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General Certificate of Education (Advanced Level) – Grade 12

UNIT TEST – QUESTION BANK

Physics I – Measurement

Coverage (competency levels 1.1 – 1.5): Physics and the scientific method · Physical quantities and SI units · Significant figures and scientific notation · Dimensions · Errors in measurement · Metre ruler and choosing the right instrument · Vernier caliper · Micrometer screw gauge · Spherometer · Travelling microscope · Balances, stopwatches and the digital multimeter · Scalars and vectors

01 **E** **I**

Time: 3 hours
(may be taken section by section)

Index No. | | | | | | | | |

Name : .....

School : .....

Instructions

- This book contains **121 questions** in **12 sections**, one section for each sub-topic of the syllabus (competency levels 1.1 – 1.5). Total **179 marks**.
- Questions in each section become progressively more demanding: ● Basic ●● Standard ●●● Exam level ●●●● A/L hardest .
- **Multiple-choice questions** (103): circle the number of the correct or most appropriate answer. Each carries **1 mark**, as in Paper I.
- **Structured questions**: answer in the space provided on this paper. Marks are awarded point by point, **(01)** per marking point, as in the official Paper II marking schemes; the marks for each part are shown at the right.
- Use of calculators is not allowed. Take g = 10 m s^{-2} unless stated otherwise.
- Show all working. A final answer needs the correct unit to earn its mark.

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Section	Max	Mk	Section	Max	Mk
A	7		G	27	
B	19		H	22	
C	9		I	12	
D	22		J	9	
E	16		K	7	
F	10		L	19	
				Total	

Total	
MCQ (103)	
Structured (76)	
In numbers (179)	
Percentage	

Code numbers	
Marking examiner	
Checked by 1	
2	
Supervised by	

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SECTION A – Physics and the scientific method

Syllabus 1.1 · Questions A1 – A4 · 7 marks

A1. (• Basic) Which of the following shows the steps of the scientific method in the correct order? **(1 mark)**

(1) experiment → hypothesis → observation → conclusion
(2) conclusion → observation → experiment → hypothesis
(3) hypothesis → conclusion → observation → experiment
(4) observation → hypothesis → experiment → conclusion
(5) observation → conclusion → hypothesis → experiment

A2. (• Basic) Physics is best described as the study of **(1 mark)**

(1) energy, matter in relation to energy, and transformations of energy
(2) the composition of substances and their reactions
(3) living organisms and their environment
(4) numbers and their relationships
(5) the history of scientific discoveries

A3. (•• Standard) Which of the following technologies is mainly an application of physics in medicine? **(1 mark)**

(1) Chemical fertilisers (2) Antibiotics (3) Ultrasound scanning
(4) Vaccines (5) Crop rotation

A4. (•• Standard) A student investigates how the time for one oscillation of a simple pendulum depends on the length of its string. **(4 marks)**

(a) Name the independent variable. (01)

.....

(b) Name the dependent variable. (01)

.....

(c) Name two variables that must be kept constant. (01)

.....

(d) Why should a conclusion be based on several measurements rather than one? (01)

.....

SECTION B – Physical quantities and SI units

Syllabus 1.2 · Questions B1 – B14 · 19 marks

B1. (• Basic) The SI base unit of luminous intensity is the **(1 mark)**

(1) lux (2) lumen (3) candela (4) watt (5) kelvin

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B2. (• Basic) The two supplementary quantities of the SI system are **(1 mark)**

(1) mass and time (2) amount of substance and luminous intensity
(3) temperature and electric current (4) length and area
(5) plane angle and solid angle

B3. (• Basic) Which of the following is a derived quantity? **(1 mark)**

(1) Mass (2) Length (3) Density
(4) Time (5) Amount of substance

B4. (• Basic) Which of the following physical quantities has no unit? **(1 mark)**

(1) Speed (2) Plane angle (3) Energy
(4) Frequency (5) Refractive index

B5. (•• Standard) 1 kW h (kilowatt-hour) is equal to **(1 mark)**

(1) 3.6×10^3 J (2) 3.6×10^6 J (3) 3.6×10^5 J (4) 1.0×10^3 J (5) 3.6×10^4 J

B6. (•• Standard) Which of the following is written correctly according to SI rules? **(1 mark)**

(1) 5 ms^{-1} (2) 5 m s^{-1} (3) 5 M s^{-1} (4) 5 mps (5) 5 m/sec

B7. (•• Standard) A density of 1 g cm^{-3} is equal to **(1 mark)**

(1) 0.001 kg m^{-3} (2) 1 kg m^{-3} (3) 10 kg m^{-3}
(4) 100 kg m^{-3} (5) 1000 kg m^{-3}

B8. (•• Standard) A current of 250 μA is equal to **(1 mark)**

(1) 2.5×10^{-2} A (2) 2.5×10^{-3} A (3) 2.5×10^{-5} A
(4) 2.5×10^{-4} A (5) 2.5×10^{-6} A

B9. (•• Standard) The joule expressed in SI base units is **(1 mark)**

(1) kg m s^{-2} (2) kg m^2 s^{-2} (3) kg m^2 s^{-3} (4) kg m^{-1} s^{-2} (5) kg m s^{-1}

B10. (••• Exam level) Convert each of the following to the SI unit shown. **(4 marks)**

(a) 108 km h^{-1} to m s^{-1} (01)

(b) 13.6 g cm^{-3} to kg m^{-3} (01)

(c) 5 mm^2 to m^2 (01)

(d) 2 litres (2 dm^3) to m^3 (01)

B11. (••• Exam level) A quantity X is defined as X = (force × time)/mass. The SI unit of X is **(1 mark)**

(1) m s^{-1} (2) m s^{-2} (3) kg m s^{-1} (4) N s (5) m

B12. (●●● Exam level) Consider the following statements. **(1 mark)**

(A) Every physical quantity has a unit.

