2 diffusion rate)</td><td>Diffusion/gaseous exchange (of O_2 from capillary/blood) to muscle is faster/ rate increased/more efficient</td></tr>
<tr><td>5.(O_2 into muscle volume)</td><td>More O_2 diffuses into the muscle</td></tr>
</table>
(Changes in dissociation of oxyhaemoglobin: submax 4)
<table>
<tr><td>6.(Bohr shift)</td><td>The (oxy)haemoglobin dissociation curve shifts to the <u>right</u>
or
Bohr shift</td></tr>
<tr><td>7. (ppCO_2 /acidity / temperature)</td><td>there is an increase in CO_2 /acidity / temperature
or
decrease in pH</td></tr>
<tr><td>8. (Effect)</td><td>Causing reduced affinity of haemoglobin for O_2
or
causing increased dissociation of oxyhaemoglobin/O_2 from haemoglobin
or
causing reduced saturation of haemoglobin with O_2</td></tr>
<tr><td>9. (O_2 diffusion)</td><td>More oxygen available for diffusion to the muscle</td></tr>
</table></td><td>6(AO3)</td><td>Do not accept: Pt.2 ppO_2 is lower in the muscles than the capillaries
Do not accept: reference to CO_2 (pt 1-5)

<u>Examiner's Comments</u>

Some candidates successfully accessed the full mark scheme. A good proportion of candidates noted the increase in diffusion gradient and were able to explain why and how this impacts on diffusion, although few candidates noted the decrease in ppO_2 in the muscle cell during exercise. Many candidates identified the increased dissociation of O_2 from haemoglobin and some candidates gave details of the Bohr shift.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>d</td><td>i</td><td>One mark from

<table><tr><td>1.</td><td>14 days + / 2 weeks minimum</td></tr></table></td><td>1(AO2)</td><td>Mark first answer only
Do not accept: any range that includes less than 14 days</td></tr>
<tr><td></td><td></td><td>ii</td><td>Two marks from:

<table><tr><td>1. (EPO)</td><td>Increased release (of the hormone) erythropoietin/EPO (by the kidneys)</td></tr><tr><td>2. (RBC)</td><td>Increased red blood cell/RBC/erythrocyte volume/haemoglobin</td></tr><tr><td>3. (Capillarisation)</td><td>Increased capillarisation (at alveoli/muscles) or increased capacity for gaseous exchange at the alveoli/muscles</td></tr><tr><td>4. (Ventilation)</td><td>Breathing rate/ventilation stabilise (at higher rate compared with sea level)</td></tr><tr><td>5. (SV/Q)</td><td>Decrease in stroke volume/cardiac output/Q (compared to arrival at altitude).</td></tr><tr><td>6. (Other effects)</td><td>Decrease in altitude sickness/headaches/poor sleep/lack of appetite.</td></tr></table></td><td>2(AO1)</td><td><u>Examiner’s Comments</u>

Generally, well answered by most candidates commonly citing increased EPO release and RBC production. Few candidates noted the stabilisation of ventilation and a proportion of candidates incorrectly considered acute responses to arriving at altitude.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>20</td><td></td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>a</td><td>i</td><td>One mark from

<table><tr><td>1.(Maximal/explosive based</td><td>Sprinting/athletics throwing or jumping/</td></tr><tr><td>sport)</td><td>rugby/weightlifting</td></tr></table></td><td>1(AO2)</td><td>Guidance Allow any named sport which is predominantly maximal/explosive strength based.

