

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

**MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2012**

SUBJECT:	ENGINEERING DRAWING / GRAPHICAL COMMUNICATION
PAPER NUMBER:	I
DATE:	4th September 2012
TIME:	9.00 a.m. to 12.00 noon

Directions to Candidates

Write your index number where indicated at the top of all drawing sheets.

Attempt **any FIVE** questions.

Programmable calculators **cannot** be used.

Unless otherwise stated:

- drawings should conform to B.S. or equivalent (ISO) standards;
- all dimensions are in millimetres;
- all answers are to be accurately drawn with instruments;
- unless otherwise stated, all construction lines must be left in each solution;
- drawing aids may be used.

Dimensions not given should be estimated.

Careful layout and presentation are important.

Marks will be awarded for accuracy, clarity and appropriateness of constructions.

Mark allocations are shown in brackets.

Question 1

i) Figure 1.1 shows a natural occurrence of a 3D spiral.



Figure 1.1

- a) A **part** of a convolution of an Archimedean spiral passes through point A. It coils clockwise about O and after going through an additional 210°, it reaches point B. Points O, A and B are located as in Figure 1.2. Construct the part of the convolution from A to B. **(6 marks)**

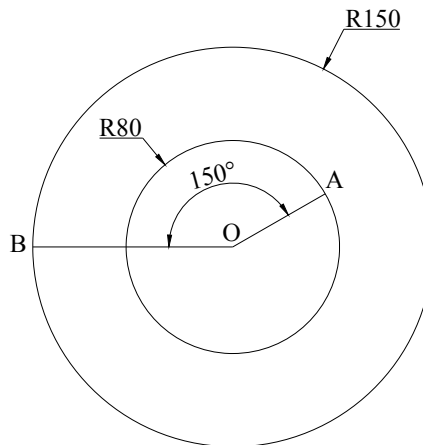
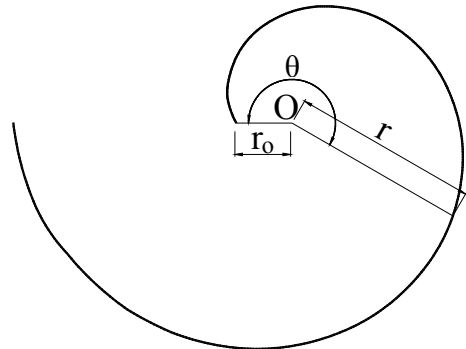


Figure 1.2

- b) The polar equation for an Archimedean spiral is given by:

$$r = r_o + a\theta$$

- where r = length of radius vector;
 r_o = length of initial radius vector;
 a = constant of the curve;
 θ = angle of radius vector measured in radians from the position of the initial radius vector.



Use the relevant data for points A and B to determine the value of the constant a of the spiral. Record the value of a . **(4 marks)**

- c) On the curve produced as the answer to part (a), construct the normal at the point which is 125 mm away from the pole O. **(3 marks)**

- ii) The cardioid is a particular case of the epicycloid. It is produced when the rolling circle has the same size as the fixed base circle. Construct the cardioid traced by a point on the circumference of a rolling circle having a diameter of 80 mm.

The candidates are free to consider any point on the circumference. The generating circle may be assumed to roll either clockwise or anticlockwise.

(7 marks)
(20 marks total)

