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Mark Scheme (Results)

GCE

GCE 08 Physics (6PH01/01)

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Mark scheme notes

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] ✓ **1**
[Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

1. Mark scheme format

1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'
1.2 Bold lower case will be used for emphasis.
1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally cause the final calculation mark to be lost.
2.2 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.
2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given.
2.4 The same missing or incorrect unit will not be penalised more than once within one question.
2.5 Occasionally, it may be decided not to penalise a missing or incorrect unit e.g. the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.
2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. Significant figures

3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.

4. Calculations

4.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

4.2 If a 'show that' question is worth 2 marks then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.

4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

4.5 The mark scheme will show a correctly worked answer for illustration only.

4.6 Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H ✓

Substitution into density equation with a volume and density ✓

Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] ✓
[If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark]
[Bald answer scores 0, reverse calculation 2/3] **3**

Example of answer:

80 cm × 50 cm × 1.8 cm = 7200 cm^3

7200 cm^3 × 0.70 g cm^{-3} = 5040 g

5040 × 10^{-3} kg × 9.81 N/kg

= 49.4 N

5. Quality of Written Communication

5.1 Indicated by QoWC in mark scheme. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.

5.2 Usually it is part of a max mark.

6. Graphs

6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

6.4 Points should be plotted to within 1 mm.

- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

6.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Unit 1 6PH01_01

Question Number	Answer	Mark
1	A	**1**
2	C	**1**
3	B	**1**
4	B	**1**
5	A	**1**
6	D	**1**
7	C	**1**
8	B	**1**
9	C	**1**
10	B	**1**

Question Number	Answer	Mark
11(a)	Show that the resultant force on the rocket is about 4×10^6 N Use of $W = mg$ (1) State or use resultant force = upward force – weight (1) Correct answer to at least 2 s.f. [4.2×10^6 N] (1) [no ue] **Example of calculation** W = mg $W = 3.04 \times 10^6$ kg x 9.81 kg m s^{-2} $= 2.98 \times 10^7$ N Resultant force = 3.4×10^7 N – 2.98×10^7 N = 4.2×10^6 N	**3**
11(b)	Calculate the initial acceleration. Use of $F = ma$ (1) Correct answer [1.38 m s^{-2}] (1) [ecf] **Example of calculation** $a = F/m$ $= 4.2 \times 10^6$ N / 3.04×10^6 kg = 1.38 m s^{-2}	**2**
11(c)	Calculate the average acceleration. Use of $v = u + at$ (1) Correct answer [15.9 m s^{-2}] (1) [beware same unit error as part b not penalised] **Example of calculation** $a = (v - u) / t$ = (2390 m s^{-1} – 0) / 150 s = 15.9 m s^{-2}	**2**
11(d)	Suggest a reason for the difference in the values of acceleration calculated. e.g. Mass decreasing / weight decreasing / net upward force increasing / fuel used up / gets lighter / *g* decreasing / air resistance decreasing with altitude (1)	**1**
	Total for question	**8**

Question Number	Answer	Mark
12 (a)	Explain what is meant by each of the following terms limit of proportionality – stress proportional to strain / obeys Hooke's law / Force proportional to extension up to this point (1) tensile strength – greatest stress before fracturing (1) yield point – point at which plastic deformation begins / point at which material shows a larger increase in strain for a smaller increase in stress (1)	**3**
12 (b)	Mark 'limit of proportionality' and the 'yield point' on the graph. L shown at end of linear part (1) Y shown beyond L and up to maximum stress (1)	**2**
	Total for question	**5**

Question Number	Answer	Mark
13(a)	Describe what is meant by: laminar flow – no abrupt change in direction or speed of flow / air flows in layers/ flowlines/ streamlines with no mixing (1) turbulent flow – mixing of layers / contains eddies / abrupt changes in speed or direction (1)	**2**
13(b)	Add to the diagram laminar flow shown - at least 3 continuous lines (1) turbulent flow shown – eddies / layers crossing over (1)	**2**
3(c)	Explain how this would increase the range of the ball. (smaller area of turbulent flow →) less resistive force (1) Less kinetic energy dissipated / kinetic energy dissipated at lower rate / less work done against air resistance / less deceleration (1)	**2**
	Total for question	**6**

Question Number	Answer	Mark
14(a)	What is meant by Newton's first law. reference to constant velocity OR rest and uniform motion in a straight line (1) reference to zero resultant force / unbalanced force (1) (examples: $\Delta v = 0$ if $\Sigma F = 0$; $\Delta v = 0$ unless $\Sigma F \neq 0$)	**2**
14(b) (i)	State 2 ways in which the forces in the pair are identical. 2 of magnitude, type of force, line of action, time of action (1) (1)	**2**
14(b) (ii)	State 2 ways in which the forces in the pair differ. <u>Opposite</u> direction, act on different bodies (1) (1)	**2**
14(b) (iii)	Describe the force that Newton's third law identifies as the pair of this force. <u>car</u> exerts <u>upward/ opposite</u> force on <u>Earth</u> (the different points) (1) <u>gravitational</u> and <u>12 000 N/ equal</u> (the identical points) (1) [no ue]	**2**
	Total for question	**8**