Do not accept: sport which does not indicate max/explosive intensity, e.g. cycling/rowing/swimming TV</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>ii</td><td>Two marks from

(Benefit: submax 1)

<table><tr><td>1.(Body composition)</td><td>Increased muscle mass/ muscle hypertrophy
or
Decreased fat mass
or
Improved body composition.</td></tr><tr><td>2.(Strength)</td><td>Increased maximal/explosive strength/power</td></tr><tr><td>3.(Recovery)</td><td>Increased speed of recovery
Or
Recovery shortened</td></tr><tr><td>4.(Training)</td><td>Increased intensity/ duration/ quality/ quantity of anaerobic/(near) maximal training</td></tr></table>(Risks: submax 1)<table><tr><td>5.(Hormonal)</td><td>Hormone imbalance/acne/greasy skin/ greasy hair/ hair loss</td></tr><tr><td>6.(Organs)</td><td>Liver/kidney/heart disease/damage</td></tr><tr><td>7. (Health)</td><td>Increased blood pressure/<u>LDL cholesterol</u></td></tr><tr><td>8.(Mood)</td><td>Increased aggression/irritability/low mood/mood swings/depression/suicidal tendencies</td></tr></table></td><td>2(AO1)</td><td>Accept first response only

Accept: Pt.5 any examples of male/female egs of hormonal imbalance: (i.e. development of facial hair in females, males testes shrink etc).

Accept: Pt.6 any correct example of organ disease effect (e.g. heart attack)</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>b</td><td>i</td><td>Three marks from

<table><tr><td>Resistance</td><td>Repetitions</td><td>Sets</td></tr><tr><td>1. 50 – 75% of <u>1rep max/1RM</u></td><td>2. 15–30</td><td>3. 3 – 6</td></tr></table></td><td>3(AO1)</td><td>If a range is stated both lower and upper value must be within the accepted range stated

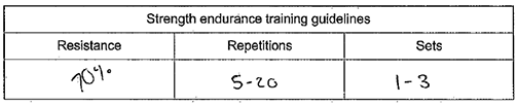
<u>Examiner's Comments</u>

Generally well answered by most candidates. Common mistakes included a lack of units for resistance (%1RM), too big a range outside the accepted norm for repetitions and sets.

 
Assessment for learning

Guidance for future teaching and learning: advise candidates to state one number rather than a range.

Exemplar 3

  <table><tr><td colspan="3">Strength endurance training guidelines</td></tr><tr><td>Resistance</td><td>Repetitions</td><td>Sets</td></tr><tr><td>70%</td><td>5-20</td><td>1-3</td></tr></table>
This candidate has made two common mistakes: 1) no units of measurement on resistance – 70% of 1RM is required, and 2) large ranges that fall outside the accepted norms – 5-20 repetitions lower end falls below the accepted range of 15-30 (and the same for sets). It may be advisable to suggest candidates select a single number which falls in the middle of their range.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>ii</td><td>Four marks from:

<table><tr><th></th><th>KU</th><th>EG</th></tr><tr><td>1.(Muscular hypertrophy)</td><td>Muscular hypertrophy / muscle mass or increase in size of muscle fibres</td><td rowspan="3">Eg: enables increased force of contraction / power during run / sprint finish</td></tr><tr><td>2.(Hyperplasia)</td><td>Hyperplasia / increased number / splitting of muscle fibres</td></tr><tr><td>3. (Cross-bridges)</td><td>Increased actin / myosin filaments / cross-bridges</td></tr><tr><td>4. (Motor units)</td><td>Increased recruitment of muscle fibres / co-ordination of motor units</td><td>Eg: Increased efficiency of muscular contraction for running action</td></tr><tr><td>5. (Stretch reflex / GTOs)</td><td>Delayed stretch reflex
or delayed / decreased reciprocal inhibition
or delayed threshold of Golgi tendon organs / GTOs</td><td>Eg: More force can be applied in the agonist for running action / stride length increases
Eg: greater stretch of the antagonist / hamstrings allows higher knee lift in run / sprint finish</td></tr><tr><td></td><td></td><td></td></tr></table></td><td>4(AO2)</td><td>Guidance:Must link explanation to the benefit to the marathon runner (eg) for mark for AO2 credit.

KU for adaptation, TICK for correct accompanying e.g.

