PE.PT3 Principles of Training, FITT and Target Heart Rate Zones

Total Marks

AQA 8582 · Calculator allowed · about 50 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Which principle of training states that fitness gains will be lost if training stops or is significantly reduced?

- ☐ A) Specificity
- ☐ B) Progressive overload
- ☐ C) Reversibility
- ☐ D) Variance

(Total for Question 1 is 1 mark)

---

2 Training programmes are built around several key principles of training.

(a) State what is meant by the principle of 'specificity'. **(1)**

(b) State what is meant by the principle of 'progressive overload'. **(1)**

(c) State what is meant by the principle of 'individual differences' (individual needs). **(1)**

(d) State what is meant by the principle of 'variance' (tedium). **(1)**

(Total for Question 2 is 4 marks)

3 Overload can be applied to a training programme using the FITT principle.

(a) State what the F in FITT stands for, and give an example of how it could be changed to increase overload. **(1)**

(b) State what the first I in FITT stands for, and give an example of how it could be changed to increase overload. **(1)**

(c) State what the second T in FITT stands for, and give an example of how it could be changed to increase overload. **(1)**

(d) State what the second, final T in FITT stands for, and give an example of how it could be changed. **(1)**

(Total for Question 3 is 4 marks)

---

4 Ahmed is training for his first half marathon in 12 weeks' time. His current programme consists of three 5 km runs per week at a steady, comfortable pace.

(a) Suggest how Ahmed could apply progressive overload to his programme over the next 12 weeks, referring to the FITT principle. **(2)**

(b) Explain why Ahmed's training should be specific to the demands of a half marathon. **(2)**

(c) Explain what is likely to happen to Ahmed's fitness if he stops training completely for several weeks after picking up an injury, and name the training principle this relates to. **(2)**

(Total for Question 4 is 6 marks)

5 Training zones can be used to make sure a performer trains at the right intensity for their goals. In this pack, maximum heart rate (MHR) is estimated using the formula: MHR = 220 minus age (in years). The aerobic training zone is defined as 60 to 80 per cent of MHR, and the anaerobic training zone is defined as 80 to 90 per cent of MHR.

(a) Using the formula given, calculate the estimated maximum heart rate of a 20-year-old athlete. **(1)**

.....

(b) Calculate the lower and upper limits of this athlete's aerobic training zone (60 to 80 per cent of their MHR). **(2)**

.....

(c) State which training zone (aerobic or anaerobic) this athlete should train in if their goal is to improve basic cardiovascular endurance over a long, steady session. **(1)**

(Total for Question 5 is 4 marks)

6 Table 1 shows the ages of three further athletes at a training camp. Using the same formulae as Question 5 (MHR = 220 minus age; aerobic zone = 60 to 80 per cent of MHR; anaerobic zone = 80 to 90 per cent of MHR), complete the calculations below. (The athlete from Question 5, age 20, had an MHR of 200 bpm.)

Table 1

Athlete	Age (years)
Bea	15
Chidi	40
Diane	50

(a) Calculate Bea's maximum heart rate. **(1)**

.....

(b) Calculate the lower and upper limits of Bea's aerobic training zone. **(2)**

.....

(c) Calculate Chidi's maximum heart rate. **(1)**

.....

(d) Calculate the lower and upper limits of Chidi's anaerobic training zone. **(2)**

.....

(e) Calculate Diane's maximum heart rate, and the lower limit of her aerobic training zone. **(2)**

.....

(f) Diane says: 'Because I am the oldest athlete at the camp, my training zones are always the highest, in beats per minute, of anyone here.' Use your calculations to evaluate whether Diane's statement is correct. **(2)**

.....

(Total for Question 6 is 10 marks)

7 During a hard interval training session, a runner's heart rate rises above the anaerobic threshold, into the anaerobic training zone defined in Question 5.

(a) Explain what happens to the runner's energy system as their heart rate/intensity rises into the anaerobic training zone. **(2)**

(b) Explain one reason why an athlete might deliberately include anaerobic-zone interval training in their programme, even though it is uncomfortable to sustain. **(2)**

(Total for Question 7 is 4 marks)

---

8 Explain how a coach should balance the principles of progressive overload and individual differences when planning to increase training intensity for two athletes with very different starting fitness levels.

(Total for Question 8 is 4 marks)

9 Sam, a 30-year-old recreational footballer, wants to design a 6-week personal exercise programme (PEP) to improve his aerobic endurance before pre-season training begins. His current training is two unstructured 20-minute jogs per week.

