Examiners' Report January 2007

GCE O Level

GCE O Level Physics (7540)

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PHYSICS 7540, CHIEF EXAMINERS' REPORT

Paper 1

General

Compared to last year the paper had fewer marks available for calculations, which candidates score well on, but some of the descriptive work was on slightly easier topics. Candidates were able to complete the questions in the time available although some sections such as 4(c) and 9(b)(ii) were occasionally not attempted.

Question 1

Candidates were required in (a) to draw the second perpendicular component of a vector representing the force exerted on the ground by a pole. The majority of candidates knew what was required. The standard of drawing, though adequate, was often poor. In part (b) candidates were often able to score both marks for explaining why two forces shown on the paper were not a Newton's Law Third Law pair by stating that they were not equal and opposite.

Part (c) was well answered with most candidates able to recognise and label a frictional force acting on the pole.

Question 2

A calculation of acceleration in (a)(i) given values of speed and time for a falling stuntman was usually correct with marks occasionally lost for incorrect rounding and units. The calculated value of acceleration was less than 10 m/s^2 and so many candidates knew that the stuntman was not experiencing weightlessness. There was some uncertainty about what happened to the stuntman's mass during the fall but a calculation to find the distance fallen by the stuntman was very well done with several different methods seen.

In part (b) many candidates were unclear why the stuntman accelerated at the corner of a slope when sliding at constant speed. Instead of stating that there was a change of direction or velocity many contradicted the stem by stating that there was a change of speed.

Question 3

The conversion of time to seconds caught out many candidates who calculated the heat energy flowing from a human foot in 5 minutes as 10 J given that the rate of flow was 2.0 W.

Asked to state two heat transfer processes apart from conduction a few candidates carelessly gave 'conduction' as an answer.

In (c) candidates were asked why a human foot feels colder in water than in air of the same temperature as the water. The response required two comparative statements; that water is a better conductor of heat than air and that there is a faster flow of heat from the foot to water. Most answers featured statements such as 'water is a conductor' or 'water is an insulator'. A significant number of responses described the convection process.

Question 4

Most candidates were able to calculate the moment of a force given the values of the force and the distance from the pivot.

A uniform balanced rule with two equal weights placed equal distance from the pivot was adjusted by moving both weights and the pivot to the left. Candidates were not able to explain why the rule was no longer balanced. The majority argued that the clockwise tilting was the result of the longer length of rule being to the right of the pivot.

In (c) it was pleasing to see many candidates able to calculate where a weight would have to be placed to restore balance. Candidates either scored three marks for a correct answer, one for stating that weight had to be placed left of the pivot or zero for leaving it blank.
In this question some candidates continued their calculation on another page. It would be appreciated if Centres could discourage their students from this practice since papers are now electronically marked.

Question 5
This question was very well answered although the value for the temperature of absolute zero was often incorrect.

Question 6
This question on static electricity contained several errors seen in the past with references to positive charges and poles. Some suggested that a polythene strip would be charged by bringing it near to a solid material such as glass or iron. Asked throughout to answer in terms of electrons some candidates seemed not to appreciate that electrons are negatively charged.

Question 7
Given a heater marked 230 V 2.5 kW many candidates were able to calculate the current in the heater from 2500 ÷ 230. Very few rounding or unit errors were seen although a number of candidates did not convert to W. A significant minority of candidates found the reciprocal of the correct value.
In (a)(ii) the amount of electrical energy transferred to the heater in 12 hours was often correctly calculated as 30 kWh. A common error was to give the unit as kW/h even though kilowatt-hour was given in the stem. A few candidates gained full credit for lengthy calculations where the energy had been calculated in joules and then converted to kWh.
In (b) candidates were asked to explain how the earth wire and fuse together make an electric heater safe. The mark scheme was as follows:

1. earth wire has low resistance
2. large current flows to earth
3. fuse wire has low melting point
4. fuse melts
5. circuit is broken or current is stopped

Full marks were scored for stating any three of these five points.
Many candidates scored the 4th and 5th mark but showed some misunderstanding about the sequence of events. The 1st and 3rd marks were rarely scored and only a few candidates scored the 2nd mark. A number of candidates also mentioned that the fuse controls or reduces the current.

Question 8
Part (a), in which candidates had to show the direction of the current in a circuit and the shape and direction of the magnetic field associated with a coil through which the current passed, was very well answered. In particular the standard of the drawing, often a failing in the past, was good.
In (b) three ways of increasing the strength of the field were required. Apart from increasing the current and the number of coils many candidates knew that replacing the plastic core with an iron core would also have the desired effect. Unfortunately some answers were unclear such as ‘use a metal’ or ‘use a magnet’.

Question 9

Part (a), in which the number of neutrons and electrons in a neutral atom of radon-222 was required, scored well.

In (b)(i) many knew what was meant by background radiation with 'cosmic rays' being the most popular answer.

