Mark Scheme (Results)

Summer 2008

GCE O Level Physics

7540/02

7540/02 O-LEVEL PHYSICS MARK SCHEME – JUNE 2008

Question Number	Answer	Mark

1(a)(i)	• 8000 – 340 = 7660
	• a = 7660 / 2560
	• = 2.992/2.99 m/s^2 UP
	
	Notes:
	Award 3 marks for a correct numerical answer of 2.992/2.99 m/s^2 without working.
	
	If ground friction missed award 2 marks as shown below
	    • a = 8000/2560
	    • = 3.125 /3.12/3.13/3.1/3(.0) m/s^2 UP
	
	If ground friction is added award 2 marks as shown below
	    • a = (8000+340)/2560
	    • = 3.2578/3.258/3.26/3.3 m/s^2 UP
	
	Award 2 marks for a correct numerical answer of 3.125 /3.12/3.13/3.1/3(.0) m/s^2 UP without working.
		1
		1
		1
		
		1
		1
		
		(1)
		(1)
		
		(1)
		(1)
		
		(3)

Question Number	Answer	Mark
1(a)(ii)	• <u>air</u> drag/ <u>air</u> friction/<u>air</u> resistance • <u>(air drag) increases</u> with <u>speed/velocity</u> Notes • ignore ground friction	1 1 **(2)**

Question Number	Answer	Mark
1(a)(iii)	2 marks for the correct calculation – see below. • 55 = 2.2 x t or t=55/2.2 • =25 s UP Notes award both marks for 25 s without working	 1 1 **(2)**

Question Number	Answer	Mark
1(a)(iv)	2 mark for the correct calculation using one of the methods shown below. Using average speed x time • 55/2 x 25 • = 687.5/688 (m) *or using s= ½ at²* • s = ½ x 2.2 x (25)² • = 687.5/688 (m) *or using v² = 2as* • 55² = 2 x 2.2 x s • s = 687.5/688 (m) Notes Allow reverse argument to show that in 700 m plane reaches 55.5/56 m/s at 700 m or takes 25.2/25.23/25.226 s to reach 700 m	1 1 or 1 1 or 1 1 (2)

Question Number	Answer	Mark
1(a)(v)	Any two points from the list below – • <u>less</u> area/ <u>more</u> streamlined/smoother surface/ aerodynamic • <u>less</u> (air) drag/(air) friction/(air)resistance • <u>larger</u> unbalanced/net/resultant force Notes • Allow reverse argument eg otherwise area would be greater (than if not folded) • Ignore wheels not needed • ignore ground friction	1 1 1 (2)

Question Number	Answer	Mark
1(b)(i)	Any two points from the list below • metre rule/ruler/measuring tape/ allow <u>distance</u> scale • blocks/books/wedges (to raise/compensate) • (more) (ticker) tapes or power supply (for timer) Note Do not accept "a ramp", balance or elastic bands or weights or masses	1 1 1 (2)

Question Number	Answer	Mark
1(b)(ii)	4 marks for the correct description of method –. Any four points from the list below – maximum 4 marks. 1. turn on (ticker) timer 2. pull trolley (with newtonmeter not elastics) 3. keeping force constant/note (measure) force 4. <u>measure</u> distance/spaces/dots on (ticker) <u>tape</u> 5. calculate acceleration (from tape <u>not</u> f=ma) 6. repeat for same force not mass 7. repeat for different forces not masses Notes • Ignore compensation for friction here	1 1 1 1 1 1 1 (4)

Question Number	Answer	Mark
1(b)(iii)	1 mark for the correct reason – shown below. • not friction compensated/not allowed for friction/some force is used to overcome friction/there is friction note • ignore "because force is not directly proportional to acceleration • this mark may be awarded here if friction compensated is seen in b(iv)	1 (1)

Question Number	Answer	Mark
1(b)(iv)	- tilt/raise (left hand end of) runway or A/use a ramp/ use a smooth surface/lubricate the surface - so trolley runs at constant speed/moves with no acceleration Notes • independent of answer to (iii) • if compensate for friction is seen here and if no marks awarded in b(iii) then return to b(iii) and award that mark in b(iii) only not here	1 1 (2)

(Total 20 marks)

Question Number	Answer	Mark

2(a)(i)	• mass = 1.2 x 7
	• = 8.4 (kg) (UP only if given as final answer)
	• weight = 84 N UP
	
	Notes
	     84 N with no working scores 3 marks
	     84 with no working scores 2 marks
	     8.4 kg with or without working scores 2 marks
	     8.4 N with or without working scores 1 mark
	     8.4 with or without working scores 1 mark
		1
		1
		1
		