(a) Calculate Sam's estimated maximum heart rate, and the lower and upper limits of his aerobic training zone (using the formulae given in Question 5). **(2)**

.....

(b) Suggest one way Sam could apply the principle of progressive overload to his programme across the 6 weeks. **(2)**

(c) Explain why Sam's programme should be specific to improving aerobic endurance for football, rather than, for example, a programme built mainly around heavy weight training. **(2)**

(d) Explain why Sam, as a 30-year-old recreational player, might need a different starting programme from a 16-year-old elite academy player aiming to improve the same component of fitness. **(2)**

(Total for Question 9 is 8 marks)

---

10 After 4 weeks of his programme, Sam finds his jogging routine boring and his motivation to train is dropping.

(a) Name the training principle most relevant to this problem. **(1)**

(b) Suggest one change Sam could make to his programme to address this, without changing his overall training goal of improving aerobic endurance. **(2)**

(Total for Question 10 is 3 marks)

11 Explain why applying overload too quickly could increase Sam's risk of injury, and suggest how the principle of progressive overload helps to reduce this risk.

(Total for Question 11 is 3 marks)

---

12 State the formula used to estimate maximum heart rate (MHR) from age.

(Total for Question 12 is 1 mark)

---

13 Explain why an elite athlete might deliberately train at a lower percentage of their maximum heart rate (e.g. 60 to 70 per cent) during a recovery session, compared with a harder threshold session at 80 to 90 per cent.

(Total for Question 13 is 2 marks)

---

14 A swimmer wants to improve their speed over a short sprint distance in the pool.

(a) Suggest how the swimmer could change the Intensity of their training to help achieve this goal. **(2)**

(b) Suggest how the swimmer could change the Type of their training to help achieve this goal. **(2)**

(Total for Question 14 is 4 marks)

15 Explain why a training programme that does not follow the principle of progressive overload is unlikely to improve a performer's fitness over time.

(Total for Question 15 is 3 marks)

Mark scheme · PE.PT3 Principles of Training, FITT and Target Heart Rate Zones

Question 1

- **B1** C (reversibility)
- **Answer: C (reversibility)**

Question 2

- (a) **B1** training should be matched/relevant to the demands of the sport or the individual's needs and goals, oe
- **(a) Answer: Training should be matched to the specific demands of the sport or the individual's needs and goals.**
- (b) **B1** gradually increasing the demands placed on the body during training so the body adapts and fitness improves, without risking injury, oe
- **(b) Answer: Gradually increasing the demands placed on the body during training, so the body adapts and fitness improves without risking injury.**
- (c) **B1** a training programme should be tailored to the specific person, taking into account factors such as age, gender, current fitness level and goals, oe
- **(c) Answer: A training programme should be tailored to the individual, taking into account factors such as their age, gender, current fitness level and goals.**
- (d) **B1** varying the type of training used to avoid boredom and maintain motivation to continue training, oe
- **(d) Answer: Varying the type of training used to avoid boredom and keep the performer motivated to continue.**

Question 3

- (a) **B1** Frequency; e.g. increasing the number of training sessions per week, oe
- **(a) Answer: Frequency; for example, increasing the number of training sessions per week.**
- (b) **B1** Intensity; e.g. increasing the speed, resistance or effort of the training, oe
- **(b) Answer: Intensity; for example, increasing the speed, resistance or effort of the training.**
- (c) **B1** Time; e.g. increasing the duration of each training session, oe
- **(c) Answer: Time; for example, increasing the duration of each training session.**
- (d) **B1** Type; e.g. changing the type/method of training used, to keep targeting the required component of fitness or to add variety, oe
- **(d) Answer: Type; for example, changing the method of training used to continue targeting the required component of fitness.**

Question 4

- (a) **B1** gradually increase the distance/duration of his runs each week (Time), and/or gradually increase his pace (Intensity), and/or add an extra session per week (Frequency), oe
- (a) **B1** building up steadily week by week rather than making a large jump all at once, oe
- **(a) Answer: Ahmed could gradually increase the distance of his runs each week (Time) and/or add an extra training session (Frequency), building up steadily rather than making a large jump in distance all at once.**
- (b) **B1** a half marathon requires mainly aerobic endurance over a long, steady distance, oe
- (b) **B1** so his training should focus on building aerobic fitness/endurance (e.g. long steady runs) rather than a different component of fitness such as maximal strength, which would not specifically prepare him for the demands of the race, oe
- **(b) Answer: A half marathon mainly requires aerobic endurance over a long, steady distance, so Ahmed's training should focus on building aerobic endurance rather than, for example, maximal strength training, which would not prepare him for the specific demands of the race.**
- (c) **B1** his fitness (e.g. aerobic endurance gains) will decrease, especially in the first few weeks of no training, oe
- (c) **B1** this relates to the principle of reversibility
- **(c) Answer: His fitness gains, particularly his aerobic endurance, will start to decrease the longer he goes without training; this relates to the principle of reversibility.**

