Mark Scheme Summer 2009

GCE O level Physics (7540)

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7540/01 O-LEVEL PHYSICS MARK SCHEME – JUNE 2009

Question Number	Acceptable Answers General	Reject	Mark
1(a)	Any of the following 300 000 N or 300 kN or 3 x 10⁵N 294 000 N or 294 kN or 2.94 x 10⁵N 294 300 N or 294.3 kN or 2.943 x 10⁵N 290 000 N or 290 kN or 2.9 x 10⁵N 300 000 kg m/s² or kg m s⁻² 294 000 kg m/s² or kg m s⁻² 294 300 kg m/s² or kg m s⁻² 290 000 kg m/s² or kg m s⁻² **Unit required for the mark**	any with kg as unit eg 300 000 kg or kg / m s² or kg m / s⁻²	(1)

Question Number	Acceptable Answers Expert	Reject	Mark
1(b)(i)	25 x 0.6 = 15 m **UP** Comparison of 15 m and 20 m or calculation to give 5m **dop** eg 20-15 = 5 m (and)distance to car is 20m This is less than 20 m 20 m is more than 15 m this is 5m less than 20m it "stops" 5m away from the car 15 m on its own without working scores first and second marks. Final mark depends on previous. Allow alternative method based on time to cover 20m ie = 20/25 =0.8s **UP** Comparison of 0.8 s and 0.6s **dop** Eg This is less than 0.6s	calculation assuming lorry stops leading to average speed of 7.5 m/s Only travels 15 m – this just repeats previous mark	(1) (1) (1)

Question Number	Acceptable Answers General	Reject	Mark
1(b)(ii)	Friction Accept an answer which includes friction eg Friction in tyres/wheels. Friction with road friction force frictional force	Do not accept answer including <u>air</u> friction <u>air</u> drag <u>air</u> resistance	(1)

2

Question Number	Acceptable Answers Expert	Reject	Mark
1(c)	**First mark** (Lorry) braking <u>force</u> greater (Lorry) stopping <u>force</u> greater (Lorry) <u>friction</u> (force) greater <u>Force</u> to stop lorry greater <u>Force</u> applied is proportional to mass **ora** **Second mark** (Lorry) braking or stopping force or friction <u>thirty times</u> greater **ora** (second statement on its own scores both marks) Allow f=ma calculation which shows equal deceleration 2 marks	(braking) force same friction does not depend on mass Answers in terms of momentum ignore reaction time or thinking distance Ignore reference to number of wheels Acceleration of lorry is less as mass is more Inertia	(1) (1)

Total 7 Marks

Question Number	Acceptable Answers Graduate	Reject	Mark
2(a)	all objects/everything/all things plus one from • accelerate equally • fall at same rate • fall with acceleration due to gravity • accelerate at 10 m/s^2 • all objects take the same time to reach the ground	acceleration due to gravity pull of gravity effect of gravity on objects heavier balls fall faster than light ones	(1)

Question Number	Acceptable Answers Expert	Reject	Mark
2(b)	**First Mark** Mention of air friction/air drag /air resistance **Second mark** has greater <u>effect</u> on lighter cannonball or produces smaller <u>resultant</u> or produces smaller <u>unbalanced force</u>. **ora.dop**	• Friction on its own • Ignore Upthrust or other irrelevant forces • heavier one has more energy • Lighter ball has more air resistance • Momentum • terminal velocity	(1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
2(c)	Mark 2c and 2d as a whole. If candidate calculates 2d first and then uses this to calculate 2c apply scheme) **First Mark** height = ½ x 10 x (3.2)^2 (allow 9.8/9.81) **Second Mark** one of - = 51.2 m/51 m/ 50 m 50.176 m/50.18/50.2/50 m for 9.8 50.2272/ 50.23/50.2/50 m for 9.81 **UP** Correct answer with unit but no working scores both marks		(1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
2(d)	speed = 10 x 3.2/ 9.8 x 3.2/ 9.81 x 3.2 = 32 m/s / 31.36 m/s / 31.392 m/s **UP**		(1) (1)

| | (accept rounding 31.4/31.39/31.4/31m) **Or** (Average) speed = 52/3.2(= 16 m/s) ecf
speed at ground = (2 x 16) = 32 m/s ecf
(Unit penalty on 16 if given as final answer)

Correct answer with unit but no working scores both marks | | |

Total 7 Marks

Question Number	Acceptable Answers Graduate	Reject	Mark
3(a)	Same pressure on both sides OWTTE	Water pressure equal in all directions Pressure is the same There is no pressure No forces acting on it	(1)