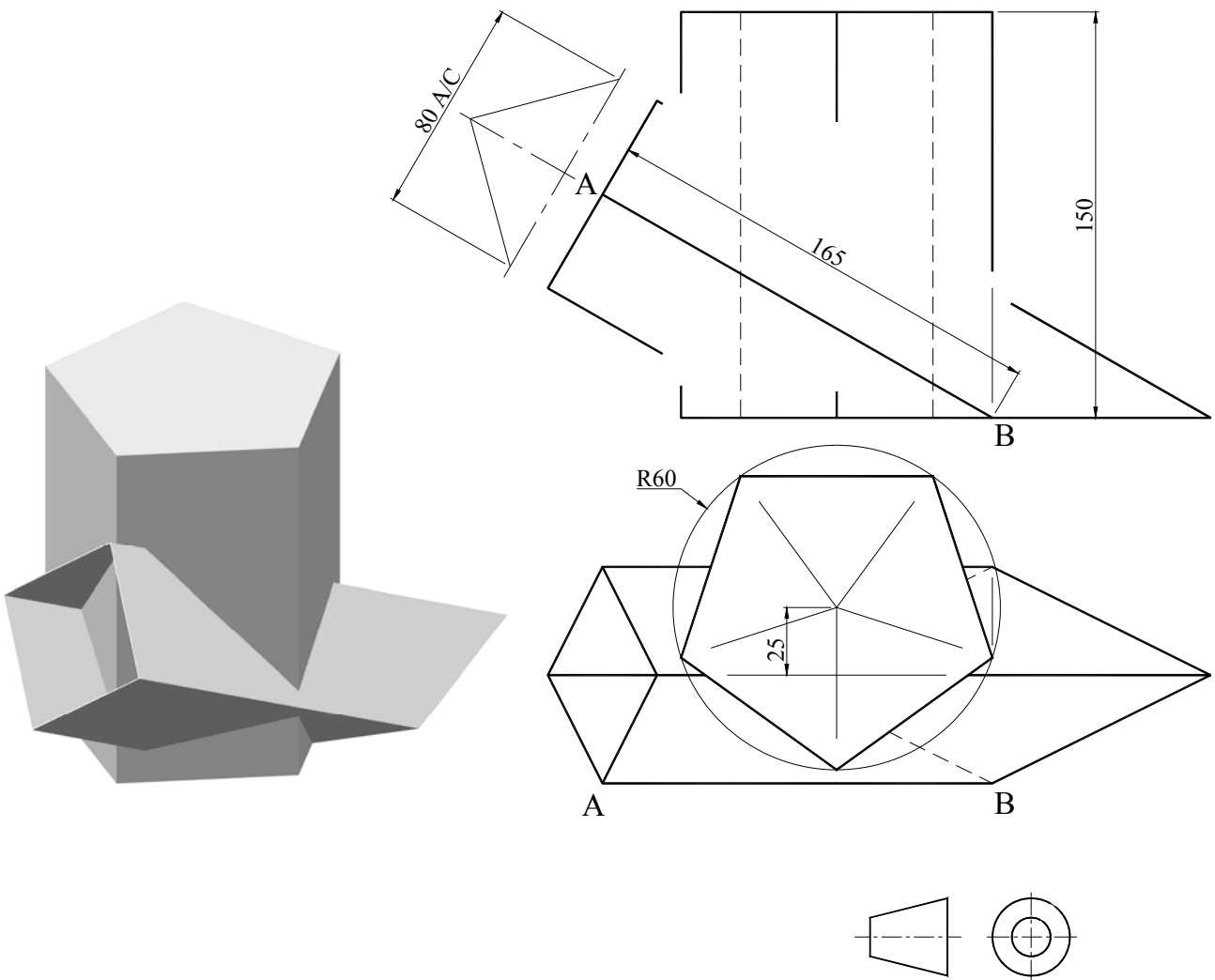
Question 2

The given views represent the intersection between two right prisms. The solid pentagonal prism penetrates a hollow square duct from above, passes through and emerges again such that both prisms stand on the same horizontal plane. The square duct is manufactured from thin sheet metal.

- i) Copy the given orthographic views. **(3 marks)**
- ii) Complete the front elevation. *Hidden detail is required.* **(9 marks)**
- iii) Produce a full development of the hollow square prism, making edge AB as the joint line. **(8 marks)**

When copying the given views candidates are advised to set them close to the left vertical margin of the border printed on the sheets provided. This ensures sufficient paper space is left on the right to accommodate the required development.

(20 marks total)



(Please turn the page)

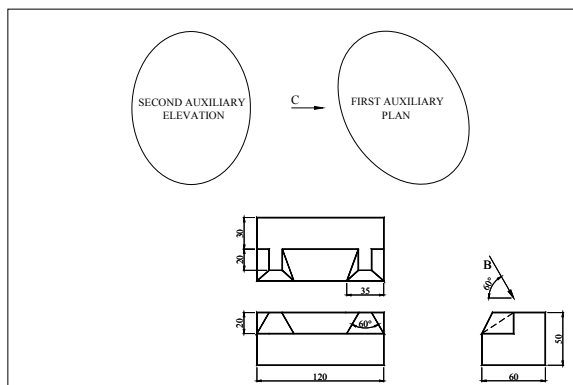
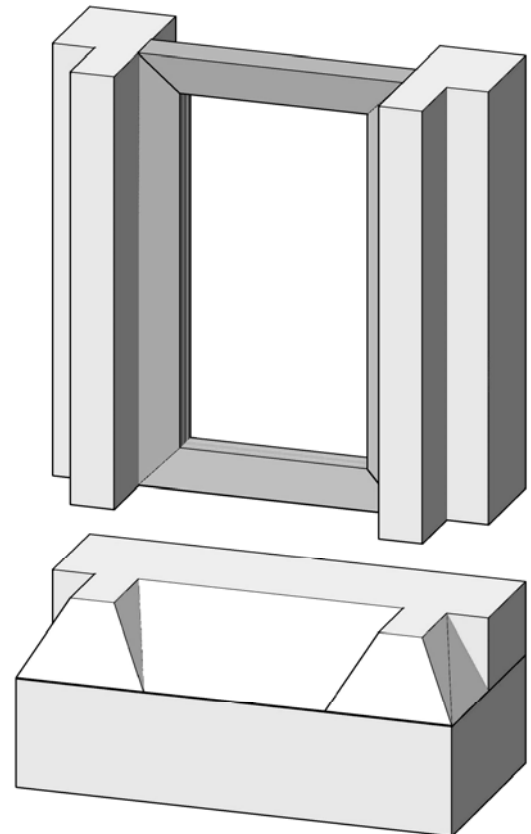
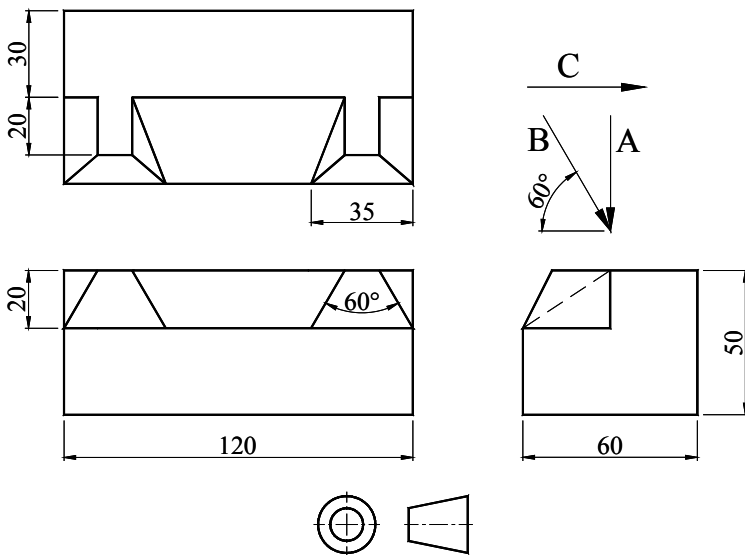
Question 3

A large block of stone is dressed into a window sill. Scaled views of the window sill are given below.

