Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2015

Sports, exercise and health science

Standard level

Paper 2

25 pages

General marking instructions

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded**.

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, use the “zero” annotation to award zero marks. Where a candidate has not attempted the part question, use the “SEEN” annotation to show you have looked at the question. RM™ Assessor will apply NR once you click complete.

7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. RM™ Assessor will only award the highest mark or marks in line with the rubric.

8. Ensure that you have viewed every page including any additional sheets. Please ensure that you stamp “SEEN” on any additional pages that are blank or where the candidate has crossed out his/her work.

9. There is no need to stamp an annotation when a candidate has not chosen an optional question in Section B. RM™ Assessor will apply NR once you click complete.

10. Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the “CON” stamp.

Subject Details: Sports, exercise and health science SL paper 2 markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A **[30 marks]** and **ONE** question in Section B **[20 marks]**. Maximum total = **[50 marks]**.

Markscheme format example:

Question			Answers	Notes	Total
5	c	ii	this refers to the timing of the movements **OR** 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✓		**1 max**

1. Each row in the 'Question' column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the 'Total' column.

3. Each marking point in the 'Answers' column is shown by means of a tick (✓) at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by '**max**' written after the mark in the 'Total' column. The related rubric, if necessary, will be outlined in the 'Notes' column.

5. An alternative wording is indicated in the 'Answers' column by a slash (/). Either wording can be accepted.

6. An alternative answer is indicated in the 'Answers' column by '**OR**' on the line between the alternatives. Either answer can be accepted.

7. Words in angled brackets ‹ › in the 'Answers' column are not necessary to gain the mark.

8. Words that are <u>underlined</u> are essential for the mark.

9. The order of marking points does not have to be as in the 'Answers' column, unless stated otherwise in the 'Notes' column.

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10. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the 'Answers' column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by *OWTTE* (or words to that effect).

11. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

12. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. 'ECF acceptable' will be displayed in the 'Notes' column.

13. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the 'Notes' column.

Section A

Question			Answers	Notes	Total
1	a		15-16 ‹mph› and 50 ‹%› maximum running speed✓	*Both required for **[1]**.*	**1**
	b		aerobic✓		**1**
	c		as distance increases from 100 m and 200 m, mean running speed increases✓ at distances of 200 m and above, mean running speed decreases as event distance increases/generally mean running speed decreases with an increase in running distance / distances of 100 m/ 200 m has a higher speed than longer distance races / shorter distances ‹100, 200, 400 m› have higher average speeds / as distance increases, mean running speed decreases✓ the hypothesis is true for distances 200 m and above✓		**2 max**

	d		Newton's Second Law F = m x a / states that force = mass X acceleration/ the acceleration of a body will be proportional to the force and in the direction of the force applied✓ an example of Newton's Second Law is straightening of the legs pushes on the upper body and accelerates the athlete down the track✓ the greater the force applied the greater the acceleration for a given mass✓ Newton's Third Law states that for every action there is an equal and opposite action ‹law of reaction›✓ the runner applies force by extending his/her legs against the ground/ pushing back against the ground/earth✓ the force from the extension of the legs is the action **OR** the action force is caused by muscle contraction✓ the ground/earth exerts an equal and opposite force on the athlete✓ the push back from the ground/earth is the reaction✓ because the ground/earth is a larger mass than the mass of the athlete, the effect on the athlete is greater than the effect on the ground/earth✓ the result of the reaction force is to displace the relatively small mass of the athlete/produces the movement of the athlete and what accelerates the entire body forward✓ the faster/harder the athlete pushes ‹action› the greater the force will be✓	*Award **[2 max]** for Newton's Second Law.* *Award **[2 max]** for Newton's Third Law.*	**3 max**