Question Number	Acceptable Answers Expert	Reject	Mark
3(b)(i)	<u>Greater</u> pressure in right hand arm than left hand arm (ora) Pressure exerted by gas was <u>greater</u> than atmospheric pressure Must compare pressure in both arms	• Atmospheric pressure increases • Water is pushed by gas	(1)

Question Number	Acceptable Answers Expert	Reject	Mark
3(b)(ii)	**First mark** One from • Weight of water on <u>left</u> side • weight of 0.14 m of water • pressure due to water on <u>LHS</u> • pressure due to 0.14 m water **Seocond mark** <u>equals</u> (extra or excess) pressure of gas **ora** <u>Or</u> <u>pressure</u> on LHS <u>equals</u> pressure of gas (scores both marks) Allow one mark for gas pressure equals atmospheric pressure	• Not enough pressure to increase water level • because of atmospheric pressure • because pressure became constant	 (1) (1)

Question Number	Acceptable Answers Graduate	Reject	Mark
3(c)	pressure = 0.14 x 1000 x 10 (or 9.8 or 9.81) = 1400 N/m² or Pa (1372 N/m² or 1373.4 N/m²) **UP** accept 1370, 1373 Pa	0.14 x 1000 =140	(1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
3(d)	One from • pressure too large (to measure) **ora** • water would be blown out (of manometer) or gas would escape • (water) manometer would not measure this pressure • tube not long enough to measure this pressure	Ignore manometer would burst or break or explode	**(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
3(e)	One from • more dense liquid • mercury • <u>much</u> longer (manometer) tubes • calculation of length of manometer tube for water (15 m) (must be seen in 3(e)) Allow a correct answer with an irrelevant one eg thicker walls and longer tubes scores	• No credit for calculation if seen in 3d • Bourdon gauge or other non-manometer apparatus • Wider manometer • fatter manometer • thicker tubes • bigger volume or more water	**(1)**

Total 8 Marks

Question Number	Acceptable Answers General	Reject	Mark
4(a)	Kinetic to Electric(al) (both needed for 1 mark) wind and kinetic to electric(al) wind's kinetic to electric(al	ignore wind	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(b)	efficiency = 60 / 150 (x 100) = 0.4 or 40% (**UP for 0.4% or 40)**		**(1)** **(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
4(c)	One from • no fuel costs • cheap to run /produce • no pollution • renewable energy • Will not run out/last forever • does not use fossil fuels	• Does not need energy • It is environment friendly • A lot of electricity can be generated • Natural source • More efficient	**(1)**

Total 4 Marks

Question Number	Acceptable Answers Expert	Reject	Mark
5(a)	Any two points from • remove heat/remove Bunsen/turn off Bunsen • wait (one two minutes) before reading pressure / wait till pressure reading is steady • stir the water • Make sure the thermometer does not touch (the bottom of) the beaker • heat above temperature allow to cool to required temperature	• room temperature constant • pressure gauge constant • keep volume constant • insulate the beaker • flask is fully immersed in water • wait for a few seconds	(2)

Question Number	Acceptable Answers Expert	Reject	Mark
5(b)	Use of correct equation with P and T Correct conversion to K (300 K and 350 K) **eg** 102/300 = P2 / 350 119 kPa/ 120kPa **UP** correct answer only allow one mark for 102/27 = P2/77 leading to 290/290.9/290.8/291 kPa **UP**	Calculations using incorrect numbers	(1) (1) (1)

Question Number	Acceptable Answers General	Reject	Mark
5(c)	-273 ^{0}C -273 C 0 K 0 ^{0}K 0 Kelvin absolute zero accept upper or lower case C or K	zero absolute <u>temperature</u> room temperature 0 ^{0}C 0 C -273 ^{0}K -273 K (-)273 K and (-)273 ^{0}C together (contradiction here)	(1)

Total 6 Marks

Question Number	Acceptable Answers General	Reject	Mark
6(a)(i)	kinetic to electric(al) allow chemical to electric(al) chemical to Kinetic and electric(al)	Answer including heat mechanical potential light	(1)

Question Number	Acceptable Answers General	Reject	Mark
6(a)(ii)	electric(al) to heat electric(al) to light electric(al) to heat and light	light to heat heat to light chemical to heat and or light chemical and electrical to heat	(1)