(B) A prefix is written in front of the unit symbol with no space, e.g. mm.

(C) 1 nm = 10^{-9} m.

Of the above statements,

(1) only (A) is true. (2) only (A) and (B) are true.

(3) only (A) and (C) are true. (4) only (B) and (C) are true.

(5) all (A), (B) and (C) are true.

B13. (●●● Exam level) Which of the following pairs of quantities have the same SI unit? **(1 mark)**

(1) work and power (2) pressure and energy

(3) force and momentum (4) momentum and impulse

(5) velocity and acceleration

B14. (●●●● A/L hardest) The gravitational force between two masses is $F = G\,m_1m_2 / r^2$, where r is their separation. **(3 marks)**

(a) Rearrange the equation to make G the subject. (01)

.....

(b) Hence find the SI unit of G in terms of the newton, and then in SI base units. (02)

.....

.....

.....

SECTION C – Significant figures and scientific notation

Syllabus 1.2 · Questions C1 – C7 · 9 marks

C1. (● Basic) The number of significant figures in 2.050 is **(1 mark)**

(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

C2. (● Basic) 3600 m written in scientific notation to two significant figures is **(1 mark)**

(1) 36×10^2 m (2) 3.60×10^3 m (3) 0.36×10^4 m

(4) 3.6×10^3 m (5) 3.6×10^2 m

C3. (●● Standard) The number of significant figures in 0.000470 is **(1 mark)**

(1) 2 (2) 3 (3) 4 (4) 6 (5) 7

C4. (●● Standard) 2.3456 rounded to three significant figures is **(1 mark)**

(1) 2.30 (2) 2.34 (3) 2.346 (4) 2.35 (5) 2.4

C5. (●●● Exam level) The length and breadth of a rectangle are measured as 3.42 cm and 2.5 cm. The area, given to the correct number of significant figures, is **(1 mark)**

(1) 8.55 cm² (2) 8.550 cm² (3) 8.5 cm² (4) 9 cm² (5) 8.6 cm²

C6. (●●● Exam level) The sum 12.11 cm + 0.3 cm, written correctly, is **(1 mark)**

(1) 12.4 cm (2) 12.41 cm (3) 12 cm (4) 12.410 cm (5) 12.5 cm

C7. (●●●● A/L hardest) A student writes the side of a cube, measured with a vernier caliper, as 2.10 cm. **(3 marks)**

(a) Explain why the student should write 2.10 cm and not 2.1 cm. (01)

.....

(b) Calculate the volume of the cube to the correct number of significant figures. (02)

.....

.....

.....

SECTION D – Dimensions

Syllabus 1.3 · Questions D1 – D14 · 22 marks

D1. (● Basic) The dimensions of velocity are **(1 mark)**

(1) LT^{-1} (2) LT (3) LT^{-2} (4) MLT^{-1} (5) $L^{-1}T$

D2. (● Basic) The dimensions of force are **(1 mark)**

(1) MLT^{-1} (2) $ML^{2}T^{-2}$ (3) $ML^{-1}T^{-2}$ (4) MLT^{-2} (5) MT^{-2}

D3. (● Basic) Which of the following quantities has no dimensions? **(1 mark)**

(1) Coefficient of friction (2) Speed (3) Momentum
(4) Pressure (5) Energy

D4. (●● Standard) The dimensions of pressure are **(1 mark)**

(1) MLT^{-2} (2) $ML^{-1}T^{-1}$ (3) $ML^{2}T^{-2}$ (4) $ML^{-2}T^{-2}$ (5) $ML^{-1}T^{-2}$

D5. (●● Standard) The dimensions of power are **(1 mark)**

(1) $ML^{2}T^{-3}$ (2) $ML^{2}T^{-2}$ (3) MLT^{-3} (4) $ML^{2}T^{-1}$ (5) MLT^{-2}

D6. (●● Standard) Which pair of quantities has the same dimensions? **(1 mark)**

(1) Velocity and acceleration (2) Force and momentum
(3) Power and energy (4) Pressure and force
(5) Work and moment of a force

D7. (●●● Exam level) Symbols have their usual meanings. **(3 marks)**

(a) Show that the equation $v^2 = u^2 + 2as$ is dimensionally correct. (02)

.....

.....

.....

