AS Level Physics, Paper 2, May/June Session 2001 (time: 1 hour) Answer **all** questions. (Paper 8702/2)

1 **(a)** The unit for a physical quantity can be expressed in terms of SI base units. Complete Fig.1.1, giving the unit for each quantity in terms of base units. Use symbols for base units.

Fig.1.1

| quantity | unit | quantity | unit |
|---|---|---|---|
| mass | ..... | ... density | |
| length | ...... | ... force | |
| time | .. | ... pressure | |
| speed | .. | ... | |

[5]

**(b)** Using your answer to (a), show that the unit of pressure is the same as that of the product *density* x (*speed*)$^2$. [2]

2 Fig.2.1 shows the variation with time $t$ of the vertical speed $v$ of a space probe as it descends towards the surface of a planet.

**(a)** State, with a reason, whether the space probe has constant vertical acceleration.

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.......................................................................................................................... [1]

**(b)** Use Fig.2.1 to determine

(i) the acceleration of the space probe at $t = 10$ s,

.......................................................................................... acceleration = .............. m s$^{-2}$

(ii) the vertical distance moved during the time interval $t = 0$ to $t = 20$ s.

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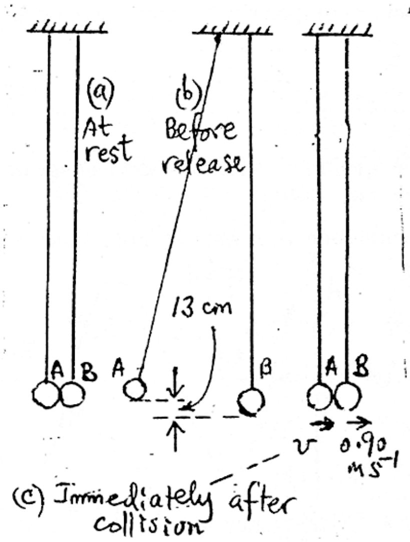
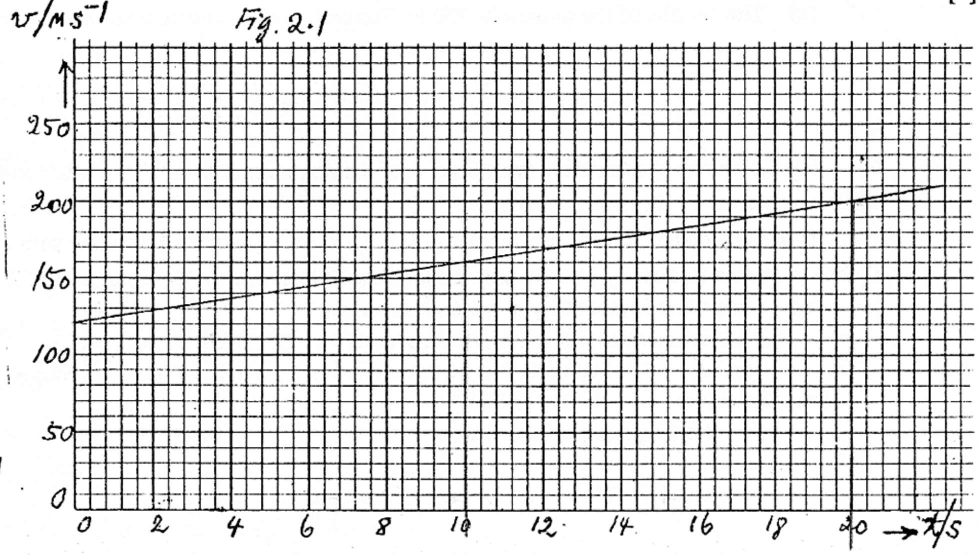
.......................................................................................... distance moved = ........... m [5]




3 Two identical spheres A and B are suspended on inextensible threads so that, when they are hanging vertically, they just touch, as illustrated in Fig. 3.1(a).

Sphere A is pulled to one side so that it rises through a vertical height of 13 cm, as shown in Fig.3.1(b). Sphere A is released and it collides with sphere B. Sphere B moves off with an initial speed of 0.90 m s$^{-1}$. Sphere A has speed $v$ immediately after the collision, as shown in Fig.3.1(c).

(a) Use the principle of conservation of energy to show that the speed of sphere A immediately before the collision is 1.6 m s$^{-1}$

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.......................................................................................................................... [3]

(b) Determine the speed $v$ of sphere A immediately after the collision.

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Speed ......................... m s$^{-1}$. [2]

**(c)** State and explain whether the collision is elastic or inelastic.

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.......................................................................................................................... [2]

4 Compare the spacing, ordering and motion of molecules in ice at 0°C and water, also at 0°C.

Spacing ..................................................................................................................

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Ordering ..................................................................................................................

..................................................................................................................

Motion ..................................................................................................................