Question Number	Acceptable Answers General	Reject	Mark
6(b)(i)	0.27 0.27A 0.275 0.275A 0.28 0.28 A 0.29 0.29A	0.24 0.25 0.3	(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
6(b)(ii)	Use of Time for 1 cycle/T = 0.02 s / use of 2cycles = 0.04s / f = 1/0.02 = 50 Hz or c/s or per second **UP**	T = 1/current f = 2 x T for second mark use of v=fλ 0.02 = 2 cycles leading to 100Hz loses both marks	(1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
6(c)	same maximum values for positive and negative parts of wave (± 1 mm for at least the first complete wave if more than one wave drawn) half frequency – One complete wave crossing the time axis at 0, 0.02 and 0.04) Treat marks independently	curve which does not cross axis score 0/2	(1) (1)

Total 7 Marks

Question Number	Acceptable Answers Graduate	Reject	Mark
7(a)	Ammeter in series with the metal conductor. Allow correct symbol or labelled circle or rectangle Voltmeter in parallel with the metal conductor. Allow correct symbol or labelled circle or rectangle. Allow voltmeter in parallel with cell if <u>no</u> other <u>resistors</u> in circuit and ammeter is in series with cell	Ignore additional components which would not affect the results Ammeter in parallel with wire and voltmeter in parallel with cell	**(1)** **(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
7(b)	1.4 / 0.002 or 1.4 = 0.002R = 700 Ω/ ohms **UP** Correct answer with unit scores both marks		**(1)** **(1)**

Question Number	Acceptable Answers General	Reject	Mark
7(c)	accept 0.001 A accept 0.001 accept 'half' accept 1×10^{-3} accept 1×10^{-3}A		**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
7(d)	Any Two of: • (cross sectional) area/ diameter/ radius /thickness/width • temperature • resistivity / Metal /material If more than two variables given mark the first two only	length voltage current mass/ weight strength of battery direction of current or voltage heat	**(1)** **(1)**

Total 7 Marks

Question Number	Acceptable Answers General	Reject	Mark
8(a)	step-down step-down transformer step down step down transformer		**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
8(b)	N/1000 = 12/240 N = 50 (turns) Allow correct equation either way up Allow 1000/240 = 4.166 x12 =50 Allow use of voltage ratios to arrive at 50 50 (turns) on its own scores both marks		**(1)** **(1)**

Question Number	Acceptable Answers General	Reject	Mark
8(c)(i)	iron soft iron ferrite stalloy mumetal	steel	**(1)**

Question Number	Acceptable Answers Graduate	• Reject	Mark
8(c)(ii)	Any one from :- • easily magnetised and demagnetised • easily magnetised • easily demagnetised • prevents core becoming permanently magnetised • no magnetic field when there is no current Ignore irrelevant information which does not contradict if an acceptable answer is seen.	• To avoid wasting energy • To conduct electricity • So coils don't attract	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
9(a)	• <u>cosmic</u> rays/ <u>cosmic</u> radiation • (radioactive) isotopes or atoms in rocks /water /air /food /walls /surroundings. • radon	Radio (waves) any em waves Sunshine Sunlight Alpha, beat or gamma rocks or buildings without mention of isotopes or radioactive atoms Heat sound radiation asteroids	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
9(b)(i)	• short range • only travel 4 to 10 cm /few cm (or any value from 4 to 10 cm) • count rate decreases to <u>background</u> in short distance • count rate decreases to <u>background</u> after 6 cm	• The longer the distance the smaller the count rate • Comparison of count rate up to 6cm with count rate for 8 or more cm • alpha detected quicker • because it travelled more than 5cm • It has a long half life • it has less penetration	**(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
9(b)(ii)	• background (only radiation) • variable (with time)/ random dop	• radiation from other sources • background varies with distance • count rate decreases with distance • Deflected by magnetic fields	(1) (1)

•

Question Number	Acceptable Answers General	Reject	Mark
9(c)	228 4 88 2 Marked vertically		**(1)** **(1)**

Total 6 Marks

Question Number	Acceptable Answers Graduate	Reject	Mark
10(a)(i)	=1000/2.90 = 344.8 m/s 345 m/s **UP** Do not penalise additional significant figures that would round to 345 m/s eg 344.8275862 /344.82		(1) (1)

