PEARSON EDEXCEL IGCSE PHYSICS · 4PH1

PHYSICS



MARK SCHEME

SECTION 1: FORCES AND MOTION (PACK 3)

SCORE	PERCENTAGE
/138	%

STEMUP

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(Total for question = 8 marks)

Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a)	both have magnitude; (only) vectors have a direction;		2
(b)	charge; power; temperature;	if 4 circled, 2 marks max. if 5-6 circled, 1 mark max. no marks if all circled	3
(c)	(resultant force =) 6 (N); (direction =) left;	ignore sign allow indication of same direction as 8 (N) force condone West	2

Q2.

Question number	Answer	Notes	Marks
(a) (i)	reflection;		1
(ii)	substitution into speed = distance / time;	ignore units condone incorrect conversion of time from 43 ms i.e. 43, 43/60, 43 × 1000, 43 × 60	4
	rearrangement; evaluation of correct total distance; halved to find distance to fish;	accept wherever applied i.e. to the time or to the distance travelled.	
	e.g. 1500 = distance / 0.043 distance = speed × time (distance =) 64.5 (distance = 64.5 ÷ 2) = 32 (m)	64.5, 65 = 3 marks (no halving) 32250 etc = 3 marks (POT) 64500 etc = 2 marks (POT and no halving)	
(b) (i)	3.0 ± 0.5 (cm);	accept '3'	1
(ii)	any three from: MP1. all frequencies show reduction in amplitude or intensity with distance; MP2. this reduction is non-linear; MP3. penetration decreases with increasing frequency; MP4. use of data from graph to justify MP3;	ignore 'inverse proportion' condone '(negative) exponential' however expressed e.g. 2MHz penetrates more than 4 MHz which penetrates more than 10MHz e.g. relative values at a given distance or distances at which the frequencies are at a given value	3

Q3.

Question number	Answer	Notes	Marks
(a) (i)	(average) speed = distance / time;	allow standard symbols and rearrangements e.g. v = s/t allow s for speed and d for distance	1
(ii)	substitution; evaluation; e.g. (speed =) 1860 / 5.6 (speed =) 330(m/s)	 allow 332.14...(m/s)	2
(iii)	light travels faster than sound; he sees explosion before hearing it;	allow idea that they travel at different speeds but not that sound travels faster Allow RA	2
(b)	vibrations (of particles) are parallel; to direction the wave travels;	allow oscillations for vibrations DOP allow direction of energy transfer	2
(c) (i)	kinetic energy = ½ × mass × speed^2;	allow standard symbols and rearrangements e.g. KE = ½ × m × v^2	1
(ii)	substitution; evaluation; e.g. (KE =) 0.5 × 1.25 × 10^7 × 19200^2 (KE =) 2.30 × 10^{15} (J)	 -1 for POT error allow 2.304 × 10^{15} (J)	2

Q4.

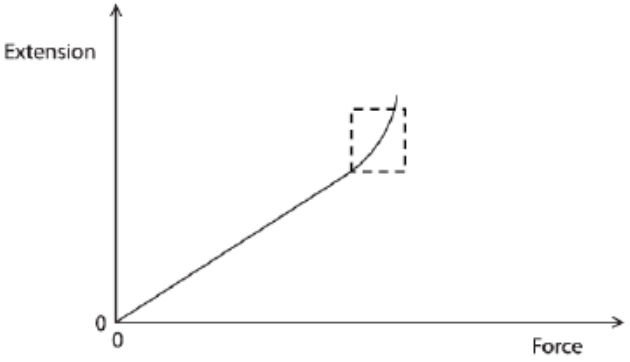
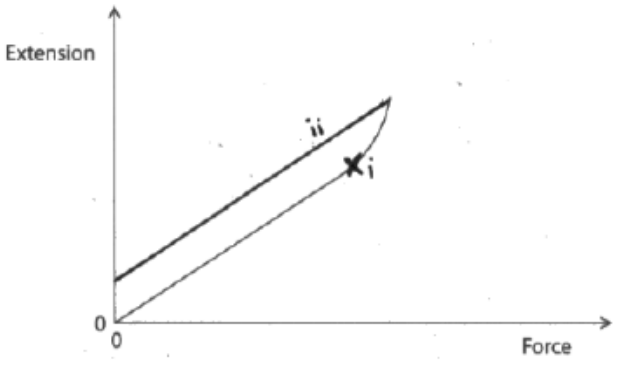
Question number	Answer	Notes	Marks
(a)	substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. $v^2 = 0 + (2 \times 10 \times 18)$ $v = \sqrt{360}$ (v =) 19 (m/s)	allow alternative method involving changing GPE lost = KE gained e.g. sub into mgh = ½mv² allow use of 9.8, 9.81 for *g* allow 18.8, 18.78..., 18.79...,18.97... (m/s)	3
(b) (i)	kinetic energy = ½ × mass × speed²;	allow rearrangements and standard symbols e.g. KE = ½ × m × v²	1
(ii)	substitution; evaluation; e.g. (KE =) 0.5 × 2100 × 19² (KE =) 380 000 (J)	allow ECF from (a) allow alternative method involving changing GPE lost = KE gain allow 370 000-372 000 from *g* = 9.8, 9.81 allow 400 000, 378 000, 379 000 1 mark only for not converting tonnes to kg e.g. KE = 380 (J), 378 (J)	2