	e		*aerobic threshold:* anaerobic ‹system› contributes approximately 3/4 % and aerobic ‹system› contributes approximately 96/97 %✓ aerobic ‹system› contributes 96/97 % compared with the anaerobic threshold where it contributes 93/94 %✓ *anaerobic threshold:* anaerobic ‹system› contributes approximately 6/7 % and aerobic ‹system› contributes approximately 93/94 %✓ the contribution of the aerobic system is higher ‹96-97 % and 93-94 %› than the anaerobic ‹3-4 % and 6-7 %› for both thresholds✓ this gap decreases at the anaerobic threshold compared to the aerobic threshold✓ as speed increases anaerobic glycolysis increases ‹3/4 % to 6/7 %› and aerobic decreases ‹96-97 to 93-94 %›✓	*Award **[1 max]** for aerobic threshold.* *Accept answers in the converse.*	**2 max**
	f		use of heart rate based upon its relationship with oxygen uptake, ‹*ie* target heart rate that coincides with a given percentage of maximal oxygen uptake›✓ the Karvonen method or percentage heart rate reserve method ‹HRR› takes into account the difference between resting heart rate ‹HRrest› and maximal heart rate ‹HRmax›/THR %=HRrest+ %(HRmax-HRrest)✓ training heart rate is calculated by taking a percentage of maximum heart rate ‹220 – age›✓ ratings of perceived exertion ‹Borg/OMNI/CERT scale›✓	*Award **[1 max]** for Karvonen method.* *HR as a method needs to be with reference to either max HR or oxygen uptake.*	**2 max**

2	a		a joint occurs where two or more bones articulate/meet ✓		**1**
	b		*axial skeleton:* main function is protection ‹internal organs›✓ attachment **OR** movement✓ support ‹spine› *appendicular:* main function is movement✓ support **OR** blood cell formation **OR** mineral reservoir✓	*Award **[1 max]** for axial skeleton function.* *Award **[1 max]** for appendicular function.* *Must have different functions for each to distinguish.*	**2 max**
	c		W: ilium✓ X: sacrum✓ Y: coccyx/coccygeal✓ Z: pubis/pubic bone✓	*Award **[1]** for two correct structures.*	**2 max**

	d		*smooth muscle:* specialized for contraction/changes the diameter of the lumen✓ located in the ‹walls of hollow internal› organs✓ inervated by autonomic motor neurons✓ involuntary✓ a single nucleus✓ *cardiac muscle:* striated muscle fibres✓ form the wall of the heart/located in the heart✓ stimulated by an intrinsic conduction system *OWTTE* ✓ stimulated by autonomic motor neurons/involuntary✓ a single nucleus✓ *skeletal muscle:* specialized for contraction/used for movement✓ Located in muscles such as biceps triceps etc composed of striated muscle fibres✓ supported by connective tissue✓ attached to a bone by a tendon✓ stimulated by somatic motor neurons/moved by our own free will/voluntary movement/conscious control✓ cells are multi-nucleated✓	*Award **[1 max]** for smooth muscle.* *Award **[1 max]** if involuntary muscle is used as a type of muscle with either cardiac or smooth.* *Award **[1 max]** for cardiac muscle.* *Award **[1 max]** for skeletal muscle.*	**3 max**

3	a	i	the amount of blood pumped out of the heart ‹left ventricle to the body› during each contraction/beat ‹measured in ml $beat^{-1}$/millilitres per beat›✓		**1**
		ii	cardiac output = stroke volume × heart rate✓ pre-trained athlete has a lower cardiac output **OR** post-trained athlete has a higher cardiac output✓ post-trained athlete will have a higher stroke volume at a given jogging speed compared to pre-trained✓ post-trained athlete will have a lower heart rate at a given jogging speed compared to pre-trained✓	*Accept answers in the converse.* *Accept answers in the converse.*	**3 max**
	b		the pulmonary circulation delivers ‹deoxygenated› blood from the right side of the heart to the lungs ‹for oxygenation›/blood from the right ventricle to the lungs/blood from the pulmonary artery to the lungs✓ the pulmonary circulation then delivers blood back to the left side of the heart/blood back to the left atrium/blood through the pulmonary vein to the heart✓ the systemic circulation delivers this ‹oxygenated› blood from the left side of the heart to the other tissues of the body ‹where oxygen is required›/blood from the left ventricle to the body/blood through the aorta to the body✓ the systemic circulation then delivers ‹deoxygenated› blood back to the right side of the heart for the cycle to continue/blood back to the right atrium/ blood through the vena cava to the heart✓ the systemic circulation includes delivery of ‹oxygenated› blood to the heart itself, which is supplied through the coronary arteries✓	*Award **[1 max]** for each circulatory system.*	**2 max**