Question Number	Acceptable Answers Graduate	Reject	Mark
10(a)(ii)	speed of light > speed of sound <u>much</u> greater **dop** speed of light <u>much</u> greater than the speed of sound scores both marks or correct numbers given for speed of light and speed of sound scores both marks or correct value of speed of light given and correct value for speed of sound in 10a(i) scores both marks	• more faster for second mark need much faster • Doubling time or halving distance (echo assumed)	(1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
10(b)(i)	Any two different points of: • distance >1 km /greater • wind in direction of building/ wind speed was different • error in timing/ timing started late/ her reaction time was 0.05 seconds longer • the speed she used was wrong or different or should have been 330 m/s • The temperature was different	• Distance different	(1) (1)

Question Number	Acceptable Answers Graduate	Reject	Mark
10(b)(ii)	reflection /echo (of sound)	sound will radiate vibration due to wind speed echo of lightning resonance	(1)

Total 7 Marks

Question Number	Acceptable Answers General	Reject	Mark
11(a)(i)	Converging Converging lens Convergent Convergent lens		**(1)**

Question Number	Acceptable Answers General	Reject	Mark
11(a)(ii)	Virtual Virtual (image)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
11(b)(i)	*c*		**(1)**

Question Number	Acceptable Answers	Reject	Mark
11(b(ii)	*a*		**(1)**

Question Number	Acceptable Answers	Reject	Mark
11(b(iii)	*b*		**(1)**

Question Number	Acceptable Answers	Reject	Mark
11(b(iv)	*a*/*b*		**(1)**

Total 6 Marks

TOTAL FOR PAPER: 70 MARKS

Question Number	Acceptable Answers Graduate	Reject	Mark
1(a)(i)	a = 2700/0.045		**(1)**
	= 60 000 m/s^2 **UP** Accept N/kg as a unit		**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
1(a)(ii)	v = 60000 x 0.0012 ecf (working must be seen)	70 m/s unless 72 is seen	**(1)**
	=72 m/s **UP** Only answer for second mark		**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
1(a)(iii)	0.045 x 72 OR 0.045 x 70 ecf	3 kg m/s or ecf answer	**(1)**
	= 3.24/3.2 kg m/s OR 3.15/3.2 kg m/s **UP** allow Ns		**(1)**

Question Number	Acceptable Answers expert	Ignore	Mark
1(a)(iv)	<u>Air</u> friction/<u>air</u> drag/ <u>air</u> resistance Accept <u>wind</u> friction/<u>wind</u> drag/ <u>wind</u> resistance	Friction on its own Wind Wind effect Air force Upthrust	**(1)**
	Weight/pull of gravity/force of gravity/pull of Earth/gravitational force (not just gravity) (Answers in either order)	Reject frictional energy or gravitational energy	**(1)**

Question Number	Acceptable Answers expert	Reject	Mark
1(a)(v)	Horizontal labelled <u>arrow</u> to left through centre of ball (by eye) or which would pass through centre if extended. It must be labelled with a <u>frictional effect</u> and point left.	a <u>horizontal</u> arrow labelled weight or gravity a <u>vertical</u> arrow labelled friction or resistance	**(1)**
	Vertical downward labelled <u>arrow</u> through centre of ball (by eye) or which would pass through centre if extended. It must be labelled with a **gravitational effect** and point down		**(1)**

	If labels 1 and 2 are used they should follow the same rules.		

Question Number	Acceptable Answers Graduate	Reject	Mark
1(b)(i)	**First mark** • 0.50 (kg m/s) • 0.50 • 0.5 • same as momentum before • allow remains constant or same **Second mark** • momentum is conserved • momentum before = momentum after • allow the law of conservation of momentum **dop**		(1) (1)

Question Number	Acceptable Answers Graduate	Reject	Mark
1(b)(ii)	• Friction • not friction compensated • not allowed for friction • friction was acting • an external force was acting	ignore <u>air</u> friction ignore gravitational force <u>balanced</u> forces resultant force	(1)

Question Number	Acceptable Answers expert	Reject	Mark
1(b)(iii)	mass = 0.8 + 1.2 (=2) velocity = <u>0.4</u> / candidates mass = 0.2 m/s (0.5 m/s for 0.8 kg 0.33 m/s for 1.2kg) **UP**	 use of 0.5 kg m/s and 2kg (leading to 0.25 m/s scores first mark only no ecf)	(1) (1) (1)

Question Number	Acceptable Answers Graduate	Ignore	Mark
1(b)(iv)	• Compensation for friction • friction compensation • friction compensated runway	Frictionless runway Neutralise (friction) Overcome friction Use a ticker timer Eliminate friction Tilt runway Air track	(1)