(b) Explain why a dimensionally correct equation may still be wrong. (01)

D8. ●●● Exam level In the equation x = A sin(ωt), x is in metres and t is in seconds. The SI unit of ω is **(1 mark)**

(1) s^{-1} (2) s (3) $m\ s^{-1}$ (4) m (5) m s

D9. ●●● Exam level In the equation P = a/b + ct^2, P is pressure and t is time. The dimensions of c are **(1 mark)**

(1) $ML^{-1}T^{-2}$ (2) MLT^{-4} (3) $ML^{-1}T^{-4}$ (4) $ML^{-1}T^{o}$ (5) $ML^{-3}T^{-2}$

D10. ●●● Exam level The resistive force on a small sphere moving slowly through a liquid is F = kv. The SI unit of k is **(1 mark)**

(1) $kg\ s^{-1}$ (2) $kg\ m\ s^{-1}$ (3) $N\ m^{-1}$ (4) $kg\ m^{-1}$ (5) N s m

D11. ●●●● A/L hardest The period T of a simple pendulum may depend on the mass m of the bob, the length l and the gravitational acceleration g. Assume $T = k\ m^x\ l^y\ g^z$, where k is a dimensionless constant. **(4 marks)**

(a) Write the dimensional equation. (01)

(b) Equate the powers of M, L and T. (02)

(c) Hence obtain the expression for T. (01)

D12. ●●●● A/L hardest The frequency f of a stretched string depends on its length l, the tension T and the mass per unit length μ. Use dimensions to show that $f = (k/l)\sqrt{(T/\mu)}$, where k is a constant. **(4 marks)**

(04)

D13. ●●●● A/L hardest Consider the following statements about dimensional analysis. **(1 mark)**

(A) It cannot give the value of a dimensionless constant.

(B) It cannot be used to derive a relation such as $s = ut + \frac{1}{2}at^2$ which has a sum of terms.

(C) An equation that is dimensionally correct must be physically correct.

Of the above statements,

(1) only (A) is true. (2) only (A) and (B) are true.

(3) only (A) and (C) are true. (4) only (B) and (C) are true.

(5) all (A), (B) and (C) are true.

D14. ●●●● A/L hardest If velocity (V), time (T) and force (F) are taken as the fundamental quantities, the dimensions of mass are **(1 mark)**

(1) FTV^{-1} (2) $FT^{-1}V$ (3) FTV (4) FVT^{-1} (5) $F^{-1}TV$

SECTION E – Errors in measurement

Syllabus 1.4 · Questions E1 – E10 · 16 marks

E1. ● Basic A zero error of an instrument is an example of a **(1 mark)**

(1) systematic error
(2) random error
(3) parallax error only
(4) human error that cannot be corrected
(5) percentage error

E2. ● Basic Parallax error when reading a scale is avoided by **(1 mark)**

(1) taking many readings
(2) using a thicker pointer
(3) subtracting the zero error
(4) keeping the eye perpendicular to the scale at the reading
(5) using a longer scale

E3. ●● Standard A length of 20.0 cm is measured with a metre ruler (least count 1 mm). The percentage error is **(1 mark)**

(1) 0.05 % (2) 0.1 % (3) 0.5 % (4) 1 % (5) 5 %

E4. ●● Standard A time of 2.50 s is measured with a stopwatch of least count 0.01 s. The fractional error is **(1 mark)**

(1) 0.004 (2) 0.01 (3) 0.025 (4) 0.04 (5) 0.4

E5. ●● Standard The best way to reduce random errors in a measurement is to **(1 mark)**

(1) correct for the zero error
(2) repeat the measurement several times and take the mean
(3) use the same instrument
(4) use a larger unit
(5) calibrate the instrument

E6. ●●● Exam level Which of the following measurements has the smallest percentage error? **(1 mark)**

(1) 0.250 cm with a micrometer (0.001 cm)
(2) 1.50 cm with a vernier caliper (0.01 cm)
(3) 3.00 cm with a vernier caliper (0.01 cm)
(4) 12.0 cm with a metre ruler
(5) 50.0 cm with a metre ruler

E7. ●●● Exam level The time for 20 oscillations of a pendulum is measured as 32.4 s using a stopwatch of least count 0.2 s. **(4 marks)**

(a) Find the period. (01)

.....

(b) Find the percentage error in the measured time. (01)

(c) What would the percentage error be if only one oscillation (1.6 s) were timed? (01)

(d) Hence explain why many oscillations are timed. (01)

E8. (●●● Exam level) Consider the following statements. **(1 mark)**

(A) Systematic errors cannot be reduced by averaging many readings.
(B) A stopwatch that runs slow produces a systematic error.
(C) A systematic error makes all readings larger (or all smaller) than the true value.

Of the above statements,

(1) only (A) is true. (2) only (A) and (B) are true.
(3) only (A) and (C) are true. (4) only (B) and (C) are true.
(5) all (A), (B) and (C) are true.