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<tr><th>At rest</th><th>Sub-maximal exercise</th></tr>
<tr><td>5000 ml distributed/less blood distributed/at a slower rate</td><td>25 000 ml distributed/more blood distributed/ distributed at a faster rate✓</td></tr>
<tr><td>20 % of total blood flow</td><td>active muscles can demand as high as 90 % of total blood flow✓</td></tr>
<tr><td>blood directed to all organs in body/blood will be more evenly distributed to regions such as brain, stomach, kidneys, muscles</td><td>the muscles that are being used become the main demand for blood flow, as more oxygen and nutrients are required and more waste products and heat need to be removed/ regions such as the stomach, kidneys will require relatively less during the run✓</td></tr>
<tr><td>‹to prevent a catastrophic drop in blood pressure› vessels supplying other organs in the body constrict and many of the capillaries close so that blood flow is reduced to these organs</td><td>‹with increased cardiac output› more blood is directed towards the active muscles by dilating the arterioles supplying the muscles and opening more of the capillary network within muscles✓</td></tr>
<tr><td>blood directed to all organs in body</td><td>essential organs eg brain and heart are protected so that they still have sufficient oxygen during sub-maximal exercise✓</td></tr>
<tr><td>at rest skin will have minimal blood flow depending on climate</td><td>Sub-max ex skin will have a significant blood flow in order to cool the body and maintain suitable temperature✓</td></tr>
<tr><td colspan="2">Vasodilation increases at regions requiring greater blood flow/vasoconstriction increases at regions not requiring blood flow for both rest and exercise situations✓</td></tr>
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</td>
<td>Award [1] per row.

Accept 80% compared to 20%.</td>
<td>3 max</td>
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<tr><th>Archery</th><th>Cycling</th></tr>
<tr><td>fine</td><td>gross✓</td></tr>
<tr><td>closed</td><td>open✓</td></tr>
<tr><td>discrete</td><td>continuous✓</td></tr>
<tr><td>more towards internal paced</td><td>internal or external✓</td></tr>
<tr><td>individual</td><td>coactive or interactive✓</td></tr>
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<td>Award [1] per row.</td>
<td>2 max</td>
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Section B

Question			Answers	Notes	Total
5	a		*consistency:* a skilled performer can repeat the task successfully time after time/achieve their goals consistently/there is maximum certainty *eg* % success of a basketball free-thrower **OR** vice versa for a novice performer✓ *goal-oriented movements/goal-directed:* a skilled performer has a clear understanding of the goal *eg* aim towards a goal/*eg* to make a pass to another player *eg* basketballer passing to open team mates or putting themselves into positions to shoot **OR** vice versa for a novice performer✓ skill has an end result ‹pre-determined result› *eg*, the ball going in when they shoot – or getting very close so that a team mate may assist **OR** vice versa for a novice performer✓ *learned:* in order to produce a skilled performance, the performer must practice so that the underlying abilities are enhanced, *eg*, players spending hours being coached and training/ practicing the skills in various situations **OR** it requires practice and results from experience in order to produce a skilled performance✓ replica of a copy of the technical model✓ a skilled performer will be at the autonomous stage of skill acquisition, *eg*, players able to adapt their shooting to the situation – irrespective of the other players or environmental conditions (crowd *etc*…) **OR** a novice performer will be at the cognitive stage of skill acquisition✓ *efficiency:* a novice performer may use a lot of energy and still be unsuccessful, *eg*, movements to complete tasks such as dribbling use only those that are required to move to positions **OR** a skilled performer is able to fit the energy required to the demands of the task	*Award **[1]** for each.*	**6 max**