Question Number	Acceptable Answers Expert	Reject	Mark
1(b)(v)	**Action (Award if seen in explanation)** 1. Tilt/raise (left hand end of) ramp/ put objects under (left) end **Explanation Any two points <u>all dependent</u> on tilt mark. Award these if seen under action** 2. Give trolley (short) push/force 3. Trolley runs at constant speed 4. Dot spacing is constant	Description of an experiment to find the speed Ignore frictionless/smooth here Ignore compensate for friction here Ignore lubricate Ignore make a runway Resultant / constant force for push	**(1)** **(1)** **(1)** **(1)**

Total Q 1 20 Marks

Question Number	Acceptable Answers Clerical	Reject	Mark
2(a)(i)	Conduction	(ignore radiation)	(1)
	Convection		(1)

Question Number	Acceptable Answers Expert	Reject	Mark
2(a)(ii)	At or near bottom (of cup) <u>Much</u> lower down Accept diagram drawn showing element at bottom	Lower down Deeper half way down	(1)

Question Number	Acceptable Answers Expert	Reject	Mark
2(a)(iii)	any **three** points from: 1. (element) heats/warms cold water/ molecules/ accept energy of molecules increases/ 2. hot/hotter/warm <u>water</u> expands 3. hot/hotter/warm <u>water</u> less dense 4. hot/hotter/warm water/molecules rise(s) 5. water is a poor conductor/(good) insulator Accept liquid instead of water	Heat rises Do not give mark 2 for molecules expand or Mark 3 for molecules less dense Ignore cold water sinks Reject answers about gases	(1) (1) (1) (1) (1)

Question Number	Acceptable Answers Graduate	Reject	Mark
2(a)(iv)	temperature change = 90 – 20 = 70 (^{0}C/K) No **UP** energy = 0.45 x 4200 x candidates temperature change = 132 300/132 000/130000 J **UP** ecf If wrong temperature used (0.45x4200x343 = 648 270J or 0.45 x 4200 x 90 = 170 100J or 0.45 x 4200 x20 = 37 800 score 2nd and 3rd Marks)		(1) (1) (1)

Question Number	Acceptable Answers Clerical	Reject	Mark
2(b)(i)	360 J 360 J/s 360 joules 360 Joules per second **UP**	360 360 kJ	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
2(b)(ii)	144 000/360 = 400 s or 6 minutes 40 seconds or 6.666 minutes **UP**		**(1)** **(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
2(b)(iii)	**2 marks from one of** Heat/energy lost to air/room/surroundings Heat/energy given to cup/heater element Heat/energy used to evaporate water	• Heat lost • Mass of water different • Errors in measurement • Position of heater • Change of volume of water • Expansion of water • Impurities in water • Time for heat to spread • Change of state • Change of atmospheric pressure • Heater not 100% efficient • Not all heat goes into water	**(1)** **(1)** **(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
2(b)(iv)	**2 marks from 3 points about cup** • Use a lid/cover the top/ cover the cup (assume lid) • Insulate the (cup)/ make the cup of insulating material lag the (cup)/ place <u>cup</u> in vacuum <u>flask</u> Place cup in insulating box • Wrap or line (cup) with shiny foil/ make (cup) shiny / paint (cup) white/ light coloured "Cover the cup " can only score in first mark. Cover <u>with</u> insulation and cover <u>with</u> shiny surface could score 2nd and 3rd marks.	• Make the room hotter • keep out of drafts or wind • leave the heater on • stir the water • Changes to the surroundings • Place/surround in a vacuum • Put <u>water</u> in another container • Cover in <u>black</u> <u>paper</u>	**(1)** **(1)** **(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
2(c)(i)	air is an insulator / air is a poor conductor/ two sheets of glass better insulator or poorer conductor than one less heat lost (to surroundings)/prevents heat loss/reduces heat loss / slows down heat loss Independent marks	traps heat energy hot air does not escape ignore vacuum between panes No heat lost Heat reflected back No heat waves lost	**(1)** **(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
2(c)(ii)	wood is an insulator/metal is a (good) conductor (less) heat transferred/conducted/escapes (to surroundings) (using wood)/ (more) heat transferred (to surroundings) using metal. Independent marks	Cheaper Metal is a good absorber Wood is a natural material Wood is renewable metal absorbs more heat metal goes rusty <u>No</u> heat lost Less heat absorbed Metal transfers	**(1)** **(1)**

		temperature	

Total Q 2 20 Marks

Question Number	Acceptable Answers Clerical	Reject	Mark
3(a)	light to electrical sunlight to electrical	light to heat light to chemical solar to electrical heat and light to electrical heat and sunlight to electrical	(1)