Question 5

- (a) **B1** 200 bpm (220 - 20 = 200)
- **(a) Answer: 200 bpm**
- (b) **M1** 0.6 x 200 or 0.8 x 200, oe
- (b) **A1** 120 bpm and 160 bpm, both correct
- **(b) Answer: 120 bpm to 160 bpm.**
- (c) **B1** aerobic zone
- **(c) Answer: Aerobic zone.**

Question 6

- (a) **B1** 205 bpm (220 - 15 = 205)
- **(a) Answer: 205 bpm**
- (b) **M1** 0.6 x 205 or 0.8 x 205, oe
- (b) **A1** 123 bpm and 164 bpm, both correct
- **(b) Answer: 123 bpm to 164 bpm.**
- (c) **B1** 180 bpm (220 - 40 = 180)
- **(c) Answer: 180 bpm**
- (d) **M1** 0.8 x 180 or 0.9 x 180, oe
- (d) **A1** 144 bpm and 162 bpm, both correct
- **(d) Answer: 144 bpm to 162 bpm.**
- (e) **B1** MHR = 170 bpm (220 - 50 = 170)
- (e) **B1** lower aerobic limit = 102 bpm (0.6 x 170), ft their MHR
- **(e) Answer: MHR = 170 bpm; lower aerobic limit = 102 bpm.**
- (f) **B1** Diane's statement is incorrect, oe
- (f) **B1** her MHR (170 bpm) is actually the lowest of the four athletes (Bea 205 bpm, the Question 5 athlete 200 bpm, Chidi 180 bpm, Diane 170 bpm), so her training zone values in bpm are also the lowest, not the highest, because MHR decreases as age increases in the formula used, oe
- **(f) Answer: Diane's statement is incorrect. Comparing all four athletes (Bea 205 bpm, the Question 5 athlete 200 bpm, Chidi 180 bpm, Diane 170 bpm), Diane, the oldest, has the LOWEST maximum heart rate and so the lowest training zone values in bpm, because the formula used means MHR falls as age rises.**

Question 7

- (a) **B1** the muscles can no longer get enough oxygen delivered quickly enough to meet demand through aerobic respiration alone, oe
- (a) **B1** so the muscles increasingly rely on anaerobic respiration (without oxygen) to produce energy, which leads to a build-up of lactic acid/lactate, oe
- **(a) Answer: The muscles can no longer get enough oxygen delivered fast enough to meet the demand of aerobic respiration alone, so they increasingly rely on anaerobic respiration, which causes lactic acid/lactate to build up.**
- (b) **B1** to improve their anaerobic threshold/tolerance to lactic acid, oe
- (b) **B1** allowing them to sustain higher intensities for longer before fatiguing, which is useful for events involving repeated bursts of high-intensity effort, e.g. sprint finishes or interval-based team sports, oe
- **(b) Answer: To raise their anaerobic threshold and tolerance to lactic acid, so they can sustain a high intensity for longer before fatiguing, which benefits events with repeated high-intensity bursts, such as a sprint finish.**

Question 8

- **B1** progressive overload means gradually increasing training demands (e.g. via FITT) to cause adaptation without risking injury, oe
- **B1** individual differences means the programme should be tailored to each athlete's own current fitness level, age and goals, rather than using an identical programme for both, oe
- **B1** applying the same overload to both athletes could overload the less fit athlete too quickly (risking injury/burnout) while under-challenging the fitter athlete, oe
- **B1** the coach should therefore set a starting intensity and rate of progression that is appropriate to each individual athlete, adjusting the FITT variables separately for each, oe
- **Answer: The coach should apply progressive overload gradually for each athlete, but the starting point and rate of increase should be set individually: overloading both athletes at the same rate could injure the less fit one while under-training the fitter one, so FITT variables should be adjusted separately based on each athlete's own fitness level and goals.**