Accept: one relevant example for multiple relevant KU points

<u>Examiner’s Comments</u>

Candidates answered this question less well. AO2 marks were required for practical application to the marathon runner which many candidates did not do correctly. Most candidates were able to identify physiological adaptations but fewer candidates applied them to benefit the marathon runner’s performance. Some candidates equally considered the marathon runner’s performance to superficially without stating specific physiological adaptations.</td></tr>
</table>

Question	Answer/Indicative content			Marks	Guidance
	6. (Fuel stores)	Increased ATP / PC / glycogen stores in muscle	Eg: Runner can work at higher intensity for longer / increased speed / anaerobic work / delay fatigue / OBLA / lactate threshold		
	7. (Buffering)	Increased buffering capacity / tolerance to lactic acid			
	8. (Aerobic)	Increased mitochondrial density / myoglobin content / capillary density			
	9. (Enzymes)	Increased enzyme / ATP-ase / creatine kinase / PFK activity / activation	Eg: Increased intensity of all energy systems during the marathon		
	10. (Tendons / ligaments)	Increased strength of ligaments / tendons	Eg: Reduce risk of runner's injury		
	11.(Bone density)	Increased bone density / mass			

Question			Answer/Indicative content	Marks	Guidance
	c	i	One mark from: (increased range of motion) — Swimmer can apply force over an increased distance/time (during the arm pull/propulsive phase) Or swimmer moves a greater distance through the water (with each arm pull/propulsive phase) or swimmer is more efficient/requires less strokes to travel the same distance/achieves faster times/swims quicker or decreased risk of injury	1(AO2)	Examiner's Comments Most candidates were able to identify the need for good shoulder flexibility, however few candidates explained why this was important for a swimmer limiting success.

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>ii</td><td>Four marks from:

(Advantages – submax 3)

<table>
<tr><td>1. + (develop mental)</td><td>Effective at increasing resting length of muscle/developmental stretching/increasing range of motion</td></tr>
<tr><td>2. + (stretch reflex)</td><td>The isometric contraction overcomes/overrides the stretch reflex (so allowing a greater stretch)</td></tr>
<tr><td>3. + (fast)</td><td>Fast method of increasing (static passive) flexibility</td></tr>
<tr><td>4. + (injury)</td><td>Less risk of injury <u>compared to ballistic</u></td></tr>
</table>
(Disadvantages – submax 3)
<table>
<tr><td>5. – (timing)</td><td>Unsuitable for use in a warm up/limit to 1 session per 36hrs</td></tr>
<tr><td>6. – (contractility)</td><td>(due to) reduction in contractility/speed of muscle contraction</td></tr>
<tr><td>7. – (connective tissue)</td><td>Risk of tendon/connective tissue damage
Or
Not advised for under 16’s</td></tr>
<tr><td>8. – (not specific)</td><td>Static flexibility gains less appropriate/specific (than dynamic flexibility gains) in some sports</td></tr>
<tr><td>9. – (reversibility)</td><td>Gains are quickly lost if stretching is not done regularly</td></tr>
</table></td><td>4(AO3)</td><td>Sub-max 3 marks for advantages/disadvantages
Pt. 6 overstretching/risk of injury TV

<u>Examiner’s Comments</u>

Few candidates demonstrated the depth of insight to fully achieve success in this question. Many candidates focused on the isometric stretching protocol and the practical or logistic strengths and weaknesses rather than evaluating its success and a method to improve flexibility. Most candidates achieved point 1 ‘increase range of motion’ although many stated ‘more or less injury risk’ which was deemed too vague as a response without further clarification.</td></tr>
<tr><td></td><td>d</td><td>i</td><td>One mark from:

<table>
<tr><td>1.(Cause <u>and</u> bone)</td><td>Caused by sudden event/impact/trauma <u>and</u> affects <u>bone</u></td></tr>
</table></td><td>1(AO2)</td><td>Guidance: Must have both cause and reference to bone for mark