Question Number	Answer	Mark
15a	Describe how you could measure *g* **QWC – Work must be clear and organised in a logical manner using technical wording where appropriate** Max 6 marks state sufficient quantities to be measured (e.g. *s* and *t* OR *v*, *u* and t OR *u, v* and *s*)) (1) relevant apparatus (includes ruler and timer/ data logger/ light gates) (1) describe how a distance is measured (1) describe how a speed or time is measured (1) further detail of measurement of speed or time (1) vary for described quantities and plot appropriate graph (1) state how result calculated (1)	**Max 6**
15b	repeat and mean (one mark max for any relevant quantity/ result) (1) Precaution – a precaution relating to experimental procedure (1)	**1**
	Total for question	**7**

Question Number	Answer	Mark
16(a)	Calculate the resistive forces State component of $T = T\cos\theta$ (1) Correct answer [1120 N] (1) **Example of calculation** $T = T\cos\theta$ = 1150 N x cos 12° = 1125 N Therefore resistive forces = 1125 N	**2**
16(b)	Calculate the work done on the boat by the horse Use of $\Delta W = F\Delta s$ (1) Correct answer [558 000 J] (1) [ecf] **Example of calculation** $\Delta W = F\Delta s$ = 1125 N x 500 m =560 000 J	**2**
16(c)	Explain using a longer rope Longer rope → smaller angle (1) cos theta then larger / need smaller force (for same component acting on boat) (1)	**2**
	Total for question	**6**

Question Number	Answer	Mark
17(a)	Correct the diagram Parabolic path shown (1) [allow for moderate effects of air resistance]	**1**
17b)	Explain why a projectile follows the path you have drawn. state horizontal speed constant / air resistance negligible (1) horizontal motion independent of vertical motion / unaffected by gravity (1) state downwards acceleration / downward force acting / gravity acts on vertical motion (1)	**3**
17(c)	Explain why the balloon follows this path. **QWC – Work must be clear and organised in a logical manner using technical wording where appropriate** Air resistance high (1) so balloon decelerates horizontally also (1) from max height/ when speed zero it falls (vertically) (1)	**3**
	Total for question	**7**

Question Number	Answer	Mark
18(a)	Add labelled arrows to show the other forces on the submarine. Label upthrust, weight and viscous drag: 3 correct (2), 1 or 2 correct (1) (Accept unambiguous single letter labels, e.g. U, W and V/ F/ D/ VD) (Accept *mg* for weight but do not accept 'gravity')	**2**
18(b)	State two equations to show the relationship between the forces Upthrust = (-)Weight (1) Thrust = (-)Viscous drag (1)	**2**
18(c)	Show that the submarine has a weight of about 7×10^7 N. Use of density = m/V (1) Correct answer [7.2×10^7 N to at least 2 s.f.] (1) [no ue] **Example of calculation** calculate weight of water as U = W m = density x volume = 1030 kg m^{-3} x 7 100 m^3 = 7.3×10^6 kg W = mg $W = 7.3 \times 10^6$ kg x 9.81 N kg^{-1} = 7.2×10^7 N	**2**

18(d) (i)	Explain what is meant by compressive strain. decrease in length / original length (1)	**1**
18(d) (ii)	Explain the action that should be taken pump out water / replace water in tanks with air (1) to decrease weight (accept mass) / to compensate for decreased upthrust / to make density the same as water (1)	**2**
18(d) (iii)	Suggest why a material like fibreglass would be unsuitable **QWC – Work must be clear and organised in a logical manner using technical wording where appropriate** A much greater (compressive) strain will be produced / compresses more easily (1) producing a larger decrease in volume/ upthrust/ deformation (1)	**2**
	Total for question	**11**

Question Number	Answer	Mark
19(a) (i)	Explain the shape of the graph in the part labelled AB Force proportional to extension / obeys Hooke's law (1)	**1**
19(a) (ii)	Explain what is happening in the part of the graph labelled CD. Fully compressed / coils closed (accept cup/ bug/ toy touches base) (1)	**1**
19(b)	Show that the stiffness of the spring is about 1000 N m^{-1}. State k = 1/ gradient or use of values in $k = F / x$ (1) Correct answer to at least 2 s.f. [1100 N m^{-1}] (1) (Values from graph must be within half a square) (Accept 1000 N m^{-1} to only 1 s.f. if the answer given by the values used from the graph is 1.0×10^3 N m^{-1} to 2 s.f.) **Example of calculation** $k = F / x$ = 20 N / 0.019 m = 1050 N m^{-1}	**2**
19(c) (i)	Calculate the energy stored in the spring at this stage State area under graph or use of energy = 1/ 2 $F\Delta x$ or state energy = 1/ 2 kx^2 (1) correct answer [0.17 J] (1) [ecf for k] (Values from graph must be within half a square) **Example of calculation** energy = 1/ 2 $F\Delta x$ = 1/ 2 x 19.2 N x 0.018 m = 0.17 J	**2**

19(c) (ii)	Calculate the maximum height reached by the bug. Use of gpe = *mgh* (1) correct answer [2.4 m] (1) [ecf] **Example of calculation** 0.17 J = *mgh* *h* = 0.17 m / 7.3 x 10^{-3} kg x 9.81 N kg^{-1} = 2.4 m	**2**
19(c) (iii)	State an assumption made in your calculation all elastic pe → ke of bug → gpe of bug (2 out of 3) / all stored energy (of the spring) transferred to the 'toy' / no energy lost due to air resistance (1)	**1**
19(d)	Explain the advantage of using the video camera improves accuracy/ reliability/ precision (1) eliminate reaction time in looking / can slow down and stop (to take reading) etc (1)	**2**
19(e)	Comment on this data Has not included 0.36 / has not included the anomalous result / 0.36 is anomalous/ outlier etc (1)	**1**
	Total for question	**12**