.................................................................................................................. [6]

5 A leg bone of a certain person may be modeled as a uniform solid cylinder of length 0.50 m and area of cross-section $6.0 \times 10^{-4} m^2$. The Young modulus of a leg bone under compression is $1.8 \times 10^{10}$ Pa and the maximum compressive stress which it can undergo before breaking is $1.7 \times 10^{8}$ Pa.

(a) Assuming that the Young modulus is constant up to the point of fracture, calculate

(i) the strain at which fracture occurs,

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.................................................................................. strain = ...............

(ii) the reduction in length before the bone fractures.

..................................................................................................................

.................................................................................. Reduction in length = .............. m [4]

(b) Calculate the minimum force required to cause compressive fracture in this bone.

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.................................................................................. force = ............N [2]

(c) The weight of the person is 750 N. Suggest, with a reason, a situation where a compressive fracture could occur.

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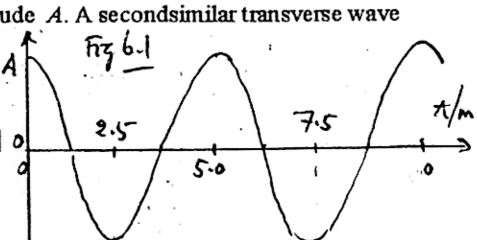
.................................................................................................................. [2]

6 Fig.6.1 shows the variation with time $t$ of the displacement $x$ of a particle in a medium as a result of the passage of a transverse wave $T_1$ through the medium.

The transverse wave $T_1$ has intensity $I$. It causes the particle to oscillate with amplitude $A$. A secondsimilar transverse wave $T_2$ has the same frequency but the amplitude of oscillation due to $T_2$ alone is $3A/2$.




(a) State what is meant bv a *transverse* wave.

[2]

(b) Calculate

(i) the frequency of the waves.

... ..........................................

... ..........................................

frequency = .................. Hz

(ii) the intensity, in terms of $I$, of the weve $T_2$.

....... ..........................................

....... .......................................... intensity = ...... ............. [4]

(c) State two conditions which are necessary for the two waves $T_1$ and $T_2$ to interfere destructively.

1. ....................

2. .................... [2]

(d) Calculate, in terms of $I$, the intensity of the resultant wave when $T_1$ and $T_2$ interfere destructively.

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intensity = ...................... [2]

7 (a) A filament lamp is marked 250V, 100W for normal brightness.

Calculate, for normal brightness

(i) the current through the lamp.

.. .................................................................. current = ........... A

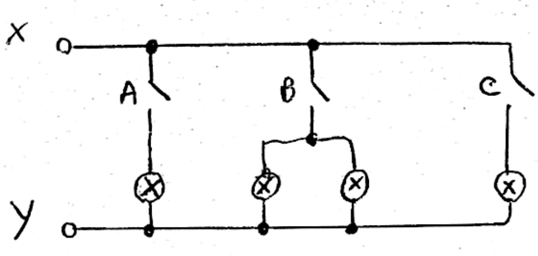


Fig. 7.1

(ii) the resistance of the filament.

.............................................. resistance = ........ Ω [4]

(b) A lighting circuit includes four lamps connected as shown in Fig.7.1.
Each lamp has a resistance of 120 Ω when cold.
Before connecting the circuit to the mains supply, an electrician tests the circuit by connecting a meter which measures resistance between points X and Y. The readings shown in Fig.7.2 were obtained.

| Switch | | | actual meter reading /Ω | meter reading if no fault in circuit /Ω |
|---|---|---|---|---|
| A | B | C | | |
| open | open | open | ∞ | ..... .... |
| closed | open | open | 120 Ω | .... .... |
| closed | closed | open | 60 Ω | .... .... |
| closed | closed | closed | 40 Ω | ... .... |

Fig.7.2

Complete Fig.7.2 to give the meter readings, assuming that there is no fault in the circuit.

(c) Use the completed Fig.7.2 to suggest the fault in the crcuit.

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.............................................................................................................. [2]

8 (a) Two isotopes of uranium are Uranuim-235 and Uranium-238. The proton number of uranium is 92.

(i) Explain what is meant bv *isotopes*.

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(ii) Write down the nuclear representation of these two isotopes.

$^{.....}_{.....}U$ $^{.....}_{.....}U$ [4]

(b) Nitrogen nuclei, when bombarded with α- particles, may undergo a nuclear transformation.
One such transformation is $^{14}_{7}N + ^{4}_{2}He$ ? $^{17}_{8}O$ +

(i) Complete the equation for this transformation.

(ii) Identifv the particle, other than the oxygen nucleus, produced in the transformation.

.............................................................................................. [3]

Answers: 2(b)(i) 4.0 ms$^{-1}$ (ii) 3200m
3(b) 0.70ms$^{-1}$
5(a)(i) $9.4\times10^{-3}$; (ii) $4.7\times10^{-3}$m
(b) $1.02\times10^{5}$N
6(b) (i) 200Hz (ii) $\frac{9}{4}I$ (d) $\frac{1}{4}I$
7(a)(i) 0.40A (ii) 625Ω
(b) ∞, 120Ω, 40Ω, 30Ω