Question 9

- (a) **M1** MHR = 220 - 30 = 190 bpm
- (a) **A1** aerobic zone 114 bpm to 152 bpm (0.6 x 190 = 114; 0.8 x 190 = 152), both correct
- **(a) Answer: MHR = 190 bpm; aerobic zone = 114 bpm to 152 bpm.**
- (b) **B1** gradually increase the duration of each jog (Time) and/or add a third session per week (Frequency), oe
- (b) **B1** building up gradually week by week rather than making a large increase in week 1, oe
- **(b) Answer: He could gradually increase the length of each jog and/or add a third session per week, building up steadily rather than making a large jump straight away.**
- (c) **B1** football requires repeated aerobic endurance over 90 minutes with intermittent higher-intensity bursts, oe
- (c) **B1** so training should target the cardiovascular/aerobic energy systems relevant to this demand, rather than a different fitness component such as maximal strength, which would not specifically prepare Sam for match demands, oe
- **(c) Answer: Football requires repeated aerobic endurance over 90 minutes with bursts of higher intensity, so Sam's training should build his aerobic/cardiovascular fitness rather than focus mainly on maximal strength, which does not target the fitness component football actually demands.**
- (d) **B1** this relates to the principle of individual differences: Sam's current fitness level, age, training history and goals (recreational fitness rather than elite performance) differ from the academy player's, oe
- (d) **B1** so his programme should start at an appropriate, safe intensity for him rather than copying a programme designed for a fitter, younger, more experienced athlete, oe
- **(d) Answer: This relates to the principle of individual differences: Sam's age, current fitness level, training history and goals are different from the academy player's, so his programme should start at a safe, appropriate intensity for him rather than simply copying a programme built for a fitter, younger, more experienced player.**

Question 10

- (a) **B1** variance (tedium)
- **(a) Answer: Variance (tedium).**
- (b) **B1** vary the type of aerobic training (Type in FITT), e.g. swap some jogs for cycling, swimming or a structured interval session, or train with a partner, or vary the route, oe
- (b) **B1** while keeping the same overall focus on aerobic endurance (rather than switching to an unrelated fitness component), oe
- **(b) Answer: Sam could vary the Type of aerobic training, for example swapping some jogs for cycling, swimming or a structured interval session, while keeping the overall focus on aerobic endurance.**

Question 11

- **B1** increasing training demands too quickly does not give the body's muscles, tendons or joints enough time to adapt to the new level of stress, oe
- **B1** this can lead to overuse injuries (e.g. strains or joint problems) because the tissues are not yet strong enough to cope, oe
- **B1** progressive overload reduces this risk by increasing demands gradually, in small steps, giving the body time to adapt safely between increases, oe
- **Answer: Increasing demands too quickly does not give muscles, tendons and joints enough time to adapt, which can**

Question 12

- **B1** MHR = 220 - age (in years)
- **Answer: MHR = 220 minus age (in years).**

Question 13

- **B1** a low-intensity recovery session (around 60 to 70 per cent of MHR) keeps the body working aerobically, promoting blood flow and recovery, without adding significant extra fatigue or stress to the muscles, oe
- **B1** this allows the athlete to recover from a previous hard session and be ready to train intensely again soon, whereas training every session at 80 to 90 per cent would risk overtraining/injury and prevent proper recovery/adaptation, oe
- **Answer: A low-intensity recovery session keeps the body working aerobically and promotes blood flow without adding significant fatigue, allowing the athlete to recover properly; training at 80 to 90 per cent every session instead would risk overtraining and prevent the recovery needed for the body to adapt.**

Question 14

- (a) **B1** increase the intensity/effort of some sets, e.g. swimming shorter repeats at close to maximum effort/speed, oe
- (a) **B1** with longer recovery between repeats so that each effort can be performed at a high intensity, oe
- **(a) Answer: The swimmer could increase intensity by swimming short repeats at close to maximum effort, with enough recovery between repeats to keep each effort high-intensity.**
- (b) **B1** change the type of training towards short, high-intensity interval sets or resistance/power-based training, rather than long steady-distance swimming, oe
- (b) **B1** because this type of training targets speed and power more directly than long, steady aerobic swimming does, oe
- **(b) Answer: The swimmer could switch some sessions to short, high-intensity interval sets or power-based training, rather than long, steady-distance swimming, because this type of training more directly targets speed and power.**

Question 15

- **B1** the body only adapts (improves fitness) in response to a demand greater than it is already used to, oe
- **B1** if the same, unchanged training load is repeated session after session, the body has no new stimulus to adapt to once it has become used to that load, oe
- **B1** so fitness gains will plateau (stop improving), even though the performer is still training regularly, oe
- **Answer: Fitness only improves when the body is made to adapt to a demand greater than it is used to; if the training load never increases, the body has no new stimulus once it has adapted to the current load, so fitness gains plateau even though training continues.**