- i) Copy the given orthographic views. **(3 marks)**
- ii) Looking on the given end elevation in the direction of arrow A, shows the given plan. Derive a first auxiliary plan by looking on the end elevation in the direction of arrow B. **Hidden detail is required.** **(8 marks)**
- iii) Construct a second auxiliary elevation by looking on the plan obtained in (ii) in the direction of arrow C. **Hidden detail is not required.** **(9 marks)**

When copying the given views candidates are advised to set them close to the bottom right corner of the border printed on the sheets provided. This ensures sufficient paper space is left to accommodate the required auxiliary views. A scheme of the suggested layout is given below.

(20 marks total)



Layout scheme

Question 4

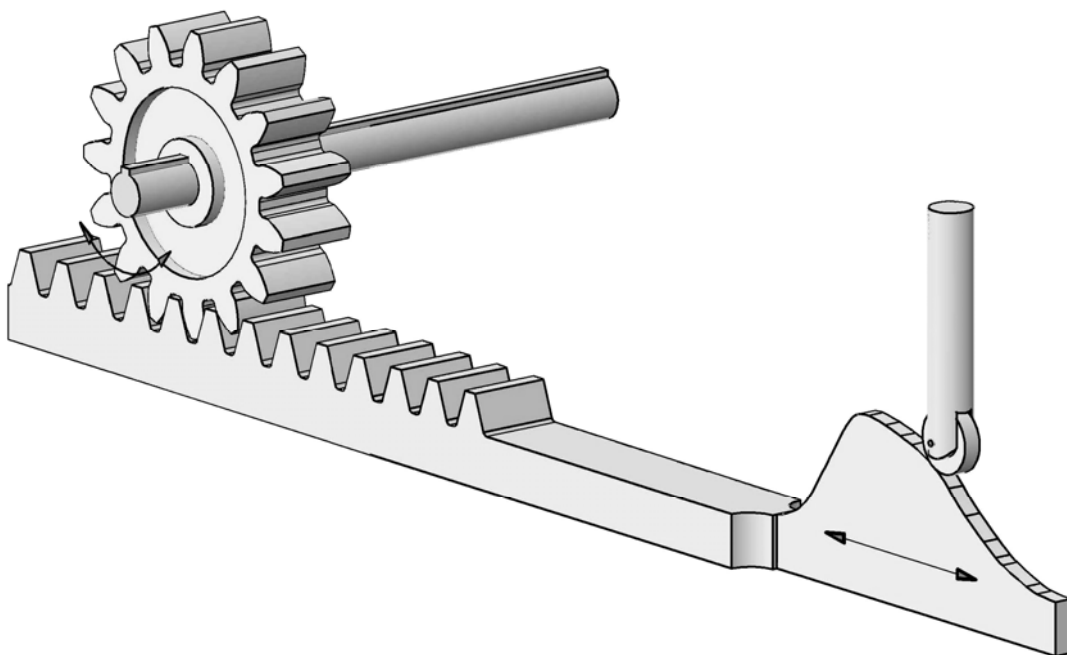
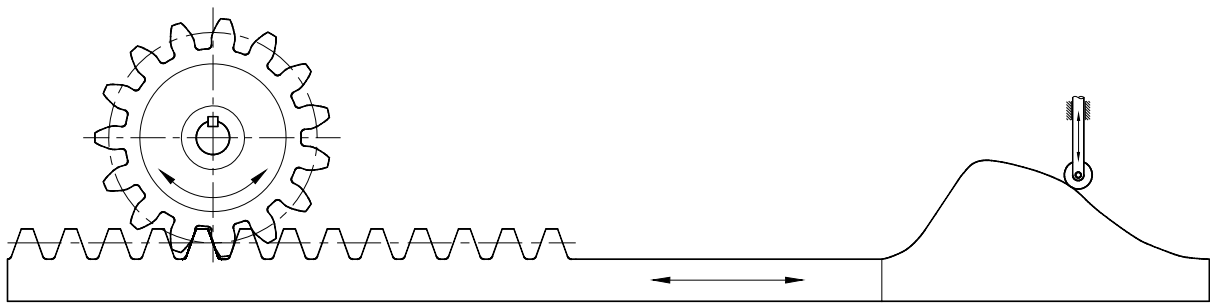
A wedge cam moves back and forth displacing a roller follower vertically. The cam is driven by a rack and pinion mechanism. The pinion performs an oscillatory rotary motion of **half a revolution in either direction** such that the rack imparts to the cam the necessary horizontal reciprocating motion. The pinion has 15 teeth and a module of 10 mm. The follower uses an R10 roller.

Derive the wedge cam profile that will displace the follower according to the following data:

- i) first 3/10ths of forward stroke of cam: 30mm UA rise;
- ii) next 1/10ths of forward stroke of cam: 20mm UV rise;
- iii) next 3/10ths of forward stroke of cam: 20mm UR rise;
- iv) remainder of forward stroke of cam: 70mm SHM fall.

For the setup given below, the forward stroke of the cam may be taken to be caused by the pinion performing its half revolution in the anticlockwise direction.