continued…

	a		**OR** movement appears fluent, controlled and aesthetically pleasing/well coordinated and precise/aesthetic ‹and smooth› for a skilled performer, *eg,* a high-level gymnastics routine **OR** vice versa for a novice performer✓ *fluency:* this will be apparent in the skilled performer *eg* movements are linked, with no noticeable breaks/*eg* coordination of limb segments in goal-directed activity/*eg* relative movements between segments of one limb ‹intra-segment coordination› or different limbs ‹inter-segment coordination›, or between limb segments and an object to intercept **OR** vice versa for a novice performer✓ *accuracy:* a skilled performer will selectively attend to, recognize, analyze and interpret visual information more accurately and in turn make the correct decision, *eg*, movements place the shot in or extremely close **OR** vice versa for a novice performer✓ *control:* a skilled performer has the ability to vary precisely the parameters of the motor production, *eg*, force, speed and duration, to suit specific performance constraints **OR** vice versa for a novice performer✓		
	b		*health-related fitness:* consists of the components of fitness that have a relationship to good health / components which are vital to ensure that an individual can meet the physical and physiological demands of an activity without excessive fatigue ✓ includes body composition, cardio-respiratory fitness ‹aerobic capacity›, flexibility, muscular endurance, strength✓ *performance related (skill-related) fitness:* these components are related to successful sport and motor skill performance✓ includes agility, balance, coordination, power, reaction time and speed✓	*Award **[2 max]** for health related fitness.* *Must provide at least 2 components for the type of fitness to get this mark. No mark awarded if they have a mixture of health and skill for the same fitness type.* *Award **[2 max]** for performance related (skill-related) fitness.*	**4**

	c		referred to as detection – comparison – recognition process ‹DCR›/the ability to detect a signal/stimulis✓ background noise is non-essential information. This can refer to actual noise ‹*eg* sound of spectators› but covers all information that is not a part of the signal✓ background noise can include internal worries/anxiety such as fear of failure✓ the detection of any given signal depends on the intensity of the signal compared to the intensity of the background noise/background noise can hinder signal detection✓ detection is affected by an individual's sensitivity to a particular signal *ie* more likely to respond to a familiar signal✓ detection depends on efficiency of a person's sense organs ‹*eg* eyes, vestibular apparatus›/efficiency can be affected by age/injury/congenital disorder✓ arousal level affects the probability of the detection of a signal ‹if arousal is too low it can cause an error of omission, if arousal is too high it can cause an error of omission›✓ selective attention of cues can lead to early detection✓ practice and learning what to watch for as a signal can assist a persons ability to detect a signal✓		**6 max**

	d		*whole practice:* involves practising a task in its entirety✓ *eg* javelin throwing✓ *whole – part – whole:* the coach presents the whole practice and then the practice is broken down into its component parts, and then the whole is practised again in order to see if effective learning of the parts has taken place✓ *eg* in a team sport the tactical element is practised, then practising a skill within that tactical element before reintroducing the tactical element as whole✓ *progressive part:* introducing elements of increasing difficulty in a sequential fashion✓ *eg* swimming when kicking is taught, followed by kicking and breathing, followed by kicking, breathing and arms✓ *part practice:* practising part of a skill in isolation to the rest of the task✓ *eg* 100 m sprinter practising the start only✓	*Award **[2 max]** for each type of presentation.*	**4 max**

6	a		breakdown of glycogen into glucose molecules✓ breakdown of glycogen to glucose is a hydrolysis reaction✓ glucose-1-phosphate converted to glucose-6-phosphate ‹to form pyruvate›✓ the process is controlled by the enzyme phosphorylase✓ liver glycogenolysis is initiated through the actions of glucagon which is secreted by the pancreas✓ muscle glycogenolysis is stimulated by epinephrine and norepinephrine ‹catecholamines› which provide glucose only for the particular muscle in which the glycogen has been stored✓ a process that must be capable of happening rapidly✓ the process is a catabolic reaction✓ when blood glucose is low glucagon is released to enable glycogenolysis to occur✓		**4 max**
	b		*Platelets*: the primary role of platelets ‹<1 % of blood volume› is to assist in the process of repair following injury✓ platelets are vital to blood clotting✓ *Leucocytes/white blood cells*: white blood cells ‹<1 % of blood volume› are known as leucocytes and are primarily involved in immune function, protecting the body from infection✓ capable of preventing the same virus/disease from attacking/ retain antibodies for previous infections✓ white blood cells converge together in great numbers wherever invading bacteria, viruses, fungi, or parasites gain entry into the body✓ white blood cells destroy bacteria, viruses, fungi, or parasites✓ *Erythrocytes/ red blood cells/rbc*: the red blood cells' effectiveness as oxygen-carriers is due to its content of hemoglobin, ‹a compound of protein and iron which gives blood its red colour›✓ rbc – carry oxygen in our blood ‹98 %›✓ rbc – carry CO_2 in blood✓	*Award **[3 max]** per type of blood cell.*	**6**