		(3)

Question Number	Answer	Mark
2(a)(ii)	• Attempt to convert temperatures to Kelvin (eg use of 237 or -273) • $7/288 = V_2 / 327$ correct conversion only • $V_2 = \underline{7.9479/7.948/ 7.95 /7.9}$ m^3 UP <p align=center>Notes</p> Working and answer must be seen for 3 marks. ignore <u>further</u> rounding to 8m^3 or allow 1 mark only for the following working shown below • temperature in Celsius • $7/15 = V_2 / 54$ • $V_2 = 25.2/25$ m^3 •	1 1 1 or (0) (1) (0) (3)

Question Number	Answer	Mark
2(a)(iii)	1 mark for each correct effect - shown below. Density smaller/less/reduced/decreases Weight same/unchanged/does not change/ no effect	 1 1 (2)

Question Number	Answer	Mark
2(b)(i)	1 mark for the correct process – shown below. • Radiation/heat radiation/thermal radiation /infra red/ infra red radiation Note Do not accept nuclear radiation/atomic radiation/radioactivity	1 (1)

Question Number	Answer	Mark
2(b)(ii)	1 mark for the correct process – shown below. • conduction/convection Note allow phonetic spelling	1 (1)

Question Number	Answer	Mark
2(b)(iii)	 • molecules/particles move faster/gain KE/gain kinetic energy (not just "gain energy") • more frequent collisions (with walls) • harder collisions (with walls)/greater rate of change of momentum	1 1 1 (2)

Question Number	Answer	Mark
2(c)(i)	• correct scale for x axis – 2cm = 5 ^{0}C (only) • labels and units on both axes (minimum upthrust N and temperature ^{0}C • plots (-1 each incorrect ± 1mm or outside grid) • straight line (not joining the plots with straight lines) Notes: • Use of an x axis scale of 1cm=5^{0}C or better can score up to 4 marks. X axis scale less than this cannot score plotting marks • Linear graph can only score label and units mark • Accept ^{0}C or C for unit	1 1 2 1 (5)

Question Number	Answer	Mark
2(c)(ii)	• 32.5 ^{0}C accept <u>32 ^{0}C to 33 ^{0}C</u> UP Notes: Accept ^{0}C or C for unit	1 (1)

Question Number	Answer	Mark
2(c)(iii)	1 mark for correct method (shown on graph) • correct line across and/or down (not just a dot)	1 (1)

Question Number	Answer	Mark
2(c)(iv)	1 mark for the correct reason – shown below. • <u>upthrust</u> bigger/larger/more than <u>weight</u> / 106.7 (N) is greater than 100(N)	1 (1)

(Total 20 marks)

Question Number	Answer	Mark
3(a)(i)	• reflection/ (ray) A reflected/ reflective • *i = r/* <u>angle</u> of <u>incidence</u> = angle of reflection Notes • (total) internal reflection loses first mark • angle of incidence = angle of reflection could gain both marks • independent marks	1 1 (2)

Question Number	Answer	Mark
3(a)(ii)	• refraction • bends towards normal/ slows down (in glass)/ refractive index of glass more than ri of air / accept less dense to more dense/ Notes • independent marks • do not accept diffraction or reflaction • do not accept n=sin i/sin r on its own	1 1 (2)

Question Number	Answer	Mark
3(a)(iii)	1 mark for the correct answer. • B	1 (1)

Question Number	Answer	Mark
3(b)(i)	1 mark for correctly drawn arrows on both diagrams. • minimum of <u>two</u> out of three correct arrows on air rays on <u>each</u> diagram Notes all arrows must be in correct direction to score.	1 (1)

Question Number	Answer	Mark
3(b)(ii)	• reflection/ to reflect light /otherwise light would not be reflected /silver is a good reflector Do not accept total internal reflection here	1 (1)

Question Number	Answer	Mark
3(b)(iii)	1 mark for each correct reason • too much light entering eye (from headlights)/person would be blinded/driver will have glare • eye would to be in wrong position (for driving) / driver would be looking down (instead of forwards) •	1 1 (2)

Question Number	Answer	Mark
3(c)(i)	2 marks for the correct calculation – shown below. • sin 17° ÷ sin 11° • = 1.5/1.53/1.532/ 1.5323 Notes • award both marks for correct answer with no working but 1.5 with no working scores 0/2 • 17/11=1.545 scores 0/2	1 1 (2)

Question Number	Answer	Mark
3(c)(ii)	1 mark for the correct answer . • total internal reflection	1 (1)

