QUESTION 1

1.1 Many candidates did not realise that the maximum F_{res} = sum of forces and minimum F_{res} = difference of force. Therefore the resultant lies between the minimum and maximum.

1.2 Answered quite well. Candidates realised that "change in momentum" = "impulse"

1.3 Many candidates could not solve the proportionality problem. They could not identify the equation of motion required in order to solve this problem.

1.4 Candidates did not realise that in order to obtain the "displacement" from a velocity-time graph, they had to determine the area under the curve.

1.5 This question tested the learner's understanding of shapes of graphs. Those who got this wrong could not link the different shapes for the different sections.

1.6 If the mass increases and the same force is applied then the acceleration decreases. This implies that the answer could be either A, B or C. From this they then needed to link the total mass initially (4 kg) with the final mass (5 kg) to obtain C as the answer. This skill was obviously lacking.

1.7 Some HG candidates could not link the formulae of two different quantities in order to see what is the common quantity in both cases. Satisfactorily answered.

1.8 Newton 3 – Quite well answered.

1.9 Candidates did not realise that what Bongi sees is the resultant velocity of the bird. Therefore, this had to be at a direction of 310^0 and therefore the answer is either A or D.

1.10 This was an unusual question which required a manipulation of the equation $E_k = \frac{1}{2}mv^2 = \frac{1}{2}mv.v = \frac{1}{2}(p)v$ and then to make p the subject of the equation. Approx. 60% of candidates got this correct.

1.11 Distribution of charge: Quite well answered.

1.12 If the resultant force at point P is zero, then the force to the left equals the force to the right. Since Q_2 is further away, it has to have a larger force. Therefore the answer is either A or B. Secondly, since Q_1 is positive then Q_2 must be positive, as the electric field strength at P, due

to Q_1 and Q_2, has to be in opposite directions, which implies that Q_2 has to be positive.

1.13 Confusion arose in applying Fleming's Left Hand rule with Fleming's Right Hand Rule.

1.14 Definitions come from a basic formula viz. $V = \frac{W}{Q}$ therefore B was the answer.

1.15 Candidates could not realise that the voltage across the parallel combination is the same and therefore the answer could be either A or C. From this then they had to figure out that if the resistor doubles then the current halves.

QUESTION 2

This question was poorly answered by most candidates. Many candidates used trigometrical (trig) ratios (sin Θ = cos Θ) incorrectly as well as the horizontal and vertical components of forces. Therefore, poor mathematical manipulation of trig ratios resulted in many candidates performing poorly in this question. As a result, many lost all 15 marks allocated to this question.

Candidates lost marks by making the following mistakes:

a) Using symbols on diagram, instead of indicating force (F), e.g. M = cos 70^o x 50, instead of $F_{horizontal}$ = cos 70^o x 50.
b) Confusing trig. ratios (wrong formulae e.g. cosΘ instead of sinΘ)
c) No formulae, e.g. simply starting the calculation without stating the formula, such as: cos 70^o x 50 = 17,1 N
d) Inappropriate use of a scientific calculator which is not set to degrees. Instead candidates use the rad/grad function on the calculator.
e) Confusing diagram of situation with a vector diagram, e.g. use PQ for vertical component, MQ for horizontal component. Because PQ and MQ and P is not a force, candidates were severely penalised for using it.

Recommendation: Teachers should instruct candidates to draw a labelled vector diagram so that they can use the symbols on their diagram to answer the question. In this diagram, do not use the symbols on the sketch in the paper, e.g. Do not use P, M, Q and N. P is the top of the pole, Q is the bottom of the pole, M and N are the strings. M is not the force in string M, P cannot be a force, etc.

QUESTION 3

3.1 Well answered.

3.2 Not fully explained. Candidates could not give a reason from their interpretation of the graph. Approximately 50% of candidates lost these 2 marks.

3.3 Since the formula for average speed is not on the data sheet, various combinations were accepted. This benefited the candidate.