	c		maximal oxygen consumption/VO_2 max represents the functional capacity of the oxygen transport system and is sometimes referred to as maximal aerobic power/aerobic capacity✓ maximal oxygen uptake quantifies the maximum rate that an individual can take in and use oxygen/it represents the maximum amount of oxygen a person can use to make ATP per minute✓ it is most often expressed in milliliters per kilogram of body weight per minute/litres per minute ‹because oxygen and energy needs differ relative to size›✓ VO_2 max is more useful as an indicator of a person's aerobic potential or upper limit than as a predictor of success in endurance events✓ VO_2 max is determined by maximal heart rate, stroke volume and AVO_2/arteriovenous oxygen difference✓ recent research suggests that genetics play a role in how much an individual can increase VO_2 max✓ amongst groups of people following the same training program there will be responders and non-responders✓ there can be differences in VO_2 max for trained versus untrained/males versus females/young versus old✓ it can vary for an individual depending on the mode of exercise✓ variations (persons score) in VO_2 max during different modes of exercise reflect the quantity of activated muscle mass eg there is more muscle mass activated during treadmill running compared to either cycling or arm ergometry✓ VO_2 max can be measured using tests such as treadmill test, beep test or some suitable test stated✓ a persons score can differ depending on the quality of the test being done *eg* treadmill versus 12 minute run – which is used to estimate VO_2✓ training improves physiological features such as capillarization, %rbc which will improve VO_2✓ skill level/training status/experience can increase the VO_2 max values✓	*Definition of VO_2 max must refer to oxygen being used as much as an uptake of oxygen.*	**6 max**

continued…

	d		exercise lowers the concentration of insulin in the blood, reducing its function in glucose transport✓ exercise is a stimulus for skeletal muscle glucose uptake, ‹with the increase in muscle contraction being greater than that elicited by maximal insulin stimulation›✓ the magnitude of exercise induced increase in muscle glucose uptake is related to both the intensity and duration of the exercise✓ blood glucose will decrease during exercise as muscles take it in✓ the delivery of glucose and insulin to contracting skeletal muscle is increased during exercise as a consequence of the large increase in muscle blood flow✓ local factors in the muscle play the major role in glucose uptake ‹these include increased sarcolemmal transport of glucose and activation of the glycolytic and oxidative enzymes responsible for glucose metabolism›✓ calcium signalling in the muscle and the mechanical stretch receptors in the lungs also increase glucose uptake✓ the pathway for glucose into cells is different to that induced by insulin✓ the effect of muscle contraction intake persists into early post ex to restore depleted stores✓		**4 max**

7	a		stretching is a useful component of a warm up before an exercise session/cool down after exercise✓ stretching may be used as part of a general flexibility training programme✓ to improve the range of motion at a joint/improve performance✓ reduce injury risk ‹in long-term›✓ static stretching is when the limb is moved slightly beyond the terminal position slowly and then maintained in that position ‹*eg* for 10–30 seconds›✓ dynamic stretching involves movement based activities within a comfortable range of motion / these are active and simulate exercise in the muscle✓ ballistic stretching involves bouncing movements to achieve the terminal range of motion ‹not recommended›✓ PNF stretching involves combination sequences using relaxation and contraction of the muscles being stretched✓ recent research questions the effectiveness of static stretching as a necessary component of the warm-up✓ there is little, if any, evidence that stretching pre- or post-participation prevents injury or subsequent muscle soreness✓ research indicates that lengthening a muscle may inhibit its ability to transfer force in power events✓ static stretching has also been shown to lead to a decrease in force production, power performance, running speed, reaction and movement time, and strength endurance✓ warm up to include dynamic exercises/stretching to increase muscle temperature/loosen-up muscles and stimulate blood flow✓ dynamic stretching does not seem to elicit the performance reduction effects of static and PNF stretching/ based on current evidence, dynamic stretching would be the preferred option for stretching during a warm-up✓		**4 max**

