Markscheme

May 2017

Physics

Standard level

Paper 2

12 pages

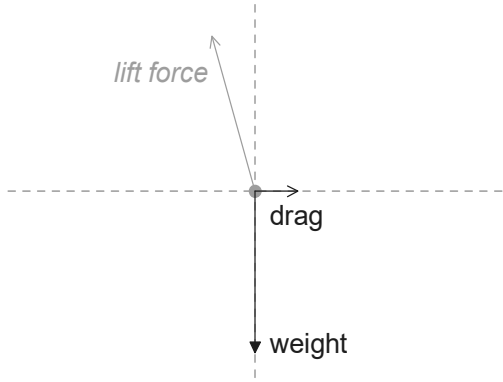| Question			Answers	Notes	Total
1.	a		correct use of kinematic equation/equations ✓ 148.5 *or* 149 *or* 150 «m» ✓	*Substitution(s) must be correct.*	**2**
	b		$a = \dfrac{27}{11}$ *or* 2.45 «m s^{-2}» ✓ $F - 160 = 492 \times 2.45$ ✓ 1370 «N» ✓	*Could be seen in part (a).* *Award **[0]** for solution that uses a =9.81 m s^{-2}*	**3**

(continued…)

(Question 1 continued)

Question		Answers	Notes	Total
c		**ALTERNATIVE 1** «work done to launch glider» $= 1370 \times 149$ « $= 204$ kJ» ✔ «work done by motor» $= \dfrac{204 \times 100}{23}$ ✔ «power input to motor» $= \dfrac{204 \times 100}{23} \times \dfrac{1}{11} = 80$ *or* 80.4 *or* 81 k«W» ✔ **ALTERNATIVE 2** use of average speed $13.5 \, \mathrm{m\,s^{-1}}$ ✔ «useful power output» $=$ force $\times$ average speed « $= 1370 \times 13.5$» ✔ power input $=$ « $1370 \times 13.5 \times \dfrac{100}{23} =$ » 80 *or* 80.4 *or* 81 k«W» ✔ **ALTERNATIVE 3** work required from motor $=$ KE $+$ work done against friction « $= 0.5 \times 492 \times 27^2 + (160 \times 148.5)$» $= 204$ «kJ» ✔ «energy input» $= \dfrac{\text{work required from motor} \times 100}{23}$ ✔ power input $= \dfrac{883000}{11} = 80.3$ k«W» ✔	*Award [2 max] for an answer of 160 k«W».*	**3**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
d			$\omega = \text{«}\dfrac{v}{r} = \text{»} \dfrac{27}{0.6} = 45$ ✔ rad s^{-1} ✔	*Do not accept Hz.* *Award [1 max] if unit is missing.*	**2**
e			*direction of motion* ← *lift force* drag weight drag correctly labelled and in correct direction ✔ weight correctly labelled and in correct direction **AND** no other incorrect force shown ✔	*Award [1 max] if forces do not touch the dot, but are otherwise OK.*	**2**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
	f		name Newton's first law ✔ vertical/all forces are in equilibrium/balanced/add to zero ***OR*** vertical component of lift mentioned ✔ as equal to weight ✔		**2 max**
	g		any speed and any direction quoted together as the answer✔ quotes their answer(s) to 3 significant figures ✔ speed $= 12.7$ m s^{-1} ***or*** direction $= 9.46°$ ***or*** 0.165 rad «below the horizontal» ***or*** gradient of $-\dfrac{1}{6}$ ✔		**3**

Question			Answers	Notes	Total
2.	**a**		PE of water is converted to KE of moving water/turbine to electrical energy «in generator/turbine/dynamo» ✔ idea of pumped storage, *ie*: pump water back during night/when energy cheap to buy/when energy not in demand/when there is a surplus of energy ✔		**2**
	b		total energy $= «\,2.7 \times 10^3 \times 1.5 \times 10^{10} = »\; 4.05 \times 10^{13}$ «J» ✔ time $= «\,\dfrac{4.0 \times 10^{13}}{4 \times 2.5 \times 10^8} = »\; 11.1\text{h}$ *or* 4.0×10^4 s ✔	*For MP2 the unit **must** be present.*	**2**
	c		friction/resistive losses in walls of pipe/air resistance/turbulence/turbine and generator bearings ✔ thermal energy losses, in electrical resistance of components ✔ water requires kinetic energy to leave system so not all can be transferred ✔	*Must see "seat of friction" to award the mark. Do not allow "friction" bald.*	**1 max**
	d		area required $= \dfrac{1 \times 10^9}{0.22 \times 180}\; «\,= 2.5 \times 10^7\,\text{m}^2\,»$ ✔ length of one side $= \sqrt{\text{area}} = 5.0\,\text{k«m»}$ ✔		**2**