- The use of “m” for gradient was once again penalised.
- A large number of candidates did not write down any formula and went straight into the calculation without stating on the left-hand side what exactly they are calculating – they lost all the marks, even though they obtained the correct answer.

3.4 Very well answered. It was an easy graph for the candidates. Approx. 80% of candidates worked out that the graph for Jabu begins at 250 s and not at the origin.

3.5 Reading from the graph of the point of intersection was very well answered.

3.6 Candidates give the answer, but no explanation.

General Comment for this question:
For the future, it is imperative that teachers teach various types of graphs in the NSC and do calculations of gradient or area under curve of these graphs. It is important to show the unit for the gradient and the unit for area and what quantities these units possibly represent. This is an important skill that teachers should not underemphasize.

QUESTION 4

Generally, this question was well answered by the majority of candidates. However, the following points require attention:

4.1 Candidates were required to state Newton's Second Law of Motion in words. Many candidates demonstrated the following misconception when stating this law: "*The applied force acting on an object causes the object to accelerate*", instead of stating that it is the RESULTANT force that causes the object to accelerate.
Candidates must be informed that "*indirectly proportional*" is not an acceptable term. "*inversely proportional*" should be used instead.

4.2 Candidates were required to label the horizontal forces on two separate objects. A few candidates indicated the vertical forces, which were not required.

The candidates use objects to label forces such as "*string*" instead of "*force of string*".

4.3 Candidates should refrain from combining the masses of the two objects to solve for the acceleration. The candidates should be encouraged to solve this type of question by identifying the forces acting on EACH object separately and then using this information to solve for the acceleration. This method is useful since it will allow candidates to solve similar types of questions in a variety of situations, whereas the "*combined mass method*" has its limitations.

QUESTION 5

5.1 The definition was not well learnt. If the word “total” was missing, candidates lost 2 of the 3 marks.

5.2 Approx. 95 % of candidates wrote only the word ‘forward’, instead of “horizontal forward”.

5.3 Calculation using Law of Conservation of momentum:

- The calculation was answered well, but many candidates got the direction wrong.
- Approximately half the candidates used “change in momentum” (i.e. $\Delta p = mv - mu$) to solve, and then became totally confused with the formula. This is a very unusual way of solving the problem. They then penalised themselves by 5 out of the 6 marks as they mixed the masses or mixed the velocities. The manner in which candidates answered this question indicates that some teachers need to seriously reconsider their method of teaching this section, especially in view of the change to the NSC, where momentum in 2-D must now be taught as well.

QUESTION 6

Candidates were penalised heavily for stating the Law of Conservation of Mechanical Energy as Ep (Potential Energy) = Ek (Kinetic Energy) instead of Ep + Ek = Ep + Ek. In the context of this question, "Ep = Ek" is not correct and, as a result, a large percentage of candidates lost up to 17 marks out of a possible 25 marks when answering this question. This was applicable to Questions 6.1, 6.3 and 6.5. Candidates must be taught to indicate the reference points when using the Law of Conservation of Mechanical Energy. For example, candidates must state $Ep + Ek_{(at\ Q)} = Ep + Ek_{(at\ 3,5\ m),}$ instead of simply stating Ep + Ek = Ep + Ek.

In Questions 6.1 and 6.5, candidates were required to use velocity and acceleration to solve the questions using equations of motion. From the responses of candidates, it is evident that they are not aware that these two (velocity and acceleration) are vector quantities. This implies that they have magnitude as well as direction. Since these two quantities act in opposite directions, candidates are required to indicate the direction of these quantities in their calculations, which was absent in many cases.

Where the Ep or Ek is zero, this must be substituted into the appropriate formula. Far too many candidates lost marks unnecessarily for omitting this.

6.1 A common mistake made by many candidates was that they calculated the maximum height above the ground, instead of above point Q as stated in the question. Teachers must insist that their candidates answer the questions asked in the question paper.

6.2 The Law of Conservation of Mechanical Energy should **not** be confused with Conservation of Energy. Many candidates responded **incorrectly** that the Law of Conservation of Mechanical Energy was "*Energy cannot be created or destroyed, but is transferred from one form to another*".

