HÖGSKOLAN
I SKÖVDE

Institutionen för Ingenjörsvetenskap

TENTAMEN

Kurs: Konceptuell Maskinteknik

Kurskod: MT102G

Högskolepoäng för tentamen: 1,0 hp

Datum: 2024-01-11

Skrivtid: 8:15-12:30

Ansvarig lärare: Niclas Strand

Hjälpmedel/bilagor: Valfri miniräknare

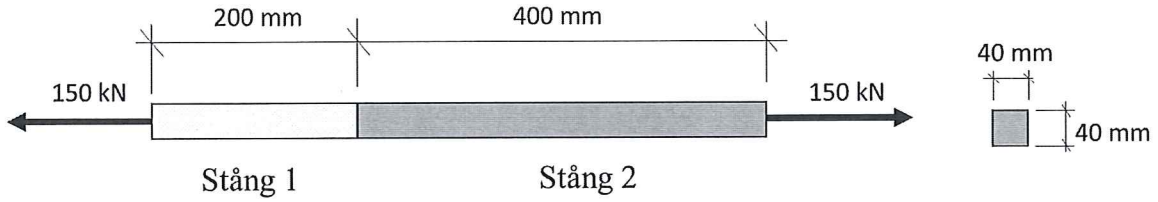
Anvisningar:

- ☒ Ta nytt blad för varje ny uppgift.
- ☒ Skriv endast på en sida av papperet.
- ☒ Skriv namn och personnummer på samtliga inlämnade blad.
- ☒ Numrera lösbladen löpande.
- ☒ Använd inte röd penna.
- ☒ Markera med kryss på omslaget vilka uppgifter som är lösta.

För godkänt resultat på tentamen krävs att alla uppgifter bedöms med betyget G. För G krävs att minst två av deluppgifterna (a, b, och c) för varje uppgift bedöms med G.

Uppgift 1 (U/G)

Ett system av två stänger belastas med en dragande kraft av 150 kN. Stängerna har likadana kvadratiska tvärsnitt med sidorna 40 mm. Stång 1 är 200 mm lång och tillverkad av ett stål med elasticitetsmodulen 210 GPa och sträckgränsen 250 MPa. Stång 2 är 400 mm lång och tillverkad av en aluminiumlegering med elasticitetsmodulen 70 GPa och sträckgränsen 100 MPa. Ingen av stängerna riskerar att plasticera under dessa förhållanden.



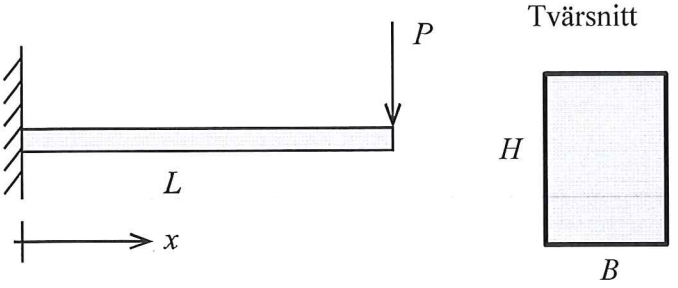
a) I vilken av stängerna är normalspänningen störst?
   1. Stång 1. 2. Stång 2. 3. Lika stor normalspänning i båda stängerna.

b) Vilken av stängerna förlängs mest?
   1. Stång 1. 2. Stång 2. 3. Båda stängerna förlängs lika mycket.

c) Beräkna den totala förlängningen av stångsystemet.

Uppgift 2 (U/G)

En konsolbalk av stål med elasticitetsmodulen E, längden L och ett rektangulärt tvärsnitt (se figur) belastas med en punktlast P.



a) Beräkna största dragspänningen (positiv normalspänning) i balken och ange x-koordinaten där denna spänning uppträder.

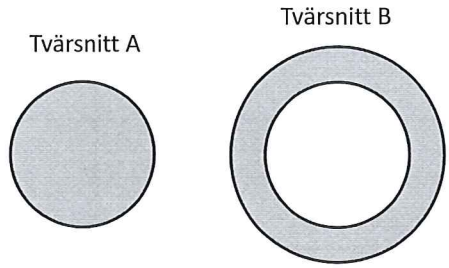
Hur förändras nedböjningen vid lastangreppspunkten under följande två scenarier (b och c)? Ange om den ökar, minskar (eller är oförändrad) och i så fall med vilken faktor?

b) Balklängden ändras från L till $3L$ (medan allt annat är lika).
c) Lasten ändras från P till $3P$ (medan allt annat är lika).

Uppgift 3 (U/G)

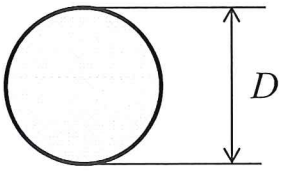
En axel skall belastas med vridmoment.

a) Två alternativ finns för utformningen av axelns tvärsnitt. Tvärsnitt A är massivt medan tvärsnitt B är rörformigt. Båda tvärsnitten har samma area.



Vilket av alternativen tål störst vridmoment innan plasticering uppstår givet att materialet är samma i båda fallen? Är det tvärsnitt A eller B eller tål båda tvärsnitten ett lika stort vridmoment?

b) Ett massivt tvärsnitt väjs för konstruktionen.



Man väljer nu mellan två olika material; ett stål och en aluminiumlegering. Stålet har högre sträckgräns och högre elasticitetsmodul än aluminiumlegeringen (stålet är både starkare och styvare än aluminiumlegeringen). Om tvärsnittets geometri är samma för båda alternativen och båda belastas med lika stora vridmoment, var blir då den maximala skjuvspänningen som störst? Blir den störst i stålet, i aluminiumlegeringen eller blir den lika stor i båda?

c) Hur förändras den maximala skjuvspänningen i det massiva tvärsnittet om diametern *D* fördubblas? Ökar den, minskar den eller är den oförändrad? Med vilken faktor ökar eller minskar den maximala skjuvspänningen?