E9. (●●●● A/L hardest) A vernier caliper of least count 0.01 cm has a zero error of −0.03 cm. Four readings of the diameter of a rod are 4.52 cm, 4.53 cm, 4.51 cm and 4.52 cm. **(4 marks)**

(a) Find the mean observed reading. (01)

(b) Find the corrected diameter. (01)

(c) Which type of error was reduced by (a) and which was removed by (b)? (02)

E10. (●●●● A/L hardest) Repeated readings of a known length of 5.00 cm, taken with a faulty vernier caliper, are 5.12, 5.13, 5.12, 5.11 cm. These readings are **(1 mark)**

(1) accurate and precise (2) accurate but not precise
(3) free of systematic error (4) neither accurate nor precise
(5) precise but not accurate

SECTION F – Metre ruler and choosing the right instrument

Syllabus 1.4 · Questions F1 – F5 · 10 marks

F1. (● Basic) The least count of a metre ruler is **(1 mark)**

(1) 1 cm (2) 0.1 mm (3) 0.5 mm (4) 1 mm (5) 0.01 mm

F2. (● Basic) The most suitable instrument to measure the diameter of a thin wire is **(1 mark)**

(1) metre ruler (2) vernier caliper (3) micrometer screw gauge
(4) spherometer (5) measuring tape

F3. (•• Standard) When measuring with a metre ruler a student starts from the 10.0 cm mark instead of the end of the ruler. The main reason is **(1 mark)**

(1) to reduce parallax
(2) to avoid random errors in timing
(3) to increase the least count
(4) to make the reading larger
(5) the end of the ruler may be worn

F4. (••• Exam level) Name the most suitable instrument to measure each of the following. **(6 marks)**

(a) The thickness of a sheet of glass about 2 mm thick (01)

(b) The depth of a hollow cylinder about 4 cm deep (01)

(c) The radius of curvature of a watch glass (01)

(d) The internal diameter of a capillary tube (01)

(e) The mass of a 0.250 g piece of foil (01)

(f) The period of a simple pendulum (01)

F5. (•••• A/L hardest) A stack of 500 sheets of paper is 4.8 cm thick when measured with a metre ruler. The thickness of one sheet and the percentage error of the measurement are **(1 mark)**

(1) 0.096 mm, 21 %
(2) 0.096 mm, 0.2 %
(3) 0.96 mm, 2.1 %
(4) 0.0096 mm, 2.1 %
(5) 0.096 mm, 2.1 %

SECTION G – Vernier caliper

Syllabus 1.4 · Questions G1 – G20 · 27 marks

G1. (• Basic) The least count of a vernier caliper is equal to **(1 mark)**

(1) one main scale division − one vernier scale division
(2) one vernier scale division
(3) one main scale division
(4) one main scale division + one vernier scale division
(5) the total length of the vernier scale

G2. (• Basic) The part of a vernier caliper used to measure the depth of a beaker is the **(1 mark)**

(1) depth bar (tail)
(2) inner jaws
(3) outer jaws
(4) main scale
(5) locking screw

G3. (• Basic) The internal diameter of a ring is measured with the **(1 mark)**

(1) outer jaws (2) inner jaws (3) depth bar (4) ratchet (5) thimble

G4. (• Basic) In a vernier caliper, 10 vernier divisions are equal to 9 main scale divisions of 1 mm. The least count is **(1 mark)**

(1) 0.01 mm (2) 0.05 mm (3) 0.1 mm (4) 0.9 mm (5) 1 mm

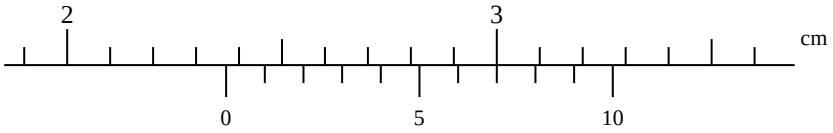
G5. (•• Standard) 20 vernier divisions are equal to 19 mm on the main scale. The least count is **(1 mark)**

(1) 0.02 mm (2) 0.05 mm (3) 0.1 mm (4) 0.5 mm (5) 0.95 mm

G6. (•• Standard) 50 vernier divisions are equal to 49 mm on the main scale. The least count is **(1 mark)**

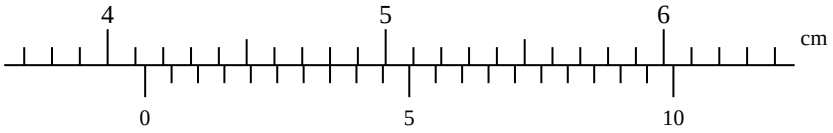
(1) 0.01 mm (2) 0.02 mm (3) 0.05 mm (4) 0.49 mm (5) 0.98 mm

G7. (•• Standard) The figure shows part of the scales of a vernier caliper (10 vernier divisions = 9 mm). The reading is **(1 mark)**



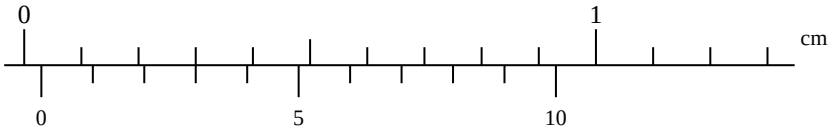
(1) 2.07 cm (2) 2.30 cm (3) 2.37 cm (4) 2.73 cm (5) 3.07 cm