Question Number	Acceptable Answers Clerical	Reject	Mark
3(b)(i)	+ on left — on right Positive terminal on left negative terminal on right Look for + and – inside or near circles labelled terminals	Ignore marks anywhere else	(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
3(b)(ii)	One point from • Allows current/electrons (to flow) in (only) one direction • Very high resistance when reversed (bias) • Only lets current flow to the cell owtte	Stop current going both ways Rectifier/changes ac to dc Changes direction of current Reverses current It lights up Controls current Stores charges Acts as a logic gate	(1)

Question Number	Acceptable Answers Graduate	Ignore	Mark
3(b)(iii)	One point from • To prevent battery discharging • Prevents battery Discharging • Stops current flowing from the battery • To stop short circuit if terminals of solar cell are reversed It is not enough to repeat the answer for bii in biii. This is a higher skills question.	So that battery is completely charged Because conventional current flows from + to – Stops current flowing to battery	(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
3(c)(i)	18 x 0.070		(1)
	=1.26W or J/s or VA UP		(1)
	treat 18 x 70 = 1260 W as unit error so 1/ 2		

Question Number	Acceptable Answers Graduate	Reject	Mark
3(c)(ii)	0.070 x 4 x 60 x 60		(1)
	= 1008 C/ coulombs **UP**		(1)
	0.07 x 4=0.28 C or *0.07 x 4 x 60 = 16.8 C scores 1mark*		

Question Number	Acceptable Answers Graduate	Reject	Mark
3(c)(iii)	Working must be shown V across Resistor = 6V or 18-12 seen	18/.07 = 257 12/0.7 =171 257-171=86 This is wrong physics even if it reaches the same numerical answer 0/3	(1)
	R = V/I = 6/0.070		(1)
	= 85.7 (Ω) Must <u>see</u> at least 85.7 for this mark but accept any number of dp which would round to 85.7 eg 85.714285 or 85.71		(1)
	(Do not penalise incorrect rounding or truncation of a calculator display which rounds to 85.7)	86 does not score final mark	
	Allow 1 mark for use of incorrect voltage eg 18/0.070 = <u>257</u>(Ω) or 12/0.07=<u>171</u> (Ω)		

Question Number	Acceptable Answers Computer marked	Reject	Mark
3(d)(i)	X to Y		(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
3(d)(ii)	(electrons) <u>negative</u>(ly) (charge(d))	That's how the diode lets it	(1)
	opposite direction to <u>conventional</u> current/ move from negative to positive Accept convectional current	"As shown on diagram" scores 0/2 From solar cell to battery (or vice versa)	(1)

	Independent marks	Ignore electrons move from X to Y here	

Question Number	Acceptable Answers Expert	Reject	Mark
3(e)(i)	_y axis_ labelled <u>Power</u> (Output)/W or watt or watts or J/s and _x axis_ labelled <u>Angle</u> (degrees / ^{0}) (Do not penalise if there is no angle unit or if ^{0} is not clear)	J for power or incorrect units on Angle axis	**(1)**
	points plotted (To within ± 1 mm or ½ small square) (-1 each incorrect max – 2)		**(2)**
	If curve is drawn over dots which do not show up on screen award the marks if curve goes through correct positions		**(1)**
	curve through (or very close to) all points		
	(Judge by seeing if straight lines are used to join plots for points from 50 to 80 only as the plots from 30 to 50 are almost in a straight line)		

Question Number	Acceptable Answers Expert	Reject	Mark
3(e)(ii)	value in range 45° to 47° only **no UP**		**(1)**
	line across and or down <u>seen</u> at correct place (0.90 W ± 1mm) on graph		**(1)**
	If you enlarge the graph and still can't see a line across or down do not award that mark		