(c)	idea that energy is transferred from a gravitational (store) to a kinetic (store); idea that energy is transferred to a thermal (store) of {car / shaft / surroundings}; idea that energy is transferred mechanically; idea that energy is transferred by radiation / by heating;	allow answers in terms of types of energy rather than stores and transfers allow GPE to KE allow heat for thermal allow energy transferred due to a named force e.g. gravity, friction allow energy transferred as sound	4
		Total for Question = 10 marks	

Q5.

Question number	Answer	Notes	Marks
(a) (i)	B, D, F;	all required for the mark reject if additional sections listed	1
(ii)	use of speed = distance / time;	seen anywhere allow symbols allow attempt to find gradient of line	4
	correctly read time or distance from graph; conversion from minutes to seconds or km to m; correct evaluation; e.g. v = s / t distance = 2.6 km or time = 2 minutes distance = 2600 m or time = 120 s (v =) 22 (m/s)	 allow s = d / t allow 21.7, 21.6... (m/s) 0.0216..., 1300 = 3 marks 1.3 = 2 marks	
(iii)	idea that speed of bus is greater in section A; (because) line is steeper / gradient is larger / eq;		2
(b)	single horizontal line drawn; horizontal line drawn at 0.5 km/minute for some period of time in journey;	judge by eye line must extend the entire length of the time axis	2

Q6.

Question number	Answer	Notes	Marks
(a) (i)	cross drawn on line in region shown;  	cross cannot be drawn at the extreme upper end of the curved line	1
(ii)	any line drawn above and starting at the end of the original that shows a reduction in extension as the force is decreased; line drawn is straight and returns to the extension axis above the origin;  	DOP judge straightness by eye	2

(b)	(i)	elastic (potential);	1
	(ii)	C (mechanically); A is incorrect because there is no electrical circuit B is incorrect because there is no temperature difference D is incorrect because transfers by radiation do not involve forces	1

Q7.

Question number	Answer	Notes	Marks
(a)	any THREE from: MP1 measure time: MP2 idea of measuring time at each mark; MP3 repeat and average (time measurement(s)); MP4 calculate speed MP5 (average) speed = distance/time; PLUS MP6 suggestion of suitable graph e.g.speed or velocity against; MP7 correct identification of how to obtain acceleration from the graph;	REJECT idea of final speed = total distance/time taken No reference to a suitable graph limits score to a maximum of 3 marks	5
(b)	any one from: human reaction time would give wrong time interval; ball may not travel in a straight line; difficult to tell when ball crosses marking;		1

Q8.

Question number	Answer	Notes	Marks
(a)	any attempt at gradient/reference to correct formula; substitution of values from graph; evaluation; e.g. acceleration = change in velocity/time taken acceleration = (-)45 / 39 acceleration = (-)1.2 (m/s^2)	check graph for evidence of working ignore minus sign allow 1.1-1.2 (m/s^2)	3
(b)	any attempt at or reference to an area; correct attempt = ½ × 45 × 39; correct evaluation; e.g. distance travelled = area under graph distance = $^1/_2 \times 45 \times 39$ distance = 880 (m)	allow alternative method using $v^2 = u^2 + 2as$ with answer from (a) allow ECF of incorrect velocity or time reading if also used in (a) allow 878, 877.5 (m)	3
(c)	line showing decreasing velocity from same initial velocity as existing line; line drawn is less steep than existing line throughout;		2
		Total for Question = 8 marks	

Q9.