(20 marks total)



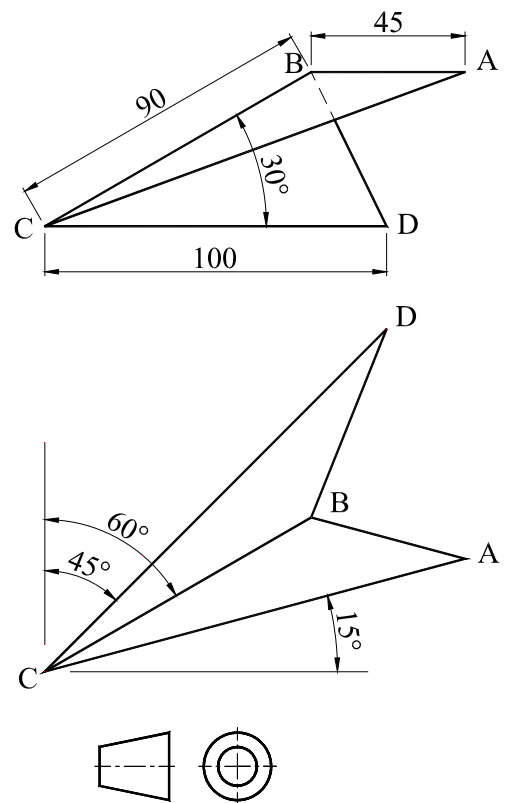
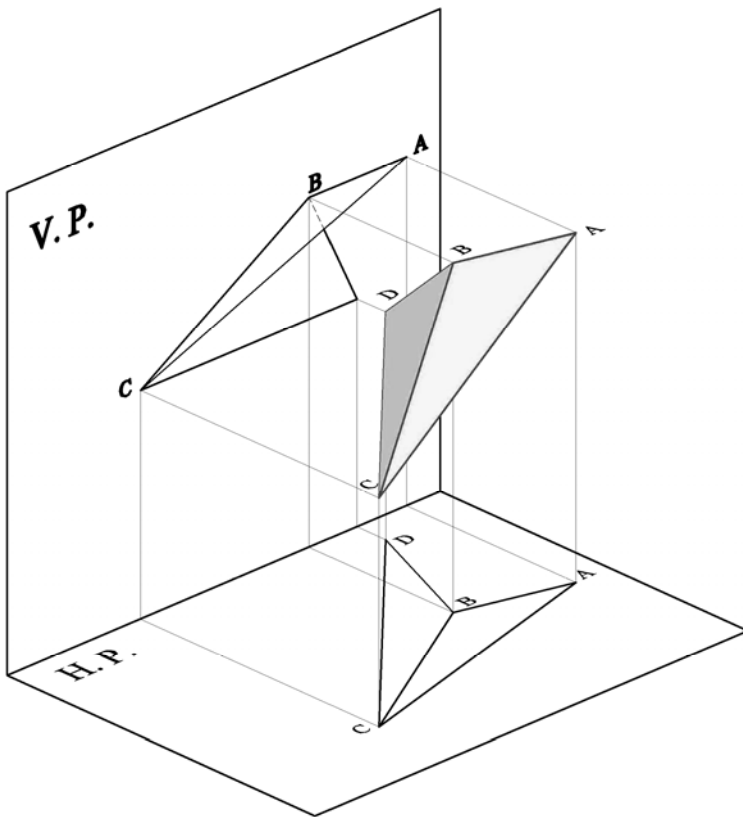
(Please turn the page)

Question 5

The views below describe a piece of thin sheet metal, bent along BC, to form two different triangular planes, BCD and BCA.

- i) Copy the given orthographic views. **(2 marks)**
- ii) By looking on the given elevation in a suitable direction, project a first auxiliary plan that includes the true length of BC. Record the true length of BC to the nearest mm and the true angle it makes with the reference vertical plane VP, measured to the nearest degree. **(5 marks)**
- iii) Using the technique of auxiliary views, determine the dihedral angle, through which the thin sheet metal plate was bent to correspond with the given views. Record the angle to the nearest degree. **(5 marks)**
- iv) Using the technique of auxiliary views, deduce the true shapes of triangles BCD and BCA. **(6 marks)**
- v) Combine the true shapes derived in (iii) to develop the original piece of thin sheet metal before it was bent. **(2 marks)**

(20 marks total)



Question 6

A **cone A**, having an apex angle of 60° , stands on the reference horizontal plane HP. A **sphere B** is brought to touch the cone in a plane parallel to the reference vertical plane VP. A larger **sphere C** is also brought to touch the cone A, but in a plane making 30° with the reference VP. A third **sphere D** is lodged in between cone A and sphere C such that it touches them both. A corresponding plan view is given in Figure 6.1.

- i) Project a front elevation and a plan of the setup described above, showing clearly the projection of the centrelines and the points of contact.
Leave all constructional work showing. **(8 marks)**

Sphere B is now rotated through a clockwise angle θ , around cone A, until it comes to touch also the smallest sphere D. In this position sphere D is in mutual contact with all the other three solids. A corresponding plan view is given in Figure 6.2.

- ii) Determine and record, to the nearest degree, the value of the angle θ . **(3 marks)**
 - iii) Update the front elevation and plan you produced in answer to part (i) to represent the final setup. Show clearly the projection of the centrelines and the points of contact.
Leave all constructional work showing. **(9 marks)**
- (20 marks total)**

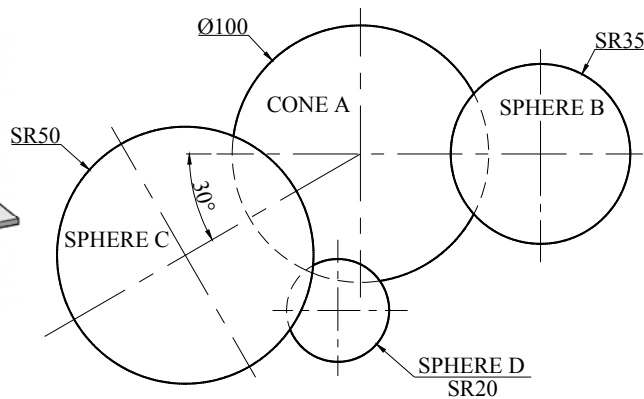
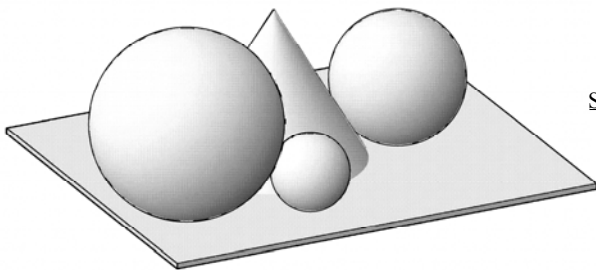