Karl Mauritsson, Högskolan i Skövde

Formler i hållfasthetslära

Grundläggande begrepp

Normalspänning: $\sigma = \frac{N}{A}$ Medelskjuvspänning: $\bar{\tau} = \frac{T}{A}$ Normaltöjning: $\varepsilon = \frac{\delta}{L}$

Hålkanttryck: $\sigma_b = \frac{F}{A_{proj}}$ Säkerhetsfaktor: $n = \frac{\sigma_s}{\sigma_{till}}$

Hookes lag: $\sigma = E\varepsilon$

Stångförlängning: $\delta = \frac{NL}{EA}$

Böjning

Maximal normalspänning: $|\sigma|_{\max} = \frac{M}{W_b}$

Vridning

Maximal skjuvspänning: $\tau_{\max} = \frac{M_v}{W_v}$

Transmission av rotationsrörelse och moment mellan axlar

Förhållandet mellan vinkelhastighet ω och varvtal n: $\omega = \frac{2\pi n}{60}$

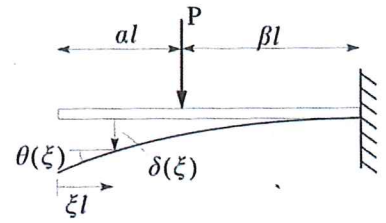
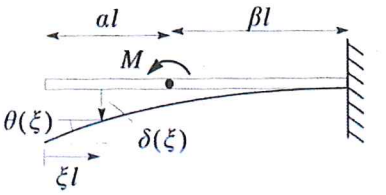
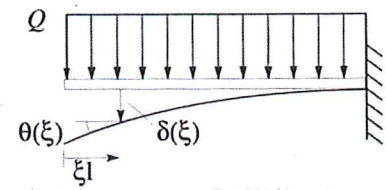
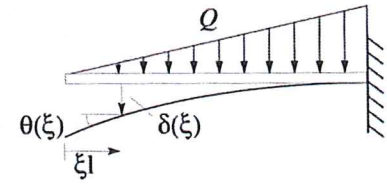
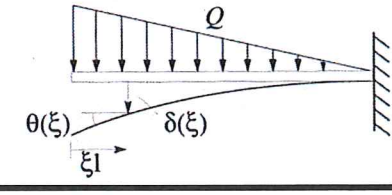
Motoreffekt: $P = M_v \cdot \omega$

Utväxling: $\frac{M_B}{M_A} = \frac{n_A}{n_B} = \frac{\omega_A}{\omega_B} = \frac{r_B}{r_A}$ där r_A och r_B är kugghjulsradier

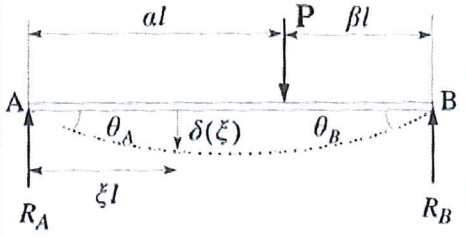
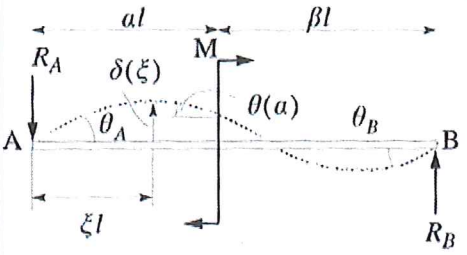
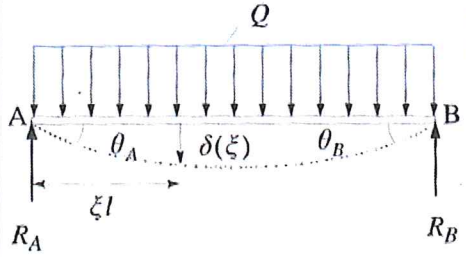
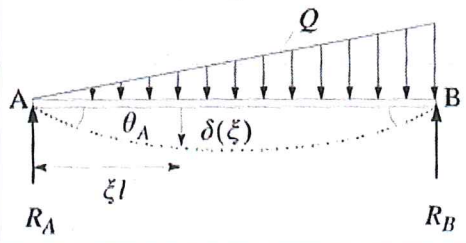
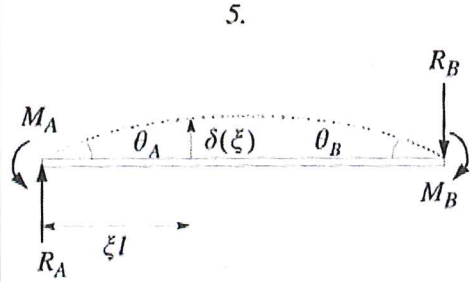
Beteckningslista

σ: Normalspänning
τ: Skjuvspänning
ε: Normaltöjning
E: Elasticitetsmodul
σ_b: Hålkanttryck
σ_s: Sträckgräns
σ_{till}: Tillåten normalspänning
n: Säkerhetsfaktor
N: Normalkraft
T: Tvärkraft
F: Kraft
M: Moment
A: Tvärsnittsarea
A_{proj}: Projicerad area
L: Längd
δ: Förlängning
W_b: Böjmotstånd
I: Yttröghetsmoment
W_v: Vridmotstånd
ω: Vinkelhastighet
P: Effekt