G8. (•• Standard) The figure shows the scales of a vernier caliper in which 20 vernier divisions = 19 mm. The reading is **(1 mark)**



(1) 4.035 cm (2) 4.107 cm (3) 4.135 cm (4) 4.170 cm (5) 4.235 cm

G9. (•• Standard) With the jaws closed, the scales of a vernier caliper (10 divisions = 9 mm) appear as shown. The zero error is **(1 mark)**



(1) −0.7 mm (2) −0.3 mm (3) 0 (4) +0.3 mm (5) +0.7 mm

G10. (••• Exam level) A vernier caliper has a positive zero error of 0.04 cm. The observed reading for a length is 3.56 cm. The correct length is **(1 mark)**

(1) 3.48 cm (2) 3.52 cm (3) 3.56 cm (4) 3.60 cm (5) 3.64 cm

G11. (••• Exam level) When the jaws of a vernier caliper (least count 0.1 mm, 10 divisions) are closed, the vernier zero lies to the left of the main-scale zero and the 6th vernier division coincides with a main-scale division. The zero error is **(1 mark)**

(1) −0.6 mm (2) −0.4 mm (3) −0.1 mm (4) +0.4 mm (5) +0.6 mm

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G12. ●●● Exam level The same instrument (zero error −0.4 mm) gives an observed reading of 25.3 mm. The correct reading is **(1 mark)**

(1) 24.7 mm (2) 24.9 mm (3) 25.3 mm (4) 25.7 mm (5) 25.9 mm

G13. ●●● Exam level The main scale of a vernier caliper is divided into 0.5 mm divisions. 50 vernier divisions equal 49 main scale divisions. The least count is **(1 mark)**

(1) 0.01 mm (2) 0.02 mm (3) 0.05 mm (4) 0.1 mm (5) 0.49 mm

G14. ●●● Exam level A hollow cylinder (open at one end) is measured with a vernier caliper. External diameter D = 3.84 cm, internal diameter d = 3.22 cm, internal depth h = 4.50 cm. (Take π = 3.14) **(4 marks)**

(a) Name the part of the vernier used for each of D, d and h. (01)

(b) Find the thickness of the wall. (01)

(c) Find the volume of water the cylinder can hold. (02)

G15. ●●● Exam level A wire of diameter about 0.30 mm is measured with a vernier caliper of least count 0.1 mm. The percentage error is about **(1 mark)**

(1) 0.3 % (2) 1 % (3) 3.3 % (4) 10 % (5) 33 %

G16. ●●●● A/L hardest In a vernier caliper, 20 vernier divisions are equal to 39 main scale divisions of 1 mm (an extended vernier). The least count is **(1 mark)**

(1) 0.025 mm (2) 0.05 mm (3) 0.1 mm (4) 0.5 mm (5) 1.95 mm

G17. ●●●● A/L hardest The main scale of a vernier is in 0.5 mm divisions. For a least count of 0.02 mm, n vernier divisions must equal (n − 1) main scale divisions where n is **(1 mark)**

(1) 20 (2) 24 (3) 25 (4) 49 (5) 50

G18. ●●●● A/L hardest A vernier caliper with a main scale in millimetres is to have a least count of 0.05 mm. **(5 marks)**

(a) How many vernier divisions are needed, and what total length of the main scale should they cover? (02)

(b) A reading has the vernier zero between 54 mm and 55 mm and the 13th vernier division coinciding. Find the observed reading. (01)

(c) With jaws closed the vernier zero is to the left of the main zero and the 18th division coincides. Find the zero error. (01)

.....

(d) Find the corrected reading of (b). (01)

.....

G19. ●●●● A/L hardest A vernier caliper with a zero error of +0.2 mm gives observed readings of 22.0 mm for the external diameter and 18.4 mm for the internal diameter of a tube. The wall thickness of the tube is **(1 mark)**

(1) 1.6 mm (2) 1.7 mm (3) 1.8 mm (4) 1.9 mm (5) 2.0 mm

G20. ●●●● A/L hardest The side of a cube is read as 2.00 cm on a vernier caliper that has an uncorrected zero error of −0.02 cm. The mass of the cube is 21.6 g. The true density of the cube is about **(1 mark)**

(1) 2.54 g cm⁻³ (2) 2.62 g cm⁻³ (3) 2.65 g cm⁻³ (4) 2.70 g cm⁻³ (5) 2.78 g cm⁻³

SECTION H – Micrometer screw gauge

Syllabus 1.4 · Questions H1 – H13 · 22 marks

H1. ● Basic The pitch of a micrometer screw gauge is **(1 mark)**

(1) the number of divisions on the circular scale
(2) the distance between anvil and spindle
(3) the least count of the main scale
(4) the total range of the instrument
(5) the distance moved by the spindle in one complete rotation

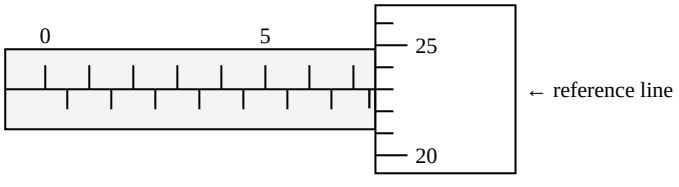
H2. ● Basic A micrometer has a pitch of 0.5 mm and 50 circular divisions. Its least count is **(1 mark)**