Figure 6.1

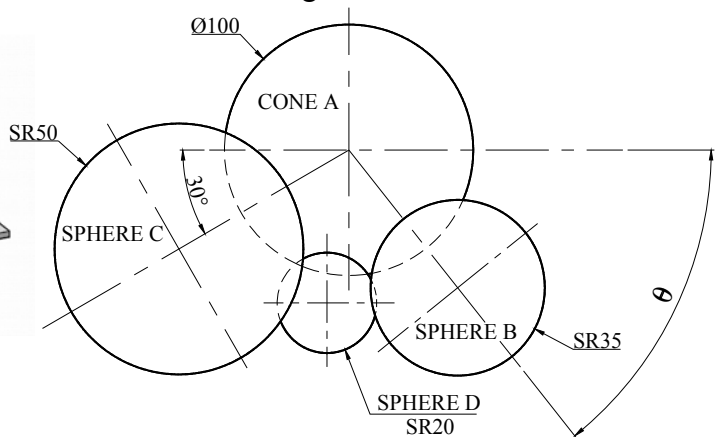
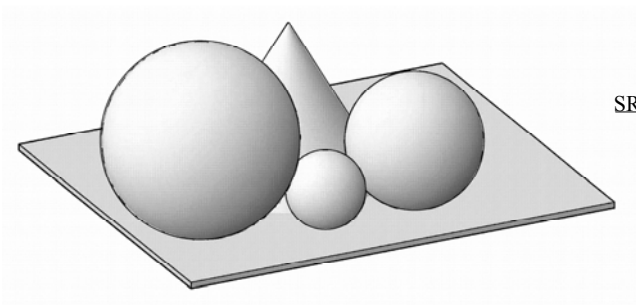


Figure 6.2

End of examination paper

BRITISH STANDARD SELECTED ISO FITS—HOLE BASIS

Nominal sizes		Clearance fits										Transition fits				Interference fits				Nominal sizes			
		Tolerance		Tolerance		Tolerance		Tolerance		Tolerance		Tolerance		Tolerance		Tolerance							
Over	To	H11	c11	H9	d10	H9	e9	H8	f7	H7	g6	H7	h6	H7	k6	H7	n6	H7	p6	H7	s6	Over	To
mm	mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	0.001 mm	mm	mm
—	3	+60 0	-60 -120	+25 0	-20 -60	+25 0	-14 -39	+14 0	-6 -16	+10 0	-2 -8	+10 0	-6 0	+10 0	+6 +0	+10 0	+10 +4	+10 0	+12 +6	+10 0	+20 +14	—	3
3	6	+75 0	-70 -145	+30 0	-30 -78	+30 0	-20 -50	+18 0	-10 -28	+12 0	-4 -12	+12 0	-8 0	+12 0	+9 +1	+12 0	+16 +8	+12 0	+20 +12	+12 0	+27 +19	3	6
6	10	+90 0	-80 -170	+36 0	-40 -98	+36 0	-25 -61	+22 0	-13 -28	+15 0	-5 -14	+15 0	-9 0	+15 0	+10 +1	+15 0	+19 +10	+15 0	+24 +15	+15 0	+32 +23	6	10
10	18	+110 0	-95 -205	+43 0	-50 -120	+43 0	-32 -75	+27 0	-16 -34	+18 0	-6 -17	+18 0	-11 0	+18 0	+12 +1	+18 0	+23 +12	+18 0	+29 +18	+18 0	+39 +28	10	18
18	30	+130 0	-110 -240	+52 0	-65 -149	+52 0	-40 -92	+33 0	-20 -41	+21 0	-7 -20	+21 0	-13 0	+21 0	+15 +2	+21 0	+28 +15	+21 0	+35 +22	+21 0	+48 +35	18	30
30	40	+160 0	-120 -280	+62 0	-80 -180	+62 0	-50 -112	+39 0	-25 -50	+25 0	-9 -25	+25 0	-16 0	+25 0	+18 +2	+25 0	+33 +17	+25 0	+42 +26	+25 0	+59 +43	30	40
40	50	+160 0	-130 -290	+74 0	-100 -220	+74 0	-60 -134	+46 0	-30 -60	+30 0	-10 -29	+30 0	-19 0	+30 0	+21 +2	+30 0	+39 +20	+30 0	+51 +32	+30 0	+72 +53	50	65
50	65	+190 0	-140 -330	+74 0	-100 -220	+74 0	-60 -134	+46 0	-30 -60	+30 0	-10 -29	+30 0	-19 0	+30 0	+21 +2	+30 0	+39 +20	+30 0	+51 +32	+30 0	+72 +53	50	65
65	80	+190 0	-150 -340	+74 0	-100 -220	+74 0	-60 -134	+46 0	-30 -60	+30 0	-10 -29	+30 0	-19 0	+30 0	+21 +2	+30 0	+39 +20	+30 0	+51 +32	+30 0	+72 +53	65	80
80	100	+220 0	-170 -390	+87 0	-120 -260	+87 0	-72 -159	+54 0	-36 -71	+35 0	-12 -34	+35 0	-22 0	+35 0	+25 +3	+35 0	+45 +23	+35 0	+59 +37	+35 0	+93 +71	80	100
100	120	+220 0	-180 -400	+87 0	-120 -260	+87 0	-72 -159	+54 0	-36 -71	+35 0	-12 -34	+35 0	-22 0	+35 0	+25 +3	+35 0	+45 +23	+35 0	+59 +37	+35 0	+93 +71	100	120
120	140	+250 0	-200 -450	+100 0	145 305	+100 0	-84 -185	+63 0	-43 -83	+40 0	-14 -39	+40 0	-25 0	+40 0	+28 +3	+40 0	+52 +27	-40 0	+68 +43	+40 0	+117 +92	120	140
140	160	+250 0	-210 -460	+100 0	145 305	+100 0	-84 -185	+63 0	-43 -83	+40 0	-14 -39	+40 0	-25 0	+40 0	+28 +3	+40 0	+52 +27	-40 0	+68 +43	+40 0	+125 +100	140	160
160	180	+250 0	-230 -480	+100 0	145 305	+100 0	-84 -185	+63 0	-43 -83	+40 0	-14 -39	+40 0	-25 0	+40 0	+28 +3	+40 0	+52 +27	-40 0	+68 +43	+40 0	+133 +108	160	180
180	200	+290 0	-240 -530	+115 0	-170 -355	+115 0	-100 -215	+72 0	-50 -96	+46 0	-15 -44	+46 0	-29 0	+46 0	+33 +4	+46 0	+60 +31	+46 0	+79 +50	+46 0	+151 +122	180	200
200	225	+290 0	-260 -550	+115 0	-170 -355	+115 0	-100 -215	+72 0	-50 -96	+46 0	-15 -44	+46 0	-29 0	+46 0	+33 +4	+46 0	+60 +31	+46 0	+79 +50	+46 0	+159 +130	200	225
225	250	+290 0	-280 -570	+115 0	-170 -355	+115 0	-100 -215	+72 0	-50 -96	+46 0	-15 -44	+46 0	-29 0	+46 0	+33 +4	+46 0	+60 +31	+46 0	+79 +50	+46 0	+169 +140	225	250
250	280	+320 0	-300 -620	+130 0	-190 -400	+130 0	-110 -240	+81 0	-56 -108	+52 0	-17 -49	+52 0	+32 0	+52 0	-36 +4	+52 0	+66 +34	+52 0	+88 +56	+52 0	+190 +158	250	280
280	315	+320 0	-330 -650	+130 0	-190 -400	+130 0	-110 -240	+81 0	-56 -108	+52 0	-17 -49	+52 0	+32 0	+52 0	-36 +4	+52 0	+66 +34	+52 0	+88 +56	+52 0	+202 +170	280	315
315	355	+360 0	-360 -720	+140 0	-210 -440	+140 0	-125 -265	+89 0	-62 -119	+57 0	-18 -54	+57 0	-36 0	+57 0	+40 +4	+57 0	+73 +37	+57 0	+98 +62	+57 0	+226 +190	315	355
355	400	+360 0	-400 -760	+140 0	-210 -440	+140 0	-125 -265	+89 0	-62 -119	+57 0	-18 -54	+57 0	-36 0	+57 0	+40 +4	+57 0	+73 +37	+57 0	+98 +62	+57 0	+244 +208	355	400
400	450	+400 0	-440 -840	+155 0	-230 -480	+155 0	-135 -290	+97 0	-68 -131	+63 0	-20 -60	+63 0	-40 0	+63 0	+45 +5	+63 0	+80 +40	+63 0	+108 +68	+63 0	+272 +232	400	450
450	500	+400 0	-480 -880	+155 0	-230 -480	+155 0	-135 -290	+97 0	-68 -131	+63 0	-20 -60	+63 0	-40 0	+63 0	+45 +5	+63 0	+80 +40	+63 0	+108 +68	+63 0	+292 +252	450	500