Elementarfall för balkar

Belastningsfall, $\alpha + \beta = 1$	θ = vinkeländring, $\delta(\xi = x/l)$ = förskjutning
	$\theta(\xi<\alpha) = \frac{Pl^2}{2EI}\beta^2$ $\delta(\xi<\alpha) = \frac{Pl^3}{6EI}(-\beta^3+3\beta^2(1-\xi))$ $\theta(\xi>\alpha) = \frac{Pl^2}{2EI}(\beta^2-(\xi-\alpha)^2)$ $\delta(\xi>\alpha) = \frac{Pl^3}{6EI}((\xi-\alpha)^3-3\beta^2(\xi-\alpha)+2\beta^3)$ $\theta(\alpha) = \frac{Pl^2}{2EI}\beta^2 \qquad \delta(\alpha) = \frac{Pl^3}{3EI}\beta^3$
	$\theta(\xi<\alpha) = \frac{Ml}{EI}\beta$ $\delta(\xi<\alpha) = \frac{Ml^2}{EI}\beta(1-\xi-\beta/2)$ $\theta(\xi>\alpha) = \frac{Ml}{EI}(1-\xi)$ $\delta(\xi>\alpha) = \frac{Ml^2}{2EI}((\xi-\alpha)^2-2\beta(\xi-\alpha)+\beta^2)$ $\theta(\alpha) = \frac{Ml}{EI}\beta \qquad \delta(\alpha) = \frac{Ml^2}{2EI}\beta^2$
	$\theta(\xi) = \frac{Ql^2}{6EI}(1-\xi^3)$ $\delta(\xi) = \frac{Ql^3}{24EI}(\xi^4-4\xi+3)$
	$\theta(\xi) = \frac{Ql^2}{12EI}(1-\xi^4)$ $\delta(\xi) = \frac{Ql^3}{60EI}(\xi^5-5\xi+4)$
	$\theta(\xi) = \frac{Ql^2}{12EI}(\xi^4-4\xi^3+3)$ $\delta(\xi) = \frac{Ql^3}{60EI}(-\xi^5+5\xi^4-15\xi+11)$

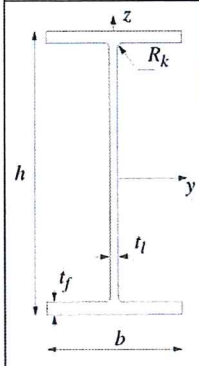
Tabellen är hämtad från *Handbok och formelsamling Hållfasthetslära* av Bengt Sundström m.fl. (1998).

Belastningsfall, $(\alpha + \beta = 1)$	θ = vinkeländring, $\delta(\xi = x/l)$ = förskjutning
1. 	$R_A = \beta P \;;\; R_B = \alpha P$ $\theta_A = \frac{Pl^2}{6EI}\alpha\beta(1+\beta) \;;\; \theta_B = \frac{Pl^2}{6EI}\alpha\beta(1+\alpha)$ $\delta(\xi) = \frac{Pl^3}{6EI}\beta[(1-\beta^2)\xi - \xi^3] \quad för \quad \xi \le a$ $\delta(a) = \frac{Pl^3}{3EI}a^2\beta^2$
2. 	$R_A = R_B = M/l$ $\theta_A = \frac{Ml}{6EI}(1-3\beta^2) \;;\; \theta_B = \frac{Ml}{6EI}(1-3a^2)$ $\delta(\xi) = \frac{Ml^2}{6EI}((1-3\beta^2)\xi - \xi^3) \quad för \quad \xi \le a$ $\delta(a) = \frac{Ml^2}{3EI}a\beta(a-\beta) \;;\; \theta(a) = \frac{Ml}{3EI}(1-3a\beta)$
3. 	$R_A = R_B = Q/2$ $\theta_A = \theta_B = \frac{Ql^2}{24EI}$ $\delta(\xi) = \frac{Ql^3}{24EI}(\xi - 2\xi^3 + \xi^4)$ $\delta\left(\frac{1}{2}\right) = \frac{5}{384}\cdot\frac{Ql^3}{EI}$
4. 	$R_A = Q/3 \;;\; R_B = 2Q/3$ $\theta_A = \frac{7Ql^2}{180EI} \;;\; \theta_B = \frac{8Ql^2}{180EI}$ $\delta(\xi) = \frac{Ql^3}{180EI}(7\xi - 10\xi^3 + 3\xi^5)$
5. 	$R_A = R_B = (M_A - M_b)/l$ $\theta_A = \frac{M_A l}{3EI} + \frac{M_B l}{6EI} \;;\; \theta_B = \frac{M_A l}{6EI} + \frac{M_B l}{3EI}$ $\delta(\xi) = \frac{l^2}{6EI}[M_A(2\xi - 3\xi^2 + \xi^3) + M_B(\xi - \xi^3)]$ $M_A = M_B = M : \theta_A = \theta_B = \frac{Ml}{2EI};$ $\delta(\xi) = \frac{Ml^2}{2EI}(\xi - \xi^2)$

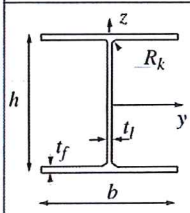
Tabellen är hämtad från *Handbok och formelsamling Hållfasthetslära* av Bengt Sundström m.fl. (1998).