(1) 0.001 mm (2) 0.005 mm (3) 0.01 mm (4) 0.05 mm (5) 0.1 mm

H3. ● Basic The ratchet of a micrometer screw gauge is used to **(1 mark)**

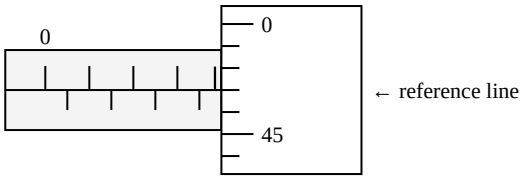
(1) read the main scale
(2) lock the spindle
(3) apply the same small pressure on the object every time
(4) correct the zero error
(5) increase the range

H4. ●● Standard The figure shows the scales of a micrometer (pitch 0.5 mm, 50 divisions). The reading is **(1 mark)**



(1) 7.23 mm (2) 7.27 mm (3) 7.50 mm (4) 7.73 mm (5) 8.23 mm

H5. (•• Standard) The figure shows the scales of a micrometer (pitch 0.5 mm, 50 divisions). The reading is **(1 mark)**



(1) 4.00 mm (2) 4.43 mm (3) 4.47 mm (4) 4.53 mm (5) 4.97 mm

H6. (•• Standard) A micrometer has a pitch of 1 mm and 100 circular divisions. Its least count is **(1 mark)**

(1) 0.001 mm (2) 0.01 mm (3) 0.05 mm (4) 0.1 mm (5) 1 mm

H7. (•• Standard) Backlash error in a micrometer is avoided by **(1 mark)**

(1) using the ratchet
(2) subtracting the zero error
(3) taking the mean of readings
(4) turning the thimble in one direction only when taking a reading
(5) cleaning the anvil

H8. (••• Exam level) With the jaws of a micrometer (least count 0.01 mm) closed, the 46th division of the circular scale is on the reference line (the zero is above the line). A reading of a wire is 3.27 mm. The corrected diameter is **(1 mark)**

(1) 2.81 mm (2) 3.23 mm (3) 3.27 mm (4) 3.31 mm (5) 3.73 mm

H9. (••• Exam level) The diameter of a 0.50 mm wire is measured with a micrometer of least count 0.01 mm. The percentage error is **(1 mark)**

(1) 0.2 % (2) 0.5 % (3) 1 % (4) 2 % (5) 5 %

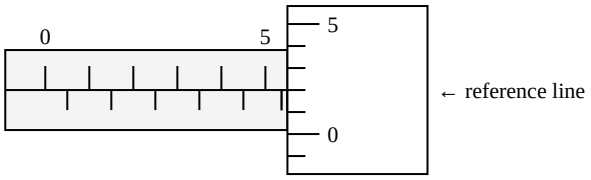
H10. (••• Exam level) The diameter of a wire is measured with a micrometer (least count 0.01 mm) at three places, in two perpendicular directions at each place. Readings (mm): 0.52, 0.53, 0.51, 0.52, 0.53, 0.51. The zero error is +0.02 mm. ($\pi = 3.14$) **(5 marks)**

(a) Find the mean reading and the corrected diameter. (02)

(b) Find the cross-sectional area of the wire in m^2. (02)

(c) Why are readings taken in two perpendicular directions? (01)

H11. ●●●● A/L hardest The sleeve of a micrometer (pitch 0.5 mm, 50 divisions) is shown. The reading is **(1 mark)**



(1) 5.02 mm (2) 5.20 mm (3) 5.52 mm (4) 5.70 mm (5) 7.00 mm

H12. ●●●● A/L hardest When the thimble of a micrometer is turned through 5 complete rotations, the spindle moves 2.5 mm. The circular scale has 50 divisions. **(6 marks)**

(a) Find the pitch. (01)

(b) Find the least count. (01)

(c) With the jaws closed, the zero of the circular scale is 3 divisions below the reference line. State the zero error. (01)

(d) A steel ball gives a main scale reading of 6.5 mm and a circular scale reading of 37. Find the corrected diameter. (02)

(e) Find the volume of the ball in mm^3. ($\pi = 3.14$) (01)

H13. ●●●● A/L hardest A glass slide is about 1.2 mm thick. Which instrument can measure it with a percentage error of less than 1 %? **(1 mark)**

(1) Micrometer screw gauge (0.01 mm) (2) Vernier caliper (0.1 mm)
(3) Vernier caliper (0.05 mm) (4) Metre ruler (1 mm)
(5) None of these

SECTION I – Spherometer

Syllabus 1.4 · Questions I1 – I8 · 12 marks

I1. ● Basic A spherometer is mainly used to measure the **(1 mark)**

(1) radius of curvature of a spherical surface (2) thickness of a wire
(3) internal diameter of a tube (4) mass of a lens
(5) focal length directly

I2. (• Basic) A spherometer has **(1 mark)**

(1) two legs and a screw (2) four legs
(3) three fixed legs and a central screw (4) one leg and a scale
(5) three screws only