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MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2012

SUBJECT:	GRAPHICAL COMMUNICATION
PAPER NUMBER:	II
DATE:	5th September 2012
TIME:	9.00 a.m. to 12.00 noon

Directions to Candidates

Write your index number where indicated at the top of all drawing sheets.

Attempt **question 1** and any other **THREE** questions.

Programmable calculators **cannot** be used.

Unless otherwise stated:

- drawings should conform to B.S. or equivalent (ISO) standards;
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- all construction lines must be left on each solution;
- drawing aids may be used.

Dimensions not given should be estimated.

Careful layout and presentation are important.

Marks will be awarded for accuracy, clarity and appropriateness of constructions.

Colour/shading should be used where appropriate.

Mark allocations are shown in brackets.

Question 1 carries 34 marks. Questions 2, 3, 4 and 5 carry 22 marks each.

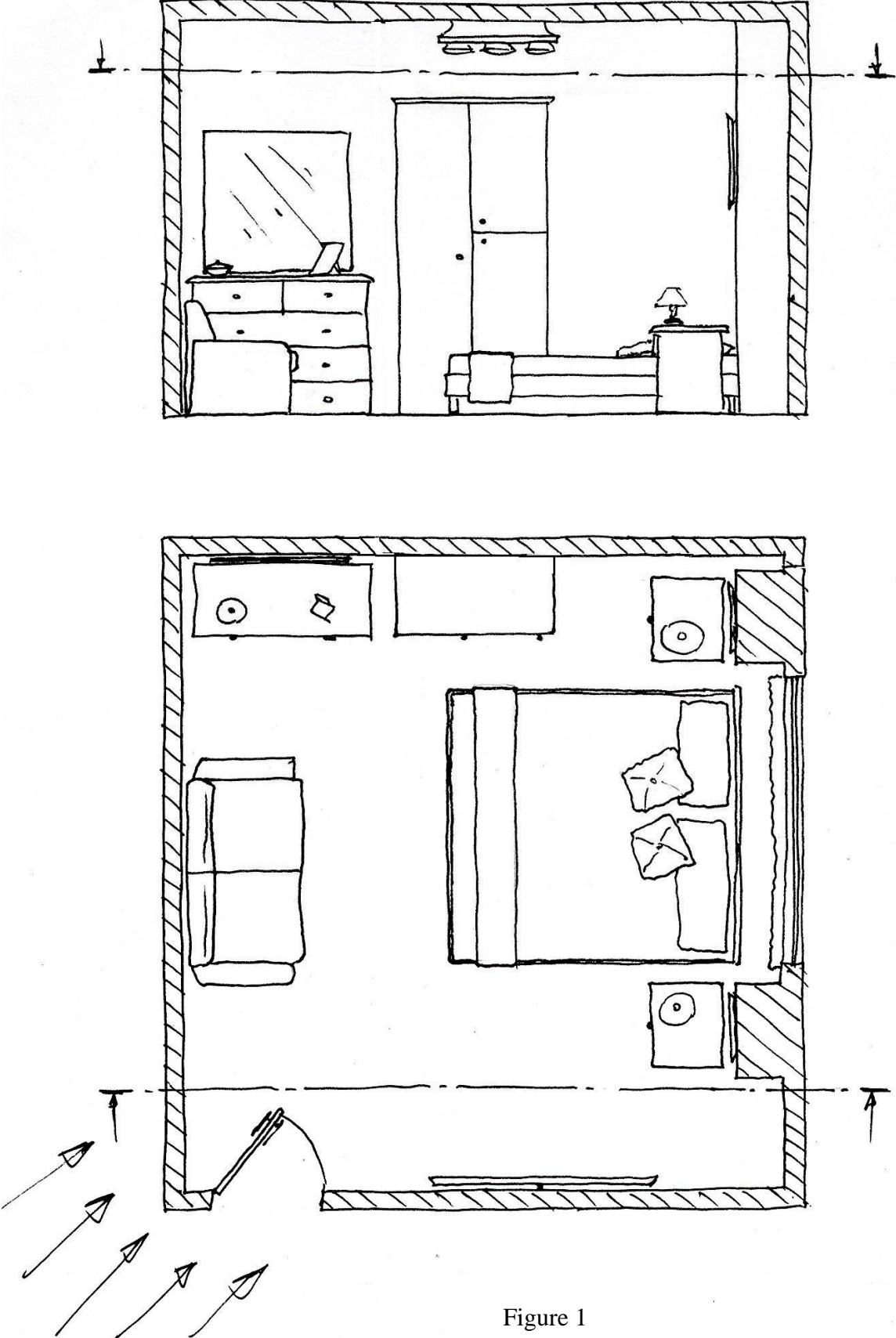


Figure 1

Question 1

Figure 1 on the opposite page shows sketches that a designer has produced for a large bedroom. These views constitute an integral part of the design process, but fail to convey a feeling of the **3D** proportions of the room.

You are to meet this requirement by making a **30°/60° planometric drawing** of the **whole** bedroom. The viewing direction required is indicated by the large arrows at the bottom of the figure.

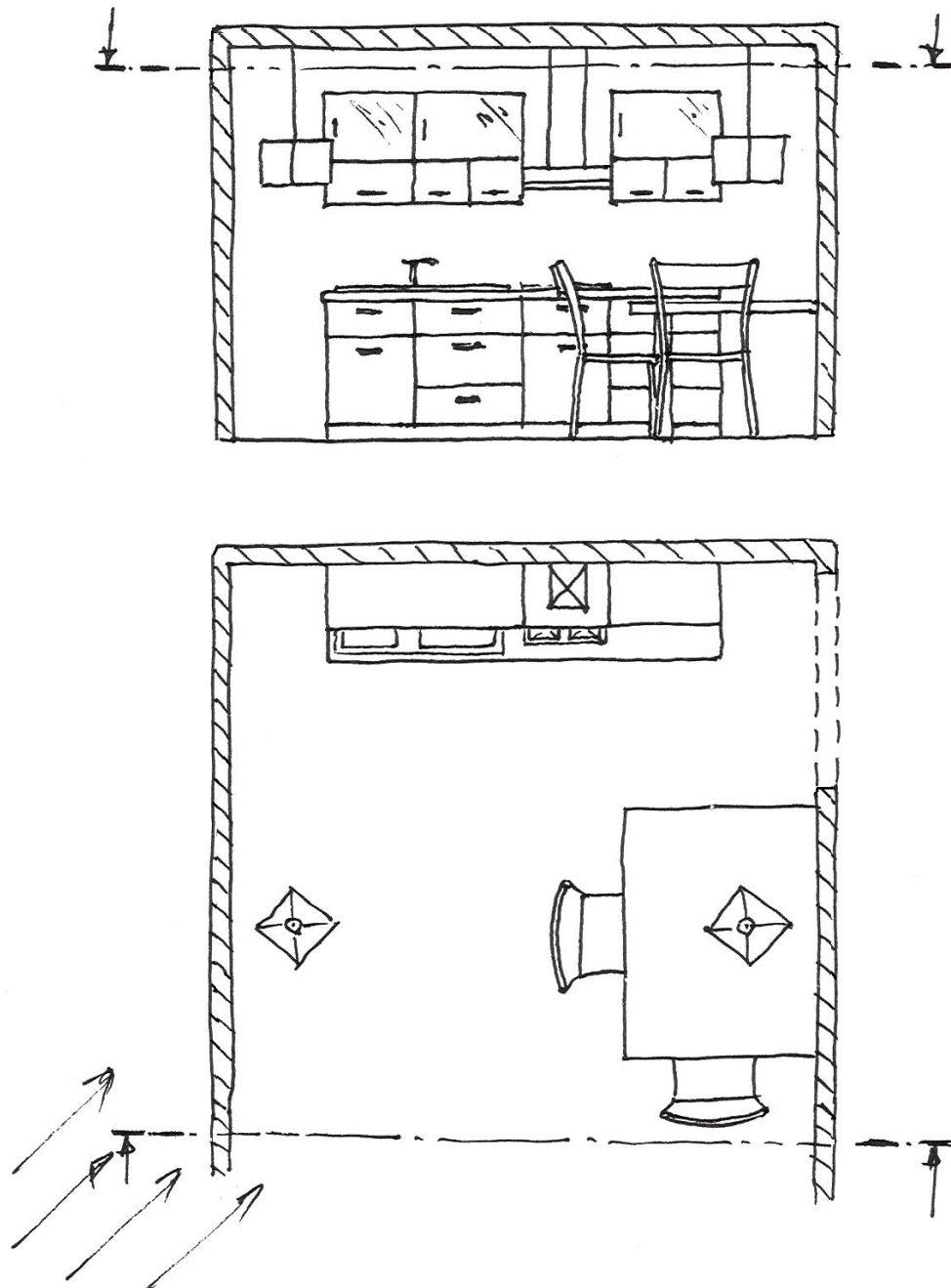
- i) Produce the required illustration on a single side of an A2 size paper **making the best use** of the space available. **(25 marks)**
- ii) Enhance your answer graphically using colours, tone and texture, suggesting also suitable materials. **(9 marks)**
You are expected to apply colour/tone/texture to your whole illustration.
(34 marks total)