Total Q 3 20 Marks

Question Number	Acceptable Answers clerical	Reject	Mark
4(a)(i)	One point from list Same speed (in vacuum) Same velocity (in vacuum) 300 000 000 m/s (in vacuum) $3x10^8$ m/s (in vacuum) Can travel in a vacuum Do not need a medium to travel Transverse	speed on its own speed In air or glass charge wavelength frequency electricity and magnetism	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(a)(ii)	blue	Violet – candidate is asked if it is red or blue	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(a)(iii)	This mark is dependent on a correct answer to a(ii). If candidate gives red for a(ii) then neither mark is awarded. shorter wavelength smaller wavelength wavelength less than red **ora dop**	blue has higher frequency	**(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
4(a)(iv)	Gold or Au ORA for Ag <u>and</u> Al Accept glod		**(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
4(a)(v)	These two marks are dependent on Gold or correct ORA reason for <u>not</u> Ag <u>and</u> Al in 4a(iv) So Ag or Al separately in (iv) score 0/2 *Scores one mark for one non uniform reflection from points 1 to 5* 1. Not effective for entire visible region 2. Others reflect well across visible 3. Reflection is not uniform across spectrum 4. Reflects least visible light 5. Percentage reflection is not stable or lower (than Ag or Al) *Scores two marks for one response explaining non uniform reflection expanded eg points 6 to 10* **6.** Reflects red but would not reflect blue and green (well) 7. Poor reflection for 200 to 500 nm 8. Needs long wavelength for good reflection ORA **9.** Does not reflect well at short(er) wavelength **ORA** 10. In half of the visible spectrum it reflects little light	Reflects light less Gold is yellow Gold does not reflect light Ignore reference to parts outside visible spectrum	**(1)** **(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(a)(vi)	**E/left side** *f* inversely proportional to *λ* use of c=f *λ* has the smaller wavelength OWTTE **dop**	E is higher for second mark	**(1)** **(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(b)(i)	Change of direction of light or waves or bending of light or waves Only award if seen here	Dispersion splitting of light change of path does not reflect	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(b)(ii)	**Response from this list scores one mark** • Change of speed/ • Change of (Optical) density/ • Change of refractive index **Not dop** **Response from this list scores both marks** • Speeds up • Goes from more (optically) dense to less dense • Goes from higher RI to lower RI	Because of coating Change of wavelength Critical angle	**(1)** **(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(b)(iii)	Requires an answer which implies that <u>some</u> light passes through the glass e.g. • (Sufficient/some) light gets through • Light capable of getting through • <u>Not all</u> light reflected • (Some) light refracted through • Because the ray from the bright room gets through • Light from bright room enters his eye	Ignore Light gets refracted Light does not reflect Some light gets reflected to dark room Glass is transparent (Almost) <u>all</u> the light is reaching the dark room	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(b)(iv)	Requires an answer which implies that little light passes into the dark room or that there is no light source to reflect off objects and pass back through the glass or that the image formed by objects in the bright room are much brighter than those in the dark room. • Not enough light gets through • Reflected light (much) brighter than transmitted light • No light <u>source</u> in dark room • No light <u>produced</u> in dark room • <u>Less</u> light refracted through	TIR Ignore <u>no</u> light gets through Ignore no light in dark room Reject less light reflected <u>to</u> dark room	**(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
4(b)(v)	We must see an application of this sort of glass so mirror is not acceptable • Privacy • One way glass • For interrogation on police stations • Spying • (Reflective) sunglasses • Tinted glass in car windows	Mirror To stop light entering Car windows Eye hole in door Windows	**(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
4(c)(i)	$1.65 = \sin 63 / \sin D$ $D = 33 / 32.7 / 32.68$ no **UP** Accept any number of dp which would round up to 33 eg 32.6839 or 32.683 or 32.6 (Do not penalise incorrect rounding or truncation of a calculator display which rounds to 33) Final answer depends on whether candidate uses value for 1/1.65 in calculator or rounds it before final calculation	$D= 63/1.65 = 38.1$ $D=65/1.65 = 39.4$ $1.65 = \sin 65/\sin D$ so $D=33.3$	(1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
4(c)(ii)	$\sin c = 1/1.65$ $c = 36.8/ 36.9 / 37 / 37.3/ 37.31$ no **UP** Accept any number of dp which would round to 37 eg 37.3052009 or 37.305 (Do not penalise incorrect rounding or truncation of a calculator display which rounds to 37) Final answer depends on whether candidate uses value for 1/1.65 in calculator or rounds it before final calculation	$1.65 = 1/\text{critical angle}$ $1.65 = c/63;\ c=104^0$ $c=1/\sin 1.65 =35^0$ $\sin c=1/1.63= 37.8$	(1) (1)