	b		*Progression*: A programme needs to gradually increase in its demands beyond the current load in order to gain improvement✓ *Overload*: To train harder/ place systems under greater load than normally encountered ‹can be achieved through adjusting frequency, intensity and duration›✓ *Specificity*: Involves training the muscles, energy system and skills that you will need and use in your sport✓ *Reversibility*: If you don't train or cannot train at all, you will gradually lose any gains you made from your training✓ *Variety/Tedium*: Having variation in your training programme can help an athlete keep motivated/can prevent the athlete plateauing in their fitness/prevents tedium✓ *Periodization*: The organisation of the training into distinct periods where specific components are done first before others in order to maximize the training effect✓ *Frequency*: The number of trainings per week✓ *Intensity*: How hard you are working/calculated a variety of ways such as from working heart rate and comparing to HR max, perceived exertion✓ *Duration*: Can refer to the length of a training session or the length of a training programme✓ *For example*: progression ‹*eg* when set number of reps is being surpassed›/increasing the load being used and not staying on the same level of resistance›✓ overload ‹frequency, intensity and duration› ‹*eg* increase sessions per week/split programme, increase weight/sets›✓ specificity ‹*eg* specific program to desired goal *ie* power/maximal strength/lean body mass/ training should be specific and planned for the individual performer/needs analysis›✓ reversibility ‹*eg* effects of training will be lost should cessation of programme occur›✓	*Award **[3 max]** for definitions and no application to resistance training.*	**6**

continued…

	b		variety/tedium ‹*eg* vary exercises targeting muscle groups›✓ Periodization ‹*eg* doing a general resistance training programme for the first few weeks of the programme to allow the body to adapt to the training›✓ intensity *eg* ‹use the weight lifted as a percentage of rep max as a way to monitor and increase intensity›✓ frequency *eg* ‹athletes should give muscle groups 24 to 48hr rest between bouts/athletes must train several times a week›✓ duration ‹*eg* will vary depending on the muscle groups being worked/no. of exercises in a session/the programme needs to be maintained for a good length of time/months in order to see the benefits›✓		

	c		the terms centre of mass and centre of gravity are often used synonymously **OR** the centre of gravity refers only to the vertical direction ‹of the force of gravity›✓ the centre of mass is the mathematical point around which the mass of a body is evenly distributed **OR** the balancing point of the body✓ the centre of mass depends on the distribution of the material in the body or object✓ the centre of mass is a theoretical point whose location may change from instant to instant during a movement **OR** the change in position of the centre of mass results from the rapidly changing positions of the body segments during movement✓ the centre of mass does not have to be inside the limits of the body✓ the centre of mass will be affected by the density of the body or object and also by its shape✓ *for example, in weight lifting:* the centre of mass is lowered✓ the body is in a reverse “C” shape with the centre of mass essentially outside the body✓ this position allows for maximal leg drive ‹summation of force›, and leverage to allow the elbows to be located below the bar for the final lift above the head✓ Fosbury Flop: the athlete bends their body like a banana around the bar and their centre of mass is below and outside the body/may be below the bar *OWTTE*✓ the jumper using the Fosbury technique will therefore not have to raise their centre of mass as high as an athlete performing the scissors when clearing the same height✓ using the Fosbury technique the jumper will be able to clear a higher bar/ athlete will more easily clear the bar✓	*Award **[2 max]** for a description of centre of mass (applies to first five marking points).* *Award **[3 max]** for the use of an appropriate example.*	**4 max**

	d		lift force component acts perpendicular to drag **OR** lift force acts perpendicular to direction of motion✓ the lift only occurs if the object is spinning **OR** the lift only occurs if the object is perfectly symmetrical✓ lift force is produced by any break in the symmetry of the air flow about an object✓ when a body or object is rotating while moving through the air ‹*eg* a spinning ball› the air is dragged around the rotation of the ball✓ this causes an increased velocity on either the top or bottom of the ball and decreased velocity on the other✓ the relationship between air flow velocity and air pressure is an inverse one, and is expressed in Bernoulli's principle✓ a spinning ball creates areas of different pressure✓ a ball will move towards the low pressure region of a rotating ball✓ *for example, top spin ground stroke in tennis:* because the rotation of spin is in the same direction as the movement of air particles at the bottom of the ball, this increases velocity at the bottom of the ball✓ causing a low pressure area at the bottom, the top of the ball is subsequently a high pressure area✓ the horizontal drag force caused by the movement from low to high pressure sees the ball drop✓ the aim of this form of spin is to hit the ball with pace but see it land within the boundary designated by the court. This is opposite to the lift force generated when a golf ball is struck✓	*Award **[3 max]** for an explanation of the Bernoulli principle.* *Award **[6]** for an answer that explains the principle using an example.* *Award **[3 max]** for the application.*	**6 max**