Question Number	Answer	Mark
3(c)(iii)	• $1.53 = 1 \div \sin x$ / $x = \sin^{-1}(1/1.53)$ must ECF from c(i) • $x = 41/40.7°/40.8^0/40.81/40.74/40.739$ Notes • actual answers depend on value entered in calculators • ecf for 1.5 from c(i) allow 42/41.8/41.81 • correct answers from list with no working score both marks • degree symbol not required • ignore a further angle slightly larger than calculated value • 41 obtained using protractor to measure diagram scores 0/2	1 1 (2)

Question Number	Answer	Mark
3(c)(iv)	1 mark for the correct explanation from list below below. • angle x must be greater than critical angle • incident angle greater than critical or 40.7/40.8 • angle x <u>is </u>the critical angle so anything bigger gives TIR or is reflected Notes • allow c or C for critical angle if used in c(iii) • allow greater than or equal to c • allow reverse argument	1 (1)

Question Number	Answer	Mark

3(d)	Apply scheme in bold to raybox method and italics answers to real and apparent depth method
	
	Award any 4 points from items 1 to 7 and any one point from 8 to 9
	
	  1. use or place (rectangular glass) block on paper
	  2. use raybox/pins/*over mark on paper*
	  3. indicate record/measure/note *i* /*measure actual or real depth of block*
	  4. measured between normal and incident ray/ *look down through block*
	  5. indicate/ record/measure /note *r/locate position of image*
	  6. use of protractor/ /*measure apparent depth or distance from top surface*
	  7. repeat for different *i* / *repeat readings*
	
	  8. n = sin *i* / sin *r* / *Calculate RI= real/apparent depth*
	  9. slope of sin *i* v sin *r* graph/ average values of RI/ *take average of values*
	
	Note
	  • Marks 1 to 6 can be given if seen on labelled diagram for both methods
		1
		1
		
		1
		
		1
		
		1
		1
		
		1
		
		1
		
		1
		
		1
		
		(5)

(Total 20 marks)

Question Number	Answer	Mark
4(a)(i)	2 marks for the correct answer – shown below. 0.10 x 1000 or 100 OR reverse argument 360 (000) (no mark) /1000 = <u>0.1</u> (kWh) no mark **Notes** - first mark is for conversion of kW to W and second mark for conversion of hours to seconds	1 1 1 1 1 1 (2)

Question Number	Answer	Mark
4(a)(ii)	2 marks for the correct calculation from two options shown below. - 360 (000) × 0.025 - = 9000 J /9kJ UP or - *0.10 x 0.025* - *= 0.0025 kWh (2.5 Wh)* UP **Notes** - treat 360 x 0.025 = 9<u>J</u> as UP so scores 1 mark - allow answer by ratios	 1 1 (2)

Question Number	Answer	Mark
4(a)(iii)	2 marks for the correct calculation – shown below. - 9000 ÷ 5.0 ecf - = 1800 s /30 minutes/ 0.5 Hour UP or - *2.5 / 5.0 ecf from (ii)* - *= 0.5 hour* **UP**	 1 1 (2)

Question Number	Answer	Mark
4(b)(i)	4 marks for the correctly completed equation – • Pu (238) bottom number is 94 • alpha top number is 4 bottom number is 2 • U (92) top number is 234	1 1 1 1 (4)

Question Number	Answer	Mark
4(b)(ii)	• 2 half lives/ 1 : ½ : ¼ • 176 years UP Note mark each point separately	1 1 (2)

Question Number	Answer	Mark
4(b)(iii)	1 mark for the correct answer– shown below. • Box 1 nuclear or atomic • Box 3 heat/thermal/internal Note • both must be correct to score • accept more than one of the correct responses in a correct box. eg nuclear and atomic in box 1 and/or heat and thermal in box 2 • do not accept an incorrect response in either box eg nuclear and chemical in box one	1 (1)

Question Number	Answer	Mark

4(c)	• alpha has short range/ stopped by 4 cm to 10 cm air
	• alpha cannot penetrate/is stopped by aluminium/is absorbed by aluminium
	
	Note
	   • 2nd line on its own scores both marks
	   • ignore other radiations or other irrelevant facts
		1
		
		1
		
		(2)