<u>Examiner’s Comments</u>

A very well answered question by the majority of candidates. Those who did not achieve the mark focused on either acute or hard tissue where the question demanded the knowledge of both.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>ii</td><td>Four marks from

<table><tr><td>1.(Open surgery)</td><td>Incision made to open a joint to access injury</td></tr><tr><td>2.(Realign bones)</td><td>Realign fractured/dislocated bones</td></tr><tr><td>3.(Stabilise)</td><td>Use of plates/pins/rods/wires to stabilise fractures/dislocation</td></tr><tr><td>4.(Arthroscopy)</td><td>Arthroscopy/keyhole surgery to access injury/small incisions/camera to access injury/be less invasive</td></tr><tr><td>5.(Knee/Meniscus)</td><td>Repair/trim/resurface meniscus/cartilage in (knee) joint</td></tr><tr><td>6.(Shoulder/Labrum)</td><td>Used to repair Bankart lesion/damaged labrum/cartilage in shoulder/treat repeated shoulder dislocations</td></tr></table></td><td>4(AO2)</td><td>Do not accept: reference tosoft tissue repairs e.g. ACL reconstruction etc.

Examiner's Comments

Most candidates demonstrated enough knowledge and understanding to achieve credit for this question although few could fully achieve all the marks available. Responses tended to be generic or steer away from the question focus 'use of surgery' rather describing recovery or rehabilitation aspects. Point two 'realignment' and point three 'use of pins to stabilise' were commonly used.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>20</td><td></td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>8</td><td>a</td><td>i</td><td>One mark from

<table><tr><td>(increasing friction)</td><td>allows greater acceleration/deceleration/change of direction/speed/velocity/drive force
or
to improve grip/decrease the chance of their foot/feet slipping/increase stability</td></tr></table></td><td>1(AO2)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>Three marks from

<table><tr><th>KU</th><th>EG</th></tr><tr><td>1. Increased roughness of footwear/tyres</td><td>athletes wear spikes
or
hockey players wear astro shoes
or
rugby players wear boots/studs
or
tyres of mountain bikes have deep tread or
gymnasts chalking/taping hands</td></tr><tr><td>2. Increased softness of contact surface</td><td>rubber soles on training shoes
or
adjust tyre pressure on bike</td></tr><tr><td>3. Increased roughness of ground surface</td><td>cross country runner choosing to run a line on rougher
ground/rubber/tartan track</td></tr><tr><td>4. Increased temperature</td><td>heating tyres /warm up laps in motor sports</td></tr><tr><td>5. Increased reaction/normal force generated</td><td>spoiler on F1 car generates downforce
high/long/triple jumpers dip at take off
or
heavy rugby players/shot putters</td></tr></table></td><td>3(AO2)</td><td>Guidance: must give sporting example for mark accept any suitable example

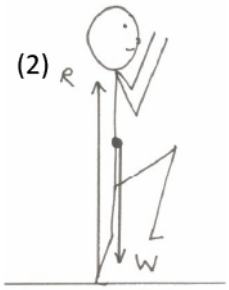
Mark KU for explanation and TICK accompanying correct example

Accept: pt.4 increased stickiness (BOD)

<u>Examiner’s Comments</u>

Many candidates were able to give good practical examples from sport however showed low levels of underlying theoretical knowledge and understanding, for example ‘a sprinter wears spikes’ without the required ‘increasing the roughness of the contact surface will increase friction’.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>b</td><td></td><td>Five marks from:
(Free body diagram)

<table>
<tr><td>1.(Weight – see pic below)</td><td>Weight force acting vertically downwards from C of M</td></tr>
<tr><td>2.(Reaction – see pic below)</td><td>(Ground) Reaction force/Normal reaction acting vertically upwards from the point of contact with the ground and longer than weight force</td></tr>
<tr><td colspan="2"> 