Question			Answers	Notes	Total
3.	a		«light» superposes/interferes ✓ pattern consists of «intensity» maxima and minima **OR** consisting of constructive and destructive «interference» ✓ voltage peaks correspond to interference maxima ✓		3
	b	i	« $s = \dfrac{\lambda D}{d} = \dfrac{6.3 \times 10^{-7} \times 5.0}{1.5 \times 10^{-3}} =$ » 2.1×10^{-3} «m» ✓	*If no unit assume m.* *Correct answer only.*	1
	b	ii	correct read-off from graph of 25 m s ✓ $v =$ « $\dfrac{x}{t} = \dfrac{2.1 \times 10^{-3}}{25 \times 10^{-3}} =$ » 8.4×10^{-2} «m s^{-1}» ✓	*Allow ECF from (b)(i)*	2

(Question 3 continued)

Question			Answers	Notes	Total
	c		**_ALTERNATIVE 1_** «reflection at barrier» leads to two waves travelling in opposite directions ✔ mention of formation of standing wave ✔ maximum corresponds to antinode/maximum displacement «of air molecules» **_OR_** complete cancellation at node position ✔		**2 max**

	Question		Answers	Notes	Total
4.	a		222 **AND** 4 ✔	*Both needed.*	1
	b		alpha particles highly ionizing **OR** alpha particles have a low penetration power **OR** thin glass increases probability of alpha crossing glass **OR** decreases probability of alpha striking atom/nucleus/molecule ✔		1
	c		conversion of temperature to 291 K ✔ $p = 4.5 \times 10^{-9} \times 8.31 \times \text{«} \dfrac{291}{1.3 \times 10^{-5}} \text{»}$ **OR** $p = 2.7 \times 10^{15} \times 1.38 \times 10^{-23} \times \text{«} \dfrac{291}{1.3 \times 10^{-5}} \text{»}$ ✔ 0.83 *or* 0.84 «Pa» ✔	*Allow ECF for 2.7×10^{15} from (b)(ii).*	3

(Question 4 continued)

Question			Answers	Notes	Total
	d		electron/atom drops from high energy state/level to low state ✓ energy levels are discrete ✓ wavelength/frequency of photon is related to energy change **or** quotes $E = hf$ **or** $E = \dfrac{hc}{\lambda}$ and is therefore also discrete ✓		**3**
	e		peer review guarantees the validity of the work **OR** means that readers have confidence in the validity of work ✓	*OWTTE*	**1**

Question			Answers	Notes	Total
5.	**a**		when an electric field is applied to any material «using a cell etc» it acts to accelerate any free electrons ✓ electrons are the charge carriers «in copper» ✓ metals/copper have many free electrons whereas insulators have few/no free electrons/charge carriers ✓	*Accept "free/valence/delocalised electrons".*	**3**
	b	**i**	$\text{area} = \dfrac{1.7 \times 10^{-3} \times 35 \times 10^{3}}{64}$ «$= 9.3 \times 10^{-6}\,\text{m}^2$» ✓		**2**
	b	**ii**	«resistance of cable $= 2\,\Omega$» power dissipated in cable $= 730^{2} \times 2$ «$= 1.07\,\text{MW}$» ✓ power loss per meter $= \dfrac{1.07 \times 10^{6}}{35 \times 10^{3}}$ *or* 30.6 «W m^{-1}» ✓	*Allow **[2]** for a solution where the resistance per unit metre is calculated using resistivity and answer to (b)(i) (resistance per unit length of cable $= 5.7 \times 10^{-5}\,m$)*	**2**
	b	**iii**	$30 = m \times 390 \times 3.5 \times 10^{-2}$ ✓ $2.2\,\text{k}$«g» ✓	*Correct answer only.*	**2**