Tvärsnittsdata för några standardprofiler

Tvärsnittsdata för IPE-balkar

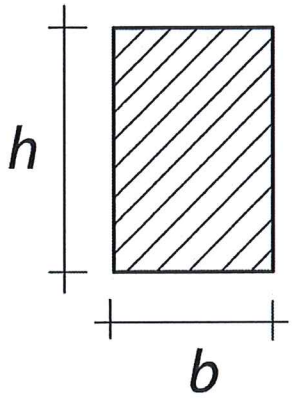
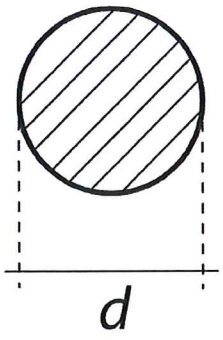
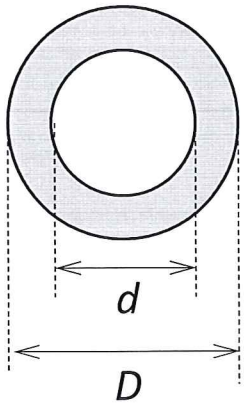
IPE-balk S275JR (SS 1412)	Beteck-ning	Mått						Area		Böjning: Axel y–y		Böjning: Axel z-z		Vridning: Saint-Venant	
		vikt kg/m	h mm	b mm	t_l mm	t_f mm	R_k mm	A mm^2	A_{liv} mm^2	I_y 10^4mm^4	W_y 10^3mm^3	I_z 10^4mm^4	W_z 10^3mm^3	K_v 10^6mm^4	W_v 10^3mm^3
	IPE 80	6,0	80	46	3,8	5,2	5	764	264	80	20,0	8,5	3,69	0,0070	1,35
	IPE 100	8,1	100	55	4,1	5,7	7	1032	363	171	34,2	15,9	5,79	0,0121	2,12
	IPE 120	10,4	120	64	4,4	6,3	7	1321	472	318	53,0	27,7	8,65	0,0174	2,76
	IPE 140	12,9	140	73	4,7	6,9	7	1643	593	541	77,3	45	12,3	0,0245	3,55
	IPE 160	15,8	160	82	5,0	7,4	9	2009	726	869	109	68	16,7	0,0362	4,89
	IPE 180	18,8	180	91	5,3	8,0	9	2395	869	1317	146	101	22,2	0,0480	6,00
	IPE 200	22,4	200	100	5,6	8,5	12	2848	1025	1943	194	142	28,5	0,0702	8,26
	IPE 220	26,2	220	110	5,9	9,2	12	3337	1189	2772	252	205	37,3	0,0910	9,89
	IPE 240	30,7	240	120	6,2	9,8	15	3912	1366	3892	324	290	47,3	0,129	13,2
	IPE 270	36,1	270	135	6,6	10,2	15	4594	1647	5790	429	420	62,2	0,160	15,7
	IPE 300	42,2	300	150	7,1	10,7	15	5381	1978	8356	557	604	80,5	0,202	18,9
	IPE 330	49,1	330	160	7,5	11,5	18	6261	2303	11770	713	788	98,5	0,283	24,6
	IPE 360	57,1	360	170	8,0	12,7	18	7273	2677	16270	904	1043	123	0,375	29,5
	IPE 400	66,3	400	180	8,6	13,5	21	8446	3208	23130	1160	1318	146	0,514	38,1
	IPE 450	77,5	450	190	9,4	14,6	21	9882	3956	33740	1500	1676	176	0,671	46,0
	IPE 500	90,7	500	200	10,2	16,0	21	11550	4774	48200	1930	2142	214	0,897	56,1
	IPE 550	106,0	550	210	11,1	17,2	24	13440	5723	67120	2440	2668	254	1,24	72,1
	IPE 600	122,0	600	220	12,0	19,0	24	15600	6744	92080	3070	3387	308	1,66	87,4

Tvärsnittsdata för HEB-balkar

HEB-balk S275JR (SS 1412)	Beteck-ning	Mått						Area		Böjning: Axel y–y		Böjning: Axel z–z		Vridning: Saint-Venant	
		vikt kg/m	h mm	b mm	t_l mm	t_f mm	R_k mm	A mm^2	A_{liv} mm^2	I_y 10^4mm^4	W_y 10^3mm^3	I_z 10^4mm^4	W_z 10^3mm^3	K_v 10^6mm^4	W_v 10^3mm^3
	HEB 100	20,4	100	100	6,0	10,0	12	2604	480	449	89,9	167	33,5	0,0929	9,29
	HEB 120	26,7	120	120	6,5	11,0	12	3401	637	864	144	318	52,9	0,139	12,6
	HEB 140	33,7	140	140	7,0	12,0	12	4296	812	1509	216	550	78,5	0,201	16,7
	HEB 160	42,6	160	160	8,0	13,0	15	5425	1072	2492	311	889	111	0,314	24,2
	HEB 180	51,2	180	180	8,5	14,0	15	6525	1292	3831	426	1363	151	0,423	30.2
	HEB 200	61,3	200	200	9,0	15,0	18	7808	1530	5696	570	2003	200	0,595	39,7
	HEB 220	71,5	220	220	9,5	16,0	18	9104	1786	8091	736	2843	250	0,768	48,0
	HEB 240	83,2	240	240	10,0	17,0	21	10600	2060	11260	938	3923	327	1,03	60,6
	HEB 260	93,0	260	260	10,0	17,5	24	11840	2250	14920	1150	5135	395	1,24	70,9
	HEB 280	103	280	280	10,5	18,0	24	13140	2562	19270	1380	6595	471	1,44	80,0
	HEB 300	117	300	300	11,0	19,0	27	14910	2882	25170	1680	8563	571	1,86	97,9
	HEB 320	127	320	300	11,5	20,5	27	16130	3209	30820	1930	9239	616	2,26	110
	HEB 340	134	340	300	12,0	21,5	27	17090	3564	36660	2160	9690	646	2,58	120
	HEB 360	142	360	300	12,5	22,5	27	18060	3938	43190	2400	10140	676	2,93	130
	HEB 400	155	400	300	13,5	24,0	27	19780	4752	57680	2880	10820	721	3,57	149
	HEB 450	171	450	300	14,0	26,0	27	21800	5572	79890	3550	11720	781	4,42	170
	HEB 500	187	500	300	14,5	28,0	27	23860	6438	107200	4290	12620	842	5,40	193
	HEB 550	199	550	300	15,0	29,0	27	25410	7380	136700	4970	13080	872	6,02	208
	HEB 600	212	600	300	15,5	30,0	27	27000	8370	171000	5700	13530	902	6,69	223
	HEB 650	225	650	300	16,0	31,0	27	28630	9408	210600	6480	13980	932	7,41	239
	HEB 700	241	700	300	17,0	32,0	27	30640	10810	256900	7340	14440	963	8,33	260
	HEB 800	262	800	300	17,5	33,0	30	33420	12850	359100	8980	14900	994	9,49	288
	HEB 900	291	900	300	18,5	35,0	30	37130	15360	494100	11000	15820	1050	11,4	326
	HEB 1000	314	1000	300	19,0	36,0	30	40000	17630	644700	12900	16280	1090	12.6	350

Tabellerna är hämtade från *Handbok och formelsamling Hållfasthetslära* av Bengt Sundström m.fl. (1998).