Question Number	Acceptable Answers Graduate	Reject	Mark
4(d)	One mark for TIR/ total internal reflect(ion) (<u>must</u> see in this form) One mark for response from • (Hits at) angle greater than the critical angle (ignore an incorrect number <43 if > critical angle seen) • $i >c$ • Because i > 42.6 or 43	Internal refraction Total internal refraction Internal reflection Fully internal reflection Because it has no coating i = r Light enters the prism at 90^0 Incident at 45^0 Critical angle greater than incident angle	(1) (1)

Total Q 4 20 Marks

Question Number	Acceptable Answers Graduate	Reject	Mark
5(a)(i)	- Current in both directions - Current in two directions - Changes direction - Current in positive and negative directions - Flows backwards and forwards - Reverses direction/ polarity Accept electron (flow) instead of current Accept a sketch graph of a sine(ish) line crossing the axis	Moves in all directions current changes changes polarity Has an alternating magnetic field	(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
5(a)(ii)	- Changing/ different direction of magnetic lines (over any specified time) - Lines reverse directions - Goes clockwise <u>and</u> anticlockwise	Anticlockwise (only) Changing (without directions) Opposite direction	(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
5(a)(iii)	50 cycles per second 50 oscillations per second 50 changes of direction per second - Accept 50 vibrations per second - Accept 50 waves in one second - Accept changes polarity 50 times a second here	<u>Changes</u> 50 times per second 50 times the current passes Frequency is 50 Hz Goes left and right Is the SI unit of frequency	(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
5(a)(iv)	One mark for (Changing) flux (Changing) magnetic field - Magnetic lines cut One mark for induction - <u>Induced</u> current/voltage/emf (in ring) - Electromagnetic induction happens	Ignore metal is a good conductor Ignore ring becomes a magnet Current flows from wire to ring Charge induced	(1) (1)

Question Number	Acceptable Answers clerical	Reject	Mark
5(b)(i)	Oscilloscope Cathode ray oscilloscope CRO Frequency meter Accept phonetic spelling	Battery watch (stop)clock voltmeter ammeter multimeter	(1)

Question Number	Acceptable Answers Graduate	Reject	Mark
5(b)(ii)	Frequency Current /ammeter reading Mark independently from b(iii)	size of wire voltage The Hz or the I Amps	(1) (1)

Question Number	Acceptable Answers Graduate	Reject	Mark
5(b)(iii)	Voltage / potential difference/ PD power supply Resistance /resistor Mark independently from b(ii)	Ignore temperature Time The wire current Light intensity	(1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
5(b)(iv)	This is an unfamiliar experiment to the candidates so award marks from list below when seen. Ignore irrelevant details that do not contradict the acceptable points. **Maximum 4 marks** 1. Clamp ammeter around wire 2. Switch on (current)/ close switch 3. Note/ measure/ calculate <u>frequency</u> 4. Note/ measure/ calculate <u>current</u> 5. Change frequency once 6. Note new current 7. Repeat (for a given frequency or another frequency or more than two frequencies or other current(s))	Ignore Take readings of oscilloscope Read voltage <u>connect</u> ammeter to circuit	 (1) (1) (1) (1) (1) (1) (1)

Question Number	Acceptable Answers Expert	Reject	Mark
5(b)(v)	*Does not need to draw a table* **Frequency and current** Accept frequency reading and /or ammeter reading Correct units Hz or c/s or /s plus A or a **dop**	Ignore additional headings (do not award unit mark for incorrect units on any additional columns)	**(1)** **(1)**

Question Number	Acceptable Answers Expert	Reject	Mark
5(c)	**Advantage one point from** • Do not need to disconnect/disturb the circuit to connect ammeter • No need to attach it to circuit • Easy to fix to circuit/ can be attached and /or removed as needed **Disadvantage one point from** • Only be able to measure a.c • Only works with a.c. • Cannot use with dc	Ignore Accurate Portable Easy to use/ take readings Can measure both ac and dc Can measure ac "Less chance of shocks" "Gives a constant reading even though the current is changing direction" Large size Expensive Inaccurate Jaws squeeze wire High resistance Not zero resistance	**(1)** **(1)**

Question Number	Acceptable Answers Graduate	Reject	Mark
5(d)	As *f* inc *I* inc / Allow current is (directly) proportional to f for first mark only Current reaches a <u>peak</u> at 50 Hz or Falls <u>after</u> 50 Hz	Ignore current is not proportional to frequency Current <u>and</u> frequency decrease after (50 Hz)	**(1)** **(1)**

Total Q 5 20 Marks

TOTAL FOR PAPER: 100 marks