Question number	Answer	Notes	Marks
(a)	value of braking distance correctly read from graph; substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. braking distance = 78 m $0 = 35^2 + (2 \times a \times 78)$ $(a =) (-) 35^2 / (2 \times 78)$ $(a =) (-) 7.9 (m/s^2)$	allow 77-79 m allow ecf incorrect distance allow 7.75... - 7.95...(m/s^2)	4
(b)	any five from: MP1. thinking distance OR braking distance increases as (initial) speed increases; MP2. braking distance increases by a greater amount than thinking distance for the same increase in (initial) speed; MP3. thinking distance is (directly) proportional to (initial) speed; MP4. braking distance has a non-linear relationship with (initial) speed; MP5. idea that braking distance is proportional to (initial) speed squared; MP6. suitable use of data to justify thinking distance relationship; MP7. suitable use of data to justify braking distance relationship;	 e.g. gradient of braking distance graph larger than gradient for thinking distance e.g. when initial speed doubles, the braking distance is four times greater / eq. e.g. reading off thinking distance for two values of initial speed and showing they increase by the same factor e.g. reading off braking distance for two values of initial speed and showing they do not increase by the same factor	5

Q10.

Question number	Answer	Notes	Marks
(a)	40 000 {waves / vibrations / oscillations}; in 1 second / unit time;	allow 40 000 wavelengths / wavefronts allow per second	2
(b) (i)	(wave) speed = frequency × wavelength;	allow standard symbols and rearrangements e.g. $\lambda = v / f$ condone s for speed ignore incorrect symbols e.g wl for wavelength, ws for wave speed	1
(ii)	substitution; rearrangement; evaluation; e.g. $345 = 40\,(000) \times \lambda$ $\lambda = 345/40\,(000)$ $(\lambda =)\ 8.6 \times 10^{-3}$ (m)	POT error = -1 correct answer with no working gains full marks 8.6, 8.62, 8.63, 8.625 = 2 marks allow 9×10^{-3}, 8.62×10^{-3}, 8.63×10^{-3}, 8.625×10^{-3} (m)	3
(iii)	use of speed = distance/time seen or implied; factor of 2 seen; substitution; evaluation; e.g. speed = distance/time distance should be doubled $345 = 4.70 \div$ time (time =) 0.0136 (s)	allow any rearrangement or in correct symbols allow d, s, x for distance allow v for speed condone s for speed 0.007, 0.0068... scores 3 marks (no factor of 2 used) allow 0.01, 0.014, 0.01362... (s)	4

(c)	idea that the person can see/know what (distance) they are measuring/eq;	e.g. marks the position that (distance) is being measured to	1
(d)	any three from: MP1. sound is longitudinal light is transverse; MP2. sound vibrations are in the direction of travel, light vibrations are perpendicular to the direction of travel; MP3. light is electromagnetic, sound is not; MP4. light can travel through a vacuum/space, sound cannot; MP5. light travels (much) faster (in air) than sound; MP6. light slows down in denser medium but sound speeds up;	allow points shown on a labelled diagram allow higher level ideas i.e. light can be polarised but sound can't allow reverse argument (RA) for all marking points can be given from diagram showing longitudinal and transverse waves allow oscillations, displacements for vibrations allow direction of energy transfer for direction of travel allow sound is mechanical, light is not allow sound needs a medium but light does not allow quoted speeds for comparison	3
		Total for Question = 14 marks	

Q11.

Question number	Answer	Notes	Marks
(a) (i)	downward arrow labelled weight; downward arrow is equal in length to upthrust arrow;	ignore starting point of arrow allow 'gravitational force', 'force due to gravity' reject 'gravity' judge by eye	2
(ii)	(a quantity with) magnitude; and direction;	allow size, amount ignore quantity, measurement	2
(iii)	any correct vector; e.g. velocity, displacement, acceleration, momentum etc.	ignore force, any named force e.g. weight, upthrust etc	1
(b) (i)	pressure (difference) = height × density × g;	allow standard symbols and rearrangements e.g. $p = h \times \rho \times g$ allow d for density ignore "gravity" for g	1
(ii)	substitution; evaluation of pressure difference in Pa OR kPa to at least 3s.f.; addition of surface pressure (100 kPa) to give answer; e.g. $p = 15.8 \times 1030 \times 10$ $p = 162740$ Pa OR 162.74 kPa $p = 162.74 + 100$ (= 260 kPa)	allow g = 9.8, 9.81 -1 for POT error unless due to physics error reject this mark if inconsistent units used allow final answer in Pa or kPa allow 262 740 (Pa)	3
(iii)	any two from: MP1. idea that {weight of ship / downwards force} is greater; MP2. larger pressure difference (when deeper in water); MP3. larger upthrust force (needed to keep forces balanced);	allow ship is heavier, ship has more mass allow larger pressure (on bottom of ship)	2

Q12.