Tvärsnittsdata för några vanliga geometrier

Tvärsnitt	Yttröghetmoment	Böjmotstånd	Vridmotstånd
Rektangel 	$\frac{bh^3}{12}$	$\frac{bh^2}{6}$	-
Massiv cylinder 	$\frac{\pi d^4}{64}$	$\frac{\pi d^3}{32}$	$\frac{\pi d^3}{16}$
Cirkulärt rör 	$\frac{\pi(D^4 - d^4)}{64}$	$\frac{\pi(D^4 - d^4)}{32D}$	$\frac{\pi(D^4 - d^4)}{16D}$

Part I – Learning objective: describe how genes are functioning and how their expression is regulated in prokaryotic and eukaryotic organisms. (20 p)

Question 1.

Below is a figure of the lac operon. There is also a table (Table 1) with different terms. I want you to combine the numbers in the figures with the correct name and letter found in Table 1. Also, briefly describe the function of each structure. Answer in your answering sheet (8p).

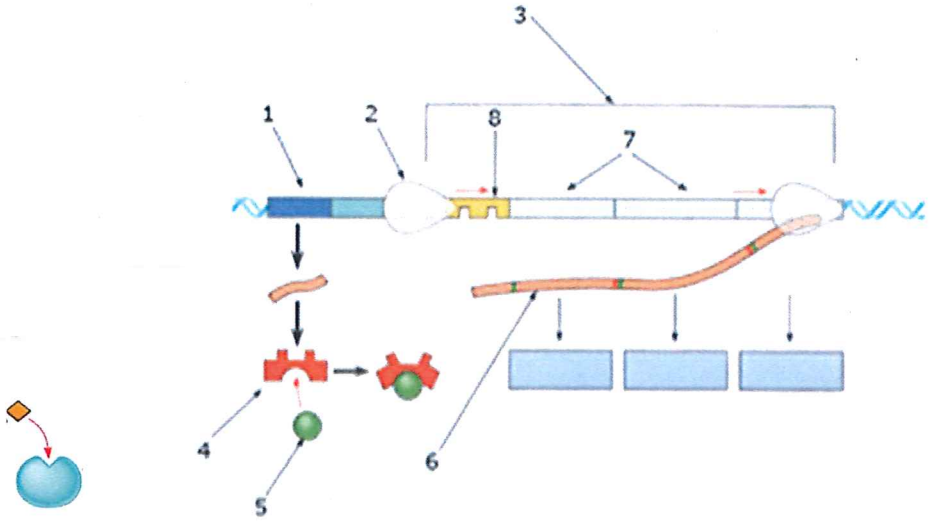


Figure 1. The lac-operon, belonging to Question 1

Table 1 Terms belonging to question 1

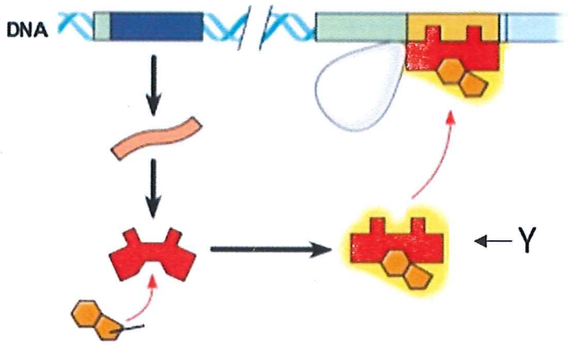
A Operon
B Inducer
C Enhancer
D Primer
E Regulatory gene
F mRNA
G Start codon
H Operon genes
I tRNA
K RNA polymerase
J Major protein
L Operator
M Repressor protein

Question 2.

Below is a figure of the tryptone operon in two different metabolic environments a) and b).

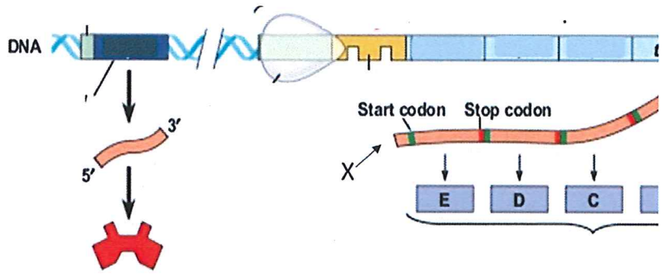
i) Tell me if the tryptophan transcription activity is on, off or has little activity in the metabolic situation a)? (1p)
Do also write down what the complex Y consist of (0,5p)

Metabolic environment a)



ii) Tell me if the tryptophan transcription activity is on, off or has little activity in the metabolic situation b)? (1p)
Do also write down what the complex X consist of (0,5p)

Metabolic situation b)



Question 3.
Match one question to one explanation below. In your answering sheet it is enough to have number and letter (9p)

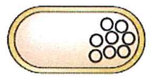
Questions
1) What is cell differentiation?
2) What is operon regulated by and what do they do?
3) What is a regulatory gene?
4) What is control element?
5) What is an anabolic pathway?
6) What are the two main types of RNA?
7) What is histone modification?
8) What is DNA methylation?
9) What are transcription factors?