(1)</td></tr>
</table>
(Explanation)
<table>
<tr><td>3.(R>W)</td><td>R>W/ Reaction force is greater than weight</td></tr>
<tr><td>4.(Net force)</td><td>(Positive) net force
Or
(external) unbalanced force</td></tr>
<tr><td>5.(Acceleration)</td><td>There is acceleration (upwards)</td></tr>
<tr><td>6.(Take off)</td><td>The basketball player leaves the ground</td></tr>
</table></td><td>5(AO2)</td><td>Pt. 2 if there is no ground indicated BOD

Pt. 6 jumps upwards'/'takes off - TV

<u>Examiner's Comments</u>

Most candidates drew appropriate free body diagrams showing both weight and reaction force from the correct origins with the correct length of arrows. Many candidates explained the resultant force well considering the relationship between the two forces, the unbalanced nature of the forces and the resulting acceleration off the ground.

  Assessment for learning

Guidance for future teaching and learning: draw a dot on the centre of mass and point of contact - the weight arrow must come from the dot representing the centre of mass downwards, and the reaction force must come from the dot representing the point of contact upwards. If the arrows are not in contact with the body they are not affecting the body therefore cannot be credited.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>c</td><td></td><td>Five marks from

<table>
<tr><td colspan="2">Weight of rugby player:</td></tr>
<tr><td>1.(Use of for mula/working s)</td><td>Weight = mass x acceleration due to gravity
/
W = mg
or
W = 96 × 10</td></tr>
<tr><td>2. (Answer with units)</td><td>960N or 960Newtons or 960kgm/s^2</td></tr>
<tr><td colspan="2">Acceleration between 0s and 2.5s:</td></tr>
<tr><td>3.(Use of for mula/working s)</td><td>acceleration = $\frac{\text{Final velocity – initial velocity}}{\text{Time}}$ / $\frac{v-u}{t}$
or
$\frac{\text{change in velocity}}{\text{time}}$
or $\frac{8-0}{2.5}$ or $\frac{8}{2.5}$</td></tr>
<tr><td>4.(Answer with units)</td><td>3.2m/s/s or 3.2 m/s^2 or 3.2 ms^{-2}</td></tr>
<tr><td colspan="2">Momentum at maximum velocity:</td></tr>
<tr><td>5.(Use of for mula/working s)</td><td>Momentum = mv or mass x velocity
or
96 x 8</td></tr>
<tr><td>6.(Answer with units)</td><td>768 kgm/s or 768 kgms^{-1}</td></tr>
</table>
</td><td>5(AO2)</td><td>Accept: Pt. 1, 96 × 9.81ms^{-2} (as alternative acceleration due to gravity)
Accept: Pt. 2, 941.76 N or kgm/s^2

<u>Examiner's Comments</u>

Many candidates showed good knowledge and understanding with many achieving full marks. Common errors included a lack of units or correct units of measurement, and use of weight instead of mass in part three.</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>d</td><td></td><td>6 marks from

(Table)

<table>
<tr><th>Angular motion quantity</th><th>Definition</th><th>Unit of measurement</th></tr>
<tr><td></td><td>1. The quantity of angular motion possessed by a (rotating) body</td><td></td></tr>
<tr><td>2. Angular velocity</td><td></td><td></td></tr>
<tr><td></td><td>3. The resistance/reluctance of a body to change its (state of) angular motion/rotation</td><td>4. kgm^2</td></tr>
</table>
(Description)
<table>
<tr><td>5. Mass</td><td>The greater the <u>mass</u> the larger the moment of inertia/ MI (or opposite)</td></tr>
<tr><td>6. Distribution</td><td>The greater the <u>distribution/distance of the mass from the axis of rotation,</u> the larger the moment of inertia (or opposite)</td></tr>
</table></td><td>6(AO1)</td><td>Accept: Pt. 1: angular momentum = moment of inertia × angular velocity (BOD)