Question number	Answer	Notes	Marks
(a)	any attempt at finding the area/ "area = distance" stated; area of triangle = ½ x 4.3 x 0.2 (= 0.43 m); area of rectangle = 4.3 x 0.2 (= 0.86 m); distance = 1.29 (m) ;	 accept area of trapezium = ½ x 4.3 x (0.2 + 0.4) for MP2 and MP3. count squares; area of 1 square = 0.001 (m); distance = 1.29 (m)	4

(b) (i)	idea that acceleration = gradient;
	gradient = (-)4.3 / 0.05;
	acceleration = (-) 86 (m/s^2);
		
		-1 for POT error
			3

(ii)	(resultant) force = mass x acceleration / F = ma		1
(iii)	substitution; evaluation; eg F = 0.13 x 86 F = 11 (N)	 allow ECF from (i) ignore sign 11.18, 11.2	2
(c)	increases time of collision; any reference to shallower gradient on graph; so acceleration will be smaller (in magnitude);		3
		(Total for Question = 13 marks)	

Q13.

Question number	Answer	Notes	Marks
(a) (i)	acceleration = change in velocity / time;	allow rearrangements and standard symbols e.g. a = v-u / t, a = Δv/t, a = Δv/Δt	1
(ii)	substitution; rearrangement; evaluation; e.g. 1.2 = (35 - 26) / t t = 9 / 1.2 (t =) 7.5 (s)		3
(b)	any four from: MP1. frequency increases; MP2. due to Doppler effect; MP3. idea that car behaves as the source of the (reflected) waves; MP4. (reflected) wavefronts closer together; MP5. (reflected) wavelength decreased; MP6. speed (of waves) stays constant;	 allow "waves become bunched up" allow quotation of $v = f \times \lambda$	4

Q14.

Question number	Answer	Notes	Marks
(a) (i)	use of acceleration = change in velocity / time; substitution; evaluation; e.g. acceleration = change in velocity / time acceleration = (-)30 / 6.2 (acceleration =) (-)4.8 (m/s^2)	seen anywhere in working allow clear indication that acceleration is gradient ignore minus sign allow (-)4.8 to (-)5.0 (m/s^2)	3
(ii)	clear indication that distance is area under line; understanding braking distance is area of triangle section only; evaluation; e.g. distance = area distance = 0.5 × 30 × 6.2 (distance =) 93 (m)	 54 (m) = 1 mark 147 (m) = 2 marks accept alternative method using ecf answer from (a)(i) and $v^2 = u^2 + 2as$ giving 93.75 (m)	3
(iii)	thinking distance: increase in thinking distance; (due to) increased reaction time; braking distance: no effect on braking distance; (due to) no effect on braking time / braking force;	 allow idea that braking distance does not depend on human factors	4

(b)	A; B is incorrect because it does not show deceleration C is incorrect because the distance cannot change abruptly and the car is moving throughout D is incorrect because the first portion shows that the car is not moving		1
		Total for Question = 11 marks	

Q15.

Question number	Answer	Notes	Marks
(a)	use of $v^2 = u^2 + 2as$; substitution; rearrangement; evaluation; e.g. $v^2 = u^2 + 2as$ $v^2 = (0) + 2 \times 10 \times 2.2$ $v = \sqrt{44}$ (v =) 6.6 (m/s)	seen anywhere in working allow use of g=9.8, 9.81 allow alternative method using $mgh = {}^1/_2mv^2$ final answer of 44 (m/s) is 2 marks only allow 6.63...(m/s), 6.56...(m/s) 6.5 scores 3 marks only	4
(b) (i)	vertical arrow drawn upwards;	ignore labels reject if more than one arrow drawn unless resultant force is clearly labelled	1
(ii)	substitution into F = ma; rearrangement; evaluation; e.g. $18000 = 4100 \times a$ $a = 18000 / 4100$ (a =) 4.4 (m/s^2)	 -1 for POT error allow 4.39...(m/s^2)	3
		Total for Question = 8 marks	