Part (b)(ii) scored very poorly. Answers were too brief and lacked clarity. Candidates were asked to describe how a G-M detector could be used to check whether the background radiation in a house is above the normal level. The mark scheme was as follows:

1. measure the count away from the house
2. count for longer than one minute or repeat counts
3. measure the count in the house
4. make sure no other sources are present
5. compare the two sets of counts

Any three correct points scored full marks.

Candidates did not refer to the count in specific locations but instead often mentioned the 'normal' count.

Question 10

In part (a) surprisingly few candidates were able to place the parts of the electromagnetic spectrum in order although in (b)(i) most knew that they were transverse waves.

The calculation in (b)(ii) to determine the frequency of waves of speed 3×10^8 m/s and wavelength 2×10^3 m was well answered. The most common error was 1.5×10^{11} Hz.

Question 11

Part (a) in which the paths of two rays from a car, reflected by prisms in the car, had to be drawn was well done. Candidates had to label with a **T** positions on the prisms at which total internal reflection took place. This was difficult because unless the T was written quite small it was unclear especially if the T was drawn inside the prism. In the event most candidates scored this mark.

Explanations involving incident angle being greater than critical angle were well known.

In (c) a problem with the image of the car as seen by the driver is that it is inverted. Many candidates gave this answer while some referred to the reduced size of the image or that it was virtual.

Paper 2

General Comments

This paper featured a new layout to enable the use of online marking. Candidates were required to answer questions on the spaces provided on the question paper. In general this has resulted in more concise answers with more candidates addressing the question being asked. A number of candidates repeated parts of the question before starting their answers and then found it difficult to fit all their words in the remaining space. This will hopefully improve as centres gain experience of the new style papers. Some candidates extended their answers beyond the space provided or continued their answers on one of the blank pages; centres should stress the need to complete answers within the space provided wherever possible and if the answer continues elsewhere to indicate this clearly within the answer space provided. The majority of candidates were able to attempt all parts of the paper in the time allocated. Many wrote good answers to questions requiring explanations of physical principles but some of it was irrelevant, incorrect and could be contradictory. Calculations were answered well although units were still being missed off or written incorrectly.

Question 1

Well prepared candidates scored well on this question.

(a) All three parts usually scored very highly with candidates knowing the correct formulae and units. In a few cases wrong figures were used in the correct formulas, often using 10 kg instead of 5 kg. In the kinetic energy calculation some forgot to multiply by ½ or to square the velocity.

(b) Most candidates could produce an acceptable definition of the meaning of centre of gravity although a few simply talked about a point where an object could be balanced. Part (ii) really tested understanding of the meaning of the centre of gravity and was not well answered. Those scoring failed to note that there were two marks available for this part and usually only gave either “moves down” or “moves backwards”, scoring only one mark.

(c) This part was frequently answered very well with many candidates scoring the full ten marks available. Many excellent diagrams were seen but marks could only be gained if the parts were labelled and trolleys were shown resting on something rather than hanging in mid air. A minority of candidates moved both trolleys towards each other or described a recoil experiment not involving a collision and hence scored poorly.

The lists of measurements given were often vague, referring only to mass or velocity without specifying to which trolley they related to, or whether they meant the individual trolleys or the combined ones after the collision. Some candidates wrote their method here and were unlikely to score any of the three marks.

The method was usually well written but some candidates repeated the measurements here or only gave details of calculations.

Many only gave “momentum before equals momentum after” rather than a suitable equation. The mark was often lost if the equation given indicated that the two trolleys were moving at different velocities after the collision.

Question 2

Responses to the calculations in this question were disappointing.

(a) (i) Many candidates failed to score full marks because of the lack of detail in the answers or because of careless reading from the graph. They often forgot that the first graph was for water, which would change state at 0 ^{0}C and 100 ^{0}C, and said "density increases at 4 ^{0}C" or "density decreases to 120 ^{0}C". Some thought that water existed, as a liquid,at -20 ^{0}C or up to 120 ^{0}C.

(ii) Here again many candidates although stating the density decreases failed to say at a constant rate and so didn't score.

(b) (i) Many candidates failed to score as they only gave one of the two points.

(ii) This was usually correctly answered although some candidates forgot to multiply by g, losing both marks.

(iii) This was poorly answered with many candidates giving either 100 kPa or adding 2 kPa instead of subtracting it.

(iv) A majority of candidates arrived at a correct answer to this part by a variety of methods all of which applied correct physics.

(c) (i) Many candidates scored only the first mark, noting the difference in heights, but failing to justify their answers by using the pressure equation or realising that the same pressure was applied to both columns.

(ii) Although many were able to measure the heights of the two columns, far fewer were able to calculate the density correctly.

(iii) Most were able to give a reason why it was more difficult to measure the height of water rather than the liquid.