Explanation
A. RNA polymerase requires these for initiation of transcription
B. Repressible - can be turned off and inducible - can be turned on
C. This process can cause long-term inactivation of genes and cellular differentiation
D. Repressors are always present in the cell, will attach and detach to the operator. Specific to particular operons
E. Repressor proteins attach to UTRs in mRNA and may prevent ribosome binding so mRNA can be stockpiled store mRNA without polyA-tails big enough to start translation. Involves activation or inactivation of protein factors needed to start transcription (plants in darkness).
F. Process of cells becoming specialized in structure and function.
G. This process loosens chromatin structure, thereby promoting the initiation of transcription.
H. A gene that codes for a protein, such as repressor, that controls the transcription of another gene or groups of genes.
I. Small and large RNA.
J. A segment of eukaryotic DNA containing multiple control elements, usually located far from the gene whose transcription it regulates.
K. Pathway synthesizes molecules and requires energy.
L. Repressible - can be turned on and inducible - can be turned off.
M. Protein coding RNA and non-coding RNA
N. Pathway breaks down molecules and produce energy
O. A specific small molecule that binds to a bacterial repressor protein and changes the repressors conformation so it can no longer bind to an operator, thus switching an operon on.

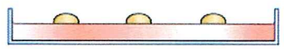
Part II – Learning objective: describe the theories behind some molecular biological techniques where DNA, RNA and proteins are studied. (80 p)

Question 4.
This question concerns the basics of gene-cloning. Put the figures 1-6 in the correct order and also tell me to which figure the following keywords belong **Host cell, Gene, Vector, Clone, Transformation** and **Recombinant DNA molecule.** The keywords can be used more than one time, but maximum two times. I want you to write in your answering sheet, not below in the figure (6p).

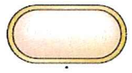
1



2

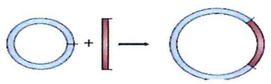


3

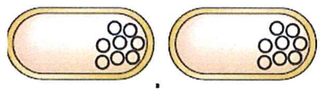


4

5



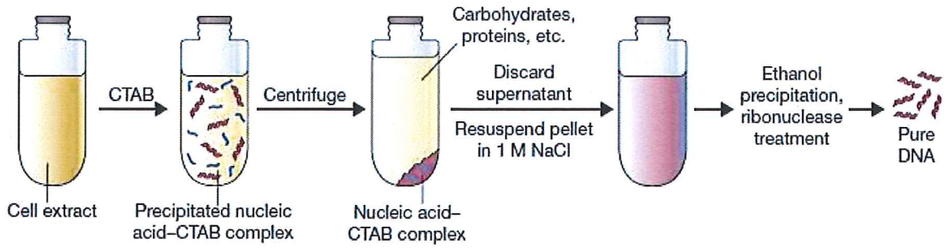
6



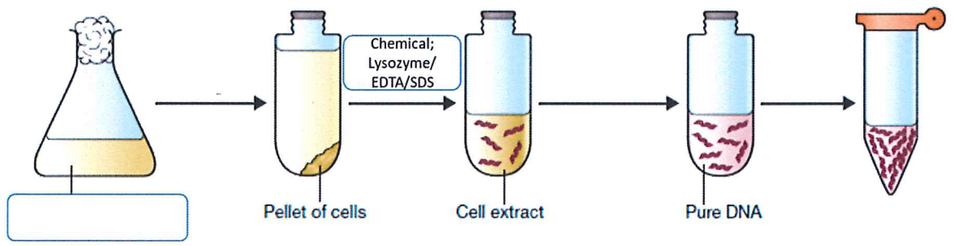
Question 5. (5p)
Below are three different kind of DNA extraction methods illustrated.

a) Which one is used for isolation of DNA from bacteria? 1p
b) Which one is used for isolation of DNA from plants? 1p
c) What machine will you use to measure the concertation of the DNA isolation? 1p
d) How can you separate DNA from RNA and proteins, when you work with bacterial DNA isolation? Give two examples. 2p

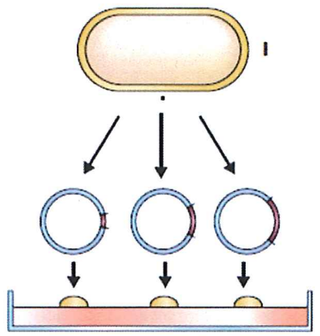
Method A



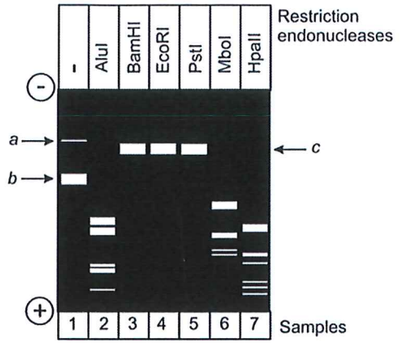
Method B



Method C



Question 6. Look into the gel below and tell which suggestion (A-D or A-C) is correct for describing the space that is empty ___ (3 x 2p)



a) ___ Are double-stranded

A: DNA molecules in band a
B: DNA molecules in band b
C: Both of them
D: Neither of them

b) ___ Contain double-strand breaks.

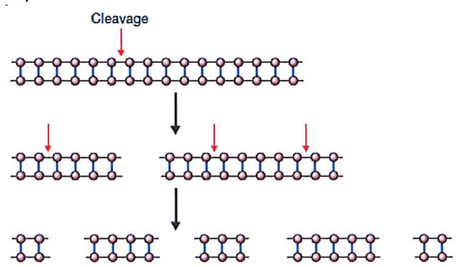
A: DNA molecules in band a
B: DNA molecules in band b
C: Both of them
D: Neither of them

c) There is a single PstI cleavage site in this plasmid.

