
PHYSICS**5054/21**

Paper 2 Theory

October/November 2017

MARK SCHEME

Maximum Mark: 75

Published

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This document consists of **10** printed pages.

Section A

| Question | Answer | Marks |
|----------|---|-----------|
| 1(a) | $(\rho =)m / V$ or $23 / (3.6 \times 0.35 \times 0.025)$ or $23 / 0.0315$ | C1 |
| | 730 kg / m^3 | A1 |
| 1(b)(i) | 230 N | B1 |
| 1(b)(ii) | $(\Gamma =)Wx_{\perp}$ or 230×1.3 | C1 |
| | 300 Nm | A1 |
| 1(c) | moment of painter / clockwise moment (about support) is greater than / not equal to / different from moment of plank / anticlockwise moment | B1 |


| Question | Answer | Marks |
|----------|--|-----------|
| 2(a)(i) | (pressure =)force / area | B1 |
| 2(a)(ii) | fewer molecules or less gas or more space / further apart | B1 |
| | less frequent collisions (with walls) | B1 |
| | less force exerted on walls | B1 |
| 2(b) | $(p_1 =)p_2V_2 / V_1$ or $p_1V_1 = p_2V_2$ $1.0 \times 10^5 \times 9.4 \times 10^{-4} / 1.8 \times 10^{-4}$ | C1 |
| | $5.2 \times 10^5 \text{ Pa}$ | A1 |

| Question | Answer | Marks |
|----------|--|-----------|
| 3(a) | any two of: irregular arrangement (of molecules) intermolecular forces weak(er) / not held as firmly together intermolecular distances greater / more spaced out move in clusters through the liquid (not just vibrations) or positions not fixed or can slide past each other | B2 |
| 3(b)(i) | work done or forces overcome | B1 |
| | atoms pulled apart or bonds broken | B1 |
| 3(b)(ii) | (Q =)ml or 0.84×64 or $0.84 \times 64\ 000$ | C1 |
| | 54 kJ or 54 000 J | A1 |

| Question | Answer | Marks |
|----------|--|-----------|
| 4(a) | use of boiling water | B1 |
| | thermometer in boiling water or in steam above boiling water | B1 |
| | mercury level at 100 °C mark or use of pure / distilled water or at a pressure of one atmosphere | B1 |
| 4(b) | (range is) decreased / smaller / reduced | B1 |
| | ethanol (thread) reaches the end at a lower temperature | B1 |

| Question | Answer | Marks |
|----------|---|-----------|
| 5(a) | pressure / vibrational / longitudinal (wave) or (wave that consists of) compressions and rarefactions or sound <u>wave</u> or inaudible sound | B1 |
| | <u>frequency</u> greater than 15 kHz–25 kHz | B1 |
| 5(b) | (ultrasound) transmitted into body | B1 |
| | echo / reflection from (baby / fetus) | B1 |
| | image produced | B1 |

| Question | Answer | Marks |
|----------|---|-----------|
| 6 | EITHER | |
| 6(a) | (high) positive potential | B1 |
| | very low gas pressure or heat filament continuously / filament must remain hot | B1 |
| 6(b) | determine distance / number of squares between pulses | M1 |
| | multiply by time-base setting or multiply by number of ms / div | A1 |

| Question | Answer | Marks | | | | | | | | |
|---|---|-----------|--------|-----|-----------|-----|---|-----|---|-----------|
| 6 | OR | | | | | | | | | |
| 6(a) |  | B1 | | | | | | | | |
| 6(b)(i) | (the NAND gate has a) power supply / battery or it is an active device | B1 | | | | | | | | |
| 6(b)(ii) | <table border="1"> <thead> <tr> <th>inputs</th> <th>output</th> </tr> </thead> <tbody> <tr> <td>0 0</td> <td>1</td> </tr> <tr> <td>0 1</td> <td>1</td> </tr> <tr> <td>1 0</td> <td>1</td> </tr> </tbody> </table> | inputs | output | 0 0 | 1 | 0 1 | 1 | 1 0 | 1 | B1 |
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| inputs | output | | | | | | | | | |
| 1 1 | 0 | | | | | | | | | |

| Question | Answer | Marks |
|----------|---|-----------|
| 7(a) | PQ: a force towards the top of the page (second box) ticked | B1 |
| | QR: a force towards the right of the page (bottom box) ticked | B1 |
| 7(b) | current reversed | B1 |
| | both forces reversed | B1 |
| 7(c) | force(s) decrease or less heat generated | B1 |

| Question | Answer | Marks |
|-----------|--|-----------|
| 8(a)(i) | 2 protons and 2 neutrons (joined together) | B1 |
| 8(a)(ii) | it is (positively) charged | B1 |
| | it pulls electrons from molecules of air or knocks electrons from the molecules of air or gains electrons from air molecules | B1 |
| 8(a)(iii) | 1 stronger and 2 stronger | B1 |
| 8(b)(i) | idea of halving | C1 |
| | $(N =)4.8 \times 10^7 / 1.5 \times 10^6$ or 1 / 32 or 5 (half-lives) | C1 |
| | $1.6 / 1.65 / 1.7 \times 10^6$ s | A1 |
| 8(b)(ii) | radioactive emission is a random process | B1 |