Accept: Pt. 3: MI = ∑m × r2(BOD);

Guidance – for mark to be awarded relationship must be stated

Do not accept: Pt. 6 centre of mass as an alternative to axis of rotation

<u>Examiner's Comments</u>

Most candidates correctly identified 'angular velocity' from the description and units provided, although less candidates could correctly describe angular momentum or moment of inertia. Most candidates described the factors affecting the size of moment of inertia well, while some candidates identified the factors affecting but did not describe them.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>20</td><td></td></tr>
</table>

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.	20 (AO1 x 6, AO2 x 7, AO3 x 7)	**At Level 4 responses <u>are likely</u> to include:** • accurate interpretation of the velocity/time graph • detailed understanding to explain the shape of the graph with reference to positive and negative sections • detailed analysis of the interplay of the energy systems relating to several factors affecting the interplay. • a range of practical examples illustrate the predominant energy systems within the team game • AO1, AO2 and AO3 all covered in detail in this level. At the top of this level, responses are likely to: • demonstrate a detailed knowledge of forces • make reference to Newton's laws of motion • and factors affecting the predominant energy system have been logically applied to the relevant examples. **At Level 3 responses <u>are likely</u> to include:** • mainly accurate interpretation of the velocity time graph with minor errors only • application of the hockey shot to most stages of the graph • good analysis of the interplay of energy systems and knowledge demonstrated of more than one factor affecting the interplay • a practical example is used to illustrate when each of the three energy systems are predominant within the team game • If AO1 and AO2 are detailed, significant AO3 is required for top of this level **At Level 2 responses <u>are likely</u> to include:** • interpretation of the velocity time graph

Question	Answer/Indicative content	Marks	Guidance
	Level 1 (1-6 marks) • basic knowledge and little understanding (AO1) • little or no attempt to give 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.		will be attempted but contain errors • application of the hockey shot to some parts of the graph is attempted but may be inaccurate • a practical example is used to illustrate when two of the three energy systems is predominant within the team game • analysis of the interplay of energy systems is attempted and a factor affecting the interplay will be identified. • Responses that are very unbalanced between each part or between each AO may be in this level. At Level 1 responses <u>are likely</u> to include: • interpretation of the velocity time graph may not include all stages and are likely to contain significant errors. • application of the hockey shot to a part of the graph may be attempted • a practical example of when one energy system is predominant may be attempted • basic knowledge of all three energy systems may be shown at the top of this level • mainly AO1 content, some AO2 at the top of this level. <u>Examiner's Comments</u> Most candidates gained access to the mark scheme, however this question differentiated between those who had a basic knowledge and understanding and those who showed a depth of insight and could apply their knowledge and understanding to hockey and other team games. Most candidates could describe the stages of the graph (A-B, B-C and C-D), although some struggled with phase D-E not appreciating the increase in velocity away from the horizontal axis. Most candidates made a good attempt applying the phases of motion to the ball in hockey showing good application from A-B and B-C, although the number of candidates who

Question			Answer/Indicative content	Marks	Guidance
					could correctly identify when the ball hit the post and rapidly decelerated reduced. A fair proportion of candidates accessed the mark scheme fully by developing their knowledge to analyse the forces involved referencing Newton's Laws of motion. Most candidates described the intensity and duration of each energy system within a team game and gave an applied example of their use, however a large proportion of candidates then focused on the characteristics of energy production via the three pathways rather than focusing on the factors which affect the interplay between the energy systems. Few candidates considered the energy continuum or thresholds between the systems. Candidates rarely considered the factors, beyond intensity and duration, that affect the energy system interplay. Candidates who considered a broader range of factors, such as playing position, tactics, recovery strategies and fitness achieved higher levels within this mark scheme. Candidates who also considered development knowledge of the velocity time graph gained potential access to the top of the mark scheme.
			Total	20	