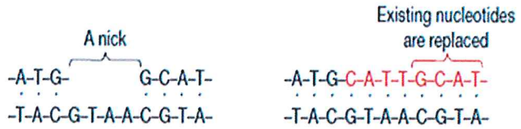
A: the statement is supported by the information given;
B: the statement is contradicted by the information given;
C: the statement is neither supported nor contradicted by the information given

Question 7. Which type of enzymes have been used in each figure a-d. Do also give one example of a specific enzyme belonging to the group of enzymes (8p)

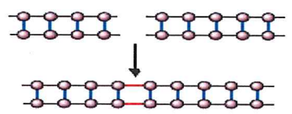
a)



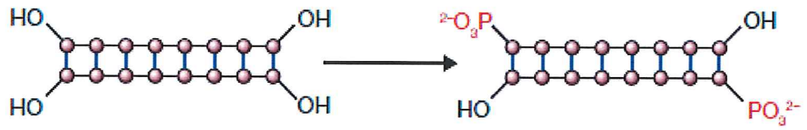
b)



c)



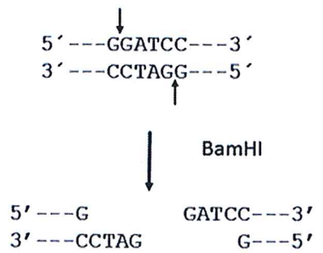
d)



Question 8. The restriction nuclease Sau3AI recognizes the sequence 5′-GATC-3′and cleaves on the 5′ side of the G (see figure below). The single-stranded ends produced by Sau3AI cleavage are identical to those produced by BamHI cleavage (see figure below), allowing the two types of ends to be joined together by incubation with DNA ligase.

A) Can all BamHI sites be cut with Sau3AI? (1p)

B) Can all Sau3AI sites be cut with BamHI? (1p)



Question 9. Conformation is important to be aware of when you are doing a plasmid preparation. Which conformation belongs to which explanation. Combine a number with a letter. There might be more than one letter to each number. If you answer wrong I will withdraw points. Write in your answering sheet. (6p)

1. Supercoiled molecules	a. A small nick by an enzyme
2. Open circular	b. Both polynucleotide strands are intact
3. Linearized DNA	c. Supercoiled
	d. Relaxed
	e. DNA helix is cut in both strands at the same place
	f. Native confirmation found in vivo

Question 10. Match each statement/question below to the correct description. In your answering sheet you can write number – letter. If you answer is wrong I will withdraw points. (10p)

Statement/Question	Description
1) What does qPCR stand for?	A. 3' end of probe, low energy dye
2) What is the goal of qPCR?	B. Reflects the cycle number at which the fluorescence generated within a reaction crosses the threshold.
3) What is a quencher?	C. Quantitative Pyro cycling enzyme reaction
4) Higher Cq means?	D. NGS termination, amplifying the cDNA and analyze the data.
5)The steps included in construction of a library for Next generation sequencing	E. To detect the number of copies of a template within a sample
6) What do all next generation sequencing methods have in common when it comes to terms of steps?	F. Quantitative (Real-Time) Polymerase Chain Reaction
7) What are Dideoxynucleotides missing?	G. Construct a library, clonal amplification, sequence the library and analyze the data.
8) What is baseline?	H. 3´-OH group
9) What is the Sanger method	I. Sugar molecule
10) What is the challenge when using SYBR green in qPCR	J. The initial cycles of PCR during which there is little change in fluorescence signal. Usually cycles 3 to 15.

	K. It is not very specific, since it intercalates in DNA and can give signals from primer dimer
	L. Chain termination method. By using ddNTP´s and dNTP's you will find different length of DNA that correspond to each nucleotide.
	M. Less starting material
	N. Breakage of the starting DNA into fragments. Immobilization of the fragments on to the solid support and amplification of the immobilized fragments.

Question 11. Answer the following multiple-choice questions (only one alternative is correct, 1p for each correct answer).

a) The DNA used in a PCR reaction is called the:
   A. Backbone
   B. Buffer
   C. Template

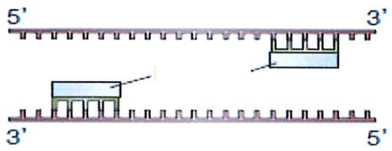
b) Deoxy nucleotide triphosphates (dNTPs) are added to the growing DNA strand during _____ phase.
   A. Annealing
   B. Denaturation
   C. Extension

c) During the annealing step, ...
   A. Primers bind to the newly separated DNA strand
   B. The two DNA strands separate at high temperatures
   C. The DNA and master mix are added together

d) In sequential order, what are the three steps of PCR?
   A. Annealing primers, extend DNA, denature DNA.
   B. Denature DNA, extend DNA anneal primers.
   C. Denature DNA, anneal primers, extend DNA.

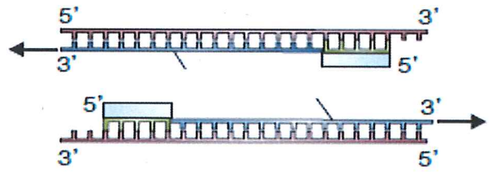
Question 12. Describe how PCR works in general by adding the four different parts (A-D) in the right order (4p)

part A

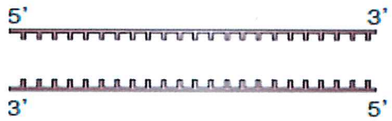


part B

part C



Part D

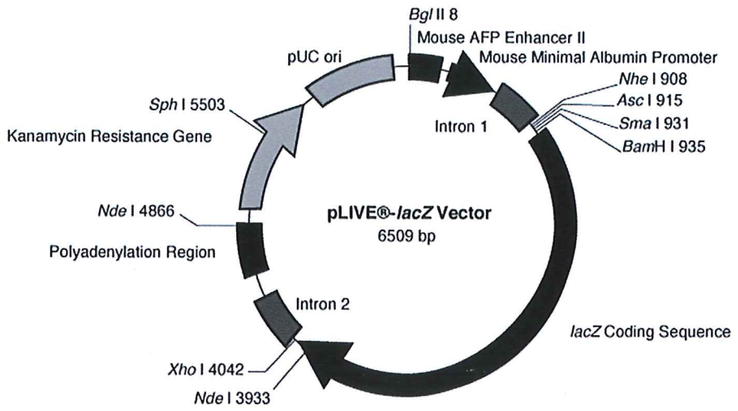


Question 13. Combine the method with what you are studying when using the method. In your answering sheet you can write number – letter (10p)