Section B

| Question | Answer | Marks |
|----------|--|-----------|
| 9(a)(i) | $(WD) = Fx$ or $2.8 \times 10^6 \times 9.7$ | C1 |
| | $2.7 \times 10^7 \text{ J}$ | A1 |
| 9(a)(ii) | from chemical (potential energy) | B1 |
| | to thermal (energy) / heat | B1 |
| 9(b)(i) | $(a =)F / m$ or $2.8 \times 10^6 / 2.2 \times 10^8$ | C1 |
| | 0.013 m / s^2 | A1 |
| 9(b)(ii) | 1 deceleration / it decreases | B1 |
| | resistive force decreases or resistive force depends on speed | B1 |
| | 2 curve/line from 9.7 to zero and gradient negative (allow zero at end) | B1 |
| | magnitude of gradient decreasing | B1 |
| | 3 area mentioned | B1 |
| | area <u>under</u> line / curve or convert cm^2 (of graph paper) to distance or in terms of the scales | B1 |
| 9(c)(i) | (efficiency =) useful energy output / total energy input or useful power output / total power input | B1 |
| 9(c)(ii) | 33×0.64 or 12 MJ / s | C1 |
| | 21 MJ / s | A1 |

| Question | Answer | Marks |
|------------|--|-----------|
| 10(a) | P - gamma(-rays) or γ (-rays) | |
| | Q - ultraviolet (radiation) | |
| | R - microwaves | |
| | any one correct | C1 |
| | all three correct | A1 |
| 10(b) | P and X-rays and Q ticked | B1 |
| 10(c)(i) | $(f =)c / \lambda$ or $3.0 \times 10^8 / 9.4 \times 10^{-7}$ | C1 |
| | 3.2×10^N | C1 |
| | 3.2×10^{14} Hz | A1 |
| 10(c)(ii) | infra-red / radiation / signal / wave emitted by control and received at set | B1 |
| | infra-red / radiation / signal / wave is encoded or is decoded | B1 |
| 10(d)(i) | normal indicated and angle of incidence indicated | B1 |
| 10(d)(ii) | $n = \sin i / \sin r$ or $1.5 = \sin 57^\circ / \sin r$ or $(r =)\sin^{-1}(\sin 57^\circ / n)$ or $\sin^{-1}(\sin 57^\circ / 1.5)$ | C1 |
| | 34° | A1 |
| 10(d)(iii) | 1 no change | B1 |
| | 2 3 decreases and decreases | B1 |

| Question | Answer | Marks |
|-----------|--|-----------|
| 10(d)(iv) | ray in glass between normal and continuation of the incident ray | B1 |
| | ray in air between continuation of the refracted ray and side of prism | B1 |

| Question | Answer | Marks |
|------------|---|-----------|
| 11(a)(i) | any suitable solid insulator (e.g. nylon, plastic, glass, rubber, polystyrene) | B1 |
| 11(a)(ii) | positive charges near to rod | B1 |
| | negative charges opposite rod and equal in number and 7 or fewer | B1 |
| 11(a)(iii) | 1 electrons / negative charges flow towards earth | B1 |
| | repelled (by negative charge on rod) | B1 |
| | (sphere) becomes positive | B1 |
| | 2 flow of electrons / negative charge and (in direction) earth to sphere | B1 |
| 11(b)(i) | $1/R = 1/R_1 + 1/R_2$ or $R_1 R_2 / (R_1 + R_2)$ or $1/R = 1/15 + 1/60$ or $15 \times 60 / 75$ or $15 \times 60 / (15 + 60)$ | C1 |
| | 12 (Ω) or 0.083 (Ω) | C1 |
| | 30 Ω | A1 |
| 11(b)(ii) | $(I =)V/R$ or 7.5/30 | C1 |
| | 0.25 A | A1 |

| Question | Answer | Marks |
|------------|---|-----------|
| 11(b)(iii) | 18 Ω resistor underlined 2 and 60 Ω resistor underlined | B1 |
| 11(b)(iv) | five cells in series and all in same direction | B1 |
| 11(b)(v) | resistance increases and current decreases | B1 |