6.3 Candidates were required to calculate the speed of the package without using the kinematics equations of motion. Many candidates did not observe this instruction and were subsequently penalised by 7 marks. Teachers must ensure that their candidates understand the term " *kinematics equations of motion*".

Candidates' poor mathematical manipulation was evident where many of them incorrectly interpreted ½ $m(v^2 - u^2)$ as being equal to ½ $m(v - u)^2$ while calculating the change in kinetic energy.

6.4 Many candidates were unable to calculate the work done by the package as it passed through the branches. They did not realise that the change in kinetic energy resulted in work done by the package.

6.5 It was possible for candidates to solve this problem without having to get the previous answers correct. Yet, many candidates swopped the values for the initial and final velocities and therefore substituted them incorrectly into the appropriate kinematic equation. Teachers must ensure that candidates understand how to substitute the initial and final velocities correctly into the equation.

QUESTION 7

7.1 Definitions must be learned. Important words, such as "unit" (in the phrase "unit charge), were left out.

7.2 This was an easy calculation of magnitude of "electric field strength" which was very well answered.

7.3 Labelling of forces is still a huge problem (as with Question 4.2). When labelling a force, it is important to mention the "agent producing the force" and "on which object it acts" e.g. $F_{\text{earth on oildrop}}$ or $F_{\text{electric field on oildrop}}$, NOT $F_{\text{attraction}}$, $F_{\text{repulsion}}$, F_{field} or gravity.

In spite of the question requiring of them to draw the length of the arrows to show their relative strengths, many candidates did not bother to do this, or simply forgot.

7.4 Candidates who equated the two formulae for force and then continued to solve, obtained full marks. Candidates who solved each force separately and simply equated them without giving a formula, lost 1 mark. This was because they did not follow the instruction on page 10, No. 3.

Candidates leave out the unit in the answer.

7.5 Very well answered.
Some candidates lost marks because they did not get the sign for each charge correct, i.e. it had to be negative over negative. Also, if they substituted positive over negative, they obtained a negative number of electrons, which does not make sense.

7.6 It is very difficult for candidates to explain the answer in the correct sequence. Even the best of candidates did not mention that "if the weight downwards increases, then the force upwards must increase. This means that the **electric field strength must increase**. Therefore, either the voltage must increase or the distance between the plates must decrease.

QUESTION 8

Since the question depended on a clear understanding of internal resistance, candidates found it very tough.

8.1 The idea of mathematical relationships is not familiar to many candidates (Less than 5 % got this correct.) The relationship between power and current was asked. Almost everyone wrote $P \alpha I$ (from $P = VI$, V doesn't stay constant) instead of $P \alpha I^2$ (from $P = I^2 R$, R stays constant).

8.3 Most candidates could not cope with this question.

a) More than 90 % said the current divides in the parallel combination and thus there is less current through the inside light and that is why it dims.

b) The candidates said that the resistance increases when connected in parallel and therefore the current decreases. That is why the light dims.

c) From Grade 8 candidates are taught that resistors connected in parallel are current dividers. The light gets less current and therefore it dims.
Candidates have problems with questions like this as this aspect of the syllabus is not explained properly in class. Candidates must realise that the brightness of the light is dependant on the amount of power received by the light.

Recommendation: When teaching this, start with

1) total resistance decreases and current increases
2) because of internal resistance, lost volts increases (Ir)
3) external potential difference decreases (V = emf – Ir; emf is constant)

4) therefore power decreases and light dims

8.4 Not answered very well. Candidates start with emf = IR + Ir. They calculated R and then they do not know what to do. They did not realise that they must use the answer in 8.2 (resistance of light) to complete the calculation.

QUESTION 9

Generally well answered.

Very good question, covering the syllabus for current electricity (internal resistance, voltage across resistors connected in parallel, ratios, lost volts) by making use of a very simple circuit.

Being the last question, it was sometimes not attempted because of a lack of time in which to complete the question paper. Candidates must be taught to manage their time appropriately in an examination setting.