Method used	What are you studying
1 Hybrid release translation	A Transcript analysis
2 Poly chain reaction	B Identify individual proteins
3 Illumina dye sequencing	C Regulatory region of a gene
4 The yeast two hybrid system	D Proteome
5 Primer extension	E Identify the translational product
6 Maldi TOF analysis	F Whole genome sequencing
7 ORF-scan	G Identify an open reading frame
8 Protein electrophoresis	H TATAA box of the protein
9 Foot printing with DNAse I	I Transcriptomics
10 Microarray	J Amino acid sequence in an protein
	K Regulatory part of the protein
	L Specific gene of interest
	M Protein-protein interaction
	N ORF attachment to protein activators

Question 14. Your supervisor has told you to use this plasmid for cloning the BV317gene, 1460bp long. You are also told to tell her

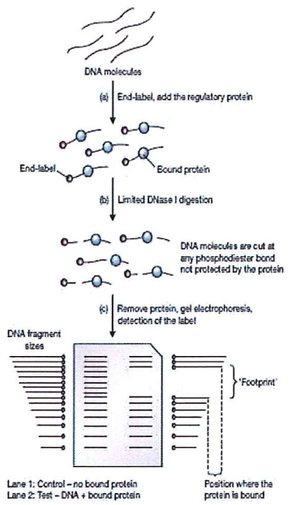
A) What is the size of the vector? (1,5p)
B) What selection pressure can be used, to select for the transformants that have picked up this plasmid? Mention two different selection pressures. (2p)
C) Mention three different restriction endonucleases that you can use to make the plasmid linearized. (1,5p)



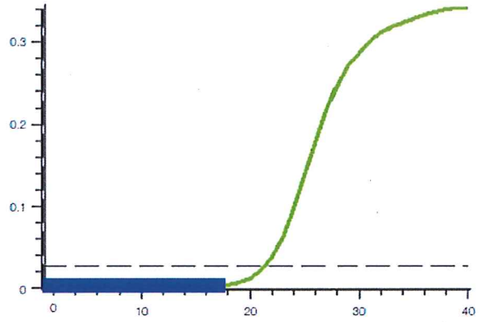
Question 15. Combine the method below with one figure. Combine number with letter and write in your answering sheet. (4p)

1. Gel electrophoresis
2. Sanger sequencing
3. Next generation sequencing
4. Rapid Amplification of cDNA Ends (RACE)

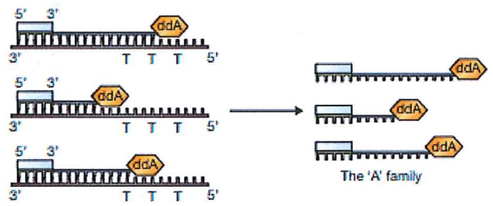
A


DNA molecules
(a) End-label, add the regulatory protein
End-label
Bound protein
(b) Limited DNase I digestion
DNA molecules are cut at any phosphodiester bond not protected by the protein
(c) Remove protein, gel electrophoresis, detection of the label
DNA fragment sizes
'Footprint'
Lane 1: Control – no bound protein
Lane 2: Test – DNA + bound protein
Position where the protein is bound

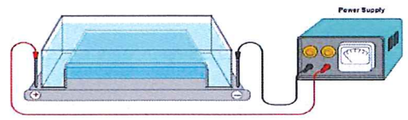
B


0.3
0.2
0.1
0
0
10
20
30
40

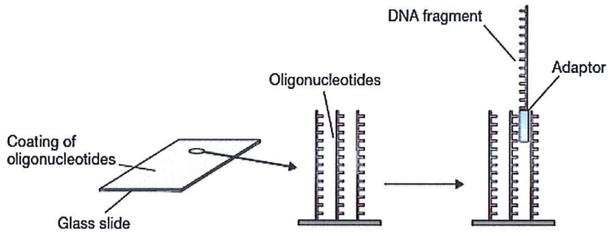
C


5' 3'
ddA
3'
T T T
5'
The 'A' family

D


Power Supply

E



F

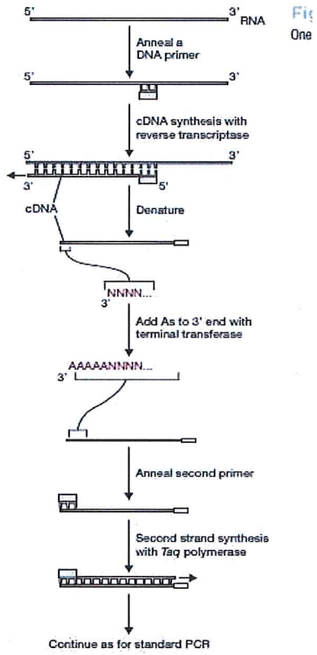


Fig
One

Question 16

What is antisense RNA (asRNA)? (1p)

Question 17

In detail describe miRNA biogenesis. The following keywords are to be used when you explain 1p for correct used keyword (RNA polymerase II, primary mRNA, Drosha enzyme, precursor mRNA, exportin 5, short ds miRNA duplex, Dicer enzyme, RISC complex, perfect complementarity, imperfect complementarity). (9p)