I3. (•• Standard) A spherometer has a pitch of 0.5 mm and 100 circular divisions. Its least count is **(1 mark)**

(1) 0.001 mm (2) 0.005 mm (3) 0.01 mm (4) 0.05 mm (5) 0.5 mm

I4. (•• Standard) A spherometer (least count 0.01 mm) reads 1.25 mm on a plane glass plate and 2.73 mm on a convex surface. The height h is **(1 mark)**

(1) 1.25 mm (2) 1.48 mm (3) 1.52 mm (4) 2.73 mm (5) 3.98 mm

I5. (••• Exam level) For a spherometer, l = 3.00 cm (distance between legs) and h = 0.150 cm. Using $R = l^2/6h + h/2$, the radius of curvature is about **(1 mark)**

(1) 1.0 cm (2) 5.0 cm (3) 10.1 cm (4) 20.0 cm (5) 30.0 cm

I6. (••• Exam level) A spherometer is used on a concave mirror. **(5 marks)**

(a) The reading on a plane glass plate is 2.36 mm and on the mirror 1.86 mm. Find h. (01)

.....

(b) The distance between the legs is l = 4.50 cm. Find R using $R = l^2/6h + h/2$. (02)

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.....

(c) Why can the term h/2 often be neglected? (01)

.....

(d) How is l found in practice? (01)

.....

I7. (•••• A/L hardest) In the calculation of $R = l^2/6h$ (h/2 neglected), h was read as 0.152 cm instead of the true 0.150 cm. The calculated R is **(1 mark)**

(1) about 1.3 % too small (2) about 1.3 % too large (3) exactly correct
(4) about 2.6 % too small (5) about 0.2 % too small

I8. (•••• A/L hardest) The three legs of a spherometer form an equilateral triangle of side 3.46 cm. For a surface, h = 0.100 cm. The radius of curvature ($R = l^2/6h + h/2$) is about **(1 mark)**

(1) 10.0 cm (2) 17.3 cm (3) 20.0 cm (4) 34.6 cm (5) 40.0 cm

SECTION J – Travelling microscope

Syllabus 1.4 · Questions J1 – J6 · 9 marks

J1. (• Basic) A travelling microscope consists of **(1 mark)**

(1) a magnifying glass only
(2) a micrometer with a lens
(3) a spherometer with a lens
(4) a telescope with a ruler
(5) a microscope that can move along a vertical and horizontal scale fitted with verniers

J2. (• Basic) A travelling microscope is most suitable to measure **(1 mark)**

(1) the length of a bench (2) the mass of a coin
(3) temperature (4) the thickness of a coin
(5) small lengths without touching the object

J3. (•• Standard) The main scale of a travelling microscope is graduated in 0.5 mm and 50 vernier divisions equal 49 main scale divisions. The least count is **(1 mark)**

(1) 0.001 mm (2) 0.01 mm (3) 0.02 mm (4) 0.05 mm (5) 0.1 mm

J4. (•• Standard) Before taking readings with a travelling microscope, the eyepiece is adjusted until the cross-wires are clearly seen. This is done to **(1 mark)**

(1) increase magnification (2) avoid backlash (3) reduce the least count
(4) correct the zero error (5) avoid parallax error

J5. (••• Exam level) A travelling microscope (least count 0.001 cm) is used to find the internal radius of a capillary tube. The cross-wire is set on opposite edges of the bore. **(4 marks)**

(a) Horizontal readings: 3.452 cm and 3.506 cm. Vertical readings: 6.215 cm and 6.161 cm. Find the mean internal diameter and radius. (02)

(b) Why are both horizontal and vertical diameters measured? (01)

(c) Why is the microscope moved in only one direction between the two readings? (01)

J6. (•••• A/L hardest) The external diameter of a rubber tube gives travelling-microscope readings of 12.45 mm and 18.97 mm; the internal diameter gives 14.10 mm and 17.32 mm. The wall thickness of the tube is **(1 mark)**

(1) 1.61 mm (2) 1.65 mm (3) 3.22 mm (4) 3.30 mm (5) 6.52 mm

SECTION K – Balances, stopwatches and the digital multimeter

Syllabus 1.4 · Questions K1 – K7 · 7 marks

K1. (• Basic) A triple beam balance measures **(1 mark)**

(1) weight (2) density (3) mass (4) volume (5) force

K2. (• Basic) The least count of a typical digital stopwatch is **(1 mark)**

(1) 0.001 s (2) 0.01 s (3) 0.1 s (4) 0.2 s (5) 1 s

K3. (•• Standard) The 'tare' button of an electronic balance is used to **(1 mark)**

(1) switch the balance off
(2) set the reading to zero with a container on the pan
(3) change the units
(4) increase the range
(5) calibrate it for temperature

K4. (•• Standard) On a four-beam balance the riders read 100 g, 20 g, 5 g and 0.6 g. The mass of the object is **(1 mark)**

(1) 120.6 g (2) 125.0 g (3) 125.6 g (4) 126.5 g (5) 152.6 g

K5. (•• Standard) To measure the current through a resistor, a digital multimeter should be **(1 mark)**