(iv) Responses to this were disappointing with many candidates talking about the effect of temperature on pressure rather than on density. It is likely they were thinking of this as a gas law problem.

Question 3
Throughout the question there was a strong preference for candidates to write in terms of density rather than refractive index. There are no marks given for this. It is clear that many candidates confuse this archaic term with physical density.

(a) (i) This was often well attempted except for those who referred to the properties of the two media rather than the property that light travels more slowly in water than air.

(ii) The majority incorrectly calculated the angle as 31.6^o because they had inverted the equation, rather than the correct 72.7^o. Students should be encouraged to check the validity of their answers – in this case by looking at the given diagram which clearly shows the required angle to be bigger than the marked 45^o. The final mark was often lost through incorrect rounding.

(b) (i) Although most candidates are familiar with this experiment, it is clear that many do not appreciate the reason for using a semi-circular block or the importance of the ray of light being incident towards the centre of the straight face.

(ii) Again candidates talked about the media rather than the light.

(iii) Here explanations were much better although a few candidates contradicted themselves by saying that the incident angle was less that the critical angle and hence total internal reflection occurred.

(iv) A correct diagram was usually drawn but some candidates failed to show the reflected ray emerging from the curved face or drew an angle of reflection clearly different from 45^0. Where this angle was labelled 45^0 the mark was always given. Some candidates thought that 45^0 was the critical angle and showed the ray emerging **along** the face AB rather than **from** face AB as asked in the question.

(vi) The speed of light calculation was usually correctly answered.

(c) This part tested the understanding of the most able candidates. Some thought that the angle of incidence would become smaller rather than that the critical angle would become larger due to the smaller change of speed when the block was immersed in water compared to that in air.

Question 4

Many candidates scored well on this question especially in the calculation.

(a) (i) This was usually well answered with many giving clear textbook answers.

(ii) This was poorly answered as there was a great deal of confusion between large amplitude and faster. Few made the link between large amplitude and loudness.

(b) (i) Candidates must read the instructions carefully before beginning drawing graphs. Many ignored the instruction to start the x-axis at 15 mm and then chose unsuitable scales, often involving factors of three or worse, and this made it difficult for them to plot their points at the correct position. Some used the correct scale but then added additional axes to the right of those already drawn on the grid. This then resulted in the final point being plotted outside the grid. Such points are not credited. A disappointing number failed to label the axes or left off the units. A very small minority rotated their grid through 90^0 and this resulted in an unsuitable scale. This practice should be strongly discouraged in future. A small number also ignored the instruction to draw a best straight line through the points, choosing instead to join the plotted points with a series of straight lines. In all cases a ruler should be used to draw such a line.

(ii) Most candidates showed how they used the graph by drawing a vertical line up to their line and then a horizontal line across to the wavelength axis. Those who had chosen a suitable scale could then read off a correct answer within the acceptable limits.

(c) Most scored well here although some lost a mark by failing to convert kHz to Hz. A few chose a value of wavelength from the graph.

(d) (i) This question challenged many candidates. Many thought that the pitch would change rather than being fixed by the source and would then state that the wavelength would decrease.

(ii) Only very good candidates scored well here. Few made the link between frequency and pitch or justified their answer for wavelength by reference to the wave equation. Some tried to explain why the speed of sound would change which was not asked for and would be beyond the scope of the specification.

Question 5
This question often scored very well for those read the information carefully before answering the question. Some candidates ignored the fact that the sphere would reach a constant speed **before** reaching the upper mark. Others ignored the fact that throughout the question the only liquid referred to was oil.

(a) (i) Most candidates could give two acceptable forces but some gave incorrect terms such as upward force rather than upthrust. There are still some who just give the term gravity rather than a correct term such as weight, or pull or force of gravity.

(ii) Those candidates who knew what they were doing could score well for this sketch graph. Those who did often showed an abrupt change of speed when reaching steady speed rather than drawing a line curving over to terminal velocity.

(b) (i) Most candidates could correctly give three suitable items of apparatus.

(ii) Candidates often found it difficult to express themselves, choosing to add things to the sphere rather than using a material of different density.

(iii) There were a lot of very good, well-described answers. Some candidates, who had not read the question carefully, ignored the two lines on the glass cylinder and measured the actual depth of oil and time for the sphere to fall from top to bottom.

(iv) Many scored well here although some candidates referred to how they would improve their **measurements** rather than how they would improve the accuracy of their **results.**

(c) Although there were at least four factors that could have been given here some candidates failed to refer to a suitable one. Many could give only one factor with a suitable explanation or two correct factors with unsuitable explanations. Some tried to answer in terms of forces such as air resistance or speed at which the sphere was thrown.

PHYSICS 7540, GRADE BOUNDARIES

Grade	A	B	C	D	E
Lowest mark for award of grade	69	59	49	44	25

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.

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