Question Number	Answer	Mark
4(d)(i)	3 marks for the correct calculation from one method shown below. 200 × 1000 x 0.0020 (= 4 h) or 200 × 1000 x 0.0020 (= 4 h) or Energy used =5.0 x 4 (= 20 Wh / 0.02 kWh) Energy needed = 20 x (100/5) (= 400 Wh/0.4kWh) Energy available = 200 x (1000 x) 0.0020 (=400 Wh/0.4kWh) or energy used = 5/1000 x 4 = 0.02 kWh energy supplied = 200 x .0020 Note There are a large number of variations as well as those above. In general award one mark for a correct calculation of the total energy transferred in the battery. One mark for applying the 5% efficiency and one mark for using 5 W to calculate a time all in appropriate units. Allow reverse calculation	 1 1 1 or 1 1 1 or 1 1 1 or 1 1 1 (3)

Question Number	Answer	Mark
4(d)(ii)	2 marks for the correct reasons – shown below. • source is (radio)active/Pu still emits alpha after 4 hours • long half life/ 4h is (much) less than half life/ half life is 88 years	1 1 (2)

(Total 20 marks)

Question Number	Answer	Mark

5(a)(i)	Correct definition – from list shown below.
	
	   • <u>maximum</u> displacement
	   • <u>maximum</u> distance from mean/normal/central /rest/zero/ equilibrium position
	   • distance between crest (or trough) and mean/normal/central /rest/zero/ equilibrium position
	
	Note allow a suitable diagram
		1
		
		(1)

Question Number	Answer	Mark
5(a)(ii)	1 mark for the correct definition • number of cycles or vibrations or oscillations or waves in unit time or per second	1 (1)

Question Number	Answer	Mark

5(a)(iii)	1 mark for a correct definition – from list shown below.
	
	   • distance between two points in phase
	   • distance between two adjacent peaks
	   • distance between two adjacent troughs
	   • distance between two identical points on adjacent waves
	
	Note allow a suitable diagram
	       Accept equivalent words for adjacent
		1
		1
		1
		
		1
		
		(1)

Question Number	Answer	Mark

5(a)(iv)	2 marks for the correct definition – shown below.
	
	   • (maximum amplitude) when <u>driving</u>/<u>applied</u> frequency
	   • equals <u>natural</u> frequency of system (wire)
	
	or
	
	   • when string or system or object is <u>made</u> to vibrate
	   • at <u>natural</u> frequency of system (wire)
		1
		
		1
		
		1
		1
		(2)

Question Number	Answer	Mark
5(b)(i)	1 mark for the correct factor – shown below. • load / type of wire / temperature /tension/ material of wire/ diameter of wire/ thickness of wire/ mass per unit length of wire	1 (1)

Question Number	Answer	Mark
5(b)(ii)	1 mark for each correct piece of equipment. • rule/metre rule/measuring tape/ <u>distance scale</u> • tuning fork(s) • piece of paper (to put on wire) • <u>balance</u> (to measure mass/weight of load or wire) • thermometer <u>to see if temperature is constant</u>	 1 1 1 1 1 (3)

Question Number	Answer	Mark
5(b)(iii)	6 marks for the correct description of method – Maximum <u>five</u> marks from points 1 to 9 1. place paper at centre of wire 2. sound tuning fork/make fork vibrate 3. place tuning fork on wire 4. vary length of wire 5. until paper falls off/wire vibrates with large amplitude 6. record/measure/note length 7. record/note frequency 8. match pitch of wire and fork before placing fork on wire 9. repeat for different <u>fork/frequency</u> Notes: Plus one mark for correct repetition from 10 below 10. repeat for same <u>fork/frequency</u>	 1 1 1 1 1 1 1 1 1 1 (6)

Question Number	Answer	Mark

5(b)(iv)	2 marks for correctly drawn <u>table</u> – shown below.
	
	columns headed with both names
	both columns with suitable units
	 eg
	    • length - frequency
	    • m Hz
	
	    ignore any additional headings
		1
		1
		
		    (2)

Question Number	Answer	Mark

5(c)	1 mark for the correct effect – shown below.
	
	no mark awarded for labelling axes
	
	    • as f inc / dec ora
	    • the shorter the length the higher the frequency
	    • frequency is inversely proportional to length
	
	Note Do not award mark if either axis is labelled incorrectly
		1
		
		    (1)

Question Number	Answer	Mark

5(d)(i)	1 mark for correctly drawn sketched graph.
	
	    • horizontal <u>non-zero</u> line (by eye)
		1
		    (1)

Question Number	Answer	Mark

5(d)(ii)	1 mark from list shown below. **All** dependent on previous answer
	
	    • frequency increases, λ decreases, $f \times \lambda$ constant
	    • speed = frequency x wavelength if f inc, λ dec
	    • speed does not depend on frequency
		1
		1
		1
		    (1)

(Total 20 marks)

TOTAL FOR PAPER: 100 marks