(1) connected in series, set to the current range
(2) connected in parallel, set to the voltage range
(3) connected in parallel, set to the current range
(4) connected in series, set to the resistance range
(5) connected across the battery only

K6. (••• Exam level) A digital stopwatch reads to 0.01 s, but the reaction time of a person is about 0.2 s. To time the period of a pendulum accurately one should **(1 mark)**

(1) time one oscillation and quote it to 0.01 s
(2) time half an oscillation
(3) use an analogue stopwatch
(4) time many oscillations and divide
(5) use a metre ruler

K7. (••• Exam level) A digital multimeter on its 20 V range shows 2.37. The voltage and the resolution of the reading are **(1 mark)**

(1) 2.37 V, 0.01 V (2) 2.37 V, 0.1 V (3) 23.7 V, 0.1 V
(4) 0.237 V, 0.001 V (5) 2.37 V, 1 V

SECTION L – Scalars and vectors

Syllabus 1.5 · Questions L1 – L13 · 19 marks

L1. (• Basic) Which of the following is a vector quantity? **(1 mark)**

(1) Mass (2) Time (3) Speed
(4) Energy (5) Displacement

L2. (• Basic) Which of the following is a scalar quantity? **(1 mark)**

(1) Force (2) Velocity (3) Momentum
(4) Acceleration (5) Work

L3. (•• Standard) Two forces of 6 N and 8 N act at right angles. The magnitude of the resultant is **(1 mark)**

(1) 2 N (2) 7 N (3) 10 N (4) 14 N (5) 48 N

L4. (•• Standard) A force of 50 N acts at 37° to the horizontal (sin 37° = 0.6, cos 37° = 0.8). Its horizontal and vertical components are **(1 mark)**

(1) 40 N, 30 N (2) 30 N, 40 N (3) 50 N, 0 (4) 25 N, 25 N (5) 40 N, 40 N

L5. (•• Standard) The resultant of forces of 5 N and 12 N acting at a point can have any value between **(1 mark)**

(1) 5 N and 12 N (2) 7 N and 13 N (3) 0 and 17 N
(4) 12 N and 17 N (5) 7 N and 17 N

L6. (••• Exam level) Two forces, each of 10 N, act at a point at an angle of 60°. The resultant is about **(1 mark)**

(1) 5 N (2) 10 N (3) 14.1 N (4) 17.3 N (5) 20 N

L7. (••• Exam level) Three coplanar forces, each of 10 N, act at a point at 120° to one another. The resultant is **(1 mark)**

(1) 0 (2) 10 N (3) 17.3 N (4) 20 N (5) 30 N

L8. (••• Exam level) Vector A is 3 units due east and vector B is 4 units due north. The vector A − B is **(1 mark)**

(1) 5 units, north of east (2) 1 unit, south of east (3) 7 units due east
(4) 5 units, south of east (5) 5 units, north of west

L9. (••• Exam level) The resultant of two forces of equal magnitude F is also F. The angle between the forces is **(1 mark)**

(1) 0° (2) 60° (3) 90° (4) 120° (5) 180°

L10. (••• Exam level) Two forces of 4 N and 6 N act at a point with 60° between them. **(4 marks)**

(a) Use the parallelogram law to find the magnitude of the resultant. (02)

.....

.....

.....

(b) Find the angle the resultant makes with the 4 N force. (02)

.....

L11. ●●●● A/L hardest When two forces act at right angles their resultant is 10 N. When they act in opposite directions the resultant is 2 N. The forces are **(1 mark)**

(1) 5 N and 5 N (2) 6 N and 4 N (3) 7 N and 5 N (4) 8 N and 6 N (5) 9 N and 7 N

L12. ●●●● A/L hardest Forces of 5 N due east, 4 N due north and 2 N due west act at a point. The resultant is **(1 mark)**

(1) 3 N due east (2) 5 N, 37° north of east (3) 11 N due east
(4) 7 N, north-east (5) 5 N, 53° north of east

L13. ●●●● A/L hardest Two forces act at a point: 10 N along the x-axis and 10 N at 60° to the x-axis. **(4 marks)**

(a) Resolve each force into x and y components and find the resultant (magnitude and direction). (03)

(b) State the single force that would keep the point in equilibrium. (01)

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SCORE CARD

Fill in after marking with the marking scheme

Section	Sub-topic	Max	My marks	%	Redo?
A	Physics and the scientific method	7			
B	Physical quantities and SI units	19			
C	Significant figures and scientific notation	9			
D	Dimensions	22			
E	Errors in measurement	16			
F	Metre ruler and choosing the right instrument	10			
G	Vernier caliper	27			
H	Micrometer screw gauge	22			
I	Spherometer	12			
J	Travelling microscope	9			
K	Balances, stopwatches and the digital multimeter	7			
L	Scalars and vectors	19			
Total		**179**			

Self-check bands (a guide, not official A/L grade boundaries): 75 % and above – exam ready · 65–74 % – polish the ●●●● questions · 50–64 % – redo the ●●● and ●●●● questions · below 50 % – read the revision notes for that section and redo it.

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