Physics – Paper 3
(Practical)

Subject content:

Practical Assessment (Paper 3) [1h 50 mins, 40 marks] Paper 3 will assess appropriate aspects of assessment objectives C1 to C6 in the following skill areas: ● Planning (P) ● Manipulation, measurement and observation (MMO) ● Presentation of data and observations (PDO) ● Analysis, conclusions and evaluation (ACE) The assessment of Planning (P) will have a weighting of 15%. The assessment of skill areas MMO, PDO and ACE will have a weighting of 85%.
● Section A will carry 20 marks and will consist of 1–2 compulsory practical experiment questions with a total duration of 55 min. ● Section B will carry 20 marks and will consist of one compulsory 55 min practical experiment question. ● Candidates would be allocated a specified time for access to apparatus and materials of specific questions.

Candidates should be able to make measurements or determinations of physical quantities such as mass, length, area, volume, time, current and potential difference. Candidates should be aware of the need to take simple precautions for safety and / or accuracy. Candidates will be required to follow the instructions given in the question paper and answer on the question paper itself.

Topics

1. measurements of length, time interval, temperature, volume, mass and weight using appropriate instruments
2. determination of the density of a liquid, or of a regularly or irregularly shaped solid which sinks in water
3. determination of the value of the acceleration of free fall
4. investigation of the effects of balanced and unbalanced forces
5. the principle of moments
6. determination of the position of the centre of gravity of a plane lamina
7. investigation of the factors affecting thermal energy transfer
8. determination of heat capacities of materials and latent heat of substances
9. the law of reflection
10. determination of the position and characteristics of an optical image formed by a plane mirror or a thin converging lens
11. the refraction of light through glass blocks
12. the principle of total internal reflection
13. the focal length of lenses
14. determination of the speed, wavelength and frequency of waves
15. measurements of current and voltage by using appropriate ammeters and voltmeters
16. determination of the resistance of a circuit element using appropriate instruments
17. investigation of the magnetic effect of current in a conductor
18. investigation of the effects of electromagnetic induction

General marking points

Marking point	Description
Taking readings	● A measuring instrument should be used to its full precision. ● Thermometers are often marked with intervals of 1°C. It is appropriate to record a reading which coincides exactly with a mark as, for example, 22.0°C, rather than as a bald 22°C. ● Interpolation between scale divisions should be to better than one half of a division. For example, consider a thermometer with scale divisions of 1 °C. A reading of 22.3 °C might best be recorded as 22.5 °C, since '0.3' is nearer '0.5' than '0'. That is, where a reading lies between two scale marks, an attempt should be made to interpolate between those two marks, rather than simply rounding to the nearest mark. ● The length of an object measured on a rule with a centimetre and millimetre scale should be recorded as 12.0 cm rather than a bald 12 cm, if the ends of the object coincide exactly with the 0 and 12 cm marks. ● A measurement / calculated quantity must be accompanied by correct unit
Recording readings	● A table of results should include, in the heading of each column, the name or symbol of the measured or calculated quantity, together with the appropriate unit. Solidus notation is expected. ● Each reading should be repeated, if possible, and recorded. ● The number of significant figures given for calculated quantities should be the same as the least number of significant figures in the raw data used. A ratio should be calculated as a decimal number, to two or three significant figures.
Drawing graphs	● Draw graph with sharp pencil ● Scale: ○ allow majority (at least ½) of graph paper to be used in both directions of axes ● Axes: ○ label with quantity + unit ○ use sensible ratios, e.g. 2 cm on the graph paper representing 1 or 2 or 5 units of the variable (or 10, 20 or 50, etc.) ● Plot data points: ○ to accuracy of ½ of smallest square on grid ○ indicate using small cross (large 'dots' are penalised) ● Best-fit line: ○ equal no. of points on either side of line ● Gradient: ○ use triangle with hypotenuse that extends over at least ½ the length of line ○ calculate gradient to 2 – 3 s.f.

Planning (P)

The lens produces a magnified image of the object on the screen.

The magnification of the object by the lens is given by ***m*** **=** $\frac{height\ of\ image}{height\ of\ object}$.

m is related to the image distance ***v*** by the equation:

$$m = \frac{1}{f}v - 1$$

Plan an experiment to obtain focal length ***f*** by using this equation.

Your plan should include

- a list of quantities that remain constant
- a description of how you would perform the experiment
- a description of the graph that you would plot
- how you would determine *f* from the graph

Variables	Independent variable : distance b/w lens and screen, v (adjust u) Dependent variable : magnification, m Constant variable : focal length of lens height of image always measured from base to apex reference point to measure distance angle of light entering centre of lens / height of torch
Data collection	1. Set up the experiment as Fig 2.4 2. Measure height of object h with a ruler 3. Place object, lens and screen along metre rule in a straight line (reliability / precaution) 4. Turn on torchlight to cast an image of object through lens onto screen 5. Place object at distance u = 25.0 cm from lens 6. Place screen close to lens + move it away from lens until clearest possible image is obtained 7. Use ruler to measure + record height of image, x and distance b/w lens and screen, v (independent variable) 8. Keep height of torchlight and distance b/w torchlight and object constant (constant variable) 9. Calculate linear magnification, m by m = $\frac{x}{h}$ (dependent variable) 10. Using same lens (constant variable), repeat steps 2 – 8 by varying object distance, u to obtain 5 other values of image distance, v and linear magnification, m (reliability)
Data presentation	11. Plot graph of linear magnification, m against image distance, v
Data interpretation	12. Calculate gradient of graph 13. Focal length of lens, f is given by reciprocal of gradient

A student suggests that the time taken for the amplitude to decrease, t is directly proportional to the mass of the pendulum bob, m.

Plan an experiment to investigate the relationship.

Your plan should include

- the quantities that you will keep constant
- a detailed description of how you will perform the investigation
- an indication of how you will achieve accurate results
- a statement of the graph you would plot to test the relationship
- a sketch of the graph you would obtain if the suggested relationship is correct

<table>
<tr><td>Variables</td><td>Independent variable : mass of pendulum bob, m
Dependent variable : average time taken for amplitude to decrease, t
Constant variable : length of pendulum bob to split cork, 100.0 cm
amplitude decrease from 12 cm to 8 cm</td></tr>
<tr><td>Data collection</td><td>1. Set up the experiment as shown in Fig 2.1
2. Set distance from bottom of split cork to pendulum bob of mass, m (independent variable) to be 100.0 cm (constant variable)
3. Adjust boss such that distance from bottom of bob to floor is 2.0 cm
4. Place piece of card where lines of card are drawn at 2 cm intervals, on floor beneath bob
5. Adjust position of card until right hand edge of bob is aligned with 0 cm mark on the card when viewed directly from above (reliability)
6. Move bob to side until right hand edge of bob is aligned with 12 cm mark on card when viewed directly from above (reliability)
7. Release bob + measure + record time t_1 for amplitude of bob to decrease from 12 cm to 8 cm (dependent variable)
8. Repeat step 7 to obtain another timing t_2 for same amplitude decrease (constant variable) + calculate average time t taken (reliability)
9. Repeat steps 2 – 8 for 5 other different masses of bobs (reliability)
<table>
<tr><th>m / kg</th><th>t_1 / s</th><th>t_2 / s</th><th>ave t / s</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
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<tr><td>Data presentation</td><td>10. Plot graph of average time, t against mass, m
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<tr><td>Data interpretation</td><td></td></tr>
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