Question 2

The orthographic sketches below describe part of a kitchen. You are required to produce a corresponding **'bird's-eye'** (ceiling removed, horizon line above level of ceiling) **interior two-point estimated perspective** drawing that respects the viewing direction indicated by the arrows at the bottom of the figure. Your work should make the best possible use of the space available of an A2 size sheet.

*The use of colour/tone/texture is **not** expected.*

(22 marks total)



Question 3

Preliminary Information

The local transport authority has lately constructed an extensive network of bicycle lanes along the main roads. The authority is now joining forces with the public health department to promote the use of these lanes. Promotion will be based on three counts:

- a) cycling favours an active and healthy lifestyle, maintaining the heart younger;
- b) bicycles do not pollute: no fume emissions, no sound pollution;
- c) cycling may well turn out to be a quicker option.

You have been asked to design ideogrammatic images that will feature on large billboards set up on the roads.

Design brief

Design ideogrammatic images to accompany the words:

GET YOUR BIKE ROLLING! YOU WILL HELP SAVE OUR
ROADS AND IT WILL HELP SAVE YOUR HEART!

These words should provide a focus for your design.

You are not required to include these or any words in your designs. Concentrate only on the images. Your work must be broken down in the steps given below, with each part being clearly identified.

- i) **Written analysis**
Identify, using keywords/short phrases, the main parameters of the problem.

(3 marks)
- ii) **Graphical analysis**
Based on your response to (i), produce a series of sketches (minimum 3) that graphically illustrate your developing ideas.
Your sketches need not necessarily represent new concepts; a development of the same idea would be acceptable.

(6 marks)
- iii) **Graphical synthesis**
Clearly identify those elements produced in your response to (ii) that you intend to use in your final images.

(1 mark)
- iv) **Final Realisation**
Produce your final solution to the problem.
Marks are awarded for the appropriateness of design and the use of colour.

(12 marks)
(22 marks total)

(Please turn the page)

Question 4

A sport/leisure magazine intends publishing a review on camping tents. You are approached and asked to help **representing and comparing graphically** the details of the sample of camping tents given in the table below.



Model	Inside headroom in m	No. of berths	Cost in €	Tent Fabric Quality	Tent fabric as a waterproof	Groundsheet Quality
A	0.9	2	25	3	2	2
B	1	3	80	3	4	2
C	0.8	2	35	3	4	3
D	1.3	3	100	4	3	2
E	1.1	4	140	5	3	3
F	1	4	180	5	4	5

Notes:

- The tent fabric quality, the tent fabric waterproofing qualities and the performance of the groundsheet have all been assessed across a 5 point scale, with 5 being the best.
 - The Tent Fabric Quality refers to the toughness and durability of the cloth used in the manufacture of the tent.
 - The tent fabric as a waterproof assesses the ability of the tent fabric to keep the rainwater out.
 - A groundsheet is an impermeable barrier placed underneath the bottom of a tent. It protects the tent bottom fabric from uprising ground moisture and from rough ground conditions. Better quality sheets incorporate a top layer of soft padding.
- i) A **3D** graphical representation is required to compare models A, C and E by way of their:
- a) inside headroom;
 - b) number of berths;
 - c) cost.

Clearly show the itemised information in an imaginative 3D block diagram form, reflecting also the theme **CAMPING TENTS**. **(12 marks)**

- ii) A **2D** graphical representation is required to compare all the models by way of their:
- a) tent fabric quality;
 - b) fabric waterproofing quality;
 - c) groundsheet quality.

Clearly show the itemised information using 2D block diagram(s) reflecting also the theme **CAMPING TENTS**.

(10 marks)

Although the use of colour is expected, it is sufficient to indicate where and how it will be used.

(22 marks total)

Question 5

A company specialises in the manufacture of cookware. It is about to launch a new ceramic frying pan. The pan is about 50 mm deep and has an approximate rim diameter of 200 mm.



Prospective buyers should be informed that:

- the pan is microwave safe;
- the pan is oven safe;
- the pan is dishwasher safe;
- the pan material is non toxic;
- the pan material is very scratch resistant, yet sharp, metal cooking utensils should not be used.

a) Develop each of the above five statements into an ideogrammatic symbol. In each case, the final symbol must be preceded by a preliminary sketch. The symbols must share the same format, style and size.

Your sketches need not necessarily represent new concepts; a development of the same idea would be acceptable. **(10 marks)**

b) Design a suitable package for the frying pan. The symbols developed in (a) should feature prominently on the package. The overall package should ideally help display the product for retail. Your final design must be developed through a series of 2 preliminary sketches.

(12 marks)

The use of